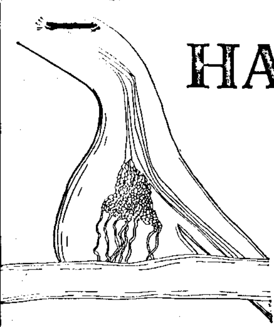

HAUSTORIUM

PARASITIC PLANTS NEWSLETTER

OLD DOMINION UNIVERSITY

December 1978
No. 1

Haustorium - Purpose and Scope

The recent Striga/Orobanche workshop held in Khartoum (see report below) provided the opportunity for workers on these parasitic weeds to meet and exchange results and to plan future collaboration. It is hoped that there will be further opportunities for such meetings in the future but it was agreed by all present that some form of communication would meanwhile serve a useful purpose in keeping workers in contact with each other and with research results which are not always readily accessible to all concerned.

The EWRC Parasitic Weeds Research Group at one time produced an irregular newsletter to serve this function, until the Group became defunct for a variety of reasons.

The Department of Biological Sciences, Old Dominion University, has agreed to prepare, print and mail a newsletter, and it is intended that this newsletter will be a means of communication between all those concerned with parasitic weeds, worldwide, though it is suggested that the emphasis should be mainly on Striga and Orobanche species. Comment will be welcomed on whether there should be a new research group equivalent to the EWRC one, but on a more international basis, and how a newsletter or other means of communication could be established on a more permanent basis.

For the time being it is proposed to produce two newsletters per year in December and in June and items of relevance will be welcomed by either Lytton Musselman at Old Dominion University or Chris Parker at Weed Research Organization, Oxford. It is not intended to "publish" original data at any length but anyone wishing to draw attention to particularly interesting new results whether already published or not is invited to send them in. Comments on the form of the newsletter will also, of course, be welcomed.

If you wish to be placed on the mailing list, please contact Lytton Musselman at the address below.

Khartoum Striga Workshop

The government of the Sudan, in cooperation with the International Development Research Centre sponsored a workshop 5-8 November 1978. The major emphasis was on control of Striga and Orobanche. Particular attention was paid to the use of the synthetic strigol analogs developed by Prof. Alan Johnson which appear to be a particularly promising means of control. Breeding for resistance/tolerance was also discussed as were other aspects of biology and control. Striga hermonthica, S. asiatica, S. gesnerioides, Orobanche ramosa, and O. crenata were the species of main concern. A more detailed account of the meeting as well as recommendations for further work is being prepared by the sponsors and should appear in PANS in due course.

The well organized sessions and field trips coupled with the warm genuine hospitality of the hosts fostered a climate conducive for much exchange of information.

Special Course in Parasites

Biology of Parasitic Seed Plants - 18 June to 17 July 1979; Mountain Lake Biological Station. For further information contact: Prof. James L. Riopel, Director, Mountain Lake Biological Station, Department of Biology, University of Virginia, Charlottesville, Virginia 22903.

Second Symposium on Parasitic Weeds

A second symposium on parasitic weeds to be held on the campus of North Carolina State University in Raleigh, North Carolina is scheduled for 16-19 July 1979. Sponsors are N.C. State University, Old Dominion University, and the USDA Witchweed Laboratory. If you are on the mailing list for this newsletter, you have received information on the meeting. Others may contact L. Musselman (address below).

Thonningia sanguinea

WRO has for the first time been approached for advice on control of Thonningia sanguinea. This is a root parasite of the Balanophoraceae and is apparently causing damage to rubber trees in Nigeria. A single plant may be affecting up to 20 trees. There is apparently no published information on the control of this plant nor even on its occurrence as a weed problem. If anyone has any information of this species, Chris Parker will be grateful to hear of it.

Killing Orobanche by Solar Sterilization

Katan et al (1976) reported in Phytopathology Vol. 66, pp 683-688, on the use of "Solar heating by polyethylene mulching for the control of diseases caused by soil-borne pathogens". Covering moist soil with clear polyethylene for two weeks or more during the hottest part of the year resulted in kill of various soil-borne diseases and weeds. More recent reports from Israel show that the technique is also effective against Orobanche crenata. A detailed account is due to be published shortly.

Agalinis purpurea

In a recent report in Tree Planters' Notes (29[4]:24-25), Musselman et al gave an account of a heavy infestation of Agalinis purpurea (Scrophulariaceae), purple gerardia, parasitizing three year old sycamore, sweetgum and loblolly pine in northeastern North Carolina. No growth loss was obvious although quantitative studies were not carried out.

Literature

Striga (a noxious root parasitic weed). M. M. Hosmani, University of Agricultural Science, Dharwar (present address: College of Agriculture, Dharwad 58005, Karnataka, India), 1978. 170 pp. Price: India Rupees 15.00.

It is encouraging to find a volume devoted exclusively to Striga despite the numerous glaring printing errors. Little new information is presented but a valuable review of previous work is included. One is impressed in perusing the contents with the paucity of information on taxonomy, or more correctly, biosystematics. A more extensive review is to be found in PANS 24(3), p. 378.

Schmarotzer: Planzen die von anderen leben. H. C. Weber. Belser Verlag. 212 pages with 100 colored pictures. Price: 18.80 Deutschmark.

This is intended to be a popular treatment of parasites for the layman. We have only received the announcement and not seen the book.

Material for the newsletter may be sent to either co-editor:

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Old Dominion University
Norfolk, Virginia 23508
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HAUSTORIUM
PARASITIC PLANTS NEWSLETTER
OLD DOMINION UNIVERSITY

No. 2 June 1979

STRIGA GESNERIOIDES IN THE NEW WORLD

On 12 October 1978 Mr Allen G Schuey collected *S. gesnerioides* as part of an environmental field survey of an old phosphate mine in central Florida. Believing this to be an unusual plant that he had not previously encountered, Schuey took the plant to Dr Richard P Wunderlin, Curator of the Herbarium at the University of Florida in Tampa, who later identified it as *S. gesnerioides*. It was flowering at the time of collection which would be the approximate time of flowering in West Africa.

This *Striga* is widespread in Africa but also grows in Arabia and India. Unlike most *Strigas*, it lacks expanded green leaves at maturity. It also differs from other pathogenic members of the genus by attacking mainly broad-leaved plants. Documented hosts include peanuts (*Arachis hypogea*), cowpeas (*Vigna unguiculata*), tobacco (*Nicotiana* spp.) and numerous other species of Leguminosae, Convolvulaceae and several other families. In fact, it may have the broadest host range of any *Striga*. In Florida it was parasitizing *Alysicarpus vaginalis* and *Indigofera hirsuta*. Both are introduced forage legumes that have become weeds in Florida.

The Director of the USDA's Witchweed Laboratory, Dr Robert Eplee, informs us that his agency is involved in survey and research activities. They found the present area of distribution to be roughly 100 km^2. A large number of crop, ornamental, and weedy species are being tested as potential hosts. Until the host range is determined, no special quarantine is to be implemented although all species of *Striga* are covered by the U S Federal Noxious Weeds law.

It is intriguing to consider how this parasite came to Florida. One speculative (and perhaps far-fetched) idea is that the very small seeds were carried in the dust that frequently is blown over Florida from the sub-saharan regions of Africa where this species is common.

ICRISAT STRIGA RESEARCH

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics) have moved their main research effort on *Striga* from their headquarters in Hyderabad, India, to the outreach station at Ouagadougou, Upper Volta. Dr K V Ramaiah has moved to West Africa to head the new expanded project, which is supported by IDRC (International Development and Research Centre of Canada). The main topics are the selection and breeding of resistant cultivars of sorghum and *Pennisetum* millets and the evaluation of germination stimulants (ethylene and synthetics) and cultural practices including rotation. The project will also provide training of African scientists in *Striga* methodology and co-ordination of all aspects of *Striga* control research in Africa. The work on millet will be mainly conducted at Maradi, Niger under the supervision of Dr B B Singh.

Materials have already been sent out for varietal trials by a number of collaborators in Africa and India. The most promising cultivars are also being studied in a collaborative project at WRO (Weed Research Organization) Oxford, England, financed by ODA (Overseas Development Administration).

Dr Ramaiah's address is:- ICRISAT/UNDP
B P 575
Ouagadougou
Upper Volta
West Africa

DIVERSITY IN STRIGA ASIATICA

On a recent visit to Indonesia, Chris Parker of WRO was interested to be able to collect seed of two more distinct forms of *S. asiatica*, one a small, yellow-flowered form occurring extensively along roadsides in South Sumatra, mainly on an *Eragrostis* sp. The other was on *Ischaemum timorense* at Bogor and even smaller with a pale pink flower. A very small, white-flowered form has previously been noted in Java, on *Axonopus compressus* and Mr S Soerohaldoko at the 5th Indonesian Weed Science Conference in April

HAUSTORIUM
PARASITIC PLANTS NEWSLETTER
OLD DOMINION UNIVERSITY

No. 3 (Special Symposium Issue) | Official Organ of the International Parasitic Seed Plant Research Group | September 1979

SECOND INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

This second international symposium on parasitic weeds was held from 16-19 July at North Carolina State University and sponsored by Old Dominion University, Norfolk, Virginia, N.C. State University, and the USDA Animal and Plant Health Inspection Service. There were three full days of sessions and a one-day (very wet) field trip. Unlike the first symposium in Malta in 1973, it was not held under the auspices of the European Weed Research Society, but many of the same workers were involved and about 85 participants from over 20 different countries enjoyed a very fruitful meeting in a similarly informal atmosphere.

Forest parasites were the topic of several papers and there were good descriptions by F. G. Hawksworth of the problem of dwarf mistletoes (*Arceuthobium* spp) in North America and by L. J. Musselman of a range of root parasites in Southern U.S.A., particularly *Seymeria cassioides* (J. F. Gmelin) Blake a member of the Scrophulariaceae causing significant problems in young pine plantings. From Australia, D. M. Calder described a number of bird-pollinated *Amyema* species (Loranthaceae). P. R. Atsatt discussed the various theories which attempt to explain the apparent mimicry of host foliage shapes by mistletoes and made a convincing case for selection through the feeding habits of birds. A short paper was also presented by Mrs. E. Wilkinson on the only known parasitie gymnosperm, *Parasitaxis ustus* (Viell.) de Laubenfels of family Podocarpaceae, which is only known from New Caledonia and whose parasitic nature (on other trees of the same family) was only discovered in recent years.

G. C. Salle described detailed anatomical studies which help to show exactly how the endophytic system in *Viscum album* L. achieves direct contact with host xylem tissues. Comparable studies with *Cuscuta campestris* Yuncker, by Y. Tsivion revealed a recognition phenomenon which causes differentiation of elongated "hyphal" cells into vascular elements on contact with host xylem. Mary Schlater described the anatomy of *Epifagus virginiana* (L.) Bart, a North American endemic of the Orobanchaceae, and its specialized "splash cup" for seed dispersal.

Other papers on *Cuscuta* included one by P. Wolswinkel giving his latest interpretation of the remarkable physiological sink effect created by the haustorium of *Cuscuta* on its hosts. He has now been able to demonstrate pronounced enhancement of phloem unloading of potassium ions and of sugars at the point of attachment. J. H. Dawson discussed control of *Cuscuta* by chlorpropham, while A. Gimesi described control by diquat, chlorthal-dimethyl and a new proprietary mixture containing pendimethalin, linuron and diuron.

The very *Cuscuta*-like *Cassytha filiformis* L. was described by C. R. Werth. This parasite of tropical coastal areas belongs to the Lauraceae but is similar to *Cuscuta* in its morphology and biology occasionally causing economic damage to trees and shrubs in the Caribbean and elsewhere.

Striga received more attention than other parasitic groups, there being several papers dealing particularly with its complex germination requirements. D. C. Reid and C. Parker showed that S. hermonthica (Del.) Benth. requires a lower pre-conditioning temperature than S. asiatica. A. I. Hsaio discussed the importance of different degrees of wetness during pre-conditioning and A. D. Pavlista showed how fungal contamination could seriously interfere. Perhaps the most interesting and unexpected results, reported by both Hsaio and Pavlista, were those showing that exposure of Striga seeds to the natural stimulant strigol or the synthetic analogue GR7 during the preconditioning period tended to reduce rather than increase eventual germination.

The damaging effect of S. hermonthica on sorghum was shown by D. S. H. Drennan and S. O. El Hiweris to be associated with dramatic changes in the balance of growth regulators in xylem sap. Gibberellins and cytokinins were both reduced drastically, while inhibitors such as ABA and farnesol were somewhat increased. Comparable changes could also be induced by drought stress but it is not clear how Striga attack brings about these changes.

The specificity of different strains of S. asiatica (L.) Kuntze and S. hermonthica for particular host species was described by C. Parker and by B. Lakshmi and Jayachandra. This specificity is based, in at least some cases, on germination response to different stimulant substances, but in S. gesnerioides (Willd.) Vatke there appears to be some other mechanism involved in the pronounced specificity of different strains for cowpea [Vigna unguiculata (L.)] Walp. aggreg, tobacco (Nicotiana tabacum L.) and certain wild legumes. The new occurrence of S. gesnerioides in Florida, U.S.A. was described by L. Herbaugh. The main host there is hairy indigo (Indigofera hirsuta (L.). It has not so far been found to attack any more important crops but testing is still in progress.

Control of Striga with the help of germination stimulants was the subject of two papers by J. E. A. Ogborn and R. A. Mansfield. They have demonstrated the effectiveness in the field of ethephon and two strigol analogs GR7 and GR45 and suggest ways in which their use might be integrated into a Striga control program. R. E. Eplee in describing the Striga eradication campaign in North and South Carolina laid emphasis on the useful contribution of ethylene in reducing Striga seed in the soil, while M. A. Langston described the way in which herbicides contribute to long-term control by preventing growth of alternate host grasses, especially Digitaria sanguinalis (L.) Scop. in rotational broad-leaved crops. The value of nitrogen in reducing Striga infestation was emphasized in a paper by N. T. Yaduraju and M. M. Hosmani.

An interesting new field is the exploration of the "haustorial factor" which is apparently responsible for initiation of the haustorium after contact between parasite and host root. J. L. Riopel described studies in which seedlings of Agalinis purpurea (L.) Raf. developed haustoria when exposed to root exudates of Lespedeza sericea (Thunb.) Miq. or to a gum tragacanth preparation. A great many compounds have been eliminated as possible active substances and while there is some evidence for phenolic substances being involved the precise structure has yet to be identified.

Other papers relating to Striga or other Scrophulariaceae included a biochemical study of the haustorium of S. hermonthica by A. T. Ba and a study of floral variation and pollination mechanisms in Rhinanthus species by M. M. Kwak.

Thesium humile Vahl. (Santalaceae) was the subject of two papers by M. A. Abou-Raya who described the germination requirements of the unusual mucilaginous seeds.

The remaining papers dealt with Orobanche species. The distribution and importance of Orobanche species in Jordan was described by B. E. Abu-Irmaileh and the history of sporadic occurrence of O. minor Sm. in U.S.A. was summarized by C. C. Frost.

P. J. Whitney discussed some aspects of germination behavior in O. crenata Forsk. especially the tendency to higher germination with more dilute root exudates. He presented evidence to show that this was attributable to separate inhibitory substances rather than supra-optimal levels of stimulant. A short paper by L. D. Chun and others suggested for the first time that Orobanche (in this case O. ramosa L.) may after all respond to ethylene. A paper by M. T. Moreno and others presented by J. I. Cubero emphasized the high levels of meiotic abnormalities in O. crenata which would be expected to result in great variability and hance perhaps ability to overcome host-plant resistance mechanisms. Some variations in distribution and virulence of O. ramosa in California were shown by A. H. Gold to be due to fungal attack but it seemed unlikely that the Rhizoctonia sp. concerned would be sufficiently selective for use for biological control. A similar conclusion was reached by Y. B. Palled and M. M. Hosmani in relation to several insects attacking O. cernua Loefl. in India.

Miss U. Schmitt described a survey which revealed the great importance of O. crenata in Morocco, where broad beans are seriously affected and the crop can no longer be grown in some areas. K. Schlüter, however, reported very promising results from extensive trials with glyphosate for selective control of this problem in Morocco. Even severe infestations were completely controlled by two applications of 60 g.a.i./ha in the early stages of parasite development. K. Petzoldt, having found a correlation of O. crenata attachment with rhizobial nodules suggested a fungicidal seed-dressing and nitrogen fertilizer (calcium cyanamide) as further components of an integrated control approach. B. E. Abu-Irmaileh was also able to show a reduction of O. ramosa on tomato with high levels of nitrogen fertilizer.

Other promising approaches to control of Orobanche to be reported were the use of synthetic strigol analogues (including GR7) for artificial germination by A. R. Saghir and the selection of resistant broad bean and lentil varieties, by F. Basler.

The symposium ended with a field trip to visit two centers of Striga research, the USDA Witchweed Test Farm at Dillon, S. Carolina, and the Witchweed Methods Development Center at Whiteville, N. Carolina. Participants were able to see the very comprehensive work at Dillon with herbicides, ethylene and maize varieties, while at Whiteville they were shown work confirming that S. asiatica also requires a "haustorial factor" in the same way as Agalinis species. This report will also appear in PANS.

Proceedings of the Symposium (296 pages + 53 pp. supplement) are available at U.S. $5.00 + $1.00 postage each from Prof. A. D. Worsham, Crop Science Department, Box 5155, North Carolina State University, Raleigh, North Carolina 27607 U.S.A. Make checks payable, in U.S. dollars, to North Carolina State University.

C. Parker

International Parasitic Seed Plant Research Group (IPSPRG).

A special session was held at the symposium (see above) to consider formation of a research group composed of anyone with an interest in parasitic seed plants. There was unanimous consent that such a group would serve a useful purpose for the exchange of information, vehicle of communication to government and other agencies, and planning of future meetings. The exact structure and functions of the group are not yet fully defined. Membership consists of those receiving HAUSTORIUM. In a way it is a successor to the European Weed Research Council Research Group on Parasitic Weeds that flourished in the early '70s but went dormant some years ago. It had served a useful purpose but could not legitimately concern itself with the most important parasitic genus of all: *Striga*.

The IPSPRG will have an advisory committee composed of about ten individuals representing a broad scope of organisms, approaches, and geographical distribution. Mr. Chris Parker was elected chairman of the group and Lytton Musselman secretary. Replies from all those asked to serve on the committee have not been received but should be in time for inclusion in the December issue of HAUSTORIUM. This newsletter will serve as the official organ of the IPSPRG.

L. Musselman
C. Parker

IPSPRG Members Invited to Participate in the 13th International Botanical Congress

At the recent symposium in North Carolina I raised the matter of the 13th International Botanical Congress which will be held in Sydney, Australia from 21-28 August, 1981. Several colleagues at the Raleigh meeting indicated interest in a Congress Symposium on parasitic flowering plants, and I have discussed this possibility with the organizers, who would be happy to have such a topic included in one of the sections, possibly Developmental Botany. I have given some thought to a suitable theme, and several possibilities seem worthy of further consideration. For the three I have suggested I have provided a title and a brief explanation of content, and I would be very interested to have your comments and any alternative suggestions you may wish to make.

Topic 1: Parasitic Seed Plants--the Haustorium
To include a general paper on the structure and function of the haustorium, followed by specific papers (invited or contributed).

Topic 2: Parasitic Seed Plants--Floral Biology and Reproduction
To include a general paper on the reproductive strategies of parasitic plants, followed by specific papers covering research into the floral biology and seed production of the various families which have been investigated.

Topic 3: Parasitic Seed Plants--the Life Style
To include a general paper on the nature and evolution of the parasitic way of life in seed plants, followed by specific research papers on assimilate translocation and water relations, including information on fine structure and physiology of the host/parasite interface as well as these aspects of the parasite alone.

No doubt there are other themes which could be suggested, but the foregoing are sufficient to give some idea of what might be done. I should very much welcome suggestions on these ideas or any other comments you would care to make. I am particularly anxious to hear from colleagues who may wish to provide a contributed paper. If you are interested please contact me at: School of Botany, University of Melbourne, Parkville, Victoria 3052, Australia.

Malcolm Calder

Samaru Striga Research

The Institute for Agricultural Research at Samaru in Northern Nigeria has a comprehensive integrated program of research on Striga hermonthica, S. gesneroides and a few other related root parasites.

The world collection of maize and sorghum cultivars which are stored at the station have been screened for field resistance by the Plant Pathology and Plant Breeding departments while the screening of cowpeas is still in progress. Useful genetic resistance has been identified in a range of sorghum and cowpea varieties which are already agronomically adapted for immediate use in the savanna environment.

Agronomic studies by the Weed Science Section have developed herbicidal and cultural control techniques which can be used by African subsistance farmers. From 1977-9 the section has been field testing the "strigol analogs" synthesized by Sussex University.

The conclusive results of these studies (breeding for resistance and cultural control) now make it possible to produce simple "integrated control" packages combining resistant or tolerant cultivars with the appropriate agronomic measures. The very exciting levels of activity and persistence discovered in the strigol analogs against S. hermonthica promise a substantial reduction in the economic damage caused by this species in cereal crops in the near future.

J. E. A. Ogborn

Index of Parasitic Seed Plant Research

One of the topics mentioned at the IPSPRG organizational meeting in Raleigh was the production of an index of workers and their research specialties. The green form attached to this issue is for that purpose. Please fill it out completely and return to the address on the form as soon as possible. From this a computerized file will be prepared for distribution to all who request it. This file will also allow for the search of specific topics, e.g., species of parasites, host plants, control, etc., that can be easily retrieved upon request.

L. Musselman

Alectra: A Pest in Botswana

Our work here involves testing animal drawn tillage systems under subsistance farming conditions aiming to increase crop production over that achieved by traditional methods of broadcasting and ploughing under crop seed mixtures. Farmers participating in the project grow sorghum, maize, sunflower and cowpeas. While patches of Striga asiatica are found in many sorghum crops, it is Alectra vogelii, called here cowpea witchweed, which is proving to be a major problem. Total crop failure caused by this parasite has occurred in a number of cowpea fields where a good plant stand had been established.

C. R. Riches

A New Striga Problem in Ethiopia

Striga latericea Vatke has recently been implicated as a serious pest in some sugar cane plantings near Addis Ababa. It is a robust striga and has pinkish-orange corollas. This is apparently the first time it has been reported to damage a crop.

T. Feredegn

Literature

Russell, G. E. Plant breeding for pest and disease resistance. Buttersworth, London. 495pp. This volume contains a separate chapter (Chapter 12) on parasitic weeds dealing largely with *Cuscuta*, *Orobanche*, and *Striga*. The author presents a succinct review of the literature and points to the need of understanding genetic variation in parasitic weeds.

L. Musselman

Requests for Previous Issues

Sorry, our supply of both prior issues is exhausted!

Material for HAUSTORIUM is to be sent to either of the editors. Readers are urged to submit any items that may be of interest.

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U.S.A.

International Parasitic Seed Plant Research Group

Index of Current Research

Please fill in this form as completely as possible and return immediately to:

Prof. Lytton J. Musselman
Secretary, IPSPRG
Department of Biological Sciences
Old Dominion University
Norfolk, Virginia 23508

1. Name ______________________________
(First) (Middle) (Last)

2. Title (Mrs., Ms., Dr., Prof., Mr., etc.) ______________

3. Position (Agronomist, Senior Scientist, Assistant Professor, etc.) ______________

4. Address:

a. ______________________________
(Department, section, etc.)

b. ______________________________
(Institution)

c. ______________________________
(Street Number, Box Number, etc.)

d. ______________________________
(City)

e. ______________________________
(Postal Code--Important!)

f. ______________________________
(Country)

5. Phone number including area/access code ______________________________

6. Parasite Research Organism(s)

a1. ______________ family
b1. ______________ genus
c1. ______________ species with author

a2. ______________ family
b2. ______________ genus
c2. ______________ species with author

a3. ______________ family
b3. ______________ genus
c3. ______________ species with author

a4. ______________ family
b4. ______________ genus
c4. ______________ species with author

7. Host or control research organism(s), (e.g., sorghum, phytomyza, etc.)

a1. ____________________ family

b1. ____________________ genus

c1. ____________________ species with author

a2. ____________________ family

b2. ____________________ genus

c2. ____________________ species with author

8. Titles of specific research projects (limit 4)

a. ____________________

b. ____________________

c. ____________________

d. ____________________

9. Geographical area of research interest (e.g., Sahel, Falkland Islands, Southern United States)

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10. Recent or significant publication with complete citation. Limit two (optional information).

a. ____________________

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b. ____________________

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HAUSTORIUM
PARASITIC PLANTS NEWSLETTER
OLD DOMINION UNIVERSITY

No. 4 Official Organ of the International Parasitic Seed Plant Research Group

December 1979

Rafflesiaceae in Libya

On April 1979 during a field trip to Gebel Akhdar area (Cyrenaica) in the region of Ras Helal, Kubba and Derna, the plant collectors were attracted by bursts of brilliant yellow and red among the green beneath the shrub; *Cistus parviflorus* L. Dr. M. H. Jafri of the Herbarium in the Faculty of Science, Tripoli identified it as *Cytinus hypocistis* L. which infects the roots of the above shrub.

This holo-root parasite is restricted to the Old World. It occurs in the Mediterranean region, Madagascar, and Cape region of S. Africa. The species has been known since the time of the Greek Herbals as reported by R. T. Gunther in his book *Dioscorides* (1968). It has been reported by H. G. Keith in *Libyan Flora* (1965) and also in Italy by D. E. Baroni in *Guida Botanica D'Italia* (1955), in France by E. Burnat in *Prodrome de al Flore Corse, Tome I*, (1910), and in Lebanon and Syria by P. Mouterde in *Nouvelle Flore du Liban et de la Syrie, Tome Premier, Atlas*, (1966).

As indicated by Kuijt in *The Biology of Parasitic Flowering Plants*, (1969), little is known about the host range, seed germination and the manner in which entry into the host is affected. These problems are now under investigation.

M. A. Abou-Raya

Variations in metabolites and pretreatment requirement in different samples of *Striga asiatica* (L.) Kuntze

Seed samples of *Striga asiatica* (L.) Kuntze collected from sorghum and pearl millet fields of Mandya (sample A) and Bellary (samples B and C) districts, Karnataka, India were found to differ in their seed weight, proteins, phenolic level and germination per cent in response to host root exudates, kinetin and GR 7. Extended studies show that these samples also differ in their metabolite levels before and after the pretreatment and the minimum pretreatment period required to induce germination.

Prior to pretreatment sample B showed the maximum levels of reducing sugars and RNA whereas, A ranked the highest with regard to free amino acids. Total protein content was at the same level in A and B but less in B. Following pretreatment there was significant increase in reducing sugars, which came to almost the same level in all the three samples, amino acids to the maximum in B and RNA to the highest in A and C. Proteins declined to a great extent in A and B and phenolics in A and C.

With regard to the electrophoretic pattern of proteins following pretreatment, in sample A, out of the six bands that were present, one completely disappeared, the intensities of the other five were decreased and two new bands appeared. In B the pretreatment caused the disappearance of all the three bands and appearance of four new bands and in C, out of the five bands two disappeared, the intensities of the other three were lowered and two new bands appeared. Among the new bands that appeared subsequent to pretreatment, one of the two in A corresponded with one of those in B and the other with one of those in C.

The minimum pretreatment period required to induce germination was four days in A, seven days in B and six days in C.

These findings reinforce the inference drawn from our earlier data that the samples A, B and C are different populations.

Bharathlakshmi and Jayachandra

Orobanche Research at ICARDA

The International Centre for Agricultural Research in the Dry Areas has as an overall mandate the improvement of the agricultural production and consequently the standard of living for the rural population of West-Asia and North-Africa, by means of agricultural research. To this end the center follows a farming systems approach integrating crop improvement, agronomic practices and other relevant approaches.

One of the main crop improvement programs is on food legumes, such as lentil (Lens culinaris) and faba (Broad) bean (Vicia faba). One serious constraint in improving production of these crops in the region is their susceptibility to the parasitic weeds broomrape (Orobanche spp.) which are present over the main areas where food legumes are grown.

ICARDA has therefore embarked on a control program with financial assistance from IDRC (International Development and Research Centre, Ottawa, Canada) involving the part-time expertise of two scientists (Mr. F. Basler and Prof. A. R. Saghir) and the full-time work of t research assistants. The work is carried out at the centre's facilities in Aleppo, Syria and at the American University in Beirut, Lebanon. In Aleppo research concentrates on field work, in Beirut mostly laboratory and greenhouse experiments are carried out.

The program involves:

1) Selection of Orobanche resistant cultivars from a large genetic stock available in ICARDA of faba bean (against O. crenata) and lentil (against O. aegyptiaca and O. crenata) and lentil (against O. aegyptiaca and O. crenata) as well as tomato (against O. ramosa) from various sources.

2) Testing synthetic stimulants such as GR-7 (provided by Prof. A. W. Johnson, Sussex University, Brighton, UK).

3) Developing chemical control means.

4) Study the usefulness of trap crops, also referred to as false host crops.

5) Study of the seed behavior of Orobanche with emphasis on dormancy and periodicity patterns. (This study has been taken up in collaboration with Dr. Pieterse at the Royal Tropical Institute in Amsterdam, outside the IDRC financial assistance.)

Some progress has been made lately with some of the control approaches studied.

1) From 768 lines of faba bean tested, four cultivars were selected as highly resistant to O. crenata. These four are undergoing - in a package with another 20 lines of fair resistant and susceptible ones - susceptibility tests in 8 countries of the Mediterranean Basin to assess their performance on the various local O. crenata ecotypes. Fair resistance to O. aegyptiaca has been found in 100 lines of lentil and to O. ramosa in 108 lines of tomato.

2) The work to date with synthetic stimulants has yielded an understanding of their performance, which is presently utilized to test them under field condition.

3) Glyphosate at low rates (60 - 160 gr acid equival per ha) applied twice in 2-3 weeks intervals starting with early flowering of faba bean has consistently given near complete prevention of O. crenata shoot development, without significantly affecting the crop. With high infestation rates a yield increase of beans was apparent.

Glyphosate has however not shown sufficient selectivity in lentil and tomato at rates required to control Orobanche.

F. Basler

Striga Gesnerioides Host Tests in Florida

Abstract

Striga gesnerioides (Willd.) Vatke (S. orobanchoides Benth.) was first collected in the New World in Polk County, Florida in October 1978. To date S. gesnerioides has been found in four counties of central Florida. In April 1979 the U. S. Dept. of Agriculture established a research plot in Orange County to determine which commercial, ornamental, and weedy species might serve as hosts. Approximately 125 species from 60 genera and 17 families have been tested. Of these, only Indigofera hirsuta (hairy indigo), Helianthus annuus (sunflower, 'mammoth Russian'), and Ipomoea batatas (sweet potato, cultivar unknown) supported growth and flowering of the parasite. Interestingly, one strain of sweet potato ('Porto Rico') was never parasitized. Although hairy indigo is the most frequent host in nature, Jacquemontia tamnifolia has been documented as a host in some weedy fields as has Alysandra vaginalis.

Norman P. Upton

Literature

Kwak, M. M. 1979. The Role of Bumblebees in the pollination and variation of some Rhinanthoideae (Scrophulariaceae). Ph.D. Diss. Univ. Groningen. 114ff.

Teryokhin, E. S. 1977. Parasitic Flowering Plants. Evolution of Ontogenesis and Life Forms. Leningrod: Naukh Pub. 220 pp. (in Russian). I am indebted to Dr. Janice Coffey for providing me with a copy of this book. She has also translated the chapter titles which are: 1. Parasitism of angiosperms and its orgins. 2 and 3. Evolutionary transformations of embryos of parasitic flowering plants. 4. Some features of endosperm evolution. 5. Influence of parasitism on the evolution of sexual structures. 6. Some generalities of the regularities of evolutionary transformations of ontogenesis of parasites.

L. J. Musselman

Knutson, Donald M. 1979. How parasitic seed plants induce disease in other plants. Chap. 16, p. 293-312. In Plant disease, an advance treatise, Vol. 4, How pathogens induce disease. J. G. Horsfall and E. B. Cowling, Eds. Academic Press, N.Y.

This is an excellent and thought-provoking review article on parasitism and physiology of parasitic higher plants. As the author explains in his summary, the basic quandry in th chapter was to resolve a seeming contradiction: General thought holds to the notion that parasitic plants rob hosts primarily of carbohydrates, especially sugars. Sugars move thro phloem tissue normally, yet the overwhelming association of conduction, tissue between para plants and hosts are xylem connections, established quickly by the parasites. How can this be explained? The basic point of this chapter is that parasitic plants induce disease by first penetrating the host and producing hormones (in the case of parasitic angiosperms, cytokinins seem especially important) and hormone imbalances. These cause host plants to "speed up" and we can measure higher respiration, sometimes greater photosynthesis, increas cell division, etc. Such host responses are common with most pathogens, whether or not the are animate.

Accompanying these events is a source-sink relationship, with a migration of sugars an inorganic ions (P. K. S. Mg) to the infection sites. The loss of these nutrients to the hos constitutes one aspect of diseasedness; the host is simply deprived of some necessary foodstuffs. A more insidious aspect, to my mind, is a pathogen-induced deregulation of a sucrose-amino acid cycle. Sugar normally moves to the roots through the phloem, combines (i part) with inorganic nitrogen, and is exported topside through the xylem as amino acids and amides. These two transport systems are linked: A reduction in one results in a reduction in the other. Parasitic plants accumulate sugar and reduce this transport to the roots. Reduced root sugar causes reduced production and export of organic nitrogen. The xylem connection between parasites and hosts ensures a bountiful flow of amino acids and amides to th parasite and reduces the amount of nitrogen available for the host. This slight nitrogen deficiency actually causes an additional reduction in the transport of sugar, which is separate from the sugar that accumulates at infection sites. The parasites, therefore, caus a vicious cycle, less sugar ⟶ less nitrogen ⟶ less sugar, which results in the chlorosis, growth reduction, and yield loss so commonly observed in parasitized plants.

F. G. Hawksworth

Computerized Bibliography of the World Mistletoe Literature

A computer-based information retrieval system to the world literature on mistletoes (families Loranthaceae and Viscaceae) has been operational since 1975. Presently, over 8,50 references are in the system, and about 500 are added yearly. Each reference entry includes: author, date of publication, title, publication outlet, species of mistletoe, geographic code, major and minor keywords, and an abstract. The following publication describing the system and listing the key words is available to anyone interested: Scharpf, R. F., F. G. Hawksworth, and B. J. Erickson. 1976. Mistletoe literature of the world: A user's guide to a FAMULUS retrieval system. USDA, Forest Service General Technical Report, RM-30, 5 p. Also, requests for searches can be forwarded to me. There is no charge for this service but we would appreciate any corrections or additions to the printouts provided. Frank G. Hawksw USDA, Forest Service, Rocky Mountain Forest and Range Experiment Station, 240 West Prospect, Fort Collins, CO 80526 USA.

F. G. Hawksworth

New biological control newsletter

The Commonwealth Agricultural Burezux (CAB) have just released a sample issue of their new "Biocontrol News and Information". This contains several pages of news items on biolog control and some 500 relevant abstracts selected from their various abstract journals. Eac issue will also contain a review article and the topic of this first issue is by chance "Th potential for biological control in the suppression of parasitic weeds" by D. J. Girling, D. J. Greathead, A. I. Mohyuddin and T. Sankaran all of Commonwealth Institute of Biological Control (CIBC). This gives an excellent overview of the present possibilities and prospect for biological control of all four main groups of parasitic weeds - Striga, Orobanche, Cuscuta and mistletoes.

The sample is free, and the journal will appear quarterly from March 1980 priced £20 in the first year. Further information can be obtained from D. J. Girling, CIBC, Informatio Service, 56 Green's Gate, London SW7 5JR, UK.

C. Parker

Annotated bibliographies on parasitic weeds

Four new bibliographies are now available in the WRO series. These consist of sets of abstracts mainly reproduced from CAB "Weed Abstracts". They are:-

No 133 on Orobanchaceae (91 abstracts, 1977-79). Price £4.00 in UK, 4.80 overseas.

No 134 on Scrophulariaceae (including Striga) and Santalales (59 abstracts, 1977-79). Price 3.50 in UK, 4.20 overseas.

No 135 on Cuscuta species (69 abstracts, 1976-79). Price £3.50 in UK, 4.20 overseas.

No 136 on mistletoes (111 abstracts, 1974-79). Price £4.00 in UK 4.80 overseas.

Please send remittance made payable to ARC Weed Research Organization with your order. For those in developing countries who would have difficulty in sending payment please addres requests direct to me at, Weed Research Organization, Yarnton, Oxford OX5 1PF, UK. Lists of earlier bibliographies in the series are also available.

C. Parker

IPSPRG News and Notes

Symposium proceedings - Copies are still available from Prof. A. D. Worsham, Crop Sci. Dept., Box 5155, N.C. Univ., Raleigh, N.C. 27607. Cost is $8.00 for the proceedings and supplement.

Symposium group picture - contact L. Musselman for details as to cost, etc.

Six Symposium on Morphology, Systematics, Univ. Ulm 9-12 March 1981 - Parasitic flowering plants will be the theme of th meeting. For information contact: Dr. H. C. Weber, Bio. V. Univ. Ulm, D-7900 Ulm, West Germany.

Index of Current Research - Response to this program (see HAUSTORIUM No. 3) has been encouraging and we can now provide names, addresses, publications, etc. of researchers upon request. Contact L. Musselman.

Previous issues of HAUSTORIUM - these are all exhausted.

From the Editors

Very best wishes for the mistletoe season and for the coming year!

C. Parker
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Table 1

Cuscuta and Viscum species, their hosts, intensity of infestation and location in the middle and nortern parts of Jordan

Parasite Generic Name	Host Generic Name	Intensity of Infestation	Location[7]
C. campestris Yunk.	Alhagi maurorum (W)[1]	S[2]	Jordan Valley
	Corchorus olitorius (C)[3]	L[4]	Alroussaifa
	Prosopis fracta (W)	S	Jordan Valley
	Trifolium alixandrinum (C)	L	Zarqa
C. epilinum Whichl.	Artemisia herba alba (W)	S	Yajouz
	Nicotiana tabacum (C)	L	Greenhouse
C. monogyna Vahl.	Citrus deliciose (C)	L	Kreimeh
	Vitis vinifera (C)	M[5]	Irbid
C. planiflora Ten.	Capparis spinosa (W)	L	Karak
V. cruciatum Sieb.	Amygdalus communis (C)	S	Wadi Shu'aib, Ajlun
	Crataegus azarolus (F)[6]	L	Ajlun
	Olea europea (C)	None/S	Jarash to Ajlun
	Punica granatum (C)	M	Wadi Shu'aib
	Quercus sp. (F)	L	Kufr abil
	Retama raetam (F)	L	Arda Rd.
	Rhamnus palaestina (F)	S	Ajlun to Wadi rumman

[1] W = wild

[2] S = severe

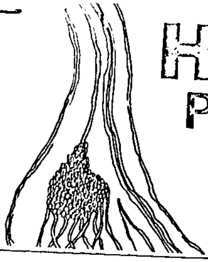
[3] C = cultivated

[4] L = light

[5] M = moderate

[6] F = forest treet

[7] Locations are shown on the attached map.



HAUSTORIUM
PARASITIC PLANTS NEWSLETTER
OLD DOMINION UNIVERSITY

No. 5

June 1980

IPSPRG News - Steering Committee Formed

At the 1979 Raleigh Symposium a Steering Committee was nominated. Some nominees were unable to serve causing considerable delay in finalizing the composition of the Committee. The Committee is constituted as follows:

C. Parker - Weed Research Organization (Chairman)
J. L. Riopel - University of Virginia
A. R. Saghir - American University of Beirut
F. Hawksworth - U.S. Forest Service
J. Kuijt - University of Lethbridge
S. ter Borg - University of Groningen
J. Dawson - U.S. Dept. of Agriculture
M. Calder - University of Melbourne
L. J. Musselman - Old Dominion University (Secretary)

This Committee will function as a co-ordinating committee for future symposia, exchang of information and ideas and communication of news, notes and literature to HAUSTORIUM.

Special Symposium on Haustoria

A special meeting on haustoria is planned for 1981 in Australia. The plans are not ye finalized but anyone interested may contact Prof. J. Kuijt, Biological Sciences, University of Lethbridge, Lethbridge, Alberta, Canada.

Sixth Symposium on morphology, anatomy and systematics, 9-12 March, 1981, Ulm, West Germany

will include a special session on parasitic angiosperms. IPSPRG members are invited to attend. Those interested in participating should contact Prof. F. Weberling, Universität Ulm, Abteilung für Biologie v, Oberer Eselberg, Postfach 4066, D-7900 Ulm/Donau, West Germany, by 1 November 1980.

Printed Supplement to the Proceedings of the Second Symposium on Parasitic Weeds Available

Due to the late arrival of manuscripts, it was necessary to produce a supplement to the print proceedings. This was made available free to all participants at the symposium. Addi tional late papers were received and it was suggested at the meeting that a second "final" supplement be produced. Through the efforts of Prof. A. D. Worsham a printed supplement was produced using the same cover, binding and printing process. The additional expense of this volume could not be covered by symposium finances. The earlier supplement should not be cited and copied and will not be distributed. Copies of the final supplement may be purchased from:

Professor A. D. Worsham
Department of Crop Science
North Carolina State University
Box 5155, Raleigh
North Carolina 27650, USA

The cost of the supplement is US $3.00 plus postage - surface foreign $0.80, surface North America $0.59, air foreign $2.00. Make cheque for the supplement and postage payable to North Carolina State University.

A limited number of copies of the Proceedings are still available at the original cost of $5.00 + $1.25 foreign surface postage.

Conservation of *Rafflesia*

Prof. Meijer (Herbarium, T. H. Morgan School of Biological Sciences, Univ. of Kentucky, Lexington, Kentucky, USA) is involved in an effort to preserve the natural habitat of *Rafflesia* species in Indonesia. He will welcome enquiries on this topic.

How many mistletoe families?

Historically, the mistletoes have been placed in the Loranthaceae. The family was divided into two subfamilies (Loranthoideae and Viscoideae) based on flower size and several embryological features. Recently, there has been a strong tendency to accept the elevation of the two subfamilies to family status: The Loranthaceae, s.s., and the Viscaceae.

LORANTHACEAE. This widespread family, mainly of southern origin, includes some 700 species in about 70 genera. Several hundred species, originally described under "*Loranthus*" have now been assigned to other genera. Now only 1 species is retained in *Loranthus* (i.e. *L. europaeus* of Europe and Asia). Some of the most widespread genera are *Tapinanthus* in Africa, *Dendrophthoe* in S.E. Asia, *Amyema* in Australia, and *Psittacanthus* and *Struthanthus* from Mexico to South America.

VISCACEAE. This family is primarily northern and contains about 400 species in 7 genera. It includes the well-known Old World genus, *Viscum*, the New World *Phoradendron* (the largest mistletoe genus with over 200 species) and *Arceuthobium* (the only mistletoe genus that occurs in both Old and New Worlds).

EREMOLEPIDACEAE. This rare South American group contains 3 genera - *Antidaphne*, *Eremolepis*, and *Eubrachion*. Its affinities are somewhat obscure as it seems to have relationships with the Santalaceae. Recently it has been generally regarded as a distinct mistletoe family.

--. G. Hawksworth.

Breeding for resistance to *Striga hermonthica* in Sorghum bicolor at Samaru, Nigeria

Significant varietal differences were observed for non-flowering *Striga*, flowering *Striga* and total number of *Striga* per hill of three sorghum plants. Three pure lines, SSV6, SSV3 and SSV2, showed resistance in that decreasing order; two single cross hybrids, SSH2 and SSH1, are also relatively resistant and tolerant respectively. These long season varieties and hybrids are adapted to the Northern Guinea savanna. Three early lines, KSV3, KSV4, KSV9, and two medium maturing varieties, KSV2 and KSV6, adapted to the Sahel and Sudan savan respectively have been found to show resistance. The line 2123 was the most susceptible in the Northern Guinea savanna.

Correlation estimates (rp) show that number of flowering *Striga* and total *Striga* counts are significantly correlated with establishment and harvest stand counts, number of heads, head weight and dry stalk weight. The negative relationship between total *Striga*, sorghum head weight and dry stalk weight indicates that total *Striga* count is important and is a good criterion for measuring resistance; the increase in total number of *Striga* leads to decrease in sorghum yield. Vice versa, the positive relationships between stand counts and the *Striga* counts indicate that with an increase in sorghum plants, there is an increase in the incidence of *Striga*. However, regression estimates show that there is little or no linearity in the observed dependence of sorghum traits on *Striga* counts.

Investigations to determine the mode of inheritance of the resistance to *Striga* and the gene action conditioning resistance are in progress.

-- A. Tunde Obilana

LITERATURE

Visser, J. H. 1978. The biology of *Alectra vogelii* Benth., an angiospermous root parasite. Beitr. Chem. Kommun. Bio-und Okosyt, 279-294. This is a review of the present state of knowledge on this interesting and sometimes damaging parasite. From information presented in this paper it is evident that much of the data on such topics as host range and autotrophic ability needs verification.

El Hiweris, S. O. 1979. Physiological studies on the relationship between *Striga hermonthica* Del. (Benth). and *Sorghum vulgare* Pers. Doctoral thesis - University of Reading, pp 328. These studies demonstrate the dramatic influence of *S. hermonthica* on the growth regulator balance within infested sorghum plants. Gibberellins and cytokinins reaching the shoot system are greatly reduced and inhibition increased - findings which explain the stunting effect on the host shoot system. The mechanism behind these changes is not explained but it is shown that the effects are similar to those caused by drought stress. Portions of this thesis were presented at the 2nd Int. Symp. on Parasitic Weeds 1979 in the paper by D. S. H. Drennan and S. O. El Hiweris, pp. 144-155.

Ozenda, P. and Capdepon, M. 1979. Recherches sur les Phanerogames Parasites. III Sur la Continuite des Appareils Parasitaires entres les Scrophulariaceas et les Orobanchacees. Bull. Soc. Bot. Fr., 126, Lett. Bot. 4, 453-460. The morphological reduction and specialization of the haustorium of the Scrophulariaceae and Onobanchaceae has long fascinated botanists. The subject of this paper is the morphology of the tuber-like organs found in some genera (e.g. *Xylanche, Striga*) where the tissue of the host root contributes considerable bulk to the parasitic organ.

Schmitt, V., Schlüter, K. and Boorsma, P.A. 1979. Chemical control of *Orobanche crenata* in broad beans. FAO Plant Protection Bulletin 27, (3), 88-91. Very successful results are reported from four trials on heavily infested sites in Morocco. Two applications of glyphosate controlled *O. crenata* almost completely and raised yields by 500 to 800 kg/ha. Two applications of 60 a.i. in 500 l water per ha are recommended, the first at tubercle or bud stage and the second 2 weeks later.

Bischof, F. 1978. Common weeds from Iran, Turkey, the near east and north Africa. Eschborn German Agency for technical co-operation. 223 pages. HAUSTORIUM readers will be interested in this book, lavishly illustrated in full colour with photographs of mature plants and drawings of seeds and seedlings. One species of *Cuscuta* (*C. approximata*) and four of *Orobanche* (*O. ramosa*, *O. aegyptiaca*, *O. cernua*, *O. crenata*)are included. The corollas of *O. cernua* (p. 168) are much bluer and more flared at the mouth than some strains grown at WRO.

Mushtaque, M. and Baloch, G. M. 1979. Possibilities of biological control of mistletoes, *Loranthus* spp., using oligophagous insects from Pakistan. Entomophaga 24 (1), 73-81. Out of 27 spp. of insects and mites, associated with *Loranthus* spp. in Pakistan, four have been found to be sufficiently damaging and host specific to be promising for further biological control studies.

Stewart, G. R. and Orebamjo, T. O. 1980. Nitrogen status and nitrate reductase activity of the parasitic angiosperm *Tapinanthus bangwiensis* (Engl. and K. Krauss) Danser growing on different hosts. Ann. Bot. 45, 587-589. This mistletoe has the capacity to synthesize and reduce nitrate ion. It is able to assimilate nitrate nitrogen into glutamine or glutamate. The nitrogen status of the parasite was very similar to that of its host plant.

Pieterse, A. H. and Daams, J. 1979. Parasitaire Onkruiden. Natur en Techniek 47 (12), 704-721 (in Dutch). This is a treatment of parasitic angiosperms, especially parasitic weeds, for the layman. The paper is beautifully illustrated with full colour pictures.

Fisyunow, A. V. 1977. (Parasitic weeds and their control). Sornyakiparasity i bor'ba s nimi. Moscow, USSR. Rossel'khozizdat. 72 pp (in Russian). Detailed description of *Cuscuta Orobanche* and native hemiparasites are given. *Striga* species, although not occurring in the USSR, are described and a quarantine advocated to keep them out.

HAUSTORIUM is edited by Chris Parker and Lytton Musselman and produced and mailed by Old Dominion University. Any news, notes, research in progress, literature or other items dealing with parasitic angiosperms is welcomed. Such material as well as requests for future copies of all newsletters (supplies of all earlier issues are exhausted) may be sent to:

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HAUSTORIUM
PARASITIC PLANTS NEWSLETTER
OLD DOMINION UNIVERSITY

Number 6. Official Organ of the International Parasitic Seed Plant Research Group. December 1980.

Striga and Alectra on cowpeas

In a pot experiment at Weed Research Organization six varieties of cowpea (*Vigna unguiculata*) were grown in soil infested with two strains of *Striga gesnerioides* (from cowpea and *Indigofera hirsuta* hosts) and three strains of *Alectra vogelii* (from cowpea, groundnut/peanut and bambara nut, *Voandzeia subterranea*). Final mean emergence of parasites per pot was as follows:

	S.gesnerioides from		Alectra vogelii from		
cowpea var.	cowpea	indigo	cowpea	peanut	bambara
blackeye	24	0	13	19	65
rhenoster	12	0	24	11	84
var.88-63	17	0	11	16	76
local(Nigeria)	21	0	11	9	49
Ife brown	12	0	19	14	78
TVV4557	2	0	8	5	46

No variety showed resistance to either species. The lower numbers on TVV 4557 were perhaps associated with lower vigor of this host

variety. The lack of strict host specificity of the *Alectra* strains is in contrast to that shown by *S. gesnerioides*. The *Indigofera* strain from the USA is unable to attack cowpea and conversely the cowpea strain has not been shown to attack other hosts even within legume family. Other strains have been found to be specific to tobacco, *Jacquemontia tamnifolia*(Convolvulaceae) and *Tephrosia pedicellata* respectively.
C Parker, N H Dixon and K Chadwick

Thesium humile on onion

Thesium humile (Santalaceae) is a common parasite of barley in the Mediterranean region. Recently, it was found parasitizing onion in Jordan.
Abu-Irmaileh

Striga in the Gambia

Two troublesome species of *Striga* occur in the Gambia, *S. aspera* as a parasite of a local crop known as findo (*Digitaria exilis* (Kippist) Stapf.) and *S. hermonthica* on sorghum, bulrush millet and maize. A survey was carried out in 1979 to ascertain the distribution and frequency of *Striga* in relation to crops, planting dates and fertilizer use.

Striga was present through the country but it tended to be more serious in the slightly drier north. Damage to all cereals varied from insignificant to severe but there was a tendency for late sown crops to suffer most. Early sown crops, especially early millet, tended to support high densities of *Striga* but they were not usually evident until the crop was at or near maturity. It was common to see dense stands of *Striga* growing in fields of harvested millet where no efforts had been made to cultivate the land and prevent seed production. *Striga* densities were markedly less in cereals inter-planted with groundnuts. This can probably be explained in terms of planting dates, better maintenance of the cash crops than occurs with a pure cereal stand and perhaps fertilizer use. There was a trend towards lower *Striga* densities where cattle dung or nitrogenous fertilizer had been applied.

Current recommendations to Gambian farmers for reducing *Striga* infestations are to plant early, rotate crops, apply dung or nitrogenous fertilizer and to destroy the weed before it produces seed. The Gambia is participating in the ICRISAT program to screen varieties of sorghum and millet for this resistance or tolerance of *Striga*.
P J Terry

Host-parasite Relationship in Cistanche (Orobanchaceae)

This report is concerned with two root-parasites species, *Cistanche violacea* G. Beck and *C. phelypaea* (L.) Cout. *Cistanche violacea* is found in nature in saline soils and is associated with a wide range of hosts, mostly species of the Chenopodiaceae. *Cistanche phelypaea*, on the other hand, is found mainly on *Tamarix aphylla* (L.) Karst. as a host.

Applications of concentrated host exudate, host root extract, or some growth regulators to pretreated seeds did not stimulate germination. Less than one per cent of the seeds germinate spontaneously. Likewise, application of a gum tragacanth extract did not induce haustoria. It therefore appears that there is a very specific requirement for germination and haustorial development in these species.

Using a fabric bag containing parasite seeds inserted close to the host roots of *Tamarix aphylla*, it was found that the the host-parasite contact is accomplished by the host root growing towards the host seed and penetrating it. In fact, a single filiform host root may penetrate several parasite seeds one after another. Within the seed the host root swells, forms roothair-like structures and becomes associated with callus tissue developing from the parasite seed embryo.

This process is in contrast with the hitherto known mechanisms of host parasite contact where the host root stimulates haustorial development. Moreover, these observations support the idea that both host root and the developing embryonic callus are involved in forming the primary haustorial-like structure.
M. A. Abou-raya

Mistletoes on commercial Trees in Columbia

Mistletoes of the genera *Phoradendron*, *Pthirusa*, and *Psittacanthus* have become serious problems in some plantations of coffee, cocoa, avocado, citrus and shade trees in Columbia. This has led to a co-ordinated effort between institutions in Eucador, Venezuela, and Columbia for research in to the control of these pathogens. There is also a report that ants can defoliate some mistletoes causing death to the parasite.
E. A. Rojas

LITERATURE

Pieterse, A. H., Daams, J. 1980. Broomrapes, Witchweeds and other

Parasitic Weeds. Bulletin 307. Royal Tropical Institute, Amsterdam. This beautifully illustrated booklet first appeared in Dutch (see review in earlier issue of HAUSTORIUM). However, this English edition has the benefit of several corrections and additions. There are a few minor spelling errors especially of scientific and place names. The colored photographs are very helpful. I have found the booklet to be well received by students in a class in parasitic weeds. The cost, however, is very high even by todays standards-over US$7.00 for A 23 page booklet!

Furuya, T. T., Koyama, I., Takabayashi, M. 1980. Studies on ecology and control of field dodder (Cuscuta pentagona Engelmann) Ecological characteristic and the control. Bulletin of the Saitama Horticultural Experiment Station 9: 33-41. (in Japanese but with an English abstract.).Crops apparently attacked by this species include onion, chrysanthemeum and eggplant. Methyl bromide did not effect control although steam killed 100% of the seeds in the soil.

Armstrong, W. P. 1980. Sand food: A strange plant of the Algodones dunes. Fremontia. A journal of the California Native Plant Society.This interesting article deals with Ammobroma sonorae a peculiar holoparasite of the Lennoaceae which grows in very arid regions of the deserts of the western United States. HAUSTORIUM readers will not be surprised to learn that this parasite exhibits a broad host range (considering the few hosts that are available.The author deals with the natural history and ecology of the plant as well as its use by Indians. In the next issue of the same journal, the author answers the query as to the perennation of the plant and clearly shows that it is a perennial.

Musser, R. l. 1979. The Fagus-Epifagus parasitic Relationship: Field Studies and Modeling of Beech Seedling and Parasite Carbon Dioxide Exchange. 209 pages. Ph.D. Dissertation, Duke University. Epifagus virginiana is one of the most common and yet most intriguing members of the Orobanchaceae in the eastern United States. However, the main emphasis of this work is on the host rather than the parasite as the author (like so many of us!) found that he could not germinate the seeds even with strigol and related compounds. In general he found that the affect of the parasite upon the host was of little importance in seedling survival of the beech.

Attawi, F. A. J., Weber H.-C. 1980. Zum parasitismus und zur morphologisch-anatomischen struktur der seckundarhaustorien von Orobanche-arten (Orobanchaceae). Flora 169: 55-83. One of the features of the genus Orobanche is the production of a primary haustorium from the tip of the radicle. Haustoria that are formed laterally on the root are termed secondary haustoria and are the subject of this paper which describes the morphology and anatomy of Orobanche species of central and southern Europe. One item that will need further study is the statement that secondary haustoria cause no damage to their hosts.

MEETINGS/SYMPOSIA

Second International Striga Workshop, October 1981

In 1978 a *Striga* workshop was held in Khartoum, Sudan to discuss recent advances in *Striga* research, especially in the countries of the African sahel where *S. hermonthica* is such a serious problem. A second meeting is now planned to be held in Ouagadougou, Upper Volta in October 1981 sponsored by ICRISAT. For further information, please contact : Dr. K. V. Ramaiah, Programme des Nations UNIES pour le Developpment-ICRISAT, B. P. 1165 Ouagadougou, Haute-Volta.

Symposium on Haustoria, International Botanical Congress, Sydney, August 1981

Plans are underway for a special session at the congress dealing with the haustoria of parasitic angiosperms. In addition, it is hoped to arrange a post-congress gathering including a field trip, in Melbourne. This might take the form of paper and demonstration sessions on aspects of the biology and life history of parasitic shrubby angiosperms. For further information contact: Professor Malcolm Calder, School of Botany, University of Melbourne, Parkville, Victoria, Australia 3052.

Please send material for the next (June 1981) issue and requests for copies to either:

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HAUSTORIUM
PARASITIC PLANTS NEWSLETTER
OLD DOMINION UNIVERSITY

Number 7. Official Organ of the International Parasitic Seed Plant Research Group. June 1981.

Cuscuta compacta on Blueberries in North Carolina

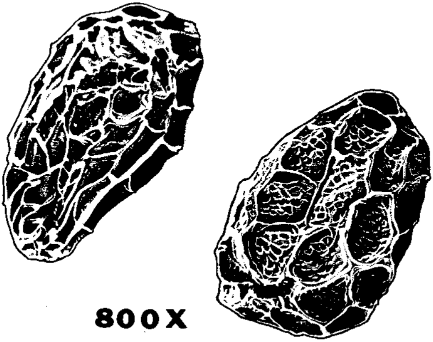
Over the past several years blueberry growers in southeastern North Carolina have reported an increased incidence of dodder (Cuscuta compacta) in their plantings. This is a native species which parasitizes woody or semi-woody plants. Extreme cases have resulted in loss of bushes in established plantings. The rabbiteye blueberry (Vaccinium ashei) produces basal shoots rather prolifically and is, therefore, more vulnerable to parasitism by the dodder as it offers greater probability of host attachments. Highbush blueberry (V. corymbosum) is also attacked.

The mechanism of invasion and spread of the dodder in blueberry plantings is unknown. Dodder is observed on adjacent ditchbanks and woodland but its distribution is typically scattered throughout blueberry fields and not localized in areas adjacent to ditchbanks or woodland. This suggests dissemination by birds or other wildlife.

Dodder seed has been observed to germinate throughout the growing season; however, little germination was observed in 1980 at several sites infested in 1979. This was attributed to the extremely dry conditions which prevailed during the 1980 growing season.
T. J. Monaco and C. M. Mainland, North Carolina State University.

Orobanche cumana in China

This broomrape, sometimes known as O. cernua is a parasite of sunflower and other crops and is a serious pest in several areas of China. It reduces sunflower yields in direct proportion to the number of parasites attached to a sunflower plant as well as to the earliness of the attack. The minute seeds are produced in capsules which split open when mature and may yield 1200 to 1500 seeds per capsule. A single plant may produce as many as 50000 or more seeds. Young seeds are yellow and become dark brown when ripe. They are irregular in shape but have very distinct reticulations (see drawing based on SEM photos).



Broomrape seeds may be spread long distances by surface water as the rough surface of the seed traps air and causes the seeds to float. Most of the seeds are buried in soil five to 10 cm. They may be dormant for five to 12 years while the land is planted in non-host crops and then germinate only in the close presence of a suitable host root.
Li Yang-han, Nanjing Agricultural College, Nanjing, China.

Studies on *Pyrularia* (Santalaceae).

The genus *Pyrularia* consists of two species, *P. edulis*, a small tree of the Himalayas, and *P. pubera*, the well known buffalo nut of the southern Appalachian Mts. A study on the natural history and ecological relations of *P. pubera* was conducted in eastern Kentucky and supplemented by studies in a controlled environment. *Pyrularia pubera* parasitized over sixty woody and herbaceous species including 28 families and 52 genera. Haustoria were less common on hosts grown in the controlled environment. Larger numbers of haustoria were evident in the forest depending on the host and the site. *Pyrularia pubera* is particularly prevalent on sites that have undergone perturbation in the form of logging, fire, windthrow and roadcuts.
D. J. Leopold, Purdue University.

Research on Viscum album at the Laboratorium Hiscia, Switzerland

Mistletoes are not only interesting for the botanist and the plant pathologist, they also represent an important material for the pharmacologist. For the first tine in 1920 R. Steiner suggested the use of *V. album* in cancer treatment. Today remedies extracted from this plant are on the market in Europe and many physicans use them in treating their cancer patients.

The oldest and most studied mistletoe remedy is registered under the trade name Iscador and is offered according to the host tree: apple, oak, elm, fir or pine. Apple, fir, and pine mistletoes are common and abundant in nature while native oaks and elms seldom bear *V. album* in Europe.

One of the main tasks of our research team is to locate and identify for protection the very rare mistletoe bearing oaks and elms along with a study of the natural condition (birds, climate, resistance) which favor or hinder the development of the mistletoe.

Another project concerns the cultivation of the mistletoe on the resistant host species. First results indicated that resistance is mainly genetically controlled and attempts are now in progress to select the most susceptible clones. This part of our research is done in cooperation with foresters who are, of course, also interested in selecting resistant clones.

The purpose of this work is to allow for chemical analysis of the mistletoe extracts and laboratory tests in order to measure their cytostatic and immunostimulant properties to improve upon non-toxic cancer therapy. The Society for Cancer Research (CH-4144, Arlesheim, Switzerland) publishes an annual report concerning our work as well as a bibliography. This report may be obtained without cost.
G. Grazi, Laboratorium Hiscia.

Parasites and epiphytes in Argentina

At the present time in Argentina there are not too many parasitic weeds in our crops, but it can be mentioned that *Cuscuta indecora* Choisy, *C. indecora* var. *longisepala* Yuncker and *C. suaveolens* Seringe. infest alfalfa (*Medicago sativa*) and occasionally other species such as privet (*Ligustrum* spp.) and *Ambrosia tenuifolia*. Many years ago the hemiparasitic *Arjona tuberosa* Cav. var. *tandilensis* (O.K.) Dawson (common names "mata trigo" and "Macachin del trigo") was very noxious in wneat crops but good systems for cleaning the seeds caused elimination of this weed.

Besides Arjona there are other species of the Santalaceae which are found in our country-Acanthosyris sp., Jodina sp., etc.

In the Loranthaceae there is Ligaria van Tieg. and Psittacanthus cuneifolius (R. et Pav.) Blume but these are of little importance to agriculture.

Work is now in progress on two species of the genus Tillandsia which live as epiphytes on many trees in the La Plata area. These plants are considered by us as true aerial weeds as they caused defoliation and finally the death of the tree. Preliminary studies suggest that the epiphytes produce an inhibitor that causes defoliation.
F K Claver, Univ Nacional de la Plata

Cuscuta in Argentina

In Argentina Cuscuta is widely distributed over almost the entire area where alfalfa is grown for seed, from the Province of Chubut to Salta. It is also found in areas where alfalfa is grown for forage but infestations are lighter because of the frequent mowing.

In the south of the Poia de Buenos Aires irrigated by the Colorado River where alfalfa has been grown for over 70 years, Cuscuta is a very serious problem. In fact, alfalfa is no longer grown in some parts of this region due to the parasite.

for these reasons alfalfa has been planted in areas that are relatively free of the pest and infestations are controlled as they appear. If the infestation is not serious, it can be controlled by localized application of paraquat 1-2% .

In the case of heavier infestations, we have obtained interesting results with the preemergence herbicides Chlorpropham (CIPC E 50% and G 20%) at rates of 6 kg a.i./ha and pronamide (=propyzamide) (Kerb 50 W, 50% wp) at rates of 2 kg a.i./ha applied overall and incorporated.

At the same time we are trying to instill in the farmers an awareness of the problem by stressing aspects that reduce the spread of the seed such as cleanliness of irrigation channels and machinery, animals grazed in infested plots and especially the sanitation of harvesting machinery.

The species involved is principally Cuscuta indecora but we suspect that other species may be involved. Host species include fodder crops such as alfalfa and red clover, vegetables such as potato and tomato and some seed species as Russian thistle (Salsola kali), Kochia scoparia and Chenopodium spp. We have also observed Cuscuta parasitizing fruit trees in the Vallo Medio de Rio Negro.

Seed cleaning in our area involves a separator with velvet-like rollers and/or magnetic separator (Gompper) to remove the parasite from the alfalfa seed. The roller type gives seed that is 95% clean with a minimum of wastage and a yield of three or four bags (50 kg ea)/hr. Th magnetic separator yields seed 99% clean but with considerable wastage. With two cleanings, it reaches a purity of 100%. This is the type of cleaner most used due to its efficiency and yield (8-10 bags/hr).
E. D. Agostino, Inst. Nac. Tec. Agropecuaria, Argentina
(Letter translated by M. Turton of WRO).

Third International Symposium on Parasitic Weeds, March 1983

A third symposium on parasitic seed plants is being organized for 1983 tentatively for the month of March. It will be held somewhere in western Europe or in the Mediterranean region at the request of numerous IPSPRG members. Please send suggestions for any aspect of the meeting to Chris Parker or Lytton Musselman.

Sixth Symposium on Morphology, Anatomy and Systematics

Special sessions on parasitic angiosperms were held at this symposium 9-13 March at the University of Ulm, Ulm, West Germany. The parasite sessions were organized by Dr Hans Christian Weber of the University of Ulm. IPSPRG was represented by members from five countries. There were four sessions dealing with parasitic angiosperms that included papers on a wide variety of subjects including morphology, floral biology, physiology and taxonomy of mistletoes as well as root parasites. Papers presented at these sessions are scheduled to appear in the German botanical journal Beiträge zur Biologie der Pflanzen.

Parasitic Weed Problems

Reports of acute parasitic weed problems continue to be brought to the notice of the ODA Tropical Weeds Group at WRO. In recent months these have included accounts of Orobanche problems in eggplant, tomato and tobacco in the state of Orissa, India (from Dr. G. C. Tosh); of O. aegyptiaca and O. ramosa in N. Iraq (Dr. Shaik Mohiddin); of Cuscuta species in soybean in Northeastern China (Mr Yu, Singapore); in Trifolium species in Uruguay (Mrs Amalia Rios de Formoso); and lucerne (alfalfa) in Argentina (Ing. Eduardo dell Agostino).

Orobanche ramosa in Texas

In February 1981, Mr Kevin Nixon and Prof Marshall Johnston of the University of Texas stopped along a hwy in central Texas for lunch and much to their surprise found themselves looking down on the first new introduction of branched broomrape reported in the United States in over 50 years! Later excavation revealed that the parasite was attached to a diversity of hosts from eight different families. The source of the infestation and the host range of this strain remain to be determined.

LITERATURE

Lynn, D. G., J. C. Steffens, V. S. Kamut, D. W. Graden, J. Shabanowitz, J. L. Riopel. 1981. Isolation and characterization of the first host recognition substance for parasitic angiosperms. J. Am. Chem. Soc. 103: 1868-70. This is perhaps one of the more significant papers to appear on the biology of parasitic angiosperms since the discovery of synthetic germination stimulants. It describes the characterization of a compound that induces haustoria in parasitic Scrophulariaceae. The compound, termed xenognosin (meaning recognizing strangers), was derived from gum tragacanth.

Tsivion, Y. 1981. Suppression of axillary buds of its host by parasitising Cuscuta. 1. Competition among sings and indirect inhibition. New Phytol. 87: 91-9. The author reports experiments that confirm the very powerful "sink" effect of C. campestris growing on peas but also suggests a further form of inhibition that does not depend on intact phloem between parasite and the buds that are suppressed. This effect may be due to a xylem transported inhibitor or to some other more complex indirect effect via the root system.

Hutchinson, J. M. and F. M. Ashton. 1980. Germination of field dodder (Cuscuta campestris). Weed Science 28: 330-3. Studies showed that dormancy of freshly shed seed depends on an intact seed coat and there is substantial loss of this dormancy within 18 months when exposed to cold conditions. Germination is then maximal at 27-33 C and mainly from the top 3 cm in the soil.

Tsybul'skaya, G. A. and A. N. Skoklyuk. 1978 Calculating releases of Phytomyza. Zashcita Rastenii 11: 49. (in Russian) and G. A. Tsybul'skaya, B. G. Degtyarov, N. A. Fedoryak, and A. N. Skoklyuk. 1978. Determination of the viability of Phytomyza puparia. ibid. 5: 29-30. (in Russian). These two papers describe many of the practical methods involved in collecting, rearing, storing and selecting Phytomyza material for least parasitization and greatest effectiveness as a biocontrol agent against Orobanche. New techniques include the use of x-rays to determine the viability of puparia. Why is it only in USSR that Phytomyza is being exploited?

Carafa, A. M., G. Carratu and G. F. Tucci. 1980. Ecology of parasitic Rhinantheae. Observations on the nutritional physiology of Bellardia trixago (L.) All. cultured in vivo. Annali della Facolta'de Scienze Agrarie della Universita'degli Studi di Napoli Portici 14:, 25-31. (in Italian). The authors suggest that this less well known member of the Rhinantheae is virtually an obligate parasite in that it cannot reach flowering without the benefit of organic nutrients from its hosts.

Weber, H.-C. 1981. Untersuchungen an parasitischen Scrophulariaceen (Rhinanthoideen) in Kultur. I. Keimung and entwicklungsweise. Flora 171: 23-38. This paper is similar in many ways to those of the famous Austrian botanist, E. Heinricher, who contributed so much to our understanding of hemiparasites. Like Heinricher, Weber discusses the growth of several genera of parasitic Scrophulariaceae in culture. The germination and development of six genera of parasitic Scrophulariaceae are described. The author states that all can grow to maturity without hosts but that haustoria do not develop unless another plant is present in the pot.

Canne, J. M. 1979. A light and scanning electron microscope study of seed morphology in *Agalinis* (Scrophulariaceae) and its taxonomic significance. Syst. Bot. 4: 281-96. The seeds of parasitic Scrophulariaceae are ideal subjects for SEM study and this author uses these criteria for their taxonomic value.

Weber, H.-C. 1980. Zur evolution des parasitismus bei den Scrophulariaceae und Orobanchaceae. Pl. Syst. Evol. 136: 217-32. The author suggests that the specialized parasitic organ of the Orobanchaceae has evolved from small annual root parasites by a tendency to form wart-haustoria in the hypocotylar region. He supports this by pointing out that leaf haustoria occur only in the most advanced members of the family.

Parker, C. 1980. Parasitic weeds and their control in the tropics. pp. 22-50 *in* Proc. Conf. at IITA, Ibadan, Nigeria, July 3-7, 1978. "Weeds and their control in the humid and subhumid tropics".

Musselman, L. J. 1980. The biology of *Striga*, *Orobanche*, and other root-parasitic weeds. Annual Review of Phytopathology 18: 463-89.

HAUSTORIUM is edited by Chris Parker and Lytton Musselman and is mailed in June and December. We are thankful for the many and diverse contributions to this issue and for the several supportive letters and comments. Unsigned items are by the editors. Please send material for the next (December 1981) issue to either editor by November.

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HAUSTORIUM
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IS THIS THE LAST ISSUE OF HAUSTORIUM?

HAUSTORIUM has been prepared, printed and mailed by the Department of Biological Sciences of Old Dominion University since its inception in 1978. However, due to severe budget limitations it is now essential to find some other source of support. This could be either through subscriptions or by subvention of costs by organizations and/or institutions. If you wish the newsletter to continue, please send suggestions for its continued support to either editor by May 1982. Otherwise, this may be the last issue of HAUSTORIUM.

Histocytological study of *Orobanche crenata*

A two year effort in Morocco to control *Orobanche crenata* on broadbeans (*Vicia faba*) has resulted in good control using glyphosate on the host plants. However, successful treatments need a better knowledge of the biology of this holoparasite. As a result, an ontogenic and histocytological study has been carried out on the host parasite interface of *O. crenata* and broadbeans.

Embryos contained in mature seeds of *O. crenata* show the beginning of differentiation with two opposite zones of meristematic cells separated by parenchyma cells. Embedding with epoxy resins and thin sectioning allowed a cytological observation of the filamentous organ developed during germination. It is a parenchymatous organ, devoid of conducting elements, with groups of primary meristematic cells at its tip. This peculiar structure plays a basic role in the attachment of the parasite to the host. Terminal meristematic cells modify their original shape and form papillae. After attachment to the host (a very rapid process), a tubercle develops. The basal part produces a haustorium or endophyte which penetrates host tissues without crushing any host cells. Very rapidly, connections are established between host and parasite xylem elements. The outer part of the tubercle is protected by two layers of vacuolated and degenerated cells. Meristematic cells are clustered in numerous groups under these protective layers and will give rise to many root apices and to one stem apex.

These morphological, anatomical, histocytological and ultrastructural results represent a basic approach that will be expanded upon in further work in greater detail and accuracy.

M. Mohamed Aber, Univ. Pierre et Marie Curie, Paris.

Low rates of Glyphosate Control Dodder Selectively in Alfalfa

Glyphosate (N-(phosphonomethyl)glycine) is usually applied at rates of 0.5 to 3 kg/ha to foliage of green plants for nonselective control of a broad range of annual and perennial weed species. Although glyphosate normally is not applied for selective weed control, low rates have been shown to control the root parasite *Orobanche* selectively in broadbeans (*Vicia faba*). Recently, it was found that low rates of glyphosate also controlled dodder (*Cuscuta*) selectively in alfalfa (*Medicago sativa*) after it had become attached as a shoot parasite.

Alfalfa was seeded in April 1981 in soil containing seed of field dodder (*Cuscuta campestris*) and largeseed dodder (*C. indecora*). In early July, when dodder was attached to the alfalfa, hay was harvested from the area. Dodder remaining on the alfalfa stubble grew and reinfested the alfalfa regrowth. In late July, when dodder was growing vigorously, had shoots 20 to 60 cm long and had begun to form buds, glyphosate at 0.075 to 0.6 kg/ha was applied in water at 860 L/ha.

One week after application, curtailed growth, reduced diameter of new stems and tendrils, and progressive necrosis were evident in dodder treated with all rates of glyphosate. The lowest rate applied, 0.075 kg/ha, caused almost no visible symptoms in the alfalfa. Stunted growth and small leaves were evident in alfalfa treated with higher rates of glyphosate. The injury increased as the rate of glyphosate increased.

Although glyphosate killed essentially all external dodder, some embedded haustoria and remnants of twinded tendrils survived. A limited amount of normal and abnormal flowers and abnormal stems developed from this surviving tissue late in the season. Plots of alfalfa treated with glyphosate at 0.075 kg/ha remained green and vigorous, whereas untreated plants became yellow from the dense infestation of dodder and the chlorotic leaves of parasitized alfalfa. Almost all of the recovering dodder was C. indecora.

At the present time, control of dodder in alfalfa after it has become attached to the host plant involves destruction of the alfalfa foliage as well as the dodder. No herbicide treatments are presently recommended for controlling dodder selectively after it has become attached to the host plant. The glyphosate treatment is of especial interest because it would fill the need for a treatment where none is presently available, and the extremely low effective rates would make it a very inexpensive treatment.

J. H. Dawson and A. R. Saghir, USDA-Irrigated Agriculture Research and extension Center, Prosser, Washington.

Second International Striga Workshop 3-8 October 1981

This gathering, in Ouagadougou, Upper Volta , was arranged by Dr K V Ramaiah of The Institute for Crop Research in the Semi-Arid Tropics (ICRISAT) and supported financially by International Development Research Centre (IDRC) as a sequel to that held in Khartoum in 1978. There were only about 25 workers from Africa, India, Europe and USA but there was valuable exchange of results and ideas. Much of the discussion inevitably revolved around the development of resistant sorghum and millet varieties and this is the only aspect to be currently receiving substantial support. The work of ICRISAT in collaboration with many local workers in Africa and India is leading to clearer ideas on the best sources of resistance to use in breeding work and some real progress has been made in selection and breeding of varieties with useful resistance, combined with improved agronomic and quality characters. Related work at Weed Research Organization (WRO) in England is helping to clarify resistance mechanism and factors influencing resistance, particularly drought stress and nitrogen. There was valuable discussion in true "workshop" sessions on research techniques. From the USA there was an updating on the eradication program for S. asiatica and some promising results presented on the strigol analog GR24 which appears superior to GR7 and comparable to ethylene in field tests. It was agreed there was urgent need for more study of the potential for germination stimulants in Africa, particularly ethylene, and it was pointed out that even if it was not a practical treatment for many situations it could be useful as a means of cleaning plots within infested areas and so allow more direct measurement of crop losses due to Striga; information badly needed as a means of persuading donor organizations to invest more in Striga research.

Very little agronomic research on Striga was reported but there were wide ranging discussions of all possible approaches and agreement on the need for good long term studies on the behavior of Striga seed under field conditions as a means of interpreting and predicting the effects of trap cropping and other cultural approaches. Similarly there was little to report on biological control but good agreement that there are real possibilities deserving more direct investigation.

A number of general recommendations were agreed including one to the Food and Agriculture Organization (FAO) of the United Nations to include Striga as a major topic in the Sahel Crop Pest Management project and another to US Agency for International Development (AID) to implement the Striga research project which had recently been formulated and agreed in principle.

One day was devoted to field visits when we saw the sorghum variety SRN 4841 performing well in experiments and farmers' fields. After the workshop three of us (C Parker, P Matteson, L Musselman) spent a further few days in the field with Dr Ramaiah and accumulated valuable observations on specimens of insect pollinators and predators which have been largely overlooked in the past, in particular a butterfly (Precis orithya =Junonia o.) . The larvae are known to be voracious feeders on Striga and realted genera in the USA and Indonesia and were observed to behave likewise in Upper Volta. Another observation of note was the occurrence at several sites of Cycnium (previously Rhamphicarpa) fistulosa causing severe damage to partially flooded rice.

Identification of Indian Striga Species

Mr B V N Reddy of the Botany Department , Nagarjuna University, Guntur, India kindly sent a copy of his paper "Colleters on the cotyledons of in vitro raised seedlings of witchweed-Striga asiatica (L.) Kuntze" (Current Science 49: 595-597, 1980) to Chris Parker at WRO. The behavior of the Striga seedlings reported in the paper including development of cotyledons in the absence of any attachment to the host seemed rather strange and the identify of the species was queried. Mr Reddy had been confident of his identification but did send seed and herbarium specimens and closer examination of these confirmed it was indeed S. euphrasioides (=S. angustifolia) rather than S. asiatica. It is not just a sporadic plant in the Guntur area but is apparently the dominant Striga species on sorghum in that district.

Following the Sorghum in 80's workshop, Chris Parker had the opportunity to make a brief field visit with Dr M J V Rao of ICRISAT to a village where S. asiatica had been particularly severe on sorghum planted dry before the monsoon rains and S. densiflora had also been abundant on immediately adjacent fields of maize. At one other site we observed another infestation in sorghum which one of us at first thought was S. asiatica and the other assumed was S. densiflora. In fact, on closer examination it was S. euphrasioides.

All three species in India have more or less similar white flowers and it seems very probable that *S. euphrasioides* is being quite commonly overlooked despite the fact it is simply distinguished. The calyx ribs are the simplest feature-only five in *S. densiflora*, one running to the tip in each calyx lobe: approximately 10 in *S. asiatica*, the additional ones ending at the sinus between the lobes: and 15 in *S. euphrasioides*, additional pairs of ribs running up to the sinus and then continuing up the sides of the calyx lobes to meet at the tips. *Striga euphrasioides* is further distinguished by larger seed, about 0.5 mm long (versus 0.03 mm in the other two species) with distinct sculpturing as shown with scanning electron microscopy.

Ultrastructural Studies on Striga hermonthica and S. gesnerioides

Light and electron microscopy have shown that there is no phloem in *S. hermonthica* only intertracheidal parenchyma cells between and along the xylem link between host and parasite. These parenchyma cells contain numerous ribosomes, rough endoplasmic reticulum, mitochondria, dictyosomes and vacuoles. The cell walls are irregular and possess numerous plasmodesmata. On the other hand, sieve elements are clearly evident in the haustorium of *S. gesnerioides* and form a sheath of phloem around the haustorial xylem. The relation of the phloem to that of the shoot and the host root have not been studied in detail although I assume that there is continuity based on preliminary studies with the light microscope.

A. T. Ba, University of Dakar, Dakar, Senegal

Medicinal Value of Striga

Members of the genus *Striga* in India have been used in the past for their therapeutic value. In *Ayurveda*, *S. asiatica*, pungent and bitter, are indicated to improve both appetite and taste and in treatment of blockage of the windpipe and diseases of the blood. *Striga gesnerioides* (or *S. euphrasioides*) has a use in diabetes. In addition to these uses recorded in the literature, we noticed in talking with some farmers from Maharashtra that *Striga* are used by them to increase the fertility of cows and buffalos, for treatment of dry cough, blisters on the tongue, and as a dermaticide.

M. J. Vasudeva Rao and V. L. Chidley, ICRISAT, Hyderabad, India

Symposium on Haustoria, Botanical Congress, Sydney, August 1981

Papers presented at this symposium included the following: J. L. Riopel-Host recognition in angiosperm root parasites. B. A. Fineran-Graniferous tracheary elements in haustoria. J. H. Visser-Host contact and initial development of the root parasite. I.

Dorr-The development of the haustorial phloem system of holo-and hemi-parasitic plants, as influenced by the host. H. C. Weber-Observations on the parasitism of Australian and New Zealand Mistletoes. M. A. AboU Raya-Observations on the parasitic behavior of Thesium humile Vahl (Santalaceae). III. Germination and chlorophyll status. M. A. Abou-Raya, M. A. El-Sharkaway and A. EL Taife-Mode of parasitism of Cistanche spp. J. Kuijt-Inflorescence geography in Loranthaceae. F. A. Onofeghara-Mistletoe parasitism in West Africa. P. Bernhardt-Reproductive isolation between Amyema species. For further detail, please contact Prof. Malcolm Calder, School of Botany, University of Melbourne, Parkville, Victoria, Australia 3052.

LITERATURE

Visser, J. 1981. South African Parasitic Flowering Plants. Juta Co., Ltd., P O Box 30, Cape Town, South Africa. 184 pp. This volume could be recommended solely for its 184 magnificent color plates but there are in addition 36 in black and white, 67 each of distribution maps and bar charts showing flowering times and a text giving valuable descriptions and many original observations on selected species of the very wide range of South Africa parasitic plants in ten botanical families.

Fer, A. 1980. Echanges de substances carbonees entre l'hote (Pelargonium zonale) et le parasite (Cuscuta lupuliformis) Brell. Soc. Bot. Fr.: 127 Actualites Botaniques, 169-174. Although at normal levels of atmospheric carbon dioxide C. lupuliformis is totally dependent on assimilated carbon from the host, it is shown that at high carbon dioxide levels the parasite can fix sufficient carbon to sustain its own growth.

_____. 1981. Recherches sur le voies de transport impliquues dans l'alimentation, dune phanerogame parasite sur des feuilles isolees parasitees par Cuscuta. Physiol. Vegetale 10: 177-196. This study demonstrates the importance of a phloem connection between host and parasite by which carbohydrates (mainly sucrose and an analog, deoxyglucosyl-fructoside) are transported. Water and calcium on the other hand are obtained through the xylem.

Panchenko, V. P. The biological protection of watermelons and tomatoes from broomrape in Astrakham Province. Dok. Vaskrnil no. 8: 25-27. Economic benefit was obtained by treatment of fields with a rice husk/maize meal culture of Fusarium oxysporum var. orthoceras. Orobanche aegyptiaca populations were reduced about 50% in alluvial soil and over 90% in sandy soil. Crops were found to act as hosts of the fungus but showed no damage symptoms.

India Central Tobacco Research Institute. 1979. Control of Orobanche leaflet no 1 (revised). 8 pp. Control methodes recommended include: weekly hand-pulling of shoots prior to flowering, deep ploughing, 3 or 4 weekly sprayings of 0.1-0.2% allyl alcohol on young shoots before flowering Kerosene is also effective but must not touch the tobacco and trap cropping during winter months.

Bebawi, F. F. 1981. Intraspecific physiological variants of Striga hermonthica. Exp. Agr. 17: 419-423. Eleven Sudanese collections

of S. hermonthica were exposed to root exudates of 27 sorghum cultivars. There were differences between Striga strains and between sorghum varieties, of which Tetron shown low stimulant character comparable to that of the known resistant variety Framida.

Bebawi, F. F. and A. F. Farah. 1981. Effects of nitrophoska and atrazine on relations between Sorghum bicolor and Striga hermonthica. Exp. Agr. 17: 425-450. Field experiments in two seasons demonstrated striking synergism between N and atrazine in reducing Striga populations and increasing yields.

Musselman, L. J. and C. Parker. 1981. Surface features of Striga seeds (Scrophulariaceae). Adansonia 20: 411-437. This short paper includes scanning electron micrographs of the seeds of nine species and several strains within S. hermonthica and S. asiatica.

_____. 1981. Studies on indigo witchweed, the American strain of Striga gesnerioides (Scrophulariaceae). Weed Sci. 29: 594-596. Further studies are reported on the host specificity of different strains of S. gesnerioides and it is concluded that the Florida strain is unlikely to parasitize any economically important crop in the southern USA.

Cetinsoy, S. 1980. Studies on the determination of effective chemical against Melampyrum arvense L. harmful in cereal fields in Central Anatolia. Turkey Plant Protection Research Annual, Arastirm Dairesa Baskanligi Sayi 15: 118-119. Melampyrum arvense is sufficiently important as a weed of wheat in central Anatolia that it was the subject of special herbicide experiments, from which Brominal Plus (bromoxynil +MCPA) proved to be most effective.

Zahran, M. K., Ibrahim, T.S. El-N., F. H. Farag, and Korollos, M. A. 1980. Chemical control of Orobanche crenata in Vicia faba. FABIS Newsletter no. 2, 47-48. In addition to confirming selective control of O. crenata by repeated post-emergence sprays of glyphosate, the authors report success with propyzamide at 7.5 and 10/kg/ha applied in high volumes of water four weeks after sowing V. faba.

Petzoldt, K. 1981. Control of Orobanche crenata Forsk. in broadbeans (Vicia faba) by means of combined cultivation and plant protection measures. Z. Pflanzenkrank. u. Plflanzensch. 9: 365-369. Glyphosate is shown to be an effective means of control. In addition, seeds treated with Benomyl and fertilization with nitrogen increased yields even in an Orobanche tolerant cultivar (ICARDA F 402).

Weber, H.-C. 1981. Orchids on the way to parasitism? On the possibility of an evolutionary transformation of the organs of contact of Corallorhiza trifida Chat. (Orchidaceae) to organs of attachment of parasitic angiosperms. Ber. Deutsch.. Bot. Deutsch. Bot. Ges. 94: 275-286. This paper sets forth the interesting idea that there is a similarity between the behavior of the hairs of the achlorophyllous orchid and primitive haustoria of parasitic plants.

HAUSTORIUM is edited by Chris Parker and Lytton Musselman. Please send suggestions for its continued existence as well as any material for a future issue to either of the authors.

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Parasitic Plants Newsletter

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Official Organ of the International Parasitic Seed Plant Research Group

HAUSTORIUM - A REPRIEVE

In the last issue (No. 8) we had to ask whether that number might not be the last. Happily it was not and we have to thank the International Plant Protection Center, Corvallis, Oregon, USA for offering to underwrite the costs of reproduction and postage, at least for a further two issues. Perhaps it will be a longer term arrangement but that cannot yet be confirmed.

The threatened loss of our newsletter has made many of us realize all the more how valuable it has been as a link between workers on parasitic plants. It also makes us appreciate the generosity of the Department of Biological Sciences, Old Dominion University, Norfolk, Virginia, USA who supported us for the first eight issues. By absorbing all costs of preparation, printing and postage they enabled us to establish the newsletter as a free service to all those requesting it. From a mailing of about 150 for the first issue the numbers increased to about 300 for No 8. Our heartiest thanks to ODU for the tremendous start they gave us.

3RD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

After considerable consultation and correspondence, we are pleased to make a preliminary announcement that the 3rd International Symposium on Parasitic Weeds will be held at the Headquarters of ICARDA (International Centre for Agricultural Research in Dry Areas) at Aleppo, Syria in the week beginning 7 May 1984. The Director General, Dr. Mohammed Nour, has kindly consented to the use of ICARDA facilities for the meeting and members of his staff will be involved, including Dr. S. Kukula, recently appointed weed scientist, who will be able to demonstrate problems and progress in research on locally important *Orobanche* species.

Further details of the programme costs etc. and a time table for the preparation of papers will be given in the next issues of HAUSTORIUM. It is intended that the proceedings will be printed beforehand and available at the time of the meeting.

The programme will be on similar lines to those at Malta and Raleigh, but any suggestions relating to the format of the meeting will be welcomed.

-C. Parker

A NEW 'POLYBAG' TECHNIQUE FOR STRIGA RESEARCH

In the course of its research on the mechanisms of *Striga*-resistance in sorghum and millet varieties, the ODA-financed *Striga* research project at WRO (now extended for a further three years) has needed a technique which allowed close observation of the early stages of attachment and development of *Striga* seedlings on crop roots.

We have found that seedlings of both crop and parasite develop normally in flattened polyethylene bags (standard 120 gauge) and can be observed repeatedly under a microscope without danger of desiccation or microbial contamination. Details of the technique are being prepared for publication elsewhere (probably in Annals of Applied Biology) but briefly, a strip of autoclaved glassfibre filter paper 9 x 30 cm is inserted in a 15 x 30 cm bag and moistened with sterile distilled water. Sterilized *Striga* seeds are sprinkled onto the paper; the bag is flattened, the top few cm is folded over a piece of cane (the type used for support in potted plants) and is stapled each side. The bags are suspended in a rectangular plastic bucket and incubated for 7-10 days to

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Parasitic Plants Newsletter

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3RD INTERNATIONAL PARASITIC WEEDS SYMPOSIUM

Arrangements are continuing for the symposium to be held at the headquarters of ICARDA (International Center for Agricultural Research in Dry Areas) at Aleppo, Syria in the week beginning 7 May 1984. Details of costs, accommodations, etc. and timetable for preparation of papers will be sent out with the next issue of HAUSTORIUM in May or June 1983. NOTE: it is intended that the proceedings will be printed beforehand and available at the time of the symposium. This means the final date for submission of papers may be as early as AUGUST 1983. Therefore, titles with brief synopses will be required by JULY 1983. Detailed instructions for authors will be available in June. Papers will be welcome on any aspect of the biology of parasitic higher plants and on the control of weedy species, preferably in English but French and German can also be considered. For further information contact Chris Parker, Weed Research Organization, Yarnton, Oxford, OX5 1PF, UK.

CUSCUTA CAMPESTRIS IN SUDAN

A heavy infestation of *Cuscuta* was found on a test plot of lucerne (*Medicago sativa*) at the University of Khartoum, Faculty of Agriculture, Shambat. It had previously been determined as *Cuscuta hyalina* Heyne ex Roth but a careful examination showed it to be *Cuscuta campestris* Yuncker. This species is not included in Andrew's "The Flowering Plants of the Anglo- Egyptian Sudan". It is native to the United States, but has been widely spread throughout the world probably by contamination of legume seed.

Species of *Cuscuta* are not easy to determine. The monograph by T.G. Yuncker (Memoirs of the Torrey Botanical Club 18 (2):113-331) is most helpful although it was published in 1932. Flowers and capsules are necessary for proper identification. Taxonomic characters include: distinct or united styles, circumscissile or non-circumscissile capsules, degree of fusion of the sepals, and acute or obtuse petal tips. A distinct feature of many species in the genus is the presence of infrastaminal scales opposite the stamens. The margins of these scales may be fringed. *Cuscuta campestris* has infrastaminal scales; *C. hyalina* which lacks them is frequent in the Khartoum and Wad Medani regions of Sudan where it usually parasitises *Tribulus terrestris* although it is not restricted to this host.

Workers should be aware of the features of C. campestris for comparison with similar appearing native species.

■ L.J. Musselman and F.F. Bebawi
University of Khartoum

CONNECTION BETWEEN THE VASCULAR TISSUE OF STRIGA HERMONTHICA AND ITS HOST

The vascular tissues in the region of *Striga hermonthica* and its host, sorghum, were studied using fluorescence microscopy. Haustoria were fixed in formalin- acetic-alcohol (1:1:8) and cleared and softened in 1N NaOH for one hour in a water bath at 60°C; stained in a 0.1% aqueous solution of aniline blue dissolved in 0.1N

K_3PO_4. The haustoria were gently squashed and examined through a fluorescent microscope, using blue light (incident) for exciting the dye.

Xylem elements in the roots of S. hermonthica and sorghum fluoresced reddish-yellow, due to their lignified cell walls, while the phloem fluoresced greenish-yellow, characteristic for callose-containing tissues. In the haustoria both types of fluorescence were observed and it was possible to follow the xylem and phloem of the parasite in the haustorium and to see their direct attachment to the xylem and phloem of the host root respectively.

The separate link between xylems and of phloems in the haustorial region supports Roger's and Nelson (1959) view of separate pathways for the translocation of organic matter and for the passage of water from host to parasite. It does not support Okonkwo's (1964) evidence in favor of a dual function of the xylem in S. hermonthica.

■ Sabir S. Safa and B.M.G. Jones
Royal Holloway College, UK

EFFECT OF BURIAL ON SEED VIABILITY IN STRIGA HERMONTHICA

Seeds were placed in "nitrex" cloth bags and suspended in perforated metal pipes at soil depths of 0, 5, 10, 20, 40 and 80 cm. Two "strains" of seeds were used, Shambat and Abu Naama. The experiment will run for two years with seeds removed and tested at 0, 1, 3, 6, 12, 18 and 24 months. Early results indicate that germination is normal in seeds removed after one month from all depths except 80 cm where no seeds germinated. However, if the seeds from the 80 cm depth which had remained in the soil for one month were stored at room temperature for four months, normal germination ensued. Seeds that had been buried for three months at 80 cm have given no germination even after five months. Hopefully these findings may be of some applied value in establishing maximum ploughing depths for Striga infested fields.

■ Ali El Awad Mazlum
University of Khartoum

ALBINO STRIGA HERMONTHICA

Albinism, the total lack of chlorophyll (not to be confused with the presence of white flowers on plants which normally have non-white flowers), is well known in many angiosperms. It is, of course, lethal in non-parasitic plants. This phenomenon has not previously been reported in the genus Striga where albinism would have special significance due to the obligate parasitism of this species. Mr. Hamza Tag El Sir found some albino Striga plants in the test plot at Shambat. These were observed carefully but failed to flower. After two weeks, they withered and died. However, while examining a field near Sennar in the Blue Nile Province, Mr. El Sir found a flowering albino plant. This has been used to make crosses with normal Striga in the hopes of preserving the albinism for further experimentation. An albino strain of Striga could be of considerable value to researchers as all foodstuffs in the albino must of necessity have been transferred from the host plant.

■ L.J. Musselman
University of Khartoum

POLLINATORS OF HYDNORA ABYSSINICA

The genus Hydnora (Hydnoraceae) is one of the most bizarre of all genera of flowering plants due to its cryptic subterranean parasitic nature and tropical distribution. Hydnoraceae contains only two genera, Hydnora and Prosopanche. Prosopanche is New World while Hydnora is palaeotropical and reaches its greatest diversity in Africa. The family has been monographed by Harms (1935) and is included in Kuijt's treatment of parasitic flowering plants (1969). Recently, Visser (1981) has included Hydnora africana in his volume on South African parasitic seed plants. Information on the biology and parasitism of Hydnora is, however, sorely lacking. We present here our observations on Hydnora abyssinica near Wad Medani in Central Sudan during September 1982. The site was along the Blue Nile in an area dominated by Acacia nilotica and A. seyal. The parasite was abundant in fine river silt soil beneath these trees.

The flowers emerge from the soil as a cone-like bud approximately 10 cm long and 2 cm wide. The perianth consists of four (rarely five) parts. In the bud stage the perianth parts begin separating at the level of the soil; opening proceeds acropetally. Unlike H. africana, Hydnora abyssinica perianth parts are separate at maturity and lay on the ground. The inner surface of the perianth tips are light orange and smooth, the lower part of the lobes as well as the inside of the tube is hairy. The outside of the flower is a rusty-brown color.

The flowers have a pronounced strongly fetid odor. We estimate that the flowers last for two days. After this, the fleshy perianth parts rapidly decay.

Pollination is apparently by beetles as we observed numerous pollen laden beetles in many flowers. The flower is so designed that beetles enter the tube, crawl to the very large anthers and then proceed to the floor of the flower which is the stigmatic surface.

About three different types of beetles were recovered from the flowers and are being identified. Insects, perhaps including these beetles, deposit eggs in the flower. These mature and the larvae feed on the decaying flowers.

<u>Hydnora abyssinica</u> is a plant well known to the residents of the Gezira Province where it is called by its Arabic name, tartouss. Dried, it is used as charcoal for fires and is considered to be superior to regular charcoal. It is also used medicinally for stomach ailments; portions of the rhizomes are boiled and the decoction drunk. This use is not surprising considering the very astringent flavor of the fresh rhizome, perhaps attributable to a concentration of polyphenols.

■ M.A. Siddig and L.J. Musselman
University of Khartoum

GOLDEN BOUGH

The 'Golden Bough' emulates HAUSTORIUM as a newsletter about parasitic plants, but aims to provide a broader forum for the interchange of ideas and information relating just to the mistletoes - Loranthaceae, Viscaceae and near relatives. The first number was issued in November 1982 and has been sent to subscribers of HAUSTORIUM known to have a special interest in these families, but if anyone else would like a copy write Dr. Roger Polhill, Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK.

LITERATURE

Dell, B., Kuo, J. and Burbridge, A.H. 1982. Anatomy of <u>Pilostyles hamiltonii</u> C.A. Gardner (Rafflesiaceae) in stems of <u>Daviesia</u>. Aust. J. Bot. 30:1-9. ● The Rafflesiaceae is a remarkable family of obligate parasites representing the ultimate in vegetative reduction. The flowers of <u>Rafflesia</u> are the largest known, those of <u>Pilostyles</u> are minute. Despite the intriguing nature of these plants, little is known about them so that this short paper, including the first EM study of <u>Pilostyles</u>, is a welcome addition. The work reported here largely corroborates the study by Rutherford on North American <u>Pilostyles</u>. In the vegetative state, <u>Pilostyles</u> occurs as thin strands of parenchyma cells in the secondary phloem of the host. At flower initiation <u>Pilostyles</u> forms "pegs" that connect with the host xylem although the pegs themselves contain no xylem.

Pesch, C. and Pieterse, A.H. 1982. Inhibition of germination in <u>Striga</u> by means of urea. Experientia <u>38</u>, 559-560. ● In vitro, urea at 200 and 400 mg/l caused severe inhibition of radicle growth in <u>S. hermonthica</u>. Ammonium sulphate had a moderate effect only at 800 mg/l and sodium nitrate had none.

Babiker, A.G.T. and Hamdoun, A.M. 1982. Factors affecting the activity of GR7 in stimulating germination of <u>Striga hermonthica</u> (Del.) Benth. Weed Research <u>22</u> (2) 111-115. ● The strigol analogue GR7 was shown to last less than 24 hours in the local alkaline (pH 8.5-9.5) soil when moist. It was also confirmed that the presence of GR7 during pre-conditioning, reduced responsiveness to a later application of stimulant.

Stangle, C.M. and Musselman, L.J. 1981. Some growth aspects of Seymeria cassioides. Research Note SO 276 USDA Forest Service, Southern Forest Experiment Station, pp 3. ● S. cassioides seedlings grow long roots before attachment to host but the shoots only elongate after attachment. Shading the parasite (leaving the host in the light) results in death, suggesting it relies on its own photosynthesis for its carbon nutrition.

Magnus, V., Simaga, S., Iskric, S. and Koeder, S. 1982. Metabolism of tryptophan, indole-3-acetic acid, and related compounds in parasitic plants from the genus Orobanche. Plant Physiol. 69, 853-858. ● Studies on three Orobanche spp including O. ramosa confirm that they have their own mechanisms for synthesis of 1AA from tryptophan. Metabolic systems may even be more complex than in autotrophic plants.

Mesa-Garcia, J. and Garcia-Torres, L. 1982. Effects of bean (Vicia faba L.) planting dates on broomrape (Orobanche crenata Forsk.) phenology and competition. Proceedings 1982 British Crop Protection Conference - Weeds, 757-764. Also: Broomrape (Orobanche crenata Forsk.) control in bean (Vicia faba L.) with glyphosate as affected by infection intensity: ibid 765-770. ● Beans planted in mid-November in S. Spain were more severely attacked by O. crenata than beans planted in mid-December or mid-January but still yielded better. Early planting gave a long spread of emergence of the weed requiring more than two glyphosate applications for control.

Burrill, L.C. 1982. Weed problems of citrus in Belize. International Plant Protection Center, doc. 43-A-82, pp. 19. ● Mistletoes Struthanthus orbicularis and S. Cassythoides continue to cause problems though a severe hurricane in 1978 provided some useful control. Other control methods involve severe manual pruning and spot applications of paraquat.

Charles, D.J., Singh, M. and Sanwall, G.G. 1982. Biochemical changes during germination and seedling growth in Cuscuta campestris. Physiol. Plant. 56, 211-216. ● Changes in starch protein, DNA, RNA, phosphorous and some enzymes are described.

HAUSTORIUM is edited by C. Parker and L.J. Musselman and typed by P.A. Brown. Material should be sent to either editor and requests for copies. Photocopies of number 1-9 are available from IPPC at US$1 per issue. Material from HAUSTORIUM may be reprinted provided that appropriate credit is given.

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Parasitic Plants Newsletter

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STRIGA TRAINING COURSE

An International Training Course on the control of Striga in cereal crops is to be held at North Carolina State University, Raleigh, NC, USA, from 7-27 August 1983. The course is being organized by A.D. Worsham, of the Department of Crop Science, and sponsored by INTSORMIL (International Sorghum Millet Program). The intention is to provide training for about 12 professional workers from less developed countries, particularly in Africa, in the biology and control of Striga and in some more general principles of weed control.

STRIGA WORKSHOP

A Workshop on the Biology and Control of Striga is to be held in Dakar, Senegal, from 14-17 November 1983. A small group of experts is being assembled by the International Council of Scientific Unions (ICSU) under the auspices of the African Biosciences Network (ABN) and the ICSU Inter-Union Commission on the Application of Science to Agriculture, Forestry and Aquaculture (CASAFA). The objectives will be to examine the latest state of knowledge on Striga, to identify gaps, and to propose research strategies that will lead to effective and economic control measures.

HOSTS OF ALECTRA VOGELII IN BOTSWANA

Striga asiatica and Alectra vogelii are important root parasites on sorghum and legumes, respectively, in southern and eastern Botswana. Cowpea and China pea (Phaseolus aureus) are the best known crop hosts for A. vogelii. Bambara groundnut (Vigna subterranea) is a well known host of A. vogelii in neighboring South Africa, but has not been parasitized in Botswana. Groundnut (Arachis hypogea) has been previously reported as a host but is not generally attacked in Botswana.

In a field trial on infested land in the 1981/82 growing season, no Alectra was observed on groundnut. However, at harvest, six plants were found to have tiny, poorly developed subterranean parasite stems. These plants were taken from rows bordered on each side by heavily parasitized cowpea.

Tepary (Phaseolus acutifolius) is a legume of minor importance. Alectra is only rarely seen on this host even in fields known to be heavily infested by the parasite. Lablab purpureus (Dolichos lablab) and Macroptilium atropurpureum, introduced fodder legumes, supported Alectra parasitism during the 1981-82 growing season.

Few wild hosts of Alectra have been reported. Three new records from diverse hosts in Botswana indicate the

3RD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

Plans are proceeding for the symposium to be held at ICARDA, Aleppo, Syria starting about 7 May 1984. Enclosed with this issue of HAUSTORIUM is a copy of the First Circular giving details of the costs, time table for preparation of papers, etc., and including a RESPONSE FORM. Completed forms, or requests for further copies of the circular or any other information, should be directed to: C. Parker, Weed Research Organization, Yarnton, Oxford OX5 1PF, U.K.

lack of host specificity in the species. Indigofera daleoides (Fabaceae) and Vernonia poskeana (Asteraceae) have been observed as hosts, as well as the widely distributed weed Acanthospermum hispidum (Asteraceae). The latter species is dominant in traditional farming systems where weed control is poor. During the 1981-82 season, infested stands were recorded at a number of sites with up to 26 parasites per host plant. Parasite development after attachment to A. hispidum is usually limited compared to the massive haustorial balls so characteristic of the parasite on cowpeas. Successful attachments rarely emerge and flower. Infestations appear to develop late in the season and the host-parasite system is subsequently killed by frost. Work is now in progress to describe further the beneficial "trap" effect of the otherwise noxious A. hispidum.

C.R. Riches, Agricultural Research Station
Gabarone, Botswana

ORIGINATOR OF STRIGOL ANALOGUES

All who knew him will be sad to learn of the sudden death last December of Professor Alan Johnson. He had recently retired as Professor but was still characteristically full of energy and enthusiasm and still hoping to see the strigol analogues (GR7, GR24) fully developed and available commercially. Unfortunately, the latter goal still looks elusive, and progress may be further slowed by lack of sample material. Those interested in further work should contact the patent holders IDRC (International Development Research Centre) P.O. Box 8500, Ottawa K1G 3H9, Canada.

CISTANCHE AND CYNOMORIUM IN SAUDI ARABIA

Two species of Cistanche (Orobanchaceae), C. phelypaea and C. tubulosa, are known from Saudi Arabia. These parasites emerge, flower, and set seed within a short period of time during February and March. Observations on Cistanche were made at the King Faisal University Farm, 17 km east of Al-Hassa. The soils in this area are sandy and the vegetation consists mainly of halophytes.

Hosts of Cistanche in this region include members of the Chenopodiaceae as well as Tamarix and Zygophyllum. Both genera are well known by the local residents and are used by the Bedouins. Cynomorium (Balanophoraceae) is used as a laxative and to cure stomach ailments. Cistanche species are used as animal feed; the young plants are preferred food for camels. In fact, the young tissues, especially the underground parts, are rich in starch and are dug, cut into pieces, and fed to young camels.

Awad Fageer Farah
King Faisal University
Al-Hassa, Saudi Arabia

BIOLOGICAL CONTROL OF STRIGA

A project has recently started at Birkbeck College, University of London, to develop a method of controlling Striga hermonthica with plant pathogens. It is hoped to develop production and usage techniques which will be both applicable and economic in those areas where Striga is a problem.

The ideal pathogen should be simple to culture and specific to Striga. Researchers are requesting that during the coming Striga season field workers finding infected Striga could collect samples and send them. Seed samples would also be appreciated. For techniques concerned with sample collection, preservation, transportation as well as details about importation licence, please contact: M.D MacQueen and J. Nicklin, Birkbeck College, Mallet St., London WCIE 7HX, U.K.

IMPORTING PARASITIC WEEDS INTO THE UNITED STATES FOR RESEARCH PURPOSES

Weeds on the U.S. Federal Noxious Weed List are denied entry or interstate transport into or within the United States. However, permission may be granted for entry and movement for research purposes if proper permits are issued. To obtain a permit the requesting investigator must establish security to prevent loss or dissemination of the plant in transit or under research conditions. An "on site" inspection may be required before approval by both State and Federal regulatory officials.

Anyone contemplating conducting research on any exotic live plant pest or noxious weed should contact James Lackey, Staff Specialist, Biological Assessment Support Staff, USDA, APHIS, PPQ, Hyattsville, MD 20782 USA, phone (301) 436-6805 or contact a local Federal Plant Protection Officer and ask for PPQ Form 526 - Application and Permit to Move Live Plant Pests and Noxious Weeds.

R.E. Eplee
Witchweed Laboratory
Whiteville, NC, USA

LITERATURE

Ba, A.T. 1983. Biologie du parasites chez deux Scrophulariacees tropicales, Striga hermonthica and Striga gesnerioides. DSc. thesis, University of Dakar, Senegal. 139 pp + Appendix Vol. 2. ★ Author's abstract: "Two tropical species of Scrophulariaceae Striga hermonthica parasite of millet, corn and sorghum and Striga gesnerioides parasite of cowpea were studied.

Studies showed that morphological variations of haustoria were related to the hosts, to the nature of the host-parasite relationship, and to the ecological conditions.

Ultrastructural studies revealed the presence of phloem in the haustoria of S. gesnerioides; however, phloem was absent in the haustoria of S. hermonthica. Ultrastructure of the "hyaline tissue" of S. hermonthica, of the meristematic cells of S. gesnerioides, and of the intrusive cells were also described.

Enzymatic activities localised in the haustoria suggest that certain tissues are involved in the mechanism of the penetration of the parasites into their hosts.

Physiological studies using 14C-labelled compounds showed that carbohydrates, especially sucrose, are the main organic compounds taken up from the hosts. High transpiration rate of S. hermonthica may be the main cause of the growth reduction of millet.

Tests were performed on several varieties of cereals. All millet varieties were susceptible, especially "souna 3." Local varieties of cowpea were found to be resistant to S. gesnerioides. The results suggest the existence of geographical strains of Striga.

Methods were suggested for the control of these parasites."

Canne, J.M. 1981. Chromosome counts in Agalinis and related taxa (Scrophulariaceae). Canadian Journal of Botany 59 (6): 1111-1116. ★ New counts are presented for several species (and other counts verify earlier counts).

Dawson, J.H. 1982. Controlling dodder. Proc. Washington State Weed Assn. 32nd Annual Weed Conference. 1982, 75-77. ★ A useful summary of chemical and cultural methods for controlling Cuscuta spp. in lucerne/alfalfa.

The Golden Bough - a newsletter to foster the biosystematics of Loranthaceae and Viscaceae. Obtainable from: R.M. Polhill, Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AB, U.K. ★ The first issue contains a list of workers, an article on the relationship between birds and mistletoes in Africa, a note on epiparasitism in mistletoes, as well as requests for material and other notes.

Grazi, Von G. and Urech, K. 1981. (Morphological characteristics of the berries of Viscum album and their taxonomic importance). Beitrage zur Biologie der Pflanzen 56, 293-306. ★ Four host specific subspecies of Viscum album are distinguished by the shape of the hypocotyl and the presence or absence of mucilaginous threads between inner and outer layers of the mesocarp.

Jones, B.M.G. and Safa, S.B. 1982. Variation of seed-coat ornamentation in Striga hermonthica (Scrophulariaceae) Annals of Botany 50, 629-634. ★ Report of an SEM study showing that seed coat patterns are extremely varied within the species, but constant on seeds from individual plants.

Kuijt, J. 1982. Seedling morphology and its systematic significance in Loranthaceae of the New World, with supplementary comments on Eremolepidaceae. Botanische Jahrbucher 103: 305-342. * Seedlings are features of taxonomic value in the mistletoes and this monograph describes the seedlings and/or mature embryos of 14 of the 16 genera of New World Loranthaceae as well as some Eremolepidaceae.

Kuijt, J. 1982. The Viscaceae in the southeastern United States. Journal of the Arnold Arboretum 63: 401-410. * This is part of the ongoing "Generic Flora of the Southeastern United States" and includes excellent illustrations and a helpful bibliography.

La Hulotte (The Wood Owl). * Two issues of this periodical (Nos. 48 and 49) published in 1981 by Societe de Protection de la Nature, were devoted to mistletoes. Those able to read French will find them enormously entertaining as well as instructive. Available from Journal la Hulotte, Boult-aux-Bois 08240, Buzancy, France.

Mahadevan, S. 1983. How the hormone controls the parasite. New Scientist 98, 164-167. * A short review on Cuscuta, illustrated with striking SEM photos, and referring to evidence that cytokinin can act as a trigger for coiling and haustorial initiation.

Nassib, A.M., Ibrahim, A.A. and Khalil, S.D. 1982. Breeding for resistance to Orobanche. In: Faba Bean Improvement, G. Hawtin and C. Webb (eds), ICARDA, 199-206. * The origin and development of a resistant line, F 402, is described.

Wolswinkel, P. 1982. Is enhanced phloem unloading in plants parasitised by Cuscuta restricted to the site of attachment? Annals of Botany 56, 863-868. * A reinterpretation of old results, suggesting that phloem unloading may not be stimulated other than at, or very close to, the site of attachment.

Zahran, M.K. 1982. Weed and Orobanche control in Egypt. In: Faba Bean Improvement, G. Hawtin and C. Webb (eds), ICARDA, 191-197. * Promising chemical treatments include three sprays of glyphosate 0.086 kg a.i./ha at three intervals from the beginning of bean flowering, and propyzamide 4.76 kg a.i./ha in 2,500 l water/ha four weeks after sowing.

HAUSTORIUM is edited by L.J. Musselman and C. Parker and typed by M.R. Welsch. Material should be sent to either editor as should requests for copies. Photocopies of numbers 1-10 are available from IPPC at US$1 per issue. Material from HAUSTORIUM may be reprinted provided that appropriate credit is given.

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C. Parker: Weed Research Organization, Begbroke Hill, Sandy Lane, Yarnton, Oxford OX5 1PF, U.K.

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THIRD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

FIRST CIRCULAR

ICARDA • ALEPPO, SYRIA • MAY 1984

This third symposium, sequel to Malta 1973 and USA 1979, is being arranged with the collaboration of ICARDA (International Centre for Agricultural Research in Dry Areas) under auspices of the International Parasitic Seed Plant Research Group. The purpose: to provide a forum for the interchange of data, techniques, and research goals in all aspects of parasitic vascular plants.

• DATES • Tentatively, May 7-10, 1984, Monday through Thursday, subject to adjustment as flight schedules become firm. Thus, meetings may start one day earlier.

• TRAVEL • Syrian Arab Airlines offers direct flights to Aleppo from Istanbul, Rome, Munich, and Paris. Or, fly to Damascus and travel to Aleppo by surface.

• REGISTRATION • The US$60 registration fee includes one copy of the proceedings, local transport, etc., but not accommodations. A US$10 pre-registration fee (or sterling equivalent) must be paid to ARC Weed Research Organization before a final circular can be mailed. The US$50 balance will be payable in Syrian Lira (SL) on arrival at ICARDA. A slight charge may be made for field trip(s).

• PROCEEDINGS • These will be printed in advance by ICARDA and available to participants upon their arrival. All contributions will be considered by the editorial committee. Full instructions will be sent on request (see: RESPONSE FORM, over).

• LANGUAGE • The Symposium will be conducted in English.

(continued on reverse)

(continued)

●ACCOMMODATION● Aleppo hotels cost SL 85 (estimated) per night, or SL 100 double; lunch and dinner each cost SL 30-35 (at least one meal must be taken in the hotel). At present US$1.00 = SL 5.60 at the tourist exchange rate.

●TENTATIVE PROGRAM● Sessions will cover major parasite groups (Striga, Orobanche, Cuscuta, mistletoes) and their biology and control, as well as basic research in physiology, biochemistry, structure, ecology, etc. At least one half-day field tour is planned to view Orobanche infestations and any other parasitic species, as well as experimental work. ICARDA facilities and Aleppo Old City can be visited.

●TIMETABLE●

As soon as possible: To indicate interest in submitting a paper and/or receiving further circulars and information, complete and return RESPONSE FORM. Instructions to contributors will be sent immediately upon request.

1 October 1983: Final date for submission of first drafts of papers.

December 1983: Second circular and tentative program mailed.

1 January 1984: All papers edited and returned to authors.

1 February 1984: Final date for receipt of camera-ready copies at WRO.

For further information, contact: C. Parker, Weed Research Organization, Yarnton, Oxford OX5 1PF, U.K.

RESPONSE FORM

THIRD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

Completed forms, expressing degree of interest, should be mailed to:
C. Parker, Weed Research Organization, Yarnton, Oxford OX5 1PF, U.K.

(Please type or print) (please X)

I wish to receive further symposium circulars .... ______

I am almost certain to attend the symposium .... ______

I will possibly attend the symposium .... ______

I / we ______________________________
(author's name)
wish to contribute a paper entitled: ______________________________

____

Name: ______________________________

Address: ______________________________

____

Telephone / telex: ______________________________

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Parasitic Plants Newsletter

NUMBER 12
FEBRUARY 1984

Official Organ of the International Parasitic Seed Plant Research Group

HAUSTORIUM IS FIVE YEARS OLD

With this issue we are five years old! The response to the newsletter is most gratifying and we now print over 400 copies per issue. Special thanks, as we begin the second half of our decade, are due IPPC who type, print, and mail HAUSTORIUM. However, we depend solely upon our readers to submit items of interest and would encourage even more help. We find that the literature section is especially well received and we value inclusion of items you send which are not easily retrievable elsewhere. Items, and requests to receive HAUSTORIUM, can be sent to either editor.

THIRD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

Arrangements for the symposium are progressing well. Those who have registered should have received all necessary information by this time. Further information and details of the meeting are still available from C. Parker at: Weed Research Organization, Yarnton, Oxford OX5 1PF, UK. (Also see insert with this issue.)

COMBINED EFFECTS OF ROOT-KNOT NEMATODE & OROBANCHE SPECIES ON TOMATO & TOBACCO

Two common and important parasites of tomato in the Jordan Valley are broomrope, Orobanche ramosa, and the root-knot nematode, Meloidogyne incognita. Similarly on tobacco in Bangladesh, two other species, Orobanche cernua and Meloidogyne javanica were commonly associated with serious damage to the crop. Both genera are root parasites with the same ecological niche and, in an attempt to determine the relative importance of the parasites in relation to their control, their individual and combined effects on growth of the two crops was studied.

In glasshouse experiments, O. ramosa and M. incognita were inoculated separately and together into pots with single tomato seedlings at rates of 2,000 seeds and 2,000 nematodes per plant respectively, and the results compared to check plants without either of the parasites. Similar treatments and inoculation rates were used for O. cernua and M. javanica on tobacco.

The results showed that, at these infestation levels, both parasites caused severe damage to tomato, but M. incognita alone caused a greater reduction in growth of tomato than O. cernua alone. The nematodes reduced foliar weight of infested plants by a mean of 76% compared to check plants; the parasitic weed caused a reduction of 46% but the greatest mean weight reduction (81%) occurred when both parasites were present on the same tomato plants. In this combined treatment, the two parasites developed normally without any apparent competition for feeding or infection sites.

The severity of nematode root galling was the same in nematode treatments with and without O. ramosa. The presence of nematodes resulted in a slight reduction in number of Orobanche heads per plant and prevented a second flush of heads after four months which occurred with Orobanche alone. This can be explained by the severity of root damage caused by the nematodes. Nematodes alone and combined with O. ramosa delayed or prevented flower formation in the tomato plants up to four months, but this was not the case with O. ramosa alone.

The results with O. cernua and M. javanica on tobacco were similar to the above. The number of leaves on tobacco plants was reduced by a mean of 50% or more of the leaf number on check plants when either of the parasites was present. The combined effect of O. cernua and M. javanica was additive, causing a mean reduction of 77% in leaf number compared to check plants (3 and 13 respectively). Both parasites developed normally in all treatments and the amount of nematode root galling and the number of Orobanche heads were the same whether the other parasite was present or not.

The results clearly demonstrate that Orobanche and Meloidogyne are both major pests independent of each other; they can occur together on the same plants without competition or interaction for infection sites and, when this occurs, the damage to tomato and tobacco is considerably greater but purely additive.

J. Bridge, S.M. Jordan & S.L.J. Page
CAB Tropical Plant Nematology Unit,
Rothamsted Experimental Station,
Harpenden, Herts, U.K.

STRIGA WORKSHOP, DAKAR 14-17 NOVEMBER 1983

About 30 scientists from several nations met to discuss the problem of Striga, its impact on food production, biology, and control as well as recommendations for further research. Papers covered a wide range of subjects on the parasite including taxonomy, morphology and ultrastructure, floral biology, chemical control, cultural practices, physiology, biochemistry, biological control, and germination stimulants. The papers presented at the meeting will be published in a single volume to be produced by the meetings' sponsors The African Biosciences Network of the International Council of Scientific Unions. Details on obtaining the volume will be printed in HAUSTORIUM.

HELP REQUIRED FOR STUDY OF INSECTS ATTACKING STRIGA

Insect damage to Striga has been noticed in many areas, but studies on its cause and extent have so far only been made in South India and East Africa —work done almost 20 years ago. Elsewhere, only casual observations have been made with very few specimens collected for authoritative determination. However, reliable information is needed as a basis for assessing the prospects for biological control both by introducing species which are absent and enhancing the action of active species.

Caterpillars and sucking insects will be encountered which can be easily reared. Of greater inherent interest are gall forming insects, especially the weevils Smicronyx spp. These are less easy to rear, but the effort should be made as there are several species galling different parts of their host plants and adequate museum specimens are lacking for the taxonomic studies needed to name many of them. Particular attention should also be paid to special feeding below ground which have not been adequately sought anywhere. The CIBC is prepared to assist with help from the taxonomist for the Commonwealth Institute of Entomology who are themselves hampered in their studies by the scarcity of good accurately labelled specimens for study.

What is needed is good series of reared specimens together with labels giving locality, date, host plant, and crop on which it was growing. If possible, each sample should consist of at least 10 specimens to ensure that both sexes are included and so that the range of individual variation can be assessed. Specimens should be thoroughly dried and if possible pinned. If this is not possible, they should be packed between layers of soft paper tissues in cardboard (not metal or plastic). Send them to: D.J. Greathead, Commonwealth Institute of Bilogical Control, Silwood park, Imperial College, Ascot, Berks, SL5 7PY, UK.

D.J. Greathead, CIBC, UK

REQUEST FOR INFORMATION ON RAFFLESIA

Mr. Takashi Sato, Kawahara-CHO 2552, Mizuhashi, Toyama-Shi, Toyama 939-05, Japan, is studying Rafflesia in the vicinity of Ranau in Sabah, Borneo, and has collected what appears to be unique materials. He is eager to correspond with anyone who has worked on this fantastic genus to determine which species he has.

STRIGA PUBLICATIONS FROM ICRISAT

1.) Proceedings of the Second International Striga workshop, October 5-8, 1981 (Published by ICRISAT; Scientific Editors - K.V. Ramaiah and M.J. Vasudeva Rao). ✱ These proceedings summarize world-wide Striga research, describe the known Striga species, and discuss control methods such as cultural practices, uses of herbicides and germination stimulants, and breeding resistant cultivars. Abstracts, summaries of discussions, and recommendations are presented in English and French.

2.) Striga Identification and Control Handbook (Published by ICRISAT; Authors: K.V. Ramaiah, C. Parker, J.J. Vasudeva Rao and L.J. Musselman). * This handbook describes the most important of the 25 species of this parasitic weed occurring in the world, their biology, and symptoms of attack. It also provides concise information about the options for control. A key is presented to assist in the identification of the seven most damaging species, and the text is supported by 34 illustrations in color.

Cost Details	Prices HDCs $	LDCs $	India Rs.
Proceedings	6.30	2.10	20.60
Handbook	4.20	1.40	13.00

Postage and handling:	overseas airmail $	overseas surface $	India surface Rs.
Proceedings	3.10	1.40	4.40
Handbook	1.20	0.75	3.50

Orders may be placed with Information Services, ICRISAT Patancheru P.O., A.P., 502 324 India.

STRIGA IN SUGARCANE IN SUDAN

Striga hermonthica is one of the best known and most serious pests of sorghum and millet in Sudan. In August 1983 a heavy infestation was observed in test plots of sugarcane at Sennar Sugar Factory in the Blue Nile Province. The plots included cultivars Co527, Co1001, Co6806, Co62175, and M31/45, but Striga was found only on M31/45, a cultivar from Mauritius.

Striga asiatica is a well known problem in sugarcane culture on Mauritius and it would be interesting to know if M31/45 exhibits any resistance to S. asiatica. The infestation at Sennar was of less magnitude on plots treated with N or P. Some of the untreated plots were completely destroyed by Striga. The infested plots were weeded when the crop was six months old. However, Striga recovered and infested the same plots. Striga was also observed on borders of treated plots of M31/45. It is worth noting that the land under sugarcane used to be under sorghum for many years. Striga infestation was not observed at New Halfa Sugar Factory in Kassala Province (Eastern Sudan) where the same cultivars were grown on similar test plots.

S.H. El Awad
M.E. Sir El Khatim
E.E. Ali
Faculty of Agriculture
University of Khartoum, Sudan

REVIEW OF PAPERS FOR HAUSTORIUM

- Hedberg, O., B. Ericson, A. Grill-Willen, A. Hunde, L. Kollsten, O. Lofgren, T. Ruuth, and O. Ryding. 1979. The yellow flowered species of Bartsia (Scrophulariaceae) in tropical Africa. Nordic Journal of Botany. (Bartsia is a small genus of hemiparasites of northern and alpine habitats.)

- Asen, P.A. and K. Blomdal. 1983. Toothwort, Lathraea squamaria, in Aust- and Vest-Agder Counties, south Norway. Blyttia 41(6)1-8. (A short paper in Norwegian but with English summary and English captions about an interesting native holoparasite.)

- Bernhardt, P. 1982. Interspecific incompatibility amongst Victorian species of Amyema (loranthaceae). Australian Journal of Botany 80: 175-184. (Some species in the genus are self-incompatible, others self-compatible. Those species that are self-compatible would receive pollen of other species.)

- Calder, D.M., F.G. Lennox, and P. Bernhardt. 1982. Natural hybridization between Amyema pendulum and Amyema quandang, Loranthaceae. Australian Journal of Botany 30: 625-633. (Hybrids are rare in Loranthaceae and this paper documents hybridization using chromatography and morphological characters.)

- Sedgley, M. 1982. Floral anatomy and pollen tube growth in the quandong (Santalum acuminatum (R. Br.) A.DC). Australian Journal of Botany 30: 601-609. (Quandong, a close relative of the commercial sandalwood (S. album) is considered a potential crop in Australia for its edible fruit and nut. This paper investigates the anatomy of the flower in relation to a program of controlled pollination.)

● Okonkwo, S.N.C. and V. Raghavan. 1982. Studies on the germination of seeds of the root parasites, Alectra vogelii and Striga gesnerioides. I. Anatomical changes in the embryos; II. DNA synthesis and development of the quiescent center in the radicle. American Journal of Botany 69(10) 1636-1656. (Much emphasis in recent years has been placed on germination stimulants as possible means of control in root parasites including these two genera. However, little attention has been paid to what actually happens in the seed so these papers are a welcome addition to our understanding of germination. The first substantiates and elucidates the well known fact that obligate parasites put all their reserves into elongation of the radicle. The second also deals with adaptive advantages of the two genera showing Striga and Alectra have perhaps the smallest quiescent center of any plants.)

● Okonkwo, S.N.C. 1982. Nutrient factors for shoot development and seedling growth of Striga gesnerioides (Willd.) Vatke. Zeitschrift fur Pflanzenphysiologie 106(5): 381-389. (With this contribution, the three most serious Striga spp. have now been grown in culture. This work indicates differences among the three. S. hermonthica and S. gesnerioides will flower in culture; to date S. asiatica has not been reported to do so.)

LITERATURE

Americanos, P.G. 1983. Control of Orobanche in broad beans. Technical Bulletin 50. Agricultural Research Institute, Nicosia, Cyprus, pp 4. (Further confirmation of the value of glyphosate for selective control of O. crenata in Vicia faba.)

Ghosh, S.K., M. Balasundaran, and M. Ali. 1983. Possible teak mistletoe control through trunk injection of weedicide. Proceedings 10th International Congress of Plant Protection, Brighton, U.K. pp 1067. (A number of herbicides were tested for controlling Dendrophthoe falcata var pubescens by injection into the sapwood of teak. 2,4-D and copper sulphate were not selective, but metribuzin, paraquat, linuron, isoproturon, and dalapon proved selective. Metribuzin was particularly effective, using 600 ml 0.05 or 0.1% suspension per tree of 24 cm d.b.h.

Ramaiah, K.V. and C. Parker. 1982. Sorghum in the Eighties: Proceedings of the International Symposium on Sorghum. ICRISAT. pp 291-302. (A review of the biology and control of Striga.)

Puzzilli, M. 1983. Tobacco broomrapes and their control and some useful references to other parasite and host species. Revista de Agricultura Sub-tropical e Tropicale 77, (2), 209-248. (A very comprehensive and useful review of all aspects of Orobanche and its control in tobacco, with 214 references.)

Lal, J., A. Kumar, and R. Saran. 1982. New records of three species and one variety of the genus Cuscuta L. (Cuscutaceae) from Madhya Pradesh, India. Journal of Economic Taxonomical Botany 3:581-583.

Hua-Shing, K. 1983. Materials for Chinese Loranthaceae. Acta Phytotaxonomica Sinica 21(2): 170-181.

Hiepko, P. 1982. A revision of Opiliaceae II. Opilia Roxb. Willdenowia 12(2): 161-182. (The Opiliaceae is a family of woody root parasites related to the sandalwoods.)

Davidar, P. 1983. Similarity between flowers and fruits in some flowerpecker pollinated mistletoes. Biotropica 15(1): 32-37.

Bernhardt, P. and R.B. Knox. 1983. The stigmatic papillae of Amyema (Loranthaceae): Developmental responses to protandry and surface adaptations for bird pollination. American Journal of Botany 70(9): 1313-1319. (Mistletoes of the Loranthaceae are bird pollinated and this work demonstrates the adaptation of the stigma to the mechanical abrasion by birds probing for nectar by the development heavily cutinized papillae of the stigma).

HAUSTORIUM is edited by C. Parker and L.J. Musselman and typed by Cindy Roy-Brown. Material should be sent to either editor as should requests for copies. Photocopies of numbers 1-11 are available from IPPC at US$1 per issue. Material from HAUSTORIUM may be reprinted provided that appropriate credit is given.

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L.J. Musselman: Dept. of Biological Sciences, Old Dominion Univ., Norfolk, VA 23508, USA

SECOND CIRCULAR

THIRD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

Arrangements are proceeding well for the Symposium to be held on the dates previously proposed, i.e., Monday, May 7 to Thursday, May 10, 1984, at the Headquarters of ICARDA, near Aleppo, Syria. On current schedules, Syrian Arab Airlines (SAA) fly into Aleppo from Paris, Munich, and Rome on Fridays and from Istanbul on Sundays (see schedule). There does not appear to be any possibility of reduced fares on the direct flights, but SAA may be able to offer a reduction for a group travelling on the flight to Damascus arriving 1925 on Sunday, May 6 from London, Paris and Munich. A minibus would be provided for immediate travel (4.5 hours) to Aleppo. We would not have to return as a group. Please let me know as soon as possible if you are interested in taking advantage of this arrangement.

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(continued)

Details of accommodation, etc., will be provided in a third circular sent only to those completing the pre-registration form below, and sending the preregistration fee of US $10 payable to Third Parasitic Weed Symposium (not WRO) to Chris Parker at WRO.

The balance of the full registration fee, i.e., a further US $50, will be payable on arrival in Aleppo. If sufficient numbers attend, it may prove possible to reduce this fee. Funds are available to support a very limited number of delegates attending. Anyone wishing to apply for such help should write to Dr. M. C. Saxena at ICARDA, PO Box 5466, Aleppo, Syria.

More than 40 papers have been offered and the Editorial Board is hard at work. Subject matter includes the physiology, biochemistry, host specificity, and control by various means of *Striga*, *Orobanche* and *Cuscuta* species, also the ecology of various Loranthaceae and Scrophulariaceae. The programme will include field trips to view local infestations of parasitic species and experimentation on *Orobanche* by ICARDA.

ADVANCE REGISTRATION FORM

THIRD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS, MAY 1984

Name: ____________________

Organization: ____________________

Address: ____________________

Telephone/ telex: ____________________

Pre-registration fee * enclosed (payable to "Third Parasitic Weed Symposium")
* sent separately

Mode of payment: ____________________ *(delete as appropriate)

Send completed forms to: C. Parker, WRO, Begbroke Hill, Yarnton, Oxford OX5 1PF, UK

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Parasitic Plants Newsletter

NUMBER 13
JULY 1984

Official Organ of the International Parasitic Seed Plant Research Group

A REQUEST FOR MISTLETOE FLOWERING MATERIAL

Mistletoes are an interesting group of plants, and their embryology shows several unique features, such as the absence of normal ovules, presence of multiple embryo sacs, extension of embryo sacs to different heights in the style and stigma, formation of composite endosperm as a result of fusion of several endosperms developing in the same ovary, vertical division of the zygote, long and tortuous embryo suspensor, and structure of the fruit.

Embryological investigations have been confined mostly to mistletoes of the Old World. There are only a few reports of similar work on the New World Loranthaceae, the most recent and very accurate observations being those of Venturelli on Struthanthus. It has long been believed that multiple embryo sacs and composite endosperm are of universal occurrence in the Loranthaceae. However, Venturelli's observations on Struthanthus show beyond doubt that only one embryo sac develops and the endosperm is thus not a composite structure. Also there is no polyembryony.

In view of these important findings, it is essential that more genera from the New World be investigated embryologically. Delhi school has made significant contributions to the embryology of this group. I am keen to continue and make extensive studies on the embryology of mistletoes, particularly the New World Loranthaceae, like Gaiadendron, Aetanthus, Struthanthus, Phrygilathus, Psittacanthus, Ixocactus, Oryctanthus, Alepis, Ileostylus, Trilepidia, and Pthirusa. I would much appreciate receiving buds, flowers, and fruits at all stages of development in sufficient quantity.

Please collect the material and preserve in formalin-acetic acid-ethanol (FAA). The standard formula is: 50 or 70% ethanol 90 cc, glacial acetic acid 5 cc, and formalin 5 cc. The material may be preserved in polythene bottles with the preservative but an alternative is to place the fixed material in cotton soaked in preservative and sealed in polythene bags. The material must be sent airmail. Mark the package "preserved material for botanical research and of no commerical value." Please send a representative herbarium specimen separately. Mail to: S. P. Bhatnagar, Department of Botany, University of Delhi, Delhi 110007, India.

STUDY OF THE RESISTANCE TO MISTLETOE (VISCUM ALBUM L.)

Mistletoe (Viscum album L.) causes important damage in orchard, forest and hardwood trees. In order to control its spread, mechanisms of resistance were studied on four cultivars of poplar known for their degrees of resistance: Populus trichocarpa Torrey and Gray cv. "Fritzi Pauley" (FPL); Populus x euramericana (Dode) Guinier cv. "I214"; Populus x euramericana (Dode); "Bergerac" (BRG); and Populus nigra L. cv. "Blanc de Garonne" (BDG).

Two hypotheses could explain this resistance: 1. a toxin contained in the flesh of the mistletoe berry could provoke a "hypersensitive" reaction according to Paine (1950); 2. a reaction of the host could be involved. Before testing the first hypothesis, a structural investigation performed on the pericarp of the berry showed the complexity of the mesocarp or viscid tissue. It consisted of outer highly vacuolated cells and inner elongated degenerated cells deeply rooted in the endocarp. Their well-developed helical cellulosic structure, identified by cytochemical methods, played an important role during the dispersion of the fruits and the attachment of the seeds on host branches.

Artificial inoculations never provoked cankers on poplar trunks as it has been previously described for pear trees. For poplar, at least, the viscid tissue is not involved in the phenomenon of resistance to mistletoe. Artificial infestations showed that whatever the cultivar the seeds of mistletoe germinated and reached the phenological stage "b" characterized by the presence of a holdfast and the development of the haustorium. This stage marks the boundary between the autotrophic and the parasitic phase of the mistletoe.

The histocytological study performed on the parasitized trunks of the four cultivars established that, irrespective of the cultivar, the penetration of primary haustorium caused the formation of several peridermal layers, the most internal surrounding the haustorium. Each periderm is composed of a thin phellem and many phelloderm cells which are characterized by: 1. a secretion of polyphonols in the vacuole; and, 2. lignification of the newly formed cell walls around the sinker.

However, the intensity of these reactions depended on the resistance of the host. In the susceptible cultivar, FPL, these structures were rapidly passed through by the young haustorium. On the contrary, in the resistant tree, BDG, the haustorium was never able to disrupt these barriers. Moreover, the secretion of polyphenols and the lignification of cell walls were much greater. In the intermediate cultivars, I214 and BRG, the haustorium developed, more or less, surrounded by the perihaustorial zone, and avoiding the clusters of fibers. However, 41 months after the inoculation, seedlings died.

Parameters involved in the resistance of poplar to mistletoe were identified on healthy barks of the four cultivars. Three anatomical aspects were specific for each cultivar: 1. the thickness of the phellem; 2. the number of secondary phloem parenchyma cells with a polyphenolic content; and, 3. the number of fibers. A statistical study established that these parameters showed a good correlation with the resistance. For example, the cultivar FPL had the thinnest phellem and the lowest number of fibers and polyphenolic cells in the secondary phloem. The cultivar BDG was just the opposite whereas I214 and BRG were intermediate. These histo-cytological criteria are proposed to test the phenomenon of resistance to mistletoe during the selection of poplars for future plantations. * A. Armillotta, Pierre et Marie Universite, Paris, France.

PROCEEDINGS OF ALL THREE PARASITIC WEED SYMPOSIA STILL AVAILABLE

Proceedings of the Third International Symposium on Parasitic Weeds are available from: Chris Parker (see address of editors below) for US$20.00 or equivalent in UK sterling per copy inclusive of air mail. Please make payment payable to: "Third Parasitic Weed Symposium," not to Weed Research Organization nor to Parker. A limited number of free copies are available to official workers in the ICARDA region on request to: M. C. Saxena, ICARDA, P.O. Box 5466, Aleppo, Syria.

Copies of the proceedings of the second symposium, including the supplement, are available from: A. D. Worsham, Department of Crop Science, Box 5155, North Carolina State University, Raleigh, North Carolina 27650, USA, for US$15.00 and US$1.00 for postage in the USA and US$2.00 for overseas surface mail. Make check payable to: North Carolina State University. Proceedings of the first symposium are available from Chris Parker for 28 Swiss francs made payable to the European Weed Research Society.

A NEW TECHNIQUE FOR OROBANCHE CONTROL?

In a verbal presentation at the Aleppo symposium, M. K. Zahran of the Ministry of Agriculture, Cairo, reported 58-85% reduction in the emergence of O. crenata on V. faba following treatment of the crop seeds with a soybean oil/herbicide mixture. The herbicides included fluazifop-butyl, sethoxydim, NC-302, and chlorazifop, each being mixed with the oil at 1.8 ul product per 2 ml oil. After wetting with the mixture, seeds were allowed to dry before sowing in pots. Further experiments are planned to confirm this interesting observation.

THIRD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

After welcoming ceremonies with the Director General of ICARDA, the technical papers began with the session on mistletoes and Hydnoraceae. Resistance to Viscum album in Populus cultivars was shown to involve both mechanical and chemical factors. Seedling stages of Cuscuta, Orobanche, and Viscum were described and compared. A review of the embryology of mistletoes included a discussion of the systematic value of embryology in the Loranthaceae and Viscaceae. Hydnora johannis in Sudan was discussed in relation to its floral biology.

■

The second session included a special paper on the evolution of parasitism in the Scrophulariaceae and Orobanchaceae. The two families were viewed as a continuum with some genera easily being placed in either or both families. The specialization of the haustorium involves the development of primary haustoria from secondary.

■

The next two papers dealt with Striga. A study of Striga hermonthica has shown that it is an obligate outcrosser. The implications of this for the breeder--resilence, variability--were discussed. In the second paper, a survey of host specificity in sorghum and millet growing regions of Sahelian Africa suggest that host specificity is the outcome of the intensive cultivation of sorghum or millet.

■

The third session dealt with the taxonomy and ecology of Scrophulariaceae and Orobanchaceae. A new key to East Africa species of Striga was discussed along with taxonomic problems in some African species. A survey of the British species of Orobanche and Lathraea and their ecology was presented. A study of Rhinanthus angustiafolius in the Netherlands elucidated some of the complexities in the population biology of this species which may produce vigorous individual plants on certain hosts while the density of the population is due to other factors.

■

Session four concerned biochemistry and physiology, mainly of Striga, and began with a survey of the glutamine synthetase complex in plants varying from normal to holoparasitic. The ration of GS1 to GS2 appears to vary according to the photosynthetic activity of the plants and the ratio in Striga species suggests a low photosynthetic efficiency--confirmed by the next speaker who also reported on the main amino acids in Striga (asparagine, aspartic acid, glutamine and glutamic acid) and the changes in amino acid balance in the infected host (a marked increase in glutamine, arginine and histidine). Nitrate reductase activity is low in Striga. The main sugar in S. hermonthica is mannitol, and this may have an osmoregulatory function related to the high accumulation of K by Striga. Striga hermonthica was shown to begin stimulating root systems of sorghum about the same stage that shoot systems were retarded. Nitrogen tends to counterbalance this change in the root/shoot ratio. "Wet dormancy" in S. hermonthica was re-investigated and more complex results were obtained than those reported earlier.

■

Indian collections of S. asiatica were shown to have pronounced host specificity (to sorghum, millet, and Paspalum scrobiculata) associated with differences in germination requirements, etc. Several phenolic substances were compared for their ability to stimulate haustorial initiation in S. hermonthica. Syringic and ferulic acids were the most active and a structure/activity relationship was proposed.

In session five, difficulty was reported in identifying the resistance mechanism in certain sorghum varieties, and it was proposed that chemotropism, rhizosphere microflora, and root morphology might all be implicated. Techniques for pot experimentation with Striga were described and critical factors identified as temperature, light, soil nitrogen, and Striga seed number. Some resistance to S. gesnerioides has been identified in cowpea, and the genetics of the resistance factor was described. Agronomic and cultural practices for Striga control in Sudan were reviewed. Short presentations on the Striga problems in Kenya and Ethiopia revealed that in both countries there are localities where S. asiatica and S. hermonthica occur together.

Session six dealt exclusively with Cuscuta. A special review paper on control in alfalfa highlighed the importance of low rates of glyphosate applied to the host and subsequently translocated to the parasite. Chlorpropham is effective when used as a soil-applied herbicide that will kill the parasite before it attaches to a host. Other, less favorable treatments as well as cultural control were discussed.

The second paper dealt with the inhibition of cellulase activity by the application of calcium chloride to Cuscuta relexa. The next discussed the spread of C. campestris, C. pedicellata, and C. hyalina in Sudan through poor seed sanitation. The last paper showed how C. planiflora can readily be distinguished from C. campestris and C. indecora by its lack of tendrils.

The last two sessions dealt with Orobanche. In session seven, a review of the O. ramosa problem in the United States emphasized the role of surveys and eradication. This was followed by a study on the early stages in germination and attachment of O. crenata where a distinctive radicle-like structure, the procaulom, is unique in never developing vascular tissue. The last two papers dealt with breeding for resistance and genetic aspects of resistance in Vicia faba and V. sativa parasitized by O. crenata. There appears to be no dominance for resistance in V. faba while a slight partial dominance for resistance may be operating in V. sativa.

In the final session on control of Orobanche, glyphosate was reported as promising for O. ramosa control in eggplant in Sudan, as was the solar heating technique using polyethylene mulch. Flax was shown to have a useful trap crop effect in pot experiments with O. ramosa in tomato. Glyphosate continues to be the main component in any control program for O. crenata in V. faba. A new program was described in which tomato is being screened for resistance both to O. aegyptiaca and to glyphosate. In field visits to local farms and to the ICARDA station at Tal Hadya an abundance of O. crenata was seen on both V. faba and on lentil. Occasionally, there was simultaneous attack by both O. crenata and O. aegyptiaca on both crops. In varietal experiments there was no clear resistance demonstrated even by the "resistant" Egyptian V. faba F402 in this dry season conducive to heavy attack. Early winter sown chickpea showed more varied susceptibility.

The scientific profit of the symposium was pleasantly augmented by the excellent staff and facilities of ICARDA which were graciously provided for symposium use. Particular thanks are due the Director General, M. A. Nour, and M. C. Saxena who attended to so many details which ensured the success of the symposium. Our hearty thanks for all this help.

INTERNATIONAL PARASITIC SEED PLANT RESEARCH GROUP BUSINESS MEETING

Chris Parker presided at the informal business meeting on 9 May at the Aleppo symposium and called for suggestions for IPSPRG activities. A good discussion followed with many helpful comments. It was suggested that it would be beneficial to assemble a collection of slides of parasites to be made available for publishers of textbooks, etc., but while all agreed this would be a worthwhile idea, no action was taken.

The matter of a "theme" for symposia was introduced, but it was the clear consensus of the group that no theme should be set at the main symposia, rather, there is benefit in having diversity with the single unifying theme being parasitic vascular plants. More specialized workshops might, however, be appropriate inbetween the main symposia, and tentative plans are already in hand for one on resistance mechanisms, resistance breeding, and associated topics for both Striga and Orobanche.

There is a need for a directory of workers in parasitic seed plant research, and it was agreed that this is an ideal subject for the organization to take up. A form will be included in the next issue of HAUSTORIUM. The idea is to make these directories available to any group or individual who needs some expertise in parasitic seed plant biology and control. No change in officers was proposed and readers may be reminded that they are Chris Parker, chairman, Lytton Musselman, secretary, and Anita Wilson, treasurer. There is also a steering committee composed of the above and J. L. Riopel, A. R. Saghir, F. Hawksworth, J. Kuijt, S. ter Borg, J. Dawson, M. Calder, and H. C. Weber.

FOURTH SYMPOSIUM ON PARASITIC WEEDS

One of the items discussed at the IPSPRG business meeting was the matter of the next, the fourth, symposium. We have been invited by Hans Christian Weber to hold the next meeting in 1987 at the university in Marburg. This year was selected as it is the year of the next International Botanical Congress to be held in West Berlin in August 1987. It was suggested that the symposium be held prior to the congress. As soon as the date is finalized we shall include information in HAUSTORIUM.

LITERATURE

Dawson, J.H., F.M. Ashton, W.V. Walker, J.R. Frank, G.A. Buchana. 1984. Dodder and its control. U.S. Dept. of Agriculture, Farmers Bulletin 2276. (This replaces an older bulletin and includes a great deal of information on both the biology and control of dodder, especially C. indecora, C. campestris and C. planiflora. There are discussions of crops affected by dodder, different means of control, and specific herbicide recommendations).

Riopel, J.L. 1983. The biology of parasitic flowering plants: physiological aspects in: Vegetative compatibility responses in plants. (A very helpful review with special emphasis on post germination phenomena such as haustorial initiation and penetration).

Bebawi, F.F., R.E. Eplee, R.S. Norris. 1984. Effects of seed size and weight on witchweed (Striga asiatica) seed germination, emergence, and host-parasitization. Weed Science 32:202-205. (Seeds classed as large and heavy gave both higher germination and greater percentage of emerged plants than did lighter seeds).

Bebawi, F.F., G.A. El Hag. 1983. Nutritive value of the parasitic weed Striga hermonthica. Tropical Agriculture 60:44-47. (Striga is classified as medium quality roughage for fodder.

However, the high N concentration in the rumen indicates that a large proportion of Striga protein is not utilized).

Thomson, V.E., B.E. Mahall. 1983. Host specificity by a mistletoe. Phoradendron villosum (Nutt.) Nutt. subsp. villosum. on three oak species in California. Botanical Gazette 144:124-131. (The occurrence of the mistletoe varied with geography, host species, and host size).

Lebrun, J.P., E. Boudouresque, D. Dulieu, M. Garba, M. Saadou, B. Roussel. 1983. Second supplement au catalogue des plantes vasculaires du Niger. Bulletin Societe Botanie France 130:249-256. (Orobanche cernue was recorded from Schouwia thebaica Webb-Brassicaceae-for the first time from this region of Africa).

Smith, P.L., D. Gledhill. 1983. Anatomy of the endophyte of Viscum album L. (Loranthaceae). Botanical Journal of the Linnean Society 87:29-53.

Aber, M., A. Fer, G. Salle. 1983. Transfer of organic substances from the host plant Vicia faba to the parasite Orobanche crenata Forsck. Zeitschrift fur Pflanzenphysiologie 112:297-308. (In French).

HAUSTORIUM is edited by L.J. Musselman, Dept. of Biological Sciences, Old Dominion Univ., Norfolk, VA 23508 USA, and C. Parker, Weed Research Organization, Begbroke Hill, Yarnton, Oxford OX5 1PF, UK , and typed by Ruth Carr, IPPC, OSU, Corvallis, OR, USA. Material should be sent to either editor as should requests for copies.

Copies of back issues #9, 10, 11, and 12 are available free while supply lasts. Photocopies of #1-8 are available from IPPC at US$.50 per issue.

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Parasitic Plants Newsletter

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Official Organ of the International Parasitic Seed Plant Research Group

INDEX OF PARASITIC SEED PLANT WORKERS

Enclosed with this issue of HAUSTORIUM is a form to be completed by anyone interested in being included in a directory of international workers in parasitic seed plant research. The need for such a directory was discussed at the 1984 IPSPRG symposium in Aleppo. The intent is to provide in a single source a listing of workers, their specialties, and parasites on which they are working. This would allow funding agencies to identify workers and projects as well as provide for lack of duplication of effort by workers. Information will be computerized and arranged by taxonomic group, area of research, as well as individual name and country. Please complete the form as thoroughly as possible and return it to the address on the form. Add any other information you consider pertinent as we want the directory to be as exhaustive as possible. The plan is for IPSPRG to publish the directory, distribute to all IPSPRG members and sell remaining copies. All this depends, of course, on available funds.

SYMPOSIUM ON THE BIOLOGY OF DWARF MISTLETOE

A symposium on the biology of dwarf mistletoes (Arceuthobium) was held at Colorado State University, Fort Collins, Colorado, on August 8, 1984 in conjunction with the national meetings of the American Institute of Biological Sciences. It was, no doubt, the largest concentration of Archeuthobiologists ever assembled. The symposium was organized by F.G. Hawksworth and R.F. Scharpf of the United States Department of Agriculture Forest Service.

Proceedings from the symposium will be available soon and can be obtained without cost by writing: F.G. Hawksworth, 240 West Prospect, Fort Collins, Colorado 80526 USA. Fifteen papers were presented under four broad topics:

* BIOSYSTEMATICS, HOSTS, AND DISTRIBUTION. Hawksworth and Wiens updated recent taxonomic developments in the genus and summarized nine new taxa described since the appearance of their 1972 monograph. Kiu Hua-sing reviewed Arceuthobium in China, including the two new species he described recently. The first isozyme study of the dwarf mistletoes was described by Nickrent, Guzmann, and Eshbaugh. Linhart discussed isozyme variation of two dwarf mistletoes in relation to their host species.

* PHYSIOLOGY, ANATOMY, RESISTANCE. Alosi and Calvin described light and SEM studies of the morphology of the endophytic system. Hormone relationships of mistletoes and hosts were discussed by Livingston, Bremer, and Blanchette. A study of water relations and seedling photosynthesis was described by Tocher, Gustafson, and Knutson. Scharpf discussed host resistance to the dwarf mistletoes.

* POPULATION DYNAMICS. Seed development, germination, and infection characteristics of Arceuthobium were described by Knutson. Gilbert and Punter discussed pollination biology of a dwarf mistletoe in Manitoba, Canada. Stevens and Hawksworth summarized literature on insect and mite associates of dwarf mistletoes. The possibility of long-distance dispersal

by birds and mammals is described by Nicholls, Hawksworth, and Merrill.

* ECOLOGY. Relationships between dwarf mistletoes and understory vegetation (habitat types) are reviewed by Mathiasen and Blake. Tinnin outlined the changes in community structure and function resulting from dwarf mistletoe infestion. The complex inter-relationships between dwarf mistletoes and fire are discussed by Zimmerman and Laven.

NEW PARASITIC WEED RECORDS AND CONCERNS

On a recent visit to Mali, Chris Parker found a serious infestation of Alectra vogelli attacking cowpea in the vicinity of Bamako. It was noticed some years ago, but had previously been misidentified as Vahlia digyna. The Flora of West Tropical Africa (FWTA) records this only from Nigeria, Ghana, and Guinea. A recent search in the Paris herbarium has turned up a single specimen dated 1964 from a different part of Mali, but this site has not been re-checked. Cuscuta campestris was also found near the old airport at Bamako. The FWTA records this potentially dangerous species from only a single site in Cameroun. It was also collected by Parker in Northern Nigeria but is still a rarity in West Africa. A recent introduction into Sudan was reported in a previous issue of HAUSTORIUM. John Terry (Weed Research Organization) collected Striga latericea on sugarcane in Somalia at the Juba Sugar Project. This species, apparently closely allied with S. forbesii, has only once before been reported as an economic problem.

In the United States, there is concern over the introduction of Cuscuta chinensis which has been reported to be a serious problem on soybean in other parts of the world. According to Jean Dawson, U.S. Dept. of Agriculture, niger seed (Guizotia abyssinica) imported into the country is contaminated with the Cuscuta. Efforts are being made to determine if it is indeed this species. Orobanche ramosa was recently found to be still extant in the burley tobacco region of Kentucky, but it is restricted to seed tobacco only and at present does not pose a threat to other tobacco production in the region because of the practice of farmers of treating seedplots with methyl bromide.

Not a new record, but one previously overlooked by weed specialists, is the presence of an established colony of Orobanche crenata in Britain, well outside its main peri-Mediterranean distribution. First recorded in Essex in 1950, it has persisted there on Vicia tetrasperema. As it has so far only occasionally occurred on Vica faba in gardens, it is still regarded as a curiosity to be protected rather than a pest to be eradicated. A report on this in Watsonia 15: 161-175 (1984) also notes that O. crenata is "firmly established" in several botanic gardens in Sweden. The origin of the British population is still not explained.

PROCEEDINGS OF THE DAKAR WORKSHOP NOW AVAILABLE

The proceedings of the Dakar workshop, titled "Striga-Biology and Control" has now been published by the International Council of Scientific Unions (ICSU) Press and will be available either from IRL Press Ltd., P.O. Box 1, Eynsham, Oxford OX8 1JJ, UK for 20 pounds sterling + one pound for surface postage or from IRL Press, Inc., Suite 907, 1911 Jefferson Davis Hwy., Arlington, VA 22202 USA for $36 + $2 postage. Airmail is extra from either source. This 216 page, paperbound volume is the best source for up-to-date information on the Striga problem and research. ICSU is to be complimented on its rapid and attractive production.

LITERATURE

Bernhardt, P. 1984. Mistletoes on mistletoes: The floral ecology of Amyema miraculosum and its host, Amyema miquelii (Loranthaceae). Australian Journal of Botany 32:73-86. (This is a

study of the floral biology of two mistletoes which are in competition for the same pollinators, in this case birds. The host mistletoe, A. miquelii, received more visits than its parasite. Although 22% of all pollinator visits were interspecific, no hybridization occurred.)

Musselman, L.J. 1984. Tracking the elusive tartous of the Blue Nile. Explorer 26:8-11. (An illustrated popular account of the biology of Hydnora johannis (=H. abyssinica) in Sudan).

Werth, C.R., J.L. Riopel, and N.W. Gillespie. 1984. Genetic uniformity in an introduced population of witchweed (Striga asiatica) in the United States. Weed Science 32:645-648. (This study confirms the long held suspicion that the autogamous American strain of this parasite is genetically uniform and suggests that the population was introduced by only a few seeds).

Bebawi, F.F., R.E. Eplee, C.E. Harris, and R.S. Norris. 1984. Longevity of witchweed (Striga asiatica) seed. Weed Science 32:494-497. (Seed remained viable on the shelf for six years; seed buried deep in the soil for 14 years had 10% germination. No germination occurred after burial for 14 years. This study helps refine our estimates on the longevity of Striga seed in the soil).

Baird, W.V. and J.L. Riopel. 1984. Experimental studies of haustorium initiation and early development in Agalinis purpurea (L.) Raf. (Scrophulariaceae). American Journal of Botany 71:803-814. (This is another contribution from the laboratory of Riopel who has been applying experimental techniques to the study of haustoria. This study uses laboratory culture under defined conditions as well as scanning electron microscopy. The precise location of haustorial initiation and the very earliest stages in development are pinpointed).

Baird, W.V. and J.L. Riopel. 1983. Experimental studies of the attachment of the parasitic angiosperm Agalinis purpurea to a host. Protoplasma 118:206-218. (See review above. This paper describes the early stages in the attachment of the parasite to the host. The distinctive root hairs play a prominent role in "cementing" themselves to the hosts. The surface of the hairs is described. A "competency" time extends to 72 hours after which the haustorium will not attach. This work has significant implications for new methods of control in root parasites).

Bebawi, F.F., R.E. Eplee, and R.S. Norris. 1984. Effects of seed size and weight on witchweed (Striga asiatica) seed germination, emergence, and host-parasitization. Weed Science 32:202-205. (Not surprisingly, seeds which were heaviest and largest gave the highest germination and were the most successful in parasitizing their host. Work such as this raises the question of what factors are involved in the development of seeds. Are first formed seeds the largest?).

Mesa-Garcia, J., de Haro, A. and Garcia-Torres, L. 1984. Phytotoxicity and yield response of broad bean (Vica faba) to glyphosate. Weed Science 32:445-450. (A useful study of the response of faba bean to glyphosate application (in the absence of Orobanche crenata) confirming that repeated applications at 60 g ai/ha are safe but 120 g/ha may cause some damage).

Nagar, R., Singh, M., and Sanwal, G.G. 1984. Cell wall degrading enzymes in Cuscuta reflexa and its hosts. Journal of Experimental Botany 35:1104-1112. (Enzymes associated with the haustorial penetration of host tissue included pectin esterase, polygalacturonase, xylanase, and exo-1, 4-beta-D-glucosidase).

Maiti, R.K., Ramaiah, K.V., Bisen, S.S., and Chidley, V.L. 1984. A comparative study of the haustorial development of Striga asiatica (L.) Kuntze on sorghum cultivars. Annals of Botany 54:445-457. (Studies of endodermis and pericycle thickening in roots of susceptible and resistant sorghum varieties are strongly suggestive of a

INDEX OF PARASITIC SEED PLANT RESEARCHERS

1. Your name (last, first, middle initial)

____

2. Title ______________________

3. Position ______________________

4. Address ______________________

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(Be certain to include postal code, if any)

5. Telex ________________ 6. Cable ________________

7. Phone ________________

8. Main taxonomic groups:

8a. Family ____________ 8b. Genus ________________

8c. Species ____________, ____________, ____________

Second group:

8d. Family ____________ 8e. Genus ________________

8f. Species ____________, ____________, ____________

Third group:

8g. Family ____________ 8h. Genus ________________

8i. Species ____________, ____________; ____________

9. Geographical area ______________________________

10. Type of research effort. Be specific, use key words as taxonomy, floristics, education, biochemistry, herbicides, evolution, weed biology, physiology, ecology, etc.

10a. First (major) emphasis __________ 10b. Second emphasis __________

10c. Third emphasis __________

(over, please)

11. Title of two recent (within the past five years) papers or reports (include complete citations):

11a. First paper/report ______________________________

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11b. Second paper/report ______________________________

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12. Source of research funding (private/government):

____

13. Title(s) of current research endeavor(s):

13a. ____

13b. ____

Send completed form by 15 April 1985 to:

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HAUSTORIUM AND IPPC

Haustorium issues 9 through 14 were word processed, printed, and distributed by IPPC, the International Plant Protection Center at Oregon State University (USA), with support derived in part from a contract with AID, the U.S. Agency for International Development. That contract ended May 31, 1985 and with it the Center's ability to absorb printing and mailing costs.

Issues #15 was printed and mailed by the INTSORMIL program headquartered at the University of Nebraska (USA). On behalf of the International Parasitic Seed Plant Research Group, we express appreciation to IPPC for its interest and assistance, to AID for support, and now to INTSORMIL for willingness to keep Haustorium alive.

The Editors

STRIGA BAUMANII ENGL. AN UNUSUAL BIOLOGY FOR A PARASITIC PLANT

Aline Raynal-Roques

Since the original description and naming of Striga baumanii by Engler in 1897 (Bot. Jahrb., 23: 515-516 and pl. 12, fig. O-T), little has been added to our knowledge of this unusual plant. It is a perennial herb with stiff glabrous stems, scale leaves and tiny flowers. The broad basal leaves have never been described, nor has its peculiar way of life which appears to be unusual among parasitic flowering plants. Striga baumanii occurs in sudanian savannas extending from Kenya and Zaire in East Africa to Sierra-Leone and Mali westwards. It is restricted to plateau and montane-grasslands, at 50 to 200 m elevation. This means that it grows in comparatively wet savannas north of the equator where, despite an 8-9 months dry season, the annual rainfall is still high, and estimated to 1.8 - 0.7 m. In the dry season, wild fires sweep the savannas.

Shortly after the beginning of the rainy season the soil becomes wet or even water-logged. At this time a short stem arises from the rootstock and bears a single pair of green, thin, delicate, nearly circular leaves which spread on the soil surface. Each leaf is about 1 cm in diameter; the perfoliate leaf-bases form a tiny cup around the abortive stem apex. With functioning leaves and water suupply the tuberous roots begin to thicken.

These two small leaves do not last long; as soon as the weather becomes dry they fade, turn pale yellow and shrink. At this stage they are easily broken off. As the savanna begins to dry nothing usually remains of the Striga, except the subterranean rootstock. As the season becomes even drier, the vegetation becomes sparser on the dried soil. The early wild fires burn the savanna, destroying grasses and leaves. After the fires the flower stems of Striga baumannii appear. From the rootstock arises one flowering stem (sometimes two or three). The stem bears opposite-decussate leaves. The upper stem (one half or two thirds of its total height) is densely covered by flowers. When the flowering stems dries, seeds disperse by exploding capsules in the hot savanna. As the dry season progresses other fires come across, burning Striga stems. When the first rains finally come the unburnt flowering stems rot quickly, and nothing remains of the plant above ground level. Soon after the tuberous rootstock will produce two new rounded leaves. The functioning leaves will restore the plants' reserves and allow flowering next dry season.

An unusual biology for a parasitic plant.

During the year, Striga baumannii has two distinct vegetative and flowering phases. It looks like two different plants with different stems and leaves. This alternation is related to food production in the vegetative phase, and food utilization in the flowering phase. As a whole Striga baumannii's biology must be considered as a geophytic one. Such a way of life is shared by a number of savanna plants belonging to various families (Compositae, Papilionaceae, Asclepiadaceae, Commelinaceae, etc.). They flower in the dry season after the burning of savanna grasses; all of them have tuberous or woody, turnip-like or bulbous root stocks; produce leafless flowering scapes; leaves appear later on, and develop after fruiting during the next rainy season. Flowers and leaves are not commonly seen at the same time except when small early flowers appear soon after flowering. These geophytic plants are called "pyrophytes", though they do not really need fire to bloom but probably only a bare overheated soil. Striga baumannii is a geo-pyrophytic species. The parasitic habit of S. baumannii is evident, its hosts are unknown but root-connections are frequent. As far as known, it is the only flowering plant being both a parasite and geo-pyrophyte.

Brief description of Striga baumannii:

Leafy stem:
*a single stem in the rainy season;
*short (2-4 mm high), just enough to raise the leaves up to ground level;
*bears no more than one pair of developed leaves; its base, on the root stock, is clasped by two minute scales;
*never grows into a flowering nor a leafy stem later.

Vegetative leaves:
*one pair per stem borne in the rainy season;
*blade round, somewhat broader than long (c. 1 cm long, 1, 3 cm broad), narrowed at base, sessile;
*leaf-bases connate.

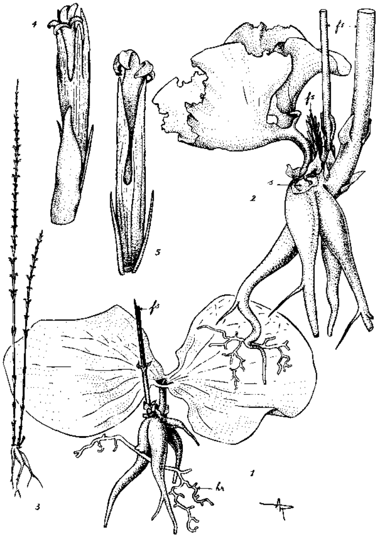
Flowering stem:
*up to four at the same time produced in the dry season;
*thin and stiff, 20-50 cm high; mostly unbranched;
*glabrous, pale grey-green; 4-angled to nearly terete, sometimes longitudinally furrowed;
*bears opposite, deussate, scale leaves, the upper ones containing auxiliary flowers; leaf length: 4-9 mm;
*internodes: up to 4 cm long in basal part of stem; abruptly shorter (10-15 mm) in flowering upper one.

Flowers:
*tiny, sessile, erect, stiff; clasped by the scaly bract;
*two acicular bracteoles;
*calyx narrowly tubular, 10-12 mm long, about 13-15 ribbed;
*four unequal erect teeth; anterior lobes shorter (c. 3 mm long) lateroposterior ones longer (c. 4 mm long); tube deeply cleft on the back;
*corolla narrow, as long as the calyx, long-tubular, dark reddish, turning brownish;
*five subequal narrow lobes, somewhat carnose-thicken, papillose incide, c.1 mm long, spreading-excurving;
*corolla tube 10 mm long, 0.5-0.9 mm wide;
*stamens 4; filaments very short (0.2 mm); anthers 1-1.5 mm high;
*inserted by pairs on two different levels in the corolla tube: the anterior pair higher than the lateroposterior one;
*pistil 3.5-4 mm high; ovary 1.5 mm long; stigma club-shaped, beneath the anthers.

Fruits and seeds:
*Capsule included in calyx and capped by marcescent corolla;
*narrowly linear, 6.5-7.5 mm high, 1-1.3 mm wide; apex truncate;
*dehiscence by 2 loculicidal slits;
*seeds numerous, angular, dark reddish brown, 0.5-0.7 mm long.

Tuberous rootstock:
*Roots clustered, fusiform, tuberous in upper part; fleshy part c. 15 mm long and 2.8 mm thick, tapering downwards; whitish, smooth when fresh; blackish, wrinkled when dry;
*roots are thinning when drying; they do not appear obviously tuberous in herbarium specimens;
*root-connections with host roots (host unidentified, probably grasses);

*top of stock: a few millimeters under ground level;
*previous year of stems leave scars on the stock; the small number of scars observed suggest that a single plant lives only a few years.



Striga baumannii -1. Whole plant in rainy season (vegetative phase); scale: 1 mm; fs, base of an old, burnt flowering stem (from last dry season); hr, host root. -2. Basal part of plant in dry season (flowering phase); scale: 1 mm; the rounded vegetative leaves are dry; fs, flowering stems, 2 are already developed and blooming, the third one is younger; s, scar left by stem (of previous year). -3. Habit of whole plant in dry season; scale: 1 cm; vegetative leaves and stem have been destroyed. -4. Flower, front view, clasped in its bract; scale: 1 mm. -5. The same, back view, showing the deep sinus on posterior face of calyx.

NEW PROJECTS

The Weed Research Division (previously Weed Research Organization, now part of the Long Ashton Research Station of Bristol University), is continuing to work on parasitic weeds under funding from the U.K. Overseas Development Administration (ODA). After many years of work on the Striga problem in cereals it is concentrating on cowpea (Vigna unguiculata), studying its resistance to Striga gesnerioides and Alectra vogelii, and the possibilities of selective control by herbicides. The project is collaborative with Birkbeck College, London, where the genetic variability of S. gesnerioides is being studied. Birkbeck College also has a separate ODA-funded Striga project, looking in depth at Striga-resistance mechanisms in the cereals.

At the Royal Tropical Institute an EEC-funded project is in progress on the resistance of Vicia faba beans to Orobanche crenata.

LITERATURE

Renaudin, S., P. Thalouarn, L. Rey, J. Vidal, F. Larher. 1984. Phosphoenol pyruvate carboxylase in parasitic plants: Further characterization in various species and localization at the level of cells and tissues in Lathraea clandestina L. Journal of Plant Physiology 116: 455-465. (This is part of a continuing effort from this laboratory to study the role of this enzyme in parasitic plants. It is suggested that PEPc might perform some kind of internal carbon dioxide cycling and also might play a role in the buffering of pH between host and parasite.)

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145:461-464. (This Mexican species of dwarf mistletoe is the largest known. Its phloem appears to be typical dicot phloem; this is the first report of normal phloem in a dwarf mistletoe.

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Capdepon, M., A. Fer, P. Ozend. 1985. About an unreported system leading to the expulsion of a parasite: Cuscuta on cotton-plant (C. lupuliformis Krock. on Gossypium hirsutum L.). Compte Rendus Acadamie Science Paris, Serie III (6): 227-232. (A new form of resistance to parasite invasion is reported involving a process described as being abcission-like.)

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Nagarajan, K., T.S.N. Reddy, R. Lal, G.V.G. Krishnamurty, N.S. Murty. Salient research findings on tobacco diseases (1953-1983). 1984. Division of Plant Pathology, Central Tobacco Research Institute, Rajahmundry, India. (Among some of the interesting findings regarding Orobanche cernua on tobacco was that flooding reduced seed germination by 90% after 4 weeks. Seeds remained viable in the field for only 7 years. A variety of trap crops showed efficacy in reducing the level of seeds in the soil.)

Fer, A., M. Capdepon. 1984. Quelques dicotyledones parasites des plants cultivees. Phytoma December 1984: 39-41.

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Musselman, L.J. 1984. Orobanche ramosa in Kentucky. Castanea 50: 57-58.

Musselman, L.J. 1985. Have you heard about the farmer's dodder? Explorer 27: 7-9. (A popular account of the biology of Cuscuta.)

Calder, M., P. Bernhardt (Eds). 1983. The Biology of mistletoes. Academic Press 348 pp. (An excellent series of specially commissioned reviews in 17 chapters including biogeography, embryology, floral, seed and germination biology, water and nutritional relations, etc. and with many good illustrations.)

Visser, J.H., A.W. Johnson. 1982). The effect of certain strigol analogues on the seed germination of Alectra. Journal of Botany, 1, (3) 75-76. (Reporting the sensitivity of Alectra vogelii to "GR" compounds 7, 24 and 28 and A. orobanchoides to compounds 5, 7, 24 and 28. Strigol had relatively low activity on both species.)

Visser, H.H., I. Door, R. Kollmann. 1984. The "hyaline body" of the root parasite Alectra orobanchoides Benth. (Scrophulariaceae) - its anatomy, ultrastructure and histochemistry. Protoplasma 121, 146-156. (The "hyaline" tissue is characterized by small, densely structured cells and unusual extracellular deposits closely associated with phloem elements. Its function remains obscure.)

Fer, A., M. Capdepon. 1984. Quelques dicotylédones parasites des plantes cultivées Phytoma - Défense des cultures December, 39-41. (A useful concise review in French of the biology and control of Cuscuta, Orobanche and mistletoe problems.)

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Trixterix aphyllus (Loranthaceae) Canadian Journal of Botany 63 (3) 488-491. (A detailed and fascinating account of the biology of this unusual parasite which, once established, is totally endophytic until flowering.)

Sharma, S., R. Khanna, G.G. Sanwal. 1985. Lipids of Cuscuta reflexa and changes in lipids of its host plants after infection. Physiologia Plantarum 63, 315-321.

Ibrahim, N.E., A.G.T. Babiker, W.G. Edwards, C. Parker. 1985. Activity of extracts from Euphorbia species on the germination of Striga species. Weed Research 25 (2), 135-140. (Reports the activity of extracts from a range of Euphorbia species in stimulating germination and pre-haustorial initiation of several Striga species.)

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Lolas, P.C. 1984. Effective control of broomrape (Orobanche ramosa) in tobacco. 1984 Coresta '84 Bulletin d'Information. Cooperation Centre for Scientific Research in tobacco (CORESTA). (Abstract of a paper presented at the 8th International Tobacco Scientific Congress, Vienna in October 1984, reporting good control of O. ramosa and improved tobacco growth from application of maleic hydrazide 0.7 + 0.7 kg/ha or glyphosate at 0.2 + 0.3 kg/ha at 40 + 60 days after transplanting.)

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Pieterse, A.H., C.J. Pesch. 1983. The witchweeds (Striga spp) - a review. Abstracts on Tropical Agriculture 9 (8), 9-37. (A concise but comprehensive review of 521 references under headings of Systematics, General Botany, Disbribution, Habitat and Major Host Crops, Germination, Effect on Host Plants, Chemical Control, Biological Control, Manual and Cultural Control, Resistant Crop Varieties and Chemical Composition and Practical Use.)

Mesa-Garcia, J., L. Garcia-Torres. 1984. A competition index for Orobanche crenata Forsk effects on broad bean (Vicia faba L.) Weed Research 24 (6), 379-382. (An equation is developed: % crop loss = 100 X 0.124 X OcN where OcN is the average final number of emerged O. crenata per crop plant.)

Weber, H.C. 1984. Haustorial struktur und granula-haltige Xylem-Leitbahnen bei Arceuthobium oxycedri (DC.) M. Bieb. (Viscaceae). Ber. Deutsch Bot. Ges. 97, 421-431. (Reporting the presence of graniferous xylem elements for the first time in an epiphytic mistletoe.)

Weber, H.C. 1984. Untersuchungen an australischen und neuseelandischen Loranthaceae/Viscaceae 3 Granulahaltige Xylem-Leitbahnen. Beitrage zur Biolgie der Pflanzen 59 (2), 303-320. (Graniferous tracheary elements are reported in 40 Australian and New Zealand mistletoe species.)

Forstreuter, von W., H.C. Weber. 1984. Zum parasitismus von Cuscuta auf Euphorbia-Wirten. Beitrage zur Biology der Pflanzan 59 (1), 31-54. (The abnormal growth of C. reflexa and C. odorata on Euphorbia spp was studied, and the further abnormalities resulting from application of growth regulator such as chlormequat.)

Schulze, E.D., J.R. Ehleringer. 1984. The effect of nitrogen supply on growth and water-use efficiency of xylem-tapping mistletoes. Planta 162 (3), 268-275. (It is proposed that the higher transpiration rates of mistletoes represent a nitrogen-gathering mechanism.)

HAUSTORIUM is edited by C. Parker, Weed Research Organization, Begbroke Hill, Yarnton, Oxford OX5 1PF, UK and L.J. Musselman, Dept. of Biological Sciences, Old Dominion University, Norfolk, VA 23508 USA, and typed by Susan Larson, IPPC, OSU, Corvallis, OR, USA. Material should be sent to either editor as should requests for copies.

Copies of back issues #9, 10, 11, 12, 13, and 14 are available free while supply lasts. Photocopies of #1-8 are available from IPPC at US$.50 per issue.

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Parasitic Plants Newsletter

Number 16
March 1986

Official Organ of the International Parasitic Seed Plant Research Group

HELP! HAUSTORIUM IS A PARASITE WITHOUT A HOST!

This could be the last issue of our newsletter as, once again, we are without a sponsor. This issue is being printed and mailed through the generosity of the INTSORMIL office but this is the last issue they can support. Can any one help?

STRIGA SPECIES IN ETHIOPIA

On a recent visit to Ethiopia it was confirmed that Striga hermonthica is continuing to spread and is now found up to an elevation of 2300M in some areas. Occurrences on some new farms at low altitude are believed to have arisen from the abundant natural infestation in the native savannah, apparently parasitic mainly of species on Setaria.

The most striking species was S. latericea which is known from native vegetation in a number of districts in Ethiopia and other parts of East Africa but occurs as a persistent localized problem on the Meta Hare Sugar Corporation farm in the Awash valley. It is as tall as S. hermonthica but has broader leaves and a dense covering of fine hairs and spikes of brick-red flowers up to 2 cm long.

Close examination of this population showed that it is perennial with a system of rhizomes several mm thick from which adventitious buds produce aerial shoots. The aerial parts also have a perennial habit with new shoots arising from the lower nodes after much of the stem has matured and died. The parasite is apparently slow to establish and is not normally noticed in the first year after planting sugar cane, but is seen as spreading patches in ratoons. These patches grow up to several meters across and persist for many years and even re-appear in the same place after the ratoon is destroyed and the crop replanted. New infestations are not often noted and it appears that it spreads mainly by vegetative reproduction. Very little seed was being set due to heavy infestation by a pollen eating larva.

C Parker

WHAT EVER HAPPENED TO THE INDEX OF PARASITIC SEED PLANT WORKERS?

We still plan to produce such an index but production has been delayed due to a change in the way HAUSTORIUM is prepared and, at present, a lack of a sponsor! It is still not too late to send your forms to L J Musselman.

A TUBEROUS HAUSTORIUM OF THONNINGIA SANGUINEA (BALANOPHORACEAE) GROWING ON HEVEA BRASILIENSIS.

In 1985 a tuber 8 cm in diameter was sent to Kew from Cameroon where it was collected by Mr P G S Hall of the Natural Resources Department, Commonwealth Development Corporation. It was said that Thonningia sanguinea was conspicuous as red rosettes on the ground in a rubber plantation. As far as we know such tubers have never been reported from this species and examination of herbarium material at Kew provided nothing like it. Although there was no reason to doubt its identity as photographs of the flowers were provided, no inflorescence was attached so confirmation was sought by anatomical study. The woody root to which the tuber was attached proved to be rubber (Hevea brasiliensis) while the tuber consists of parenchymatous ground tissue with islands of vascular tissue pursuing an irregular course and some sclereids. This is anatomically similar to the only reference slide at Kew of another member of the same family, Langsdorffia papuana from New Guinea, which is good evidence that the tuber consists of Thonningia rather than Hevea tissue.

It would be interesting to know whether such a tuber is frequent and whether or not it occurs on host plants other tha rubber. According to the Anatomy of the Dicots, tuberous rhizomes in the Balanophoraceae range in size from a small nut to a human head. Striga gesnerioides also forms a tuber-like structure of some size but only when the host is an arborescent species of Euphorbia, which like Hevea, is a latex producing member of the Euphorbiaceae. Is where an analagous function in these two parasites from totally unrelated families each producing tuberous haustoria? (See figure on page 4).

F N Hepper and P Gasson, Royal Botanic Gardens, Kew.

FOURTH SYMPOSIUM ON PARASITIC WEEDS, SUMMER 1987.

Plans are proceeding for our next IPSPRG meeting which will be held in Germany during the summer of 1987 at the Philips University in Marburg.

The actual date of the meeting has not yet been decided but will be either before or after the Botanical Congress to be held in Berlin 24 July to 1 August 1987.

MEDICINAL USES OF A MEMBER OF THE BALANOPHORACEAE IN SOMALIA

During a recent collecting trip in the Middle Juba Region of Somalia, we encountered a preparation in the local markets sold as a cure for diarrhea and menstrual disorders called in Somali, dinsi. Because of its resemblance to tartous (a member of the Hydnoraceae used in other parts of Africa as a medicine for the same ailments), we attempted to locate the source of the dinsi. After some consultation with local people we found that what was being sold was the dried and broken pieces of a member of the Balanophoraceae. The plant has not yet be identified but it does not resemble plans of the genus Balanophora and could be a species of Chlamydophytum or a related genus. Further work is under way to determine the plant and other uses as well as some information on the chemical makeup of the medicine.

Cistanche is also known as dinsi in the same area and we were led by a nomad to a stand of Cistanche and told it was dinsi. However, the material being sold in the market definitely was not Cistanche.

Aweys Yusef and L J Musselman

EFFECT OF FERTILIZER ON STRIGA COUNT IN WHEAT

An experiment on the long range effect of continuous cropping and manuring on Jowar wheat rotation is in progress at the Agricultural Research Station of the University of Agricultural Sciences at Sirguppa in the Tunga Bhadra Project area. The soil is a vertisol and the experiment has been in progress since 1977. The treatments consist of all combinations of three levels of N (40, 80, and 120 kg N/ha), three levels of P_2O_5 (0, 40, and 80 kg/ha) and two levels of K_2O (0 and 40 kg/ha). The experiment is laid out in a 3^2x 2 partially unfounded design with four replications.

The crop of Hy. jowar-CSH-5 was sown on 8-7-1985 with a spacing of 40 cm between rows and 10 cm between plants within a row. Counts of Striga asiatica were recorded treatment-wise at 70 days after sowing. The data on weed counts and visual observation indicates that the weed population is low in the plots receiving higher doses of N. The effect of P_2O_5 levels and K_2O level did not show any influence on the Striga count. The data indicates that the intensity of Striga is greater in N poor soils.

M M Hosmani, V Jagannath, K M S Sharma, University of Agricultural Sciences, Shimoga, India.

LITERATURE

The underground sorcery of witchweed. Discovery. December 1985. (This is a popular account of a very significant and as yet unpublished discovery of the "chemical radar" of Striga asiatica. J L Riopel and D Lynn have found that the parasite sends a message to the host which in turn tells the parasite to produce a haustorium).

Yatskievych, G, Zavada, M. 1984. Pollen morphology of Lennoaceae. Pollen et Spores 26: 19-30. (Pollen structure supports the concept that this North American family of holoparasites consists of only four species.)

Iranshar, M. 1983. New records of Cuscuta (Cuscutaceae) from Iran. Iranian Journal of Botany 2(1): 9-12.
(Not surprisingly, C. campestris is now known from Iran. Also noted for the first time is C. lehmanniana. There are figures of the species and a map of their distribution.)

International Institute of Agriculture. 1985. IITA Research Highlights for 1984. (Two articles on Striga, one describing a survey of species on maize in Nigeria and suggesting that S. aspera is much more important than previously thought and also that S. forbesii and a yellow flowered form of S. asiatica are of more local importance. Another species, perhaps S. passargei, has also been noted on maize. A second article describes the discovery

of resistance to S. gesnerioides in the cowpea variety Suvita-2 and the transfer of the resistance into varieties with insect resistance.).

Vasudeva Rao, M J . 1985. Techniques for screening sorghums for resistance to Striga. Information Bulletin 20, ICRISAT. (An extremely well-illustrated and clear guide to a range of techniques for the study of Striga from laboratory to field which will be useful not only to the researcher on crop resistance but to those working on other approaches also. This forms a chapter in the forthcoming volume Striga Biology and Control to be published by CRC Press in 1986.)

Kuijt, J, Bray, D, Olson, R. 1985. Anatomy and ultrastructure of the endophytic system of Pilostyles thurberi (Rafflesiaceae). Canadian Journal of Botany 63: 1231-1240. (Three cell types are described from the cortical strands one of which is considered to be a sieve element although vestigal.)

Nassib, A M , Hussein, A H A, El Rayes, F M. 1985. Effect of variety, chemical control, sowing date and tillage on Orobanche spp infestation and faba bean yield. Fabis Newsletter 10:11-15. (A useful summary of a wide ranging series of studies on O. crenata in Egypt.)

Yatskievych, G. 1985. Notes on the biology of the Lennoaceae. Cactus and Succulent Journal (U.S.) 57: 73-79. (A well illustrated, in color, and interesting account of this fascinating family.)

Scrophulariaceae Research Newsletter 1(2). (This may be of interest to HAUSTORIUM readers who are work with parasitic Scrophulariaceae. Most of the newsletter is concerned with non-parasitic species but there is also a helpful review of literature which covers the entire family. You can obtain the newsletter by writing: K Barringer, Field Museum of Natural History, Chicago, Illinois 60605.)

Olson, A R, Kuijt, J. 1985. Sieve elements in the morphologically reduced mistletoe Viscum minimum Harvey (Viscaceae). American Journal of Botany 72: 1220-1224. (This minature mistletoe with shoots only 2-3 mm long on Euphorbia horinda is shown to have functional phloem elements, unlike some other reduced mistletoe species.)

Clay, K, Dement, D, Rejmanek, M. 1985. Experimental evidence for host races in mistletoe (Phoradendron tomentosum). American Journal of Botany 72: 1225-1231. (Parasite seed collected from Celtis, Ulmus, and Prosopis were grown on all three hosts. Growth was best on the host from which the seed was collected, suggesting some degree of host race development.)

Ehleringer, J R, Schulze, E D. 1985. Mineral concentration in an autoparasitic Phoradendron californicum growing on a parasitic P. californicum and its host Cercidium floridum. American Journal of Botany 72: 569-571. (Concentrations of a range of mineral elements were least in the host and highest in the hyperparasite. It is suggested this is due to higher transpiration rates in the parasite.)

Sahai, A, Shivanna, K R. 1985. Seed germination and seedling growth in Sopubia delphinifolia-a hemi-root parasite: germination requirements and :requirements for seedling growth and the role of cotyledons. Annals of Botany 55: 775-783 and 785-791. (Light is shown to be essential for germination, which is also greatly increased by washing or chilling (4 C) for a few days or by ethylene. Continued growth in the absence of a host requires a carbohydrate source or high light intensity.)

Alosi, M C, Calvin, C L. 1985. The ultrastructure of dwarf mistletoe (Arceuthobium spp.) sinker cells in the region of the host secondary vasculature. Canadian Journal of Botany 63: 889-902. (Sinker cells are similar in three different species. Xylem is not continuous through the sinker cells but apoplastic continuity is provided by fused cellulosic cell walls.)

Musselman, L J. 1985. Bean stranglers! Explorer 27(3): 23-25. (A popular illustrated account of the genus Orobanche.)

Musselman, L J. 1985. Fertility and floral patterns in some species of Striga (Scrophulariaceae). National Geographic Society Research Reports 20: 487-491.

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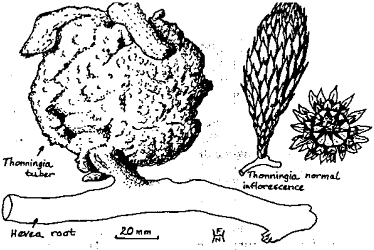

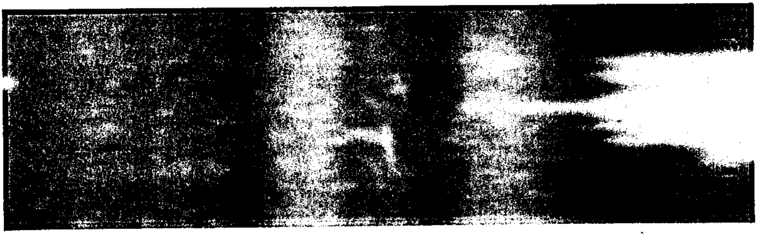

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Parasitic Plants Newsletter

NUMBER 17
DECEMBER 1986

. Official Organ of the International Parasitic Seed Plant Research Group

HAUSTORIUM LIVES! We are very pleased to state that our newsletter has once again been resuscitated and it now appears that we can resume production of two copies per year for the next three years. This is due to funding from the U.S. Agency for International Development through grant 86-CRSR-2-2869 administered by the Cooperative State Research Service and awarded to Old Dominion University. Happily, the International Plant Protection Center at Oregon State University, who produced HAUSTORIUM several years, will resume doing layout and printing with mailing by Old Dominion University.

However, funding is not all that is needed. We need contributions from readers of HAUSTORIUM! Co-editor Chris Parker will be working in Ethiopia for three years (see following item) so please send any item of interest to Lytton Musselman.

HAUSTORIUM is a newsletter and items submitted should be brief, understandable by the general reader, and usually without a bibliography. Unsigned articles are by the editors.

WEED RESEARCH ORGANIZATION The Weed Research Organization (WRO) was sadly closed down on March 1986, but the core of the staff has been transferred to form the Weed Research Division (WRD) of Long Ashton Research Station (LARS) at Bristol. The Tropical Weeds Unit continues in existence at the new site and has been awarded a two-year contract to continue work on Striga gesnerioides and Alectra vogelii on cowpea. The aim will be to continue evaluating resistant material for IITA and Botswana and to identify the the mechanism of resistance in the cowpea. Chris Parker will be leaving this and other work at LARS in the hands of John Terry, Anita Wilson and Teresa Polniaszek while he takes up a three-year secondment to do field work on Striga and other parasitic weeds in Ethiopia from where he will be pleased to maintain contact with HAUSTORIUM readers via Post Office Box 32477, Addis Ababa.

THE FOURTH INTERNATIONAL SYMPOSIUM ON PARASITIC FLOWERING PLANTS This meeting is scheduled for 2-7 August 1987 at Philipps-University in Marburg, West Germany. The organizer, Prof. Hans-Christian Weber, has done an excellent job arranging the meetings and other activities. This symposium will immediately follow the International Botanical Congress in Berlin where there will be a special session on parasitic plants. As a result, a large number of parasite workers are expected at the Marburg meetings. This should prove to be an outstanding meeting. The language of the meeting will be English. For further information contact: Prof. Hans-Christian Weber, Fachbereich Biologie, Lahnberge, Philipps-Universitat, 3550 Marburg, West Germany. Telephone: 06421-282091. Telex: 482372 UMRD c/o Weber-Biologie.

INDEX OF PARASITIC SEED PLANT RESEARCHERS After a long delay, it is now possible to state that this project is once again viable. The data is being fed into the computer and we hope to have final production within a year. If you wish to be included, please send a short summary of your research interests, the taxa involved, hosts (if any), citation of recent publications (if any), and your complete address with phone and telex number (if you have these). NOTE—if you have already returned the form sent out long ago with HAUSTORIUM, you do not need to send any further material unless you wish to update your entries.

POLLEN STRUCTURE IN STRIGA

A recent thesis at Old Dominion University deals with the pollen exostructure in Striga. Mark DeLeonardis has used scanning electron microscopy as well as light microscopy to elucidate the strucutre of pollen and attempt to relate structural differences to the taxonomy of the genus. Striga pollen is relatively uniform with tricolpate or tetracolpate grains and psilate to rugulate surfaces. One interesting feature was a correlation showing some relationship between surface features and pollination mechanisms. Most species which are autogamous (self-pollinating) are psilate (smooth) while Striga hermonthica, an allogamous (out-crossing) species, was rugulate (with an irregular surface). There was no correlation between subgeneric classification and pollen structure. Thirteen of the approximately thirty species were surveyed. This work is part of an overall investigation into the systematics of the genus Striga.

PROCEEDINGS OF THE 1986 OROBANCHE WORKSHOP, WAGENINGEN

This symposium was held 13-17 January at the Agricultural University in Wageningen, The Netherlands. The proceedings have now been published under the title of Biology and Control of Orobanche, edited by Sine ter Borg. This is an attratively produced paper bound volume of 206 pp. + VII which is certainly the most up-to-date treatment on this important genus of root parasites. Topics include taxonomy and the general agronomic problems; dormancy, germination and haustoria formation; growth and development and population studies; breeding and control; and a helpful summary of work and recommendations for further research. Copies can be ordered by writing: Dr. S. J. ter Borg, Department of Vegetation Science, Plant Ecology and Weed Science, Agricultural University, Bornsesteeg 69, 6708 PS Wageningen, The Netherlands. The price is Hfl 25 and checks should be made payable to S. J. ter Borg/Proceedings Orobanche, account number 47.75.61.039, Amrobank, Wageningen, The Netherlands.

LITERATURE

Van hulst, R., A. Theriault, B. Shipley. 1986. The systematic position of the genus Rhinanthus (Scrophulariaceae) in North America. Canadian Journal of Botany 64:1443-1449.

Musselman, L. J. 1986. The genus Cuscuta in Virginia. Castanea 51:188-196.

Reuter, B. C. 1986. The habitat, reproductive ecology and host relations of Orobanche fasciculata Nutt. (Orobanchaceae) in Wisconsin. Bulletin of the Torrey Botanical Club 113:110-117. (This broomrape is very rare in Wisconsin, and the aim of the study was to determine aspects of its biology which might be used to favorably manage the species. One interesting feature is the setting of seeds parthogenetically, a phenomenon which should be looked for in agronomically important species).

Bebawi, F. F., A. E. Awad, S. A. Khalid. 1986. Germination host preference and phenolic content of witchweed (Striga hermonthica) seed populations. Weed Science, 34:529-532.

Kulkarni, N. and V. K. Shinde. 1985. Genetics of grain yield in sorghum (Sorghum bicolor) under striga (Striga asiatica) stress. Indian Journal of Genetics and Plant Breeding 45:21-24.

Kulkarni, N. and V. K. Shinde. 1985. Genetic analysis of striga resistance in sorghum (Sorghum bicolor) stability of yield and its components with and under striga (Striga asiatica) stress. Indian Journal of Genetics and Plant Breeding 45:25-29.

Hepper, F. N. 1986. Proposal to reject the name Buchnera euphrasioides/Striga euphrasioides (Scrophulariaceae). Taxon 25:390-391. (The plant once known as Striga euphrasioides, widespread in India but also found in the Arabian penninsula and parts of East Africa, should now be correctly referred to as S. angustifolia due to an error in typification).

Farina, M.P.W., P.E.L. Thomas, P. Channon. 1985. Nitrogen, phosphorus, and potassium effects on the incidence of Striga asiatica in maize. Weed Research 25:443-448.

Gupta, A. and M. Singh. 1985. Mechanism of parasitism by Cuscuta reflexa: Distribution of cytokinins in different regions of the parasite vine. Physiologia Plantarum 63:76-78.

Raynal-Roques, A. 1985. Striga baumannii (Scrophulariaceae) a hemiparasitic and geopyrophytic species. Adansonia 7:123-134. (A summary of this work appeared in HAUSTORIUM 15).

Nakanishi, T., J. Ogaki, A. Inada, H. Murata, M. Nishi. 1985. The alkaloids of Striga asiatica. Journal of Natural Products 48:491-493.

Nickrent, D. L. 1986. Genetic Polymorphism in the morphologically reduced dwarf mistletoes (Arceuthobium, Viscaceae): an eletrophoretic study. American Journal of Botany 73:1492-1502.

Nassib, A. M., A. H. A. Hussein, E. F. Hassenein, H. A. Saber. 1985. Effect of pronamide and resistant varieties on Orobanche infection and faba bean yield. FABIS Newsletter 13:22-25. (Bean variety Giza 402 supported similar numbers of emerged O. crenata to susceptible varieties but weight of parasite was generally much less and bean yields, in the presence of heavy Orobanche, higher. Propyzamide 9.5 kg product/ha applied one month after planting further reduced attack and enhanced yield of Giza 402).

Gayed, S. K. 1986. Dodder in tobacco seedbeds in Ontario and its control. Canadian Journal of Plant Science, 66:421-423. (Infestation of tobacco seedbeds by C. gronovii was eliminated by steam sterilization or methyl bromide 500 kg/ha but only partly reduced by dazomet 500 kg/ha or allyl alcohol 680 l/ha).

Aalders, A. J. G. and R. Pieters. 1986. In vitro testing with 2,3,5-triphenyl tetrazolium chloride (TTC) of Orobanche crenata seed metabolism. FABIS Newsletter, 13:35-37. TTC can be used to confirm the viability of O. crenata seeds but only when freshly imbibed. After a few days of incubation, the seeds no longer show coloration within 2 days, apparently due to reduced metabolic activity, rather than loss of viability.

Ramaiah, K. V. 1985. Hand-pulling of Striga hermonthica in pearl millet. Tropical Pest Management 31:326-327. (Hand-pulling S. hermonthica once only, 10 days before harvest on 9 farmer sites in Burkina Faso resulted in over 50% reduction of Striga emergence in the following year and over 50% increase in yield).

Musselman, L. J. and F. N. Hepper. 1986. The witchweeds (Striga, Scrophulariaceae) of the Sudan Republic. Kew Bulletin 41:205-221. (Ten species are described and illustrated along with information on distribution, pollinators, hosts, etc.).

Bradow, J. M. 1986. Germination promotion in dorman shepherdspurse (Capsella bursa-pastoris) seeds by strigol analogs and other stimulants. Weed Science 34:1-7. (Strigol and epistrigol failed to influence germination of dormant Capsella seeds, but the analogs GR24, 2RAS and 3RAS promoted up to 80% germination at 0.1 mm, the first evidence for effect of these compounds on non-parasitic plants).

Nisa, M., S. Akbar, M. Tariq. 1985. Anti-inflammatory activity of Cuscuta chinensis. Fotiterapia 56:315-317. (This parasite is used as an anti-arthritic drug in India. It is not clear if C. chinensis is the only species with this activity).

Fer, A. and M. Capdepon. 1985. Un aspect meconnu due parasitisme des angiospermes: l'existence d'une secretion de substances au niveau des sucoirs de cuscute. Annales des Sciences Naturelles-Botanique Series 137:229-236. (Small quantities of materials are secreted by haustoria into the host tissue. The amount of material is very small, less than 1% of the total labeled photosynthate in the host, and the nature of the materials are unknown).

Visser, J. H. 1985. Parasitic Flowering Plants. Pretoria: Hollandsch Afrikaansche Uitgevers Maatschappij. (This is a very attractive, hardbound book of 47 pages, produced as part of the publisher's "Insight" series intended as supplementary material in the public school curriculum. It is an excellent introduction to the subject of parasitic flowering plants with three sections: The parasitic way of life which deals with the principles of parasitism, the haustorium etc. and then a section each on stem and root parasites. Readers will recognize some of the beautiful full color photographs from the author's other book on South African parasites, but there are also new photos as well as some helpful line drawings.

Minkin, J. P. 1986. A comparative pollen morphology of the Orobanchaceae and Rhinanthoid Scrophulariaceae. 83 pp. PhD Dissertation, Botany, Miami University, Oxford, Ohio. (Based on pollen morphology, the author suggests that the parasitic Scrophulariaceae, all in the subfamily Rhinanthoideae, show closer affinity with the Orobanchaceae than with the other subfamily, Antirrhinoideae, of the Scrophulariacaeae).

Hunter, I. J. and J. H. Visser. 1986. The nitrate reductase activity (NRA) of some South African parasitic flowering plants and their hosts. South African Journal of Botany 52(3):246-248.

STRIGA LATERICEA - ERRATUM

My co-editor humbly apologizes for rashly editing my note on "Striga species in Ethiopia" in Haustorium No. 16, such that Striga latericea was described as spreading by a system of "rhizomes". I had originally recognized and described these structures as "roots", and my colleague now agrees that they are indeed root rather than rhizome (i.e., underground stem) structures. This was confirmed by sectioning and microscopic study of preserved material and I thank student David Knepper for the careful work and excellent pictures that he produced in the course of his investigation of this material. (Co-editor: grovel, grovel).

HAUSTORIUM is edited by L. J. Musselman, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23508 USA, Telex 823428, answerback OLDDOM, and by C. Parker, Weed Research Division, Long Ashton Research Station, Long Ashton, Bristol BS18 9AF, UK. Send material for publication in HAUSTORIUM, as well as requests for copies, to L. J. Musselman.

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haustorium

Parasitic Plants Newsletter

Number 18
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Official Organ of the International Parasitic Seed Plant Research Group

CACTI AS PARASITES? It has long been been known that cacti will very rarely grow on cacti or other desert plants in the American Southwest as first noted by MacDougal in 1911. Kuijt (1969) discusses these few reports and a case of *Opuntia* on *Idria* in Baja California, Mexico. Reid and Krappa (1983) reported instances of *Opuntia* on *Juniperus deppeana* in West Texas and *Echinocereus* on the same tree in southern New Mexico. In both instances the cacti were growing in decayed wood as epiphytes. Recently, an introduced *Opuntia* has been reported on several trees in India (Pande and Joshi, 1986). *Opuntia elatior* was found growing on *Aesculus, Lagerstroemia, Pinus, Sapium*, and *Toona*. The physiological status of these associations has not been adequately established. MacDougal considered that a parasitic relationship existed because, in at least one case, roots of *Opuntia* were established within living tissue of *Cereus gigantea*. In most cases, however, the cacti seem to become established in cavities in the "host" tree, and the relationship is more akin to epiphytes than parasitism.

Detailed analyses of these relationships are a fertile field for investigation, particularly in light of the possibility that parasitism in plants may have begun from such chance encounters (Kuijt, 1969).

Frank G Hawksworth, U.S. Forest Service, Fort Collins, CO, USA

PARASITE SYMPOSIUM AT XIV BOTANICAL CONGRESS A special symposium was held as part of the congress in West Berlin the last week of July. In addition to this symposium there were many other papers dealing with parasitic vascular plants scattered in different symposia. Summaries of all the presentations are contained in the published abstracts.

FOURTH SYMPOSIUM ON PARASITES A HUGE SUCCESS! The largest and, according to many "old hands", the finest symposium on parasitic plants was held the first week of August at Philipps University in Marburg, West Germany. A great diversity of papers were presented and most of them are contained in the published proceedings which was made available to participants upon arrival at the symposium. This book, with more than 800 pages, attractively produced on glossy paper, will be required reading for anyone involved in parasitic plants. Very few copies remain and we have been advised that those wishing to order must do so immediately! To obtain a copy send a check or money order payable to "Fourth IPSP Symposium" for DM 120 payable in Deutschmarks to: Prof. Hans Christian Weber, Fachbereich Biologie, Philipps University, Marburg West Germany. Price includes air mail.

The excellent mix of basic and applied papers, a diversity of parasites from exotic to common, rarities to weeds (but where was *Cassytha*?) as well as a breadth of disciplines including biochemistry, old fashioned taxonomy, new fangled taxonomy, control, ultrastructure, etc, etc all contributed to make the scientific content invaluable. In addition, the well planned and sometimes elegant social functions added to the value despite the unseasonable soggy weather. The occasion of the symposium was used as an opportunity to open a greenhouse devoted to parasitic plants-perhaps the only such in the world! About 150 were in attendance representing all parts of the world. From all who participated, hearty thanks to Hans Christian and his crew for organizing and sponsoring the whole affair not only with German efficency but with warm gemutlichkeit!

FIFTH SYMPOSIUM ON PARASITIC PLANTS

The fourth symposium will be a hard act to follow but it is important to begin thinking about our next meeting. It is apparently the general consensus that the next meeting should be in southern Africa. Botswana and Zimbabwe have been suggested as venues for the meeting, probably to be held in 1990. If you have any suggestions and/or are willing to help organize such a meeting, please contact one of the editors.

For the uninitiated-the first symposium was in Malta in 1973, the second in Raleigh in 1979, and the third in Aleppo in 1984, and the most recent is described above. Published proceedings were prepared for each and if you are interested in obtaining a copy of the first three, please contact the editors of HAUSTORIUM.

LITERATURE

du Plessis, N. M. 1986. Harveya squamosa in the Cape Flats Nature Reserve. Veld and Flora 72(1): 16-17. (Deals with the cultivation of this attractive holoparasite. Illustrated in color. This sort of work should encourage others to attempt to grow holoparasites.)

Lee, K. B. 1986. Studies on the haustorial development of *Cuscuta australis* R. Brown. PhD Dissertation, Sung Kyun Kwan University, Korea. (A detailed ultrastructural study in Korean but with an English abstract.) A portion of this is apparently included in the following: Lee, C. D. and K. B. Lee. 1986. Ultrastructure of haustorial cells of *Cuscuta australis* R. Brown. Korean Society of Electron Microscopy. 16(2): 49-60.

Musselman, L. J. 1986. Parasitic weeds in world agriculture. Volume 1. Striga. CRC Press. (A collection of papers on the biology and control of *Striga* species with a section dealing with techniques for field and laboratory investigations).

Axtell, J. D. and J. W. Clark. 1986? Niger sorghum and millet workshop. INTSORMIL, Purdue University. (A collection of papers presented at a workshop in October 1985. At least one paper deals with *Striga*.)

Russo, V. Russo, B., and D. Bissing. 1986. The parasitic interface between *Balanophora indica* and *Cynometra ramiflora*. Beitrage zur Biologie der Pflanzen 61: 173-178. (The anatomy of the host-parasite interface using light microscopy.)

Grazi, G. and M. Zemp. 1986. Genista cinerea DC., ein naturlicher sammelwirt fur *Viscum album* L. ssp. *album* und *Viscum album* ssp. *austriacum* (Wiesb.) Vollmann. Berichte Deutschen Botanische Gesellschaft 99: 99-103. (This is the first report of ssp. austriacum occurring on a dicot host.

The authors suggest that, since the biochemistry of the two subspecies of the parasite are different, the differences between the subspecies may be attributable to the influence of the host.)

Leonard, J. 1986. Observations sur le genre *Cynomorium* L. en Asie (Cynomoriaceae). Bulletin Jardin Botanique de Belgique 56: 301-304. (The author considers the genus to consist of one species with two subspecies.)

__________. 1987. Contribution a l'etude de la flore et de la vegetation des deserts d'Iran. Fascicule 7. Observations et modifications. Index general. Jardin Botanique National de Belgique, Meise. (In the treatment of the Cynomoriaceae there is a diagram of the inflorescence and flowers of this intriguing parasite as well as photographs showing the plant in its natural setting and illustrating the massive rhizomes of the plant.)

Oliver, I. 1987. Teemohlware-a refreshing bush tea. Veld and Flora 73(1):16. (A very interesting note dealing with the use of *Viscum rotundifolium* leaves as a tea!.)

Musselman, L. J. and J. H. Visser. 1987. Hydnora johannis in southern Africa. Dinteria 19: 77-82. (The plant known in Namibia and other parts of southern Africa as *Hydnora solmsiana* is shown to be the same as *Hydnora johannis* which is common in parts of Sudan and Ethiopia and perhaps elsewhere. Reference to *Hydnora angolensis* Decne., also synonymous with *H. johannis* was inadvertently left out of this paper.)

Yohe, J. M., coordinator. 1986. Annual report. Sorghum/millet collaborative research support program. INTSORMIL, University of Nebraska, Lincoln. (Several papers refer to *Striga*.) Benharrat, H. 1986. Contribution a l'etude de la biologie des phanerogames parasites: Recherche sur *Osyris alba* L. (Santalaceae). University of Nantes, Nantes. (A large PhD dissertation dealing with the structure and physiology of this shrubby root parasite of Mediterranean countries.)

Musselman, L. J. and J. H. Visser. 1986. The strangest plant in the world! Veld and Flora 71: 109-111. (A popular account of *Hydnora africana* and *H. johannis*; illustrated in color.

Lolas, P. C. 1986. Control of broomrape (*Orobanche ramosa*) in tobacco (*Nicotiana tabacum*). Weed Science 34(3): 427-430.

Mesa-Garcia, J. and L. Garcia-Torres. 1986. Effect of planting date on parasitism of bradbean (*Vicia faba*) by crenate broomrape (*Orobanche crenata*). Weed Science 34(4): 544-550.

Bradow, J. M. 1986. Germination promotion in dormant shepherdspurse (*Capsella bursa-pastoris*) seeds by strigol analogs and other stimulants. Weed Science 34(1): 1-7.

Editors note: Because both editors were in the field during the past twelve months, we are somewhat behind on a survey of the literature and have had to truncate our listing in this issue. Please continue to send us material which is not readily abstracted such as reports, theses, etc for inclusion in the next issue scheduled for January 1988.

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haustorium

Parasitic Plants Newsletter

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Official Organ of the International Parasitic Seed Plant Research Group

ALECTRA AND STRIGA ASPERA IN BURKINA FASO

As part of field surveys of parasitic weeds with ICRISAT, we have noticed *Alectra vogelii* for the first time in Burkina Faso attacking cowpeas 5 km east of Gode and groundnuts in Toussiana village 50 km, southwest of Bobo-Dioulasso. Two plants were present on cowpea and several on groundnuts. In both localities sorghum was interplanted with the legumes and was itself parasitized by *Striga hermonthica*. Cowpea was parasitized by *S. gesnerioides*, a common occurence in Burkina Faso. The Flora of West Tropical Africa (FWTA) records *A. vogelii* from Nigeria, Ghana, and Guinea. Recently Parker (1984) reported *A. vogelii* on cowpeas in Mali. According to FWTA, this parasite is a serious pest at at least one site in Cameroon. In southern Africa it is reported to be serious on cowpeas, groundnuts and bambara groundnuts (*Vigna subterranea*). We have not seen it on bambara in Burkina Faso but further surveys are needed.

Striga aspera, a species which closely resembles *S. hermonthica*, is usually considered a sort of biological curiosity when it is found parasitizing grain crops. However, in a large sugar plantation near Banfora this species was heavily damaging sugarcane. Likewise, we found heavy infestations in maize. No doubt some reports of damage from *S. hermonthica* actually involve *S. aspera*.

K. V. Ramaiah*, S. B. Safa,
L. J. Musselman

CUSCUTA SPECIES AS CONTAMINANTS IN SEED SHIPMENTS

During the past several years, we have been investigating the occurrence of *Cuscuta spp.* in commerical shipments of seeds, especially niger seed (*Guizotia abyssinica*) which is imported in large quantities into the United States largely for birdseed. Much of the seed originates in India. The Plant Protection and Quarantine service of the U S Department of Agriculture has the responsibility of determining contaminants at ports of entry. These have been shipped to the Foreign Weed Research Center at Frederick, Maryland where we have grown them to flowering for identification. To date we have found that all contaminants belong to only two species: *C. pentagona* (*syn. C. campestris*) and *C. australis*. *Cuscuta pentagona* is native to the United States (the type specimen was collected not far from Old Dominion University!) but is becoming established in many parts of the world. We have recently seen it in India on niger seed and in Burkina Faso on roadside weeds. It is ironic that it is now being reintroduced into the United States. *Cuscuta australis* superfically resembles *C. pentagona* but has different corolla lobes. Preliminary work indicates that seed surface characteristics may be useful in distinguishing among species.

Richard Craeger, U S Department of Agriculture, Agricultural Research Service, Frederick, Maryland and L. J. Musselman

CHROMOSOME NUMBERS OF SOME STRIGA SPECIES

In this preliminary study, new chromosome counts were obtained for *S. elegans* (N=18), *S. asiatica* (N=19), and *S. forbesii* (N=22). A correlation of P=0.27 was found between chromosome number and pollen exostructure. Further work is needed to determine relationships within the genus using as many characters as possible.

Cynthia L. White, Old Dominion University

HAUSTORIUM TEN YEARS OLD!

HAUSTORIUM was started ten years ago as an outcome of a *Striga* workshop in Khartoum. Our newsletter now has a mailing list of 450 "subscribers" in 71 countries. The purpose remains the same-to provide communication among workers on any group of parasitic plants. This includes basic and applied researchers as well as many library subscribers. Most of our subscribers are in developing countries and so we often get requests from these colleagues for copies of articles we review in the literature section. We regret this is not possible but it may be possible to produce more lengthy reviews or abstracts if there is a large enough demand.

Remember, HAUSTORIUM is a newsletter, not a journal, so articles should be informal but accurate and informative. We are happy to receive any information you wish to share. For the format, see a recent copy. Please consider sending any information on your work with parasites. No articles, no newsletter!

IS STRIGA HERMONTHICA NATIVE TO MOST OF WEST AFRICA?

Recent field work in West Africa has raised this question because *Striga hermonthica* is seldom, if ever, seen in native grasslands. This is in contrast to *S. aspera* and *S. asiatica* which are often frequent in natural plant communities. Has *Striga hermonthica* been widely spread along with its most common hosts, sorghum and millet?

GENETIC DIVERSITY IN STRIGA HERMONTHICA

The genetic diversity of the millet and sorghum strains of *Striga hermonthica* in Burkina Faso is being studied in a joint effort with ICRISAT. Using the technique of allozyme analysis eight enzymes have been examined by starch gel electrophoresis. Preliminary results indicate that there is variation within populations but little variation among populations as would be predicted for an obligate outcrosser. These results contrast sharply with the situation in *Striga asiatica*, a strongly autogamous species, in which there is great genetic uniformity within the American population as determined by Werth et al.

Bharathalakshmi, Old Dominion University

SCREENING FOR RESISTANCE TO STRIGA FORBESII

The development of *Striga*-resistant sorghum cultivars is considered to be the most economically feasible form of witchweed control for it requires minimal input from subsistence farmers. In a recent cooperative project with Dr. A. B. Obilana (SADCC/ICRISAT) and Old Dominion University some *S. asiatica*-resistant (SAR) cultivars developed at ICRISAT Center were screened for their performance against *S. forbesii* in Zimbabwe using the advanced screening checkerboard layout.

Evaluation of test entry performance was obscured by poor and variable host emergence, however, general trends were evident. Cultivars supporting no or very little emerged witchweed included SAR 29, SAR

33, and SAR 19. RADAR, PMC, RED SWAZI, and SAR 26 were found to be quite susceptible. Information on yield was not recorded due to extensive cow and bird damage.

The fact that SAR lines show promising levels of resistance to *S. forbesii* indicates the possibility of broad-based resistance to problem witchweeds.

David A. Knepper, Old Dominion University

LITERATURE

Riches, C. R. 1987? Witchweeds (*Striga* species) of Southern Africa. A field Identification Guide. SADCC/ICRISAT Sorghum and Millet Improvement Program, Bulawayo, Zimbabwe. (An attractively printed, four page pamphlet with colored pictures of *Striga hermonthica*, *S. asiatica*, *S. gesnerioides*, *S. forbesii*, and *Alectra vogelii.* There is a mimeographed insert with a key to *Striga* species of economic importance in southern Africa. SADCC/ICRISAT is to be complemented on developing this very practical pamphlet which should make farmers in the region more aware of the *Striga* problem.)

Chang, M., Netzly, D. H., Butler, L. G., and D. G. Lynn. 1986. Chemical regulation of distance: Characterization of the first natural host germination stimulant for *Striga asiatica.* Journal of the American Chemical Society 108: 7858-7860. (Strigol, an exudate from cotton roots, was identified and later synthesized several years ago. But cotton is not a host for *Striga asiatica* so this report is the first identification of a germination stimulant from a host of *Striga asiatica.* The compound is as a benzoquinone derived from sorghum root exudate. It is apparently very labile. The ability of *Striga* to recognize this labile hydroquinone allows it to commit itself to a host through germination only within the distance through which the compound can diffuse before being oxidized. This report demonstrates the biological committment of this parasite to a transient chemical species that can define viability of and distance to a potential host.)

Chang, M. and D. G. Lynn. 1986. The haustorium and the chemistry of host recognition in parasitic angiosperms. Journal of Chemical Ecology 12(2): 561-579. (2,6-dimethoxy-p-benzoquinone (2,6-DMBQ) from sorghum root exudate is described as a "haustoria-inducing principle" in *Agalinis*, a hemiparasite of the Scrophulariaceae, and *Striga.* The parasite apparently exudes an enzyme which digests part of the host root releasing 2,6 DMBQ which, in turn, triggers haustorial development.)

Williams, C. E. and R. K. Zuck. 1986. Germination of seeds of *Epifagus virginiana* (Orobanchaceae). Michigan Botanist 25: 103-106. (*Epifagus virginiana* is the most common member of the Orobanchaceae in most parts of Eastern North America. It is an obligate parasite of beech trees (*Fagus grandifolia*), flowers in the late fall, and produces large quantities of dust-like seeds which have never been known to germinate! Using soil from beneath *Epifagus* plants, small quantities of seeds were germinated. These are illustrated in the paper.)

Rozema, J., Broekman, R., Letschert, W.Arp. J., Van Esbroek, M. and H. Punte. 1986. A comparison of the mineral relations of a halophytic hemiparasite and holoparasite. Acta Botanica Neerlandica 35(2): 105-109. (This study compares the salt uptake of *Odontites verna*, a hemiparasite, and

Cuscuta salina, a holoparasite. The holoparasite did not concentrate salts even though it was parasitizing a host with high salt concentration while the hemiparasite took up a high concentration of salt.)

FIFTH PARASITIC PLANTS SYMPOSIUM Planning has begun for a fifth parasitic plants symposium, tentatively scheduled for 1990, following the successful 1987 symposium held in F.R. Germany. Suggested venues include Spain, Sudan, Zimbabwe, and Botswana. Anyone with suggestions for a site, or other ideas, is invited to contact one of the editors.

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haustorium

Parasitic Plants Newsletter

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June 1988

Official Organ of the International Parasitic Seed Plant Research Group

FROM THE EDITORS

For your response and comments:

Striga "networking". It has been suggested that a separate review of the *Striga* literature be provided which would include abstracts from the world literature. This would be mailed twice a year.

HAUSTORIUM is still not autotrophic! We will need new funding within the next year.

We plan to have an announcement in the next issue of HAUSTORIUM announcing the Fifth Parasitic Weed Symposium.

Your responses to any of the above should be directed to either editor.

ALECTRA VOGELII AND COWPEA: STUDIES IN THE SOUTHERN REGION OF BOTSWANA *Alectra vogelii* is commonly found as a parasite of cowpea in Botswana's Southern Region and has been selected for study as part of the Farming Systems Southern Region Research (FSSR) program. In a farmer's field noted for its particularly serious infestation, a replicated trial was carried out in conjunction with the Department of Agricultural Research (DAR) to evaluate the field resistance of 15 lines of cowpeas to *A. vogelii*. The trial, conducted in the 1985-1986 season, confirmed the existence of a very high level of resistance in at least two of the lines tested and overall there was good correlation between the results obtained by DAR in similar trials conducted at other sites in previous years. At least two of the lines appeared to show some resistance at this site which had not registered in DAR studies. Observation of adjacent plots indicated that this may have been an anomaly associated with the spatial distribution of *A. vogelii* seed in the soil for one of the varieties but for the other of these two varieties there was evidence of resistance (low infection where adjacent plots had high infection). The implication of this is that there is more than one strain of *A. vogelii* in Botswana. However, the identification of resistance to *A. vogelii* in cowpeas provides the Government of Botswana cowpea breeding program with the potential for incorporating resistance into high yielding lines.

In a survey conducted among extension staff throughout the Southern Region, *A. vogelii* was ranked the second most important weed by 10% of the respondents. (*Cynodon dactylon* is by far the most important in this region.) There was some confusion among respondents between *Striga asiatica* which is a fairly common parasite of sorghum in the region and *A. vogelii* because they are not easily separated in the Setswana language. Both are given the generic name *matabele* or *metelo* with the qualifiers, *a mabele* (for *Striga asiatica*) or *a dinawa* (for *A. vogelii*, literally "of beans"). *Alectra vogelii* is recognized to be of prime importance of the two. *Alectra vogelii* is widespread in the region but I have never spotted it on bambara groundnut, this despite the fact that bambara is widely cultivated but of secondary importance to cowpea in the area. It has also not been seen on any of the many leguminous weeds which can be found in farmers' fields. The leguminous fodder *Dolichoslablab* is being extended to farmers in the region but despite monitoring no parasitism by *A. vogelii* has been reported. Similarly, the perennial legume *Macroptilium atropurpurem* (siratro) which is also being evaluated for its fodder potential by FSSR has not yet been parasitized by *A. vogelii*.

Philip Bacon, FSSR, Lobatse, Botswana

CUSCUTA ON CARROTS Dr. C. E. Beste, Weed Scientist at the University of Maryland, recently reported that dodder (species not identified) causes damage to carrots in the Eastern Shore region of Maryland. These crops in Maryland and adjacent Delaware are valued at US$1500/acre. Up to 50% of these crops may be damaged by dodder in a year of heavy infestation. Some years there is no dodder infestation at all, while in one out of every three to five years crops may suffer heavy damage. The major carrot growers in parts of Maryland and Delaware have been plagued by the uncontrollable and unpredictable appearance of the dodder and the damage it causes. Contaminated carrot seed is suspected to be the source of the problem.

R. A. Creager, Foreign Disease-Weed Science, USDA, Frederick, Maryland, USA

STRIGA FORBESII: A CONTINUING PROBLEM IN SUGARCANE IN SOMALIA Recent word from the Juba Sugar Project in southern Somalia indicates that *Striga forbesii* is spreading. Control centers on hand pulling the weed before seeds develop.

WEEDY POPULATIONS OF OROBANCHE UNIFLORA IN GEORGIA Near the Plant Protection and Quarantine station in Moultrie, Georgia, USA, one of the staff scientists, Edna Virgo, noticed large populations of the native root parasite *O. uniflora* present throughout an abandoned airfield. Further surveys showed that the parasite was also common in lawns and along roads in the Moultrie area. It has since been found in nearby Tift County. In each case the host was *Hypochoeris brasiliensis*, an introduced weedy member of the Compositae. According to Dr. Richard Carter, *H. brasiliensis* is an introduced weed which is expanding its range in southern Georgia. *Orobanche uniflora* is restricted in nature to the Compositae for its hosts. The advent of what is presumably a more suitable host is apparently allowing the parasite to spread out of its usual habitat which is typically rich moist slopes, often above streams. The Plant Protection and Quarantine staff will be monitoring the spread of this root parasitic weed.

VESICULAR-ARBUSCULAR MYCORRHIZAE (VAM) IN STRIGA--AN UN-DESIRED SYMBIOSIS? In soils with low nutrients, vigorous growth of flowering plants is usually attributed to enhanced nutrient uptake by mycorrhizal roots. This association is now known in most plant species, for example, maize. We have found that *Striga asiatica* can establish such a relationship but the mycorrhizae are found only in the roots, not in the haustoria. Nevertheless, it is possible that the presence of VAM might lead to a form of biological control. On the other hand, it might also be possible that VAM increases the resistance of the host against *Striga*.

Dietmar Krause, Philipps University, Marburg, FR Germany

CURRENT RESEARCH IN CUSCUTA AND CHARACTERS DEFINING SPECIES AND SPECIES GROUPS

During the last four years I have been conducting systematic studies of the Western Hemisphere *Cuscuta* for my doctoral dissertation (Beliz, 1985), concentrating in the section Cleistogrammica. This section is characterized by indehiscent fruits at maturity, two styles of unequal length, rounded capitate stigmas, and plants that are mostly annuals. Section Grammica, the second and largest group of cuscutas in the Western Hemisphere, includes taxa that are characterized by drupes, berries, or capsules that have a conspicuous basal line of dehiscence; capitate stigmas of variable shape, with plants that are long lived annuals or perennials. After examining a large number of herbarium specimens, and field populations of *Cuscuta*, I have constructed a data matrix with qualitative and quantitative characters, and used numerical techniques as a tool for examining relationships within and between populations. The results of the numerical analyses, field observations, and my understanding of the taxa in Cleistogrammica are summarized as follows. Species of *Cuscuta* are separated by habitat, more than by host specificity. A particular species tends to parasitize the dominant component of the plant community where it is growing, except in tropical habitats where there is a tendency of the parasite to be opportunistic. Temperate species tend to be annuals, a possible response to the fact that their host plants are also annuals. Tropical taxa and those parasitizing evergreens, tend to be long lived annuals or perennials.

Characters of interest in separating groups of species: (1) Shape of the corolla, whether it is campanulate, shallow campanulate, or cylindrical campanulate separates groups of species. *Cuscuta subinclusa* and *C. cephalanthii*, for example, have cylindrical campanulate corolla tubes; this character separates these two species from others in Cleistogrammica. Acampanulate corolla is characteristic of *C. gronovii* and *C. indecora*, and a shallow campanulate corolla is typical of *C. pentagona*. (2) Relationships between calyx and corolla tube size, and corolla lobes to corolla tube size and shape. Sometimes the calyx and corolla lobes are variable in shape and length within an individual species; this variability accounts for many of the problems in species determination. For example, *C. pentagona* (once known as *C. campestris*, *C. pentagona* is the correct name for this widespread and noxious taxon) has regularly shallow campanulate flowers, the calyx and corolla lobes are generally acute, but within a single flower one may find lobes that are obtuse and some others acute. This is also true of *C. sandwichiana*. In fact these two taxa are very similar morphologically, except for the fact that *C. pentagona* has well developed corolla appendages and is distributed world wide, and *C. sandwichiana* lacks corolla appendages and is endemic to the Hawaiian Islands. If one looks at the mature fruits of these two taxa they are almost identical. (3) Ovary length in relation to style length, the presence or not of an apical ovary thickening (stylopodium), and shape of the ovary are important. In *C. subinclusa* the ovary is ovoid, the styles are equal in length or longer than the ovary, and the ovary thickening is collar like. In *C. cephalanthii* the ovary is generally depressed-globose, the styles are equal in length or shorter than the ovary, and the apical thickening is variable, from very conspicuous to relatively inconspicuous, generally not collar like but consisting of two, three, or four thickened areas in the apex of the ovary. An important difference between *C. indecora* and *C. pentagona* is the presence of a conspicuous apical ovary thickening in the first, and its absence in *C. pentagona*. (4) The shape and degree of development of the corolla appendages (also known as infrastaminal scales) separates major groups of species. Corolla appendages are well developed, spatulate with abundant finger-like fimbria in *C. salina* and *C. subinclusia*, and lacking in *C. californica* and *C. sandwhichiana*.

Other characters such as a consistent number of calyx and corolla lobes (4 or 5); lobes appressed, reflexed, or erect with apices reflexed; anthers sessile or with filaments; and presence or not of an intrastylar aperture in the fruit may be taxonomically important. I have found that the mature pistil is of key importance in determining closely related taxa, specially when their distribution ranges overlapped, since other floral chracters may be very polymorphic.

T. Beliz, University of California-Berkeley
Berkeley, California, USA

POST EMERGENCE CONTROL OF OROBANCHE CERNUA ON TOBACCO WITH OILS

In an effort to identify chemicals for post emergence control of broomrape, three mineral oils, diesel, kerosene, and paint thinner, and 12 plant oils, castor, coconut, cottonseed, dalda, gingelly, groundnut, linseed, mustard, neem, palm, sunflower, and safflower were tested. The oils were applied on young shoots (without flowers) at 1, 2, 3, 4, and 5 drops/shoot with a dropper. All three mineral oils showed quick knock down effect within 24 hours, while plant oils were also effective but slow in action. The optimum dosages were 1 or 2 drops/shoot. Mineral oils were phytotoxic to tobacco leaf while plant oils were not. An applicator has been developed to apply oils by swab method in the field. In the absence of sufficient and suitable chemicals for broomrape control this finding draws special attention. Further studies are in progress to test field efficacy.

G. V. G. Krishna Murthy and K. Nagarajan, Central Tobacco Research Institute, Rajahmundry, India.

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various species occurring in Saudi Arabia while the *Orobanche* section lists *O. cernua* and *O. ramosa*. Drawings and keys are given for each group of weeds).

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THE FUTURE OF HAUSTORIUM

At present, we have no financial support for our newsletter. IPPC has generously printed this issue for us and postage is being paid out of residual grant funds at Old Dominion University. Old Dominion University, in collaboration with IPPC, has submitted a proposal to USAID to fund **HAUSTORIUM** for three years. This proposal is pending. Support would provide an expanded newsletter with as exhaustive a review of the *Striga* literature as possible. In addition, the 1956 USDA annotated bibliography on *Striga* would be reprinted.

Although this issue is late, it is a special one. There is a great deal of activity to report regarding meetings on parasitic weeds. Sherwin Carlquist has written a special article on the remarkable feat of culturing *Hydnora africana*, surely one of the strangest plants on earth.

STRIGA FORBESII AND STRIGA ASIATICA IN SOUTHEAST ZAIRE

A farming systems team consisting of IITA researchers and their Zairean counterparts from the Programme National Mais (PNM) working for the USAID/Zaire Project de Rechereche Agronomique Appliquee et Vulgarisation (RAV) have observed *Striga forbesii* and *S. asiatica* in Shaba region, southeast Zaire during a study of maize production constraints.

Striga forbesii was first observed in October 1987 in Kaponda, 35 km southwest of Lubumbashi. Three off-season maize fields of about 0.5 ha along a river bank were completely infested. Because of the location, the parasite appears to be distributed by flood water. Losses in these fields were estimated at 70-100%. *Striga forbesii* was also found in two neighboring villages and among weedy *Brachiaria*, *Setaria*, and *Cyperus*. *Striga asiatica* was found in five villages north of Lubumbashi where maize and sorghum were attacked as well as on roadside grasses and in a residence compound. In cases where maize and sorghum were intercropped, the sorghum appeared to be more severely affected with yield losses of 40-60%. *Striga asiatica* has been known from the area since 1962 but *Striga* species appear to be only in isolated pockets. However, with the increase of areas under continuous maize culture and with declining soil fertility, *Striga* may become a major constraint in maize production in the region.

◆ **T. Berhe, W. Vogel (both IITA), and**
◆ **M. Mutanda, M. Kabwe (both PNM)**

AFRICAN TASK FORCE OF STRIGA

A workshop was held in early December in The Gambia to review work on witchweed in Africa and to recommend further work, especially the development of control packages for the small farmer. A more detailed report will appear in the next issue of HAUSTORIUM.

HYDNORA IN MY GARDEN!

During 1973, I spent six months in South Africa collecting wood for anatomical studies; I wished to see other plant wonders of the region and chose *Hydnora* over other plants such as *Welwitschia*. Herbarium study revealed that a fine population of *H. africana* could be seen north of Ceres, at the entrance of the Karoo Desert, and I visited that population in October. In December, a visit to the Karoo Garden in Worcester revealed that on a nearby hillside, some of the older *Euphorbia mauritanica* shrubs were yellowish, and I thought their decline might be the result of parasitism. *Hydnora africana* was fruiting abundantly on the roots of one such shrub, and I collected fruits in the hope of cultivating them upon my return to the United States the last week of December.

Shortly after arrival back in California, I bought several rooted cuttings of *Euphorbia caputmedusae* in the hope of germinating seeds of the *Hydnora*; the fruits were still in fresh condition and intact. *Euphorbia mauritanica* is not in cultivation in California, but *E. caputmedusae*, most commonly cultivated here, was judged suitable because it is the host of a small population of *H. africana* at Houtbaai on the Cape Peninsula. I tapped the *Euphorbia* plants from their pots, lined the pots thickly with masses of the seeds, and reinserted the plants so that *Euphorbia* roots would be in intimate contact with *Hydnora* seeds. About a year later, I removed the *Euphorbia* plants, noted no apparent infection, and planted them in a larger ceramic pot. Three years from the time of original sowing, removal of the plants revealed no apparent infection. I assumed I had been unsuccessful, and planted the *E. caputmedusae* plants in a convenient sunny corner of my garden as a way of using the *Euphorbia* merely as an ornamental. Early in July 1979, five and one-half years after the attempted inoculation of the *Euphorbia* plants, I was startled to see a single *Hydnora* flower emerge from the soil surface. When the flower opened, on July 29, 1979, I dug up the colony and made a specimen (Carlquist 15635, located in the Rancho Santa Ana Botanic Garden herbarium), photographing and preserving portions in liquid. Evidently two large plants of the *Hydnora* had developed (*Hydnora* roots were radiating from two centers); a small nodule about 5 mm in diameter with the same surface characteristics as *Hydnora* roots was also attached to the *Euphorbia* roots, and I assumed this might have been a young seedling of *Hydnora*. I have not yet studied liquid-preserved portions, including that nodule, but I do plan anatomical studies.

I replanted the *Hydnora*-infected *Euphorbia* plants before they could dry out, and, during the years that followed, I added two additional *Euphorbia* species, *E. aitonii* and *E. hexagona* (the latter name under which this plant is commonly known in cultivation; the correct name may be different, and possibly this plant is a hybrid of *E. bubalina* according to Dr. Daryl Koutnik.) As a result of thinning out excess *Euphorbia* plants, I have found root connections of this *Hydnora* to all three *Euphorbia* species. The *E. aitonii* has now been killed by frost, so the *Hydnora* colony is now nourished by two species of *Euphorbia*.

Each year since 1981 the colony has yielded two or more flowers, and various botanists have witnessed the flowering, which occurs during July and August. Large dermestid beetles have been found in the flowers as visitors, much as the dermestids that are known to pollinate the flowers in South Africa according to Marloth, but no fruits have ever been formed. The colony has not expanded greatly in size since 1979, but it appears in no danger of dying out. Conditions for cultivation are not ideal with respect to soil, for my garden is composed of an adobelike clay. For this reason, the *Hydnora* roots may grow closer to the surface than they would in a sandier soil (judging by my excavation of wild-occurring plants in the Karoo locality). Southern California is a favorable site because frosts are sufficiently mild so that various succulent species of *Euphorbia* can be cultivated with little or no damage.

I would encourage others to attempt cultivation of this and other species of *Hydnora*--lack of host specificity would seem to favor cultivation. Obviously, considerable patience is involved, judging from the interval between sowing seeds and flowering that I experienced. Although seeds may well be capable of dormancy, one is well advised when cultivating any species not hitherto attempted to begin with seeds taken directly from fresh fruits.

- **S. Carlquist, Rancho Santa Ana Botanic Garden**

OROBANCHE IN NEPAL A survey trip in January 1988 to assess the *Orobanche* problem in *Brassica* oilcrop growing areas of Nepal was sponsored by IDRC, Canada, and Nepal Agricultural Association. *Orobanche* was widespread in the "terai" (plains between the Churia range and the Indian border) and the "inner-terai" (plains between the Churia and the Mahabharat ranges) on *Brassica* oilcrops, tobacco, tomato, faba beans and other crops. We could not actually see *Orobanche* in the high hills though we found reports of its occurrence in hills as high as 3800 m in Manang district. *Orobanche aegyptiaca* was the predominant species on the *Brassica* oilcrops; the same species was in tobacco along with *O. solmsii* (a first record for Nepal). Toria (*Brassica campestris* var. *toria*) parasitized by *Orobanche* had a 20% yield loss according to the National Oilseed Development Project at Nawalpur. In the farmer's fields, toria following rice apparently had less *Orobanche* than toria following maize or jute.

- **M. J. Vasudeva Rao, ICRISAT,**
- **M. L. Jayaswal, National Oilseed Development Project, and**
- **Jagat Devi Ranjit, Agronomy Division**

CONTROL OF STRIGA WITH A SYSTEMIC HERBICIDE We have found excellent results with the systemic herbicide dicamba (3,6-dichloro-2-methoxybenzoic acid) in controlling *Striga asiatica*. The herbicide is applied as a foliar spray to corn or sorghum at the time of incipient attachment of the parasite to the host root system. The material translocates through leaf to roots and kills unemerged *Striga* up to 3 cm long. Adil Eisa Awad, graduate student at North Carolina State University, has demonstrated movement of dicamba from the host into the parasite with radioactive tracers. The treatment provides 45 days of protection to the crop. This procedure of using a relatively inexpensive herbicide to systematically control *Striga* in cereal crops opens up new avenues of control.

- **R. Eplee, USDA, Whiteville Methods Development Center**

COMBATING STRIGA IN AFRICA WORKSHOP AT IITA, AUGUST 1988 About fifty scientists from many nations met at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, the last few days of August 1988 for the purpose of developing research priorities and collaboration among *Striga* researchers. A series of sessions reviewed present research and research planned for the future. A series of recommendations on priority areas of research was developed. These have been published as "Combating *Striga* in Africa: Opportunities for Research Collaboration." This 24 page booklet is available from Publications, IITA, Oyo Road, PMB 5320, Ibadan, Nigeria. One of the recommendations involves information networking and states that **HAUSTORIUM** should be supported as well as developing a directory of *Striga* workers and a catalog of literature.

EARLY SELECTION OF SUNFLOWER SEEDLINGS FOR BROOMRAPE (OROBANCHE CUMANA WALLR.) RESISTANCE

Orobanche cumana, broomrape, is one of the important problems in sunflower culture in Hungary so that effective control methods are constantly being sought. Two methods appear promising: the use of phytophagous insects or hyperparasitic microorganisms; and the selection of resistant sunflower lines and the production of resistant hybrids. Both methods have been the subject of study for many years at the Bacsalmas Sunflower Producing System (BNR). For the early diagnosis of broomrape infection, a new testing method has been developed using potted sunflower seedlings for inoculation with broomrape seed. The frequency of infection within a sunflower line has been made on the basis of histological changes at the host-parasite interface, the resistant plants showing secondary lignin accumulation near the site of penetration. The induction of lignin seems to prevent the establishment of parasitic contact between vessels of the two plants. As lignin accumulation is associated with brown necrotic lesions of the host tissue accompanied with dead broomrape plants in a number of cases, the response of sunflower to infection can be easily assessed by means of a dissecting microscope. As a result, the sunflower populations (lines) can be divided into four phenotypic groups: 1- Plants showing broomrape knots yellow in color and detectable with the naked eye; 2- plants with very small, undeveloped knots; 3- plants with necrotic lesions; 4- plants with neither necrosis nor parasite. Groups 3 and 4 are considered resistant to broomrape.

◆ **Z. Horvath, Bacsalmas Sunflower Producing System, Bacsalmas**

CUSCUTA IN PULSES AFTER RICE IN ANDHRA PRADESH

Cuscuta reflexa has been noted in pulses and certain other crops in Andhra Pradesh, India. The infestation is severe in pulse crops under a rice-pulse relay cropping system where pre-soaked pulse seed is broadcast into a standing paddy crop a week before harvest in November and December. Pulse crops utilize the residual soil moisture and mature in 90 to 110 days. Seed contamination through manure/compost/cattle dung and human activity appears to be the major sources of infestation in new areas. *Cuscuta* germination was not observed during the rainy season in paddy either on crops or on weeds because of the water. One week to ten days after germination of the pulse, the *Cuscuta* germinates and attaches to the nearest crop seedling either directly or by becoming established first on a weed. The cooler weather and cloudy skies apparently help germination of the *Cuscuta*. If the infestation is heavy, the entire crop may be lost. Susceptible crops include *Vigna mungo*, *V. radiata*, *V. aconitifolia*, *Cicer arietinum*, *Cajanus cajan*, *Medicago sativa*, *Crotolaria juncea*, *Glycine max* and the non-legumes: *Guizotia abyssinica*, *Sesamum indicum*, *Hibiscus sabdariffa*, *Lycopersicon esculentum*, *Capsicum annuum*, *Allium cepa*, and *Coriandrum sativum*. Tolerant crops include *Vigna unguiculata*, *Cyamopsis tetragonoloba*. Resistant crops are *Macrotyloma uniflorum*, *Gossypium spp*, *pomoea batatas*, and *Abelmoschus esculentus*. In addition, many weed species are potential hosts.

◆ **K. Narayana Rao and R. S. N. Rao, Andhra Pradesh Agricultural University, Bapatla**

INTERNATIONAL WORKSHOP ON OROBANCHE RESEARCH

Orobanche is a serious root parasitic weed in many areas where it may be a major factor in yield reduction of legumes and vegetables. A better understanding of the biology of *Orobanche* and especially the physiological and biochemical host-parasite relations may lead to new means of control. Accordingly, a workshop is planned 19-22

August 1989 in Obermarchtal, West Germany. All aspects of the biology and biochemistry of *Orobanche* will be considered with special emphasis on germination, haustorial initiation, host specificity, genetics, and host crop resistance. The venue of the meeting is the former Premonstrant Abbey. Obermarchtal is located halfway between Stuttgart and Lake Constance. The fee for the workshop is DM400 which includes all expenses including accomodation and meals. We plan to produce a published proceedings of the workshop. For more information contact one of the organizers, K. Wegmann, Institute of Chemical Plant Physiology, University of Tubingen, Corrensstrasse 41, D-7400 Tubingen, West Germany; telephone 07071-296396, telex 7262867 UTZV D/attn Wegmann, or L. Musselman (address below).

COPIES OF THE 4th PARASITE SYMPOSIUM PROCEEDINGS STILL AVAILABLE Some copies of the Proceedings of the Marburg symposium are still available. This is a large, well produced volume crammed with information on a diversity of parasitic plants. To order a copy, send a check in the amount of DM125 made payable to Hans Christian Weber and send it to him at Fachbereich Biologie Botanik, Phillipps-Universitat, Lahnberge, 3550 Marburg, West Germany.

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Parker, C. 1988. Parasitic plants in Ethiopia. Walia 11: 21-27. (This is a review of the diverse groups of parasitic plants occurring in Ethiopia including such weird creatures as *Hydnora*, various mistletoes and their relatives as well as the well known and agriculturally important *Orobanche* and *Striga* species).

Press, M. C., N. Shah, J. M. Touhy, and G. R. Stewart. 1987. Carbon istotope rations demonstrate carbon flux from C-4 host to C-3 parasite. 1987. Plant Physiology 85: 1143-1145. (Another in a series from a productive research group, this paper suggests that there is a substantial input of carbon from the host, approximately 28% in the case of *Striga hermonthica*, and 35% in *S. asiatica*).

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HAUSTORIUM is edited by L. Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA, telex 823428 OLD DOM NK; and C. Parker, Post Office Box 32477, Addis Ababa, Ethiopia and mailed twice a year, usually in January and June. Send material for publication to either editor and requests for copies to L. J. Musselman.

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(Haustorium 20 was mailed in June 1988).

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epartment of Biological Sciences, Old Dominion University, Norfolk, VA 23529-0266, USA

Tess
Anita

HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Seed Plant Research Group

October 1989 .... Number 22

▪ HAUSTORIUM FUNDING

We are very pleased to announce that USAID has funded HAUSTORIUM for the coming year with notification of intent to fund it for another two years. This is the first time that our newsletter has received direct funding. In addition, funds are available for a *Striga* information retrieval system. This will be a collaborative effort among several organizations involved in *Striga* research

▪ FIFTH INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

IPSPRG has recently been invited to consider Nairobi, Kenya as the venue for the next International Symposium on Parasitic Weeds in June 1991. Negotiations are underway and we hope to have the first formal announcement in the January 1990 issue of HAUSTORIUM. Please send your comments about the venue of the next symposium to either editior.

▪ SEMI-ARID TROPICAL CROPS INFORMATION SERVICE (SATCRIS)

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) announces an information retrieval system dealing with the five mandated crops of ICRISAT: sorghum, pearl millet, chickpea, pigeonpea, and groundnut. Topics would certainly include parasitic weeds. Interested persons should contact: SATCRIS, ICRISAT, Patancheru, Andhra Pradesh 502 324, India.

▪ INTERNATIONAL OROBANCHE WORKSHOP, OBERMARCHTAL, AUGUST 1989

Sixty *Orobanche* workers gathered in the beautiful surroundings of the old monastery at Obermachtal to hear and discuss 40 presented papers and 15 posters. Some 16 countries were represented, including for the first time at such a meeting USSR, Bulgaria, Ethiopia and Nepal. The main conclusions to be drawn from the meeting included the following:

Taxonomy/parasite variation. There was further discussion, but still no clear conclusion on, the relationship/status of taxa in the *O. cernua*/*O.cumana* (Teryokhin) and *0. ramosa*/*O. aegyptiaca* complexes (Musselman); while an unfamiliar name, *O. solmsii*, was introduced by Bharati to describe an important species in Nepal, apparently close to *O. cernua*. The allozyme/iso-enzyme technique had been used by Verkleij to confirm that the out-crossing *O. crenata* shows much greater variation within populations than between them. It was suggested that corresponding work with this or other techniques was needed on the above species complexes and on host species/variety-specific biotypes, in parallel with further simple host-range studies, so that the potential importance of local populations of parasite can be determined more quickly and positively.

Ecology. Jones described how the pollination of most British populations of *Orobanche* is autogamous; but in discussion it transpired that cross-pollination of some of the same species may occur by insects where they are not so near their northern limit of distribution. Teryokhin emphasized the perennial nature of many *Orobanche* species. A number of papers described results or techniques which contribute to population dynamics studies. Total seed production over 200,000 per plant was reported for both *O. crenata* (Garcia Torres) and *O. cernua* (Agrawal). In Syria, Sauerborn had developed a method for sampling soil for buried seed and looked at alternative sampling patterns for optimum precision of the estimate. On the same theme, Linke studied the longevity of seed of *O. crenata* and loss assessment was considered by Zaitoun. Distribution by wind was shown to be important in *O. cernua*, resulting in contamination of sunflower seed heads and hence long-distance transfer of infestations across Spain (Garcia Torres).

Physiology/biochemistry. A number of papers on seed conditioning and germination reported progress in the design of artificial stimulants (Zwannenburg), understanding the role of gibberellins (Joel, Al Ghamwary) and the direct effect of nitrogen compounds (Pieterse). A study on the sugar balance in *O. crenata* showed the importance of mannitol in the parasite (Harloff). Effects of glyphosate on amino acids in faba bean and *O. crenata* were reported by El-Masry. The possible effects of vesicular-arbuscular mycorrhiza were explored by Klein. Khalaf described continued efforts at the characterization of the *O. crenata* stimulants from faba bean.

Resistance breeding. No substantial progress was reported but there had been some clarification of the nature of the resistance of 'Giza 402' (ter Borg) and its incorporation into improved faba bean cultivars (Cubero), while Darwish claimed some progress in the selection of tolerant varieties in Egypt. The study by ter Borg was of interest in terms of the detailed technique for observation and quantification of root growth. A final paper by Wegmann suggested the involvement of phytoalexins in resistance, and the possibilities for genetic engineering to introduce appropriate genes into breeding material.

Control. In Egypt promising results had been obtained on *O. crenata* with rotation into Egyptian clover and other break crops (Al Menoufi). The value of delaying planting date of faba beans had been further confirmed and explained in terms of soil temperature effects on germination (van Hezewick). The practical usefulness of 'solarization' had been extended by Abu-Irmaileh's report of successful use of black plastic which could be left down and transplants planted through it. The usefulness of glyphosate has not quite lived up to expectations, with some disappointing results in faba bean and lack of adequate selectivity in carrot (Jacobsohn) and tobacco (Nemli). One useful tracer study by Muller and Dieter suggested that poor control of *O. crenata* may be associated with heavy infestations. Fortunately some new herbicides (e.g. imazepyr, imezathepyr, chlorsulfuron) are showing promise for use against *Orobanche* in legume crops and sunflower (Garcia Torres, Linke): and undisclosed chemicals understood to be iso-cyanates were reported to be proving successful as germination stimulants in field trials in Bulgaria (Tchalakov). "Telone" (1,3-dichloropropane) had shown some promise as a fumigant in Israel, but not consistently (Jacobsohn). Other chemicals were also proving of interest in at least reducing the damage to crop, if not controlling the parasite, e.g. asorbic acid (Bhargava) and cycocel and gibberellins (Kheir). And at a very simple level, wiping newly-emerged plants with vegetable oils had proved successful in India (Krishna Murty).

There were also several papers on *Striga hermonthica* - on carbon fluxes (Press Graves), stomatal behavior (Smith), and changes in protein during conditioning and germination (Logan and Wylde). There were also three papers on the development of cowpea varieties resistant to *S. gesnerioides* (Hussain, Gworgwor, Lane).

Prof. Wegmann is to be thanked for arranging a successful meeting in delightful surroundings, and the sponsors GTZ, Bayer and BASF for providing financial assistance to many of the participants.

Preparation of a published proceedings incorporating the majority of the papers presented at the symposium is underway. The estimated date of publication is early 1989.

Further details in the January issue of HAUSTORIUM.

▪ *CYCNIUM* ON SUGARCANE IN SOMALIA

Minor infestations of this annual root parasite of the Scrophulariaceae were observed on young sugarcane ratoon shoots of different cane varieties at the Juba Sugar Project. There are also a wide range of secondary hosts including *Digitaria* spp. *Cycnium tubulosum* is common in marine soils in the Juba region of central Somalia. The large, showy white flowers open at night and have no obvious fragrance. Seeds can remain viable for up to the seventh ratoon. The parasite is seldom noticed before it flowers. By the time flowers appear, severe damage to the host has occured.

A. Yusef, Juba Sugar Project

▪ HOSTS OF *STRIGA GESNERIOIDES* IN BOTSWANA

In our paper "Morphology and hosts of three *Striga* species in Botswana" (Bulletin Museum Nationale Histoire Naturelle, Paris. Fourth series, 9. Adansonia: 195-215), four morphotypes of *Striga gesnerioides* were described. These were differentiated by distinct combinations of stem morphology, internode length, and flower color. In that paper only the genus of each host was given. Identification of field specimens was subsequently provided by F. N. Hepper of the Kew Hebarium. The morphotypes are listed below in the order of the original paper.

A. Short internodes, succulent stems, with yellow flowers. Host: *Ipomoea bolusiana* Schinz.

B. Short internodes, succulent stems, with light-pink to deep-purple flowers. Host: *Indigofera schimperi* Jaub. & Spach. and *Pteridiscus* sp.

C. Medium internodes, non-succulent stems, with small light-pink flowers, lower lobes 2-3.5 mm long. Host: *Indigofera costata* Guill. & Perr. ssp *theuschii* (O. Hoffm.) Gillett.

D. Long internodes, non-succulent stems, occasionally red pigmented, large light-pink flowers, lower lobes 5-8 mm long. Hosts: *Ipomoea magnusiana* Schinz; *Rhynchosia* cf *subulata* Schum. & Thonn.; *Tephrosia purpurea* (L.) Pers. ssp. *leptostachya* (DC.) Brummitt.

D. M. Ralston, C. R. Riches, and L. J. Musselman

▪ JOINT FAO/OAU REGIONAL WORKSHOP ON *STRIGA* CONTROL

This workshop was jointly organized by the FAO and OAU and held in Banjul, The Gambia in December 1988. Some of the recommendations include an increased *Striga* program in other countries, a re-evaluation of the use of paraquat and a search for an herbicide to replace it, better control of the spread of the parasite, increased collaboration among national programs by forming a network, and a recommendation that the next meeting of that network be held in conjunction with the Fifth International Symposium on Parasitic Weeds (see announcement earlier in this issue).

▪ PARASITIC FLOWERING PLANTS OF SOUTH AFRICA STILL AVAILABLE

Copies of this lavishly illustrated volume published in 1981 are once again available. To obtain a copy, send payment of ten US dollars to: Professor Johann H. Visser, Department of Botany, University of Stellenbosch, 7600 Stellenbosch, South Africa or you may order through the editors.

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▪ SABIR BARSOUM SAFA

We regret to inform HAUSTORIUM readers of the death of Dr. Safa on 1 October 1989, just nine days before his fortieth birthday. Dr. Safa received his PhD in botany from Royal Holloway College (University of London) working on the floral biology of *Striga hermonthica*. He was on the faculty of Gezira University, Wad Medani, Sudan and took a leave of absence to join the Parasitic Plant Laboratory at Old Dominion University in 1987 where he continued his work on floral biology, especially of *S. aspera* in West Africa, until the time of his illness.

HAUSTORIUM is edited by L. J. Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA, telex 823428 OLD DOM NK, fax 804-683-5155 and C. Parker, Long Ashton Research Station, University of Bristol, Bristol, BS18 9AF, ENGLAND, fax (0272) 394007. It is published by Old Dominion University and sent free of charge under a grant (59-319R-9-003) administered by the Office of International Cooperation and Development of the U S Department of Agriculture and mailed twice a year, usually in January and July. Unsigned articles and literature reviews are by the editors. Send material for publication to either editor and requests for copies to L. J. Musselman.

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HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Seed Plant Research Group

January 1990 .... Number 23

• FIFTH SYMPOSIUM ON PARASITIC WEEDS

The Fifth Symposium on Parasitic Weeds is scheduled for June 1991 in Nairobi, Kenya. Current sponsors are IPSPRG and CIYMMT. If you are interested in being placed on the mailing list for future announcements, return the attached form ***by 15 April 1990.*** Like other IPSPRG symposia, plans are to have papers prepared from camera ready copy available at the meetings. All areas and parasites are to be included, as in past meetings, although emphasis will be on African *Striga*. A two day field trip to see parasites is planned. Registration and other information will be sent with the second circular no later than June 1990.

• *STRIGA* BIBLIOGRAPHIES

1. 1957 USDA *Striga* Bibliography. This invaluable resource has been reprinted by the Parasitic Plant Laboratory. It contains summaries of 298 papers and along with several indicies of *Striga* and host species. It is a model bibliography and the most exhaustive review of the literature. Single copies of the 132 page publication are free upon request. In addition, the entire bibliography is available on disk. Specify disk size and choice of WordPerfect 5.0 or ASCII formats. Production and distribution of this bibliography is made possible by grant 59-319R-9-003 from the U S Department of Agriculture, Office of International Cooperation and Development.

2. A second bibliography has been prepared by Dr Joel Ransom, CIYMMT maize agronomist. It contains more than eight hundred entries of selected *Striga* literature, without summaries, through 1989. Single copies are available upon request as are disk copies.

3. Exhaustive *Striga* bibliography in progress. Under the direction of Dr Vasudeva Rao, ICRISAT has collected all known papers on *Striga*. Summaries of the more than 1400 titles are now being prepared and publication, as a joint effort between ICRISAT and the Parasitic Plant Laboratory, is planned for late 1990 or early 1991. The entire bibliography with summaries will be available on disk. Plans are also underway to determine the feasibility of optically scanning papers for computer output of papers upon demand.

• MISTLETOES ON RUBBER TREES IN NIGERIA

Severe infestations of mistletoes (Loranthaceae)--perennial, woody, parasitic plants--have been observed in rubber, *Hevea brasiliensis*, plantations in southern Nigeria. Two mistletoes have been observed as most prevalent. Although they have similar vegetative characters, they are easily recognized by their flower color. *Loranthus incanus* has yellow flowers with pink streaks while *Loranthus brunneus* has red flowers with black streaks; this latter species is mainly restricted to the tree tops of abandoned rubber plantations. Amongst monoclonal plantations surveyed, the RRIM 600 and PR 107 have been found to be more susceptible to *L. incanus* infestation. Because of the distance between the crown and the ground, the presence of the parasite is hardly noticed until flowering. The mistletoes flower twice a year and shed their leaves approximately one month earlier than their hosts. The obvious effect of this is the decrease in the rubber latex yield. Due to the excessive weight of the parasite, parasitized limbs readily break in the wind. Furthermore, the effects of the parasite on the crown, coupled with the root parasite *Thonningia sanguinea* and the white wood rot fungus (*Fomes lingasus*) on the lower portion of the bole ultimately lead to tree fall. All this results in losses not yet quantified.

L. S. Gill and H. I. Onyibe, University of Benin (Nigeria)

• *STRIGA HERMONTHICA* ON BARLEY IN ETHIOPIA

Striga hermonthica is a common occurence in sorghum and maize in many parts of Ethiopia. In 1988 it was found growing on tef (*Eragrostis tef*) in several fields in East and West Gojam and North Wello Administrative Regions. Last September *S. hermonthica* was found growing on barley (*Hordeum vulgare*) in a field where sorghum was growing the previous year. The owner of the farm said that he had not expected *Striga* to grow on barley and that he had changed from sorghum to barley in an attempt to escape the menace of *Striga*. The area, in general, has very heavy *Striga* infestation in almost every sorghum and/or tef field. But the attack on barley was observed only in one field, on several plants. During the coming (1990) cropping season, more survey in the region will be made.

Ahmed M. Sherif, Holetta Research Center

• A NEW TERMINOLOGY FOR PARASITIC PLANTS

Parasitic flowering plants have been studied for for more than 150 years by scientists from different fields of research. The result has been a large number of publications (eg, Kuijt 1969). In the last 20 years in particular, there has been an explosion of papers on taxonomy, morphology, anatomy, ecology, physiology and biochemistry of parasitic plants. New aspects, phenomena or structures, described in different languages, have resulted in a chaos of terms, even in the same language. We propose the development of a uniform terminology, which can be used by everyone who studies these plants by eliciting the input for all workers. A series of definitions will be published in the next issues of HAUSTORIUM. Send your criticisms and/or alternative definitions to Hans Christian Weber, Fachbereich Biologie, Philipps University, D-3550 Marburg, West Germany or to Lytton Musselman. After receiving all your input, we shall prepare a glossary for distribution at the Nairobi meeting. The first installment follows.

Parasitism

1. Parasitic flowering plant-A plant which penetrates a living host for nutrition.

2. Endoparasite-Plants in which the majority of the plant body is inside the host. Examples. Rafflesiaceae, some mistletoes.

3. Ectoparasite-Plants in which the majority of the plant body is outside the host. Most parasites are in this category.

4. Hyperparasitism-Plants which are obligate parasites of other parasites, as some mistletoes.

• YIELD LOSSES IN MAIZE DUE TO *STRIGA ASIATICA* IN THE CAROLINAS, 1989

A better understanding of the actual and potential yield losses associated with *Striga* is needed if sufficient resources are to be committed to its control. From a number of experiments conducted in 1989 in North and South Carolina which varied in planting date, nitrogen rate, and yield potential (2400 kg/ha to 8500kg/ha), regression equations were calculated to predict yield losses in maize using *Striga* plant counts early in the season (70- 75 days after planting), and *Striga* above ground dry weight at the time of maize harvest. The predicted loss of maize yield varied between 32 and 141 kg/ha per *Striga* plant/ m^2 for late counts, and 20 and 71 and 96 kg/ha per gm/ m^2 *Striga* dry weight. *Striga* emerging early in the season was consistently more damaging than *Striga* emerging late. Only 20 *Striga* plants/ m^2 late in the season were required to reduce yield by 50% in the lowest yielding trial while 43 plants/ m^2 were needed to produce the same effect in the highest yielding trial. Nevertheless, these data suggest that yield losses due to *Striga*, even in a well managed crop (i.e. adequately fertilized and free from other damaging pests) can be substantial.

Based on these data, 1 gm of above ground *Striga* growth represents a 4 to 15 gm reduction in maize growth (based on the assumption that the harvest index of the maize was 40% and not considering any *Striga* which attached, grew, but failed to emerge from the soil). Assuming that with a competitive effect, 1 kg of weed growth will result in the reduction of 1 kg of crop growth, then only 7 to 25% of the reduction in the growth of maize in these experiments can be attributed to competition. More information on the "toxic" effects of *Striga* is needed.

Joel K. Ransom, Maize agronomist CIMMYT, Nairobi

• LITERATURE

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Anonymous. 1989. *Striga*-Improved Management in Africa. FAO Plant Protection and Production Paper 96. 205 pages. (This is the published proceedings of the All-Africa Government Consultation on *Striga* Control held in Cameroon in 1987 and sponsored by OAU/FAO).

Anonymous. 1989. Tobacco Production Technology. Central Tobacco Research Institute, Rajahmundry, India. (*Orobanche cernua* control is discussed).

Ba, A.T. 1988. Structure et ultrastructure de l'haustorium du *Striga hermonthica*, une scrophulariaceae parasite du mil (*Pennisetum typhoides*). Canadian Journal of Botany, 66(11): 2111- 2117. (This is another paper in this worker's series of papers on haustorial structure. No phloem was evident).

Bewick, T.A., L.K. Binning, and B. Yandall. 1988. A degree day model for predicting the emergence of swamp dodder in cranberry. Journal of the American Society for Horticultural Science 113(6): 839-841. (A model that predicts the onset of *Cuscuta gronovii* emergence using growing degree days and low temperature thresholds was developed. This dodder is a serious problem on cranberries and and blueberries, both species of the genus *Vaccinium*).

El-Hiweris, S.O. 1988. Growth inhibitors of *Sorghum vulgare* Pers. from *Striga hermonthica* (Del.) Benth. Arab Gulf Journal of Scientific Research B 6(2): 163-172. (Some of this work has been reported earlier. Extracts of infected sorghum plants inhibited non-infected sorghum).

Foy, C.L., R. Jain and R. Jacobsohn. 1989. Recent approaches for chemical control of broomrape. Reviews of Weed Science 4: 123-152. (An extensive review of herbicide control. Helpful tabular information is included as well as more than 200 bibliographic citations).

Hemmerly, T.E. 1989. Mistletoe parasitism in Tennessee. Journal of the Tennessee Academy of Science 64(3): 121-122. (This paper deals with *Phoradendron serotinum* and its hosts).

Krause, D. 1989. *Striga*-Biologie, Shaden, Kontrolle. Mikrokosmos, 78(10): 289-294. (Many helpful scanning electron micrographs are included).

Lyshede, O.B. 1989. Electron microscopy of the filiform seedling axis of *Cuscuta pedicellata.* Botanical Gazette 150(3): 230-238.

Melero-Vara, J.M., J. Dominguez and J.M. Fernandez-Martinez. 1989. Evaluation of differential lines and a collection of sunflower parental lines for resistance to broomrape (*Orobanche cernua*) in Spain. Plant Breeding 102: 322-326. (Results confirmed the existence of several physiological races of broomrape in Spain, different than those from Eastern Europe. Good resistance was found in some lines).

Mohlenbrock, R.H. 1989. Paint Rock, North California. Natural History, 8: 64-66. (Paint Rock is one of the famous locations of *Buckleya disticophylla* of the Santalaceae. The biology of the plant is briefly discussed).

Orloff, S. B., R. N. Vargas, D. W. Cudney, W. M. Canevari and J. Schmiere. 1989. Dodder control in alfalfa. California Agriculture 43(4): 30-32. (Dinitroanaline herbicides applied pre-emergent provided extended control; prodiamine was the most persistent. Excellent colored pictures are included).

Pepperman, A.B. and J.M. Bradow. 1988. Strigol analogs as germination regulators in weed and crop seeds. Weed Science, 36: 719-725. (Strigol analogs inhibited or did not affect monocot germination whereas several dicots exhibited both inhibitory and stimulatory responses).

Parameter, J.R. and R.F. Scharpf. 1989. Dwarf mistletoe in red and white firs in California-23 to 28 years after inoculation. USDA Forest Service Research Note PSW-406: 1-5.

Scharpf, R.F. and A.H. McCain. 1988. Avoid planting scotch pine near dwarf mistletoe-infected california pines. USDA Forest Service Research Note PSW-400: 1-2.

Scharpf, R.F., R.S. Smith and D. Volger. 1988. Management of western dwarf mistletoe in ponderosa and jeffrey pines in forest recreation areas. USDA Forest Service General Technical Report 103: 1-11.

Takeuchi, Y, A. D. Worsham and A. E. Awad. 1989. Effects of brassinolide on conditioning and germination of witchweed (*Striga asiatica*) seeds. Proceedings of the 12th Asian-Pacific Weed Science Conference 149-158. (Brassinolide, a steroidal derivative of a mustard, eliminated the inhibitory effect of conditioning by strigol and natural stimulants on witchweed seeds).

HAUSTORIUM is edited by L. J. Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA, electronic mail LJM100f at ODUVM, telex 823428 OLD DOM NK, fax 804-683-5155 and C. Parker, Long Ashton Research Station, University of Bristol, Bristol, BS18 9AF, ENGLAND, fax (0272) 394007. It is published by Old Dominion University and sent free of charge under a grant (59-319R-9-003) administered by the Office of International Cooperation and Development of the U S Department of Agriculture and mailed twice a year, usually in January and July. Unsigned articles and literature reviews are by the editors. Send material for publication to either editor and requests for copies to L. J. Musselman.

HAUSTORIUM 22 was mailed 16 October 1989

FIFTH INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS NAIROBI, JUNE 1991

FIRST CIRCULAR-JANUARY 1990

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INDEX OF PARASITIC SEED PLANT WORKERS

Several years ago, an attempt was made to produce an index of of workers and others interested in parasitic plants. Facilities and resources are now available to do this. Please TYPE your responses as they will be computer read. Send to address on reverse side.

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8. Specific research interest (s):

8a.

8b.

8c.

9. Organisms (give genus and family of no more than four)

9a. (1):

9b. (2):

9c. (3):

9d. (4):

10. Publications. List three of your most recent or most important by last name. initials of first author followed by initials and last name of other authors. Date. Title. FULL NAME OF JOURNAL, REPORT, PROCEEDINGS, ETC (do not abbreviate!). Volume (number). Pages. City and publisher (for reports and books).

Index of Parasitic Seed Plant Workers

HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Seed Plant Research Group

October 1990 .... Number 24

• FIFTH SYMPOSIUM ON PARASITIC WEEDS JUNE 1991

The Fifth Symposium on Parasitic Weeds is scheduled for June 1991 in Nairobi, Kenya. By now you should have received registration material. If not, please contact Dr. Joel K. Ransom, CIMMYT, Post Office Box 25171, Nairobi, Kenya, Telex: 22040 ILRAD; Fax: 593499 ILRAD.

• HAUSTORIUM IN TROUBLE AGAIN!

Once again, our newsletter has received the ax! Through a grant administered by the U S Department of Agriculture, Office of International Cooperation and Development we were able to mail the last two issues of HAUSTORIUM in addition to the preparation and mailing of the *Striga* bibliographies. This was tentatively a three year grant but due to budget cuts, only one year was funded. Thus, we have no sponsor. This issue is being produced by Old Dominion University and postage paid from residual monies from the 1984 symposium. Can any one help?

• DEFINITIONS OF PARASITIC PLANTS

This column in the last issue of HAUSTORIUM provoked considerable interest. Here are some of the responses.

From M. Jones, Clwyd, UK-- Are these hyperparasitic mistletoes only found on other species of parasites or can they also grow on free-living hosts? If not is hyperparasitism congruent with epiparasitism, which has been defined by Calvin and Weins (1987) as the obligate occurrence of one mistletoe on another? Should polygonal parasitism (see Moran, 1987) also be referred to in the definition. If hyperparasitism and epiparasitism have the same meaning how should non-obligate associations such as those recorded for *Cuscuta* on *Striga* and *Cuscuta* on *Orobanche* be referred?

From A. Lane, Long Ashton Research Station, Bristol, UK-- Haustorium: an outgrowth from a parasite which penetrates a tissue or cell of its host and acts as an organ for absorbing nutrients. In fungal/host relationships, the haustorium is "a special hyphal branch within a living host cell". The fungal cells on the surface of the penetrated host cell are not regarded as part of the haustorium. They are not inside the cell nor are they involved in nutrient absorption.

In these terms, the use of haustorium is often misleading when applied to plant parasites. Haustorium should be restricted to the absorptive part of the parasite which is within the living host tissue.

On this basis all parasitic plants have haustoria. However, many species of parasitic plants, e.g. *Alectra vogelii*, *Striga gesnerioides* and *Orobanche minor*, also have a large organ on the surface of the host root. A preferable term for this small swelling or nodule is tubercle (sensu Kuijt page 97).

From B. Fineran, University of Canterbury, Christchurch, New Zealand-- Parasitic flowering plant. I feel this needs a slight modification to clarify the nature of the living host. The present wording "a living host" is too vague and conceivably could include anything from an animal, fungus, to any form of plant life. I don't know of any functional hosts other than vascular plants. Also, since we have one example of a parasitic gymnosperm, perhaps the heading should recognize this fact. Thus, the whole entry might read as follows: Parasitic seed plant. A plant which penetrates a living vascular plant host for nutrition.

2 - 3. Endoparasite and ectoparasite

I can't say that I am overly fond of either of these terms. They smack too much of what I remember from my zoology student days. However, if you wish to introduce such terms into the botanical literature then I suggest the following (to improve the tense and precision of meaning).

Endoparasite. A seed plant in which most of the vegetative tissues of the parasite lie embedded within the host plant.

The term "plant body" is not favored by many botanists outside North America. They consider its meaning too ill-defined. I have introduced the term "vegetative tissues" to distinguish this part of the parasite from its reproductive tissue, which typically lie outside the host.

Ectoparasite. A seed plant in which only a small portion of its tissues penetrate the host plant.

4. Hyperparasitism. This definition seems fine, but it is not strictly grammatically correct. "Hyperparasitism" is a condition (i.e., a state of being); it cannot be a plant. The definition should therefore read: Either (a) Hyperparasitism: The condition in which a parasitic seed plant is an obligate parasite on another parasitic seed plant, as found among some mistletoes, or (b) Hyperparasite: A parasitic seed plant which is an obligate parasite on another parasitic seed plant. Typically found among some mistletoes.

• NEW CEREAL HOSTS OF *STRIGA HERMONTHICA* IN ETHIOPIA

The cereals of Ethiopia, in order of importance, are: t'ef (*Eragrostis tef*), maize, sorghum, wheat, barley and dagussa (finger millet, *Eleusine coracana*). *Striga hermonthica* is a serious pest of sorghum, maize and dagussa in many parts of Ethiopia at altitudes below about 2,000 metres, but is has not been reported on the other, more temperate cereals.

However, in 1988 *S. hermonthica* was found growing on t'ef in three areas of northern Ethiopia at altitudes between 1,500 and 2,000m: in south-eastern Gojam, in the middle Abay (Blue Nile) Gorge and in northern Welo. A fuller account of these occurrences and a discussion of their implications for t'ef cultivation is given in the I.A.R. Newsletter of Agricultural Research (Ethiopia) 4(1): 1-3 (1989).

The same year (1988) *S. hermonthica* was also found growing on barley in Gojam Administrative Region.

F. Reda, G. Jones, A. Sherif; Institute of Agricultural Research, Addis Ababa, Ethiopia

JOHANN H. VISSER

It is with extreme sadness that we record the untimely death of Johann Visser, one of the most prominent workers in the field of parasitic flowering plants. Johann had a tremendous love and boundless enthusiasm for these plants, well beyond pure scientific interest. He underwent surgery in May 1989 to remove a brain tumor and died in January 1990.

Johann had a remarkable ability to combine both field and laboratory research and as a result had a keen understanding of the biology of parasitic plants. His love for the field was evident to any of us who enjoyed his hospitality and followed him bounding through the veld. He took immense pleasure in taking his visitors around southern Africa to see the fascinating array of parasitic plants. In addition to work in South Africa, he established strong links with labs around the world and was always eager to assist in the collection of material for his colleagues.

Johann Visser was born in 1931 and studied botany at the University of Potchefstroom, completing a course in plant physiology in 1950, an MSc in 1958, and his PhD in 1961 at the University of Gottingen, Germany, on a topic involving root extracts. He took the post of senior lecturer at Pretoria in 1972 and Professor of Plant Physiology at Stellenbosch in 1979 which he held until the time of his death. Perhaps his most lasting memorial is the beautifully illustrated "South African Parasitic Flowering Plants" although he published more than 47 titles of which 35 concern parasitic plants.

Our deepest sympathy to his wife, Thresia, and his family. His loss will be keenly felt by any of us who had the privilege of knowing him.

B. Fineran and L. Musselman

• FAO WORKSHOP/AFRICA *STRIGA* NETWORK

This workshop, held at the International Institute of Tropical Agriculture (IITA) Ibadan from 11 to 14 March 1990, involved about 60 scientists from Nigeria, Gambia, Ghana, Mali, Burkina Faso, Benin, Italy, USA, France, Netherlands and UK. After opening remarks from representatives of Nigeria's Ministry of Agriculture and from FAO, Dr. S. C. Okonkwo reviewed the status of *Striga* work to date and emphasized the need for further collaborative research.

Describing FAO projects in West Africa, Dr. Carson (Gambia) first reported on successful use of a package of pre-emergence ("Propagard" or "Primagram") and post-emergence herbicides (2, 4-D and/or glyphosate) and fertilizer. Use of paraquat had been discontinued, and minimum tillage was no longer part of the package. In Cameroon, herbicides had again been the main input tested but results were less consistent and availability was admitted to be a problem. A new project in Burkina Faso had only preliminary results to report and there was no report from Zimbabwe. The Network Coordinator, Dr. S. Lagoke (Nigeria) had conducted extensive surveys for two years, showing high levels of infestation by *S. hermonthica* and apparently spreading problem of *S. gesnerioides*. Varietal and agronomic trials had been conducted, but, as in other countries, there was no resistant variety of sorghum yet suitable for inclusion in a "package" though tolerant varieties of sorghum and maize looked interesting. As in Gambia, the successful package was one depending on both pre- and post-emergence herbicides. For *S. gesnerioides* resistant cowpea lines, B.301 and IT82D-849 looked promising but there was an unconfirmed report of "breakdown" of resistance at one site.

Among other contributions there was a report of survey work and agronomic trials in Mali, including the interesting use of solarization to control *S. hermonthica* for the purpose of assessing yield loss (suggesting about 5% yield loss per *Striga* per square meter). From Ghana there was a report of trials in which the cumulative effects of treatments were to be assessed over a five year period. Another refreshing approach was reported by staff of the International Livestock Centre for Africa (ILCA) involving the laying down of "fodder banks" with leguminous species which would address the basic problem of the link between *Striga* and low soil fertility.

There were summaries from IITA on their progress with tolerant maize and resistant cowpea varieties, from Dr. Pieterse on the EEC funded collaborative project involving Netherlands, France and several West African countries; from Dr. Riches on the ODA-funded work in UK; from Dr. Musselman on USAID-funded projects, including one in conjunction with ICRISAT which will lead to the publication of a comprehensive bibliography of the world literature on *Striga*; and from Mme Ba on the interest and activities of CILSS, including ideas for the creation of a Sahel *Striga* Research Center.

One of the most important achievements of the Network has been the publication of the first issue of a new *Striga* Newsletter for which Dr. Lagoke is to be congratulated. It is to be published twice per year and copies are available from him at IAR, Ahmadu Bello University, Samaru, Zaria, NIGERIA.

• HOST SPECIFICITY: THREE WAYS OF ESTIMATION

The range of hosts utilized by a parasite is a product of numerous chemical and physical attributes of both host and parasite, but is fundamentally linked to the diversity of suitable hosts and to their temporal and spatial availability (cf. Atsatt 1983). Ways of estimation used in host specificity analysis may affect results. Three different approaches can be usually distinguished:

1. A floristic approach is the conventional practice of evaluating host specificity by compiling lists of hosts utilized over a species' entire range. Such evaluation indicates the general plasticity of the species in the region under consideration, but usually has no relevance to a particular population's capacity to exploit its immediate host-environment (Atsatt, 1983).

2. The populational-biological approach evaluates host specificity in terms of the proportion of vascular plants in a particular community that are hosts for the parasite. According to Atsatt (1983), populations restricted to one or few host species can be considered to be host-specialized, while those utilizing many unrelated hosts are generalists.

3. Inoculation tests have been used in experimental analysis of host specificity. Plants considered as potential hosts are artificially inoculated with a parasite. Such tests indicate genetic potential of the parasite as well as host resistance to parasite infection. Results obtained are also determined by some biological features of the host and by techniques of inoculations, e.g. adequate amount of inoculum, age of infected host branch, time of year of inoculation, etc. However, several environmental and populational-biological factors are eliminated by this approach, e.g. presence/absence of hosts in the region/community, presence/absence of avian dispersers in the region, amount of fruits (seeds) produced, etc.

P. Elias, Slovak Academy of Sciences, Bratislava, Czechoslovakia

• FUNCTIONING OF *CUSCUTA* HAUSTORIA BY BENZYLAMINOPURINE

The incompatibility to parasitism by *Cuscuta* can be caused by structural as well as physiological factors. A physiological one is obviously the reason for the incompatibility of *Hibiscus rosa-sinensis* and *Cucurbita pepo* to *Cuscuta reflexa*, as in the case of *Cuscuta reflexa* parasitizing on its own species (intra-specific parasitism). In all three cases the parasite can pass through the first stages of haustorial development up to the penetration of the closed haustorial cone into the plant which is attached. The further stages of development of functioning haustorium, that is to say, the forming of a connection with the vascular tissue of the host by means of search hyphae ceases however and the parasite dies. When the attack of the penetrating parasite is supported by synthetic cytokinin (6-benzylaminopurine), applied exogenously to the haustorial cone, the development is continued until normal operating contacts to the host are resumed. Such a method of initiating the functioning of haustoria could be found in all three cases of incompatibility mentioned above.

B. Ihl and F. Jacob, Institute of Plant Physiology, University of Halle, Germany

• LITERATURE

Arjona-Berral, A., J. Mesa-Garcia and L. Garcia-Torres. 1990. Distribution of C^{14} glyphosate in legumes parasitized by *Orobanche crenata*. Weed Research 30: 53- 59.

Cherif-Ali, O., T. L. Housley and G. Ejeta. 1990. Sorghum root length density and the potential for avoiding *Striga* parasitism. Plant and Soil 121: 67-72.

Coetzee, J and B. A. Fineran. 1989. Translocation of lysine from the host *Melicope simplex* to the parasitic dwarf mistletoe *Korthalsella lindsayi* (Viscaceae). New Phytologist 112: 377-381. (Results indicate that organic substances like lysine are translocated apoplastically probably through plasmatubules).

Combari, A., R. Pineau and M. Schiavon. 1990. Influence du degre de decomposition de produits organiques sur la germination de graines de *Striga hermonthica* (Del.) Benth. Weed Research 30: 29-34.

Dawson, J. H. 1989. Dodder (*Cuscuta* spp.) control in established alfalfa (*Medicago sativa*) with glyphosate and SC-0224. Weed Technology 3:552-559.

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Dawson, T. E., J. R. Ehleringer and J. D. Marshall. 1990. Sex-ratio and reproductive variation in the mistletoe *Phoradendron juniperinum* (Viscaceae). American Journal of Botany 77: 584-589.

Dawson, T. E., E. J. King and J. R. Ehleringer. 1990. Age structure of *Phoradendron juniperinum* (Viscaceae), a xylem-tapping mistletoe: inferences from a non-destructive morphological index of age. American Journal of Botany 77: 573-583.

Elias, P. 1989. Size structure and sex ratio of a host-tree population of *Loranthus europaeus* mistletoe. Biologia (Bratislava) 44(9): 855-861. (In the single host studied, there were 61 different mistletoes of varying ages. Sixty nine percent of the plants were male).

Hauck, C. and H. Schildknecht. 1990. Separation of enantiomers of the germination stimulant strigol on cellulose triacetate and determination of their biological activity. Journal of Plant Physiology 136: 126-128.

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Jones, M. 1989. Taxonomic and ecological studies on the genus *Orobanche* in the British Isles. PhD Dissertation, University of Liverpool. (A study of the cultivation, taxonomy, comparative morphology, reproductive biology, ecology and conservation of broomrapes in the British Isles).

King, B. L. 1989. Seed germination ecology of *Aureolaria virginica* (L.) Penn. (Scrophulariaceae). Castanea 54(1): 19-28. (*Aureolaria virginica* germination is similar to that described for other species in the genus. However, the author noted variation in the percent germination and stratification times in different years and suggests this may be an adaptation for surviving in a patchy environment).

Kroschel, J. 1989. (The influence of nutrients on phanerogam parasites and their host, with particular reference to *Striga hermonthica* (Del.) Benth. (Scrophulariaceae). PLITS 7 (3): 1-154. (In German).

Kumar, R. M., S. M. Kondap, P. C. Rao and C. N. Reddy. 1989. Chemical control of *Cuscuta* in mungbean (*Vigna radiata* L.). Abstracts of the Twelfth Asian-Pacific Weed Science Society Conference. Page 69. (Incidentally reports 94% yield loss due to uncontrolled infestation).

Lane, A. 1989. Prospects for the control of *Striga*, a noxious parasitic weed of tropical crops. Rural Development in Practice 1(4): 9-10. (A helpful summary of the problem and control measures).

Linke, K-H., J. Sauerborn and M. C. Saxena. 1989. *Orobanche* field guide. University of Hohenheim/ICARDA. 42 pp. (A compact, colorfully illustrated pocket guide to the major species of *Orobanche*, their biology and control).

Mcintire, J. and L. K. Fussell. 1989. On-farm experiments with millet in Niger: crop establishment, yield loss factors and economic analysis. Experimental Agriculture 25: 217-233. (Occurrence of *Striga hermonthica* on millet up to 12% infestation did not appear to be a significant yield limiting factor).

Melero-Vara, J. M., J. Dominguez and J. M. Hernandez-Martinez. 1989. Evaluation of differential lines of a collection of sunflower parental lines for resistance to broomrape (*Orobanche cernua*) in Spain. Plant Breeding 102: 322-326. (Several races of *Orobanche cernua* occur in Spain, but at least two sunflower lines show immunity to all races).

Parker, C. 1990. Some observations on the prevention of *Striga* seed production by handpulling. In: Proceedings of the Ethiopian Weed Science Committee Sixth Annual Meeting, Addis Ababa, 1988, 83-88. (Concludes that hand pulling and removal need be done only every three weeks from onset of flowering).

Parker, C. and T. I. Polniaszek. 1990. Parasitism of cowpea by *Striga gesnerioides*: variation in virulence and discovery of a new source of host resistance. Annals of Applied Biology 116: 305-311. (Reports three levels of virulence and discovery of immunity to all three types in cowpea line B.301).

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Ramaiah, K. V., V. L. Chidley and L. R. House. 1990. Inheritance of *Striga* seed-germination stimulant in sorghum. Euphytica 45: 33-38. (Low stimulant production is apparently under the control of a single recessive gene but it is not clear if the same allele is operating in the three low stimulant lines tested).

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Thalouarn, P., S. Canevet and S. Renaudin. 1990. Carbon and nitrogen metabolism in the holoparasitic plant *Lathraea clandestina* L. with respect to the main phenologic state. Journal of Plant Physiology 136: ~~766-768.~~ 193-197

Tommasi, F., L. De Gara, R. Liso and O. Arrigoni. 1990. The ascorbic acid system in *Cuscuta reflexa* Roxb. Journal of Plant Physiology 135: 766-768.

Tuquet, C., N. Farineau and G. Salle. 1990. Biochemical composition and photosynthetic activity of chloroplasts from *Striga hermonthica* and *Striga aspera*, root parasites of field-grown cereals. Physiologia Plantarum 78: 574-582. (Concludes that the low photosynthesis of these parasites is due to the lower numbers of chloroplasts and lower chlorophyll content per chloroplast).

Visser, J. H., I. Dorr and R. Kollman. 1990. Compatibility of *Alectra vogelii* with different leguminous host species. Journal of Plant Physiology 135: 737-745. (*Alectra vogelii* penetrates the cortex of *Vicia faba* and *Pisum sativum* but is apparently unable to digest host cell walls).

HAUSTORIUM is edited by L. J. Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA, electronic mail LJM100f at ODUVM, telex 823428 OLD DOM NK, fax 804-683-5155 and C. Parker, C/O Long Ashton Research Station, University of Bristol, Bristol, BS18 9AF, ENGLAND, fax (0272) 394007. It is published by Old Dominion University. Unsigned articles and literature reviews are by the editors. Send material for publication to either editor and requests for copies to L. J. Musselman.

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HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Seed Plant Research Group

February 1991 .... Numb

• FIFTH SYMPOSIUM ON PARASITIC WEEDS

The Fifth Symposium on Parasitic Weeds is scheduled for June 24-30 at the Safari Park Hotel in Nairobi with a field trip to Lake Victoria and intermediate stops. The program is full and this should be the largest and one of the most interesting of any of our symposia! For further information, contact:

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Fifth International Symposium on Parasitic Weeds
International Maize and Wheat Improvement Center
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The tentative program is as follows: Session 1 taxonomy/ecology (14 papers); Session 2 morphology/structure (7); Session 3 physiology/biochemistry (6); Session 4 germination (7); Session 5 economic impact (11); Session 6 resistance (17). in addition to posters and the field trip there are two invited papers and the meeting of the African *Striga* Network (PASCON). It will be a busy and informative meeting!

• NEW RECORD OF *ALECTRA VOGELII* IN TANZANIA

Alectra vogelii, a hemi-parasitic weed of leguminous crops, was observed for the first time during the 1988/89 season in national trials at Hombolo Research Station. The parasite infested cowpeas. During the same season, A. *vogelii* was reported on farmers fields at Naliendele in southern Tanzania. The parasite ha large yellow flowers, 10-15 cm across and a sechoe shaped stigma. In the 1989/90 crop season preliminary observations were made Sational Trials sown at the same location. Severe A. *vogelii* infestation was observed o Cowpea Uniform Yield Trial, with the rang from 94 to 287 A. *vogelii* per plant. In Ta nia, early Cowpea Maturing Variety Trial tl range was from 20-242 A. *vogelii* per plant Groundnuts planted about 200m from A. *v* infested plots were free of the parasite. *Ale vogelii* has already been reported in some c tries south of the Sahara viz. Zimbabwe. Bc swana, South Africa, Burkina Faso, Mali, K and Ethiopia. The hemi-parasite has been reported to have a wide range of hosts whic include cowpeas, groundnuts, bambara grot nuts, fodder legumes, pigeon peas and mun ans.

A. M. Mbwaga, Ilonga Agricultural Research and Training Institute. Kilosa. Ta nia

• MORE MONEY PROBLEMS FOI HAUSTORIUM!

We still do not have a sponsor for our newsletter! In an era witnessing the demis donor agency projects, federal and state fin cial stringency and university budget cuts, are thankful that we can produce this *issue* miscellaneous residual funds. But it may be last! Can any one help?

• LITERATURE

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(Herbicides applied 4-5 weeks after. transplanting in pots and field. None fully selective but chlorsulfuron promising at 5-10 g/ha.).

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HAUSTORIUM is edited by L. J. Musselman. Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA, electronic mail LJM100F at ODUVM.CC.ODU.EDU, telex 823128 OLD DON NK, fax 804-683-5155 and C. Parker, C/O Long Ashton Research Station. University of Bristol, Bristol, BS18 9AF, ENGWSI fax (0272) 394007. It is published by Old Dominion University and mailed free of charge twice year, usually in January and July. Unsigned articles and literature reviews are by the editors. Send material for publication to either editor and requests for copies to L. J. Musselman.

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Parasitic Plants Newsletter

Official Organ of the International Parasitic Seed Plant Research Group

November **1991** .... Number **26**

● HAUSTORIUM LIVES, IPSPRG NEWS, NEW SYMPOSIUM VOLUMES

We are pleased that once again temporary funding has been found for our newsletter! This assures us of at least two more issues. Please continue to supply articles for publication as well as titles which we can include in our literature section. Due to space limitations, literature must have a publication date of within the past two years.

■ *Index of Parasitic Plant Workers*

This data has been entered on the computer. Hard copies are not available but the list is on disks in either ASCII or WP5.0. Write L. Musselman for information.

■ *Obtaining Copies of the Nairobi Proceedings*

A few copies are available free to workers in developing countries upon request to L. Musselman. Others may order them at **$40** per copy (surface mail) or **$65** per copy **(air** mail) from: J. K. Ransom, CIMMYT, Post Office Box **25171,** Nairobi, Kenya. Check must be drawn on an American bank.

■ *Combating Striga in Africa*

This is the title of the Proceedings of the International Workshop on ***Striga*** organized jointly by IITA, ICRISAT and IDRC at Ibadan, Nigeria in August **1988,** which have now been edited by S. K. Kim and published by IITA. It includes **17** papers, all providing useful reviews of the status of the ***Striga*** problem and of research in progress both in advanced laboratories and in the field. It concludes with a set of recommendations. Copies are available free from IITA, P.M.B. **5320,** Ibadan, Nigeria.

■ *Venue for Next Parasitic Weeds Symposium*

At a final discussion in Nairobi, questions of the timing and venue for the next symposium were raised. It was generally agreed that further broad-spectrum symposia were desirable in addition to the more specialized meetings on ***Striga*** and ***Orobanche*** that have become a more-or-less regular feature. Assuming PASCON would be holding ***Striga*** workshops every two years, the next general symposium could be held in four years time, in conjunction with PASCON as this year, or independently in **3-4** years time. There is a tentative plan for an ***Orobanche*** meeting in Europe but no date is set. Various sites in the U. K. and U. S. were suggested and three main sites were offered for the 6th symposium (subject to confirmation by the respective host institutions):

1. University of Cordoba, ARGENTINA. (Proposer: A. Cocucci)

2. International Institute of Tropical Agriculture, Ibadan, NIGERIA or Cotonou, BENIN. (Proposer: K. Cardwell) (In conjunction with PASCON)

3. University of Cordoba, SPAIN. (Proposer: J. Cubero)

A number of comments and objections were raised in relation to each of these and it was not felt possible nor necessary to arrive at any decision immediately. It was agreed that Chris Parker and Lytton Musselman should be responsible for inviting and seeking a consensus decision in conjunction with the three proposers, within the next **12-18** months and certainly not later than the next specialized workshop. PLEASE, therefore let either of us know what you think. Bear in mind that a dedicated on site staff and substantial financial support are essential.

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• *CUSCUTA* SPECIES IN THE UNITED ARAB EMIRATES

There are severe infestations of ***Cuscuta*** species in various crops in the UAE. ***Cuscuta campestris*** was observed on mint, Jew's mallow, turnip, and alfalfa in the Masafi area in the northern emirates. Further, ***Cuscuta monogyna*** was seen on ***Convolvulus arvensis*** and climbing citrus trees in an orchard in Ghayathia area in the western region.

A. R. Saghir, United Arab Emirates University, Al Ain

• FIFTH INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS, NAIROBI 1991

This latest in our series of international symposia, completed successfully between June 23rd and 30th, was attended by 132 delegates from at least 33 countries. The Proceedings, available to delegates on arrival, included approximately 100 papers or abstracts, of which 65 were presented as papers and 10 as posters.

Job Kuijt was given a warm welcome as key-note speaker and gave useful clarification of the roles of xylem, phloem and parenchyma at the interface between host and parasite. Inge Dorr later added more detail on the ***Cuscutalhost*** interface, involving unicellular searching hyphae which penetrate both between and within host cells and show plasmodesmata. Other topics covered in the sessions on Morphology and Structure included ***Orobanche, Striga gesnerioides*** and ***Lophophytum*** (Balanophoraceae).

Sessions on Taxonomy and Ecology included the description by Cardwell et al of a useful population dynamics model as the background to IITA's ***Striga*** research program. Other papers provided valuable data on the seed bank dynamics of ***Orobanche crenata*** in Syria, by Linke et al., and described isoenzyme and host-range studies on ***Orobanche,*** diversity in ***Striga,*** nitrogen effects on ***Striga,*** and biology of the Hydnoraceae.

A session on Germination opened with a useful review on ***Striga*** germination by Sam Okonkwo. Egbers et al reported on after-ripening in S. ***hermonthica*** and showed that some germination can occur within one month of seed shed. After-ripening is hastened by high humidity, but at high temperatures, high RH can result in loss of germinability after some months. Whether this represented loss of viability or induced dormancy was not quite certain, and TTC testing was felt not to be reliable. Ransom and Njoroge confirmed the responsiveness of S. ***hermonthica*** to ethylene under field conditions and incidentally showed a lack of after-ripening requirement, even 3 weeks after harvest of seed. Hess et al concluded that something other than sorgoleone is responsible for germination of ***Striga*** seed at a distance from sorghum roots. They describe a useful new assay technique for stimulant exudation based on the distance from roots up to which germination occurs in an agar medium, e.g. 0-0.5 mm in Framida, 20-30 mm in susceptible varieties. A chinese sorghum line IS 4225 produces exceptionally high stimulation and ***Setaria italica*** even higher. Babiker et al reported on the activity of thidiazuron, causing both germination and haustorial initiation in S. ***hermonthica*** but not in S. ***gesnerioides***

Under the heading of Physiology and Biochemistry, Butler et al reported on their search for ***Striga*** germination inhibitors for possible use as crop seed treatments, and tissue culture techniques for selecting tolerant sorghum clones. This session also included an observation from ter Borg and van Ast on the tendency for some parasitic plants to cause stimulation of host growth.

Under the heading of Economic Impact, Sauerborn estimated 16 M ha affected by ***Orobanche*** and 44 M ha by ***Striga,*** the latter causing annual losses of $3 billion. Vogt et al reported on surveys in Ghana and Togo which showed clear correlation between ***Striga*** intensity and years of continuous cropping, apparently linked to soil fertility factors. Other papers concerned S. ***gesnerioides,*** S. ***hermonthica*** on sorghum/sudan grass, and ***Osyris alba*** (Santalaceae) on almond in Israel.

In sessions on Resistance, Salle et al updated us on the resistance of poplars to ***Viscum album,*** and Scarpf and Roth reported on the continuing efforts to select ponderosa pine resistant to ***Arceuthobium.*** The time scale involved in this effort was emphasized by the fact that this work was initiated in 1960. Singh and Emechebe gave a report on the very encouraging progress in development of cowpea lines with combined resistance to ***Striga, Alectra*** and a range of other pests and diseases. Isogenic lines with and without ***Striga*** resistance had been used to show **40%** yield loss from ***Striga*** infection. Bagnall-Oakley et al confirmed the resistance of cowpea lines B.301 and B.359 to ***Alectra*** in Kenya. They also reported an unexpected and unexplained increase in *Alectra* infestation following a "trap crop" of guar bean. Olivier et al reported on the latest ICRISAT work on sorghum in Mali, including the observation of extremely high *Striga*-resistance in the line IS-7777. Ejeta et al reported that the *Striga* resistance in sorghum line SRN-39 is associated with 1 or 2 recessive genes. Other papers concerned resistance of tomato to *Cuscuta*, the resistance mechanism of faba-bean Giza 402 to *O. crenata,* sorghum work in Ethiopia, South Africa, Sudan and Zimbabwe, progress with maize at IITA, and resistance of sugar-cane varieties to *S. hermonthica.*

In sessions on Control, Adu-Tutu and Drennan reported some promising results with new sulphonyl urea herbicides, especially in maize. A report by Awad et al on dicamba showed good reductions in attack by S. *asiatica* in sorghum but surprisingly little benefit in terms of yield of the host. Several reports confirmed benefits from nitrogen in suppressing *Striga* but others were less favorable and in discussion it was suggested that effects of N will only persist so long as the nutrient continues available and this might explain why higher intrinsic soil fertility (providing N more continuously) may be more reliable than mere addition of fertilizer. For control of *Orobanche* Garcia-Torres and Lopez-Granados reported promising new results with several new herbicides in legumes and sunflower, while Kleifeld et al defined some of the conditions necessary for successful use of metham-sodium. Bedi and Donchev gave a very interesting account of the development of a mycoherbicide preparation for control of *O. cernua* on sunflower in Bulgaria.

In a final session, Jean Dawson gave a useful review of *Cuscuta* control by herbicides, Eplee and Langston described progress in the eradication of S. *asiatica* in U.S.A. (83% of the affected area has now been cleared) and Carson and Kunjo reported on the substantial progress being made in the development of practical *Striga*-control methods in the Gambia, based on manuring, rotation, dense planting, hand-pulling and spot-spraying. Well organized extension campaigns aim at progressive introduction of increasingly intensive methods. These involved 15,000 farmers in 1990 and twice this number should be reached this year.

In the Poster session, some items of interest included the observation of serious attack on millet by *Buchnera hispida* in Benin and measurements showing that Striga weights were increased, rather than reduced by *Smicronyx* infestation. Progress in *Striga* research in Cameroon was well illustrated; also the importance of *Tapinanthus* on shea trees in Burkina Faso. A novel introduction on this occasion was the continuous showing of a video film on *Striga* prepared by Georges Salle and colleagues. One and a half days were devoted to a very enjoyable field trip westwards to Kisumu on Lake Victoria. This included a visit to the Kibos research station where CIMMYT and KARI have *Striga* trials and Eplee had recently installed equipment for the extraction of *Striga* seeds from soil samples. Field trials showed encouraging effects from intercropping cereals with legumes, but failed to show control of *Striga* by spraying anti-transpirants, presumably because local air temperatures are not sufficiently high.

The International Symposium was held in conjunction with the Second Workshop of the Pan-African *Striga* Control Network (PASCON), under the auspices of FAO. They met on Sunday 23rd and again on Tuesday 25th. In introductory addresses, FAO personnel emphasized their commitment to continuing support of the *Striga* network, and with the help of a consultant they had prepared a plan for a 5-year program, requiring a budget of $2M. Funding will be sought for this proposal which covers continuation and expansion of the present Network, publication of the *Striga* Newsletter (to be bilingual), further workshops on a 2-year cycle, and training and support to a number of in-country research programs. Four individuals were elected to represent different regions of Africa on a steering committee. A second issue of the *Striga* Newsletter was available at the meeting and copies can be obtained from the FAO Regional Office for Africa, P.O. Box 1628, Accra, Ghana. Presentations included country reports from most of the 15 countries already involved and brief reports from collaborating institutions such as CILSS (who have their own plans to establish a *Striga*-research centre and 3 sub-stations if funds can be raised), IITA, CIMMYT, ICRISAT, etc. Proceedings of this meeting will be published jointly with those from the meeting in Ibadan in 1990.

Overall, the Nairobi meeting was thoroughly successful and enjoyed by all who attended, though a great many of us were sad at the unprecedented absence of Lytton Musselman. CIMMYT are to be congratulated on their relatively new commitment to parasitic weeds and Striga in particular, and thanked for their allocation of substantial resources towards the success of the symposium. Above all, Joel Ransom is to be thanked for his heroic near single handed efforts with both the local organization, and the preparation of the Proceedings. We hope he has by now had time to recover! Thank you, Joel, from all of us!

C. Parker

• GROWING *BUCKLEYA* AND *PYRULARIA* (SANTALACEAE)

Over the last decade, I have made a study of the North American root parasites ***Buckleya distichophylla*** and ***Pyrularia pubera.*** Seeds germinate equally well after artificial cold treatment or natural outdoor winter conditions. However, outdoor grown seeds almost always lie dormant until spring while refrigerated ones germinate within one to two months of planting. It seems that seeds do not need a long period of very low temperatures to break dormancy as our winters are much warmer than the plants natural habitat. Germination is about 60% if seeds are planted outdoors. Times for germination are similar for both ***Buckleya*** and ***Pyrularia.*** Plants are difficult to grow beyond the seedling stage. My experience over a 10 year period shows that less than 10% of seedlings are successful. In spite of recent contrary evidence, I have found that early haustorial connection seems to be essential for long term survival particularly with ***Buckleya.*** Any plants I have grown without hosts have not survived longer than twelve months, even when seedlings have been transplanted to a host. The few plants I have grown from seed have all been planted directly above the root system of a suitable host, in a situation kept shaded, weed free and well watered during dry periods. I have found that consistent soil moisture seems to be a critical factor for seedling survival in the field.

At the present time I have several plants of both species growing outdoors. The most successful host plants are ***Tsuga canadensis, Pinus taeda,*** and ***P. uirginiana.*** The site is west facing and shaded, near sea level in a clay loam with a clay sub soil, and an artificial layer of surface humus about 30 cm deep. Two thirds of the yearly rainfall occurs between the months of May and September, while summers and autumns are hot and dry. I have tried to simulate the natural habitat of these parasites, and the results are encouraging. The first plants of ***Buckleya distichophylla*** I grew from seed in the 1985/86 season have just completed their sixth growing season. Initial growth was slow with less than 15 cm in the first two years but from the third year onwards extensive lateral branching and height increase took place. In the 1989/90 season one of the plants on ***Tsuga canadensis*** put up several new stems and after two growing seasons these stems are 75 cm in height with many side branches. Another plant on ***Pinus taeda*** is 90 cm tall with a 2 cm basal stem diameter and many branched side shoots.

It seems that these original plants have established themselves for in their fifth growing season they flowered. One plant produced female flowers on a few branches and two other plants bore several male flowers. The female plant set two fruits; one of these germinated. The same three plants again flowered the next year, but more profusely. More fruits were formed but the majority aborted during the summer; only twenty (30%) matured. With ***Buckleya,*** under New Zealand conditions leaf growth seems to be mainly in one major flush from early September to mid December, and most leaves have fallen by mid April. The first flowers appear not long after commencement of leaf growth and continue until early summer. Most fruits are fully ripe by March.

Pyrularia pubera grows much slower than ***Buckleya*** and generally only one third as tall. Most have not yet branched, but have thick woody stems and seem to be well established. The best hosts appear to be eastern U.S. species of ***Quercus*** and ***Pinus.*** The largest plant, growing with ***Liquidambar styraciflua*** is now five seasons old, and 20 cm tall - an average annual growth of only about 4 cm. In comparison to ***Buckleya*** leaf growth is later in spring for ***Pyrularia,*** and leaves fall earlier in the autumn. None of the plants of ***Pyrularia*** have shown any sign of flowering.

Leaf eating insects do considerable damage to the foliage of ***Pyrularia,*** sometimes completely defoliating some plants, but virtually no damage is done to the leaves of ***Buckleya.***

G. L. Cox, Kaukapakapa, New Zealand

• FLOWER MORPHOLOGY IN *STRIGA HERMONTHICA* AND *S. ASPERA*

These two species have striking resemblance in the color of their flowers and there is often difficulty in distinguishing them. The key in the ICRISAT Information Bulletin No. 15 (Ramaiah et al., 1983, ***Striga*** Identification and Control Handbook) refers to the corolla tube being "bent immediately above the calyx" in S. ***hennonthica,*** and "distinctly longer than the calyx" in S. *aspera.* but in some areas the calyx of S. *hermonthica* is relatively short and part of the lower corolla tube is distinctly exposed. The alternative character in the key, the width of the bracteoles (2-3 mm in *S. hermonthica* and 1-2 mm in S. *aspera)* is a reliable difference but not especially easy to use. For West Africa, Berhaut's key in Flore du Senegal is more reliable in using the position of the bend in the corolla tube - just about halfway in *S. hermonthica* and two thirds of the way up in *S. aspera.* However in Kenya, I have noted that S. *hermonthica* is consistently different in that the bend in the corolla tube is well above halfway, and hence more like S. *aspera,* though the wide, pectinate bracteoles and generally greater robustness leave no doubt that it is true S. *hermonthica.*

Some limited measurements on herbarium specimens at Long Ashton Research Station are as follows [length of tube below bend (mm/length above bend ratio-mean of 3 flowers in each case]:

S. hermonthica
Cameroon 8.3/9.0/9:1
Niger 7.017.310.9:1
Mali 8.0/8.7/0.9:1
Ethiopia 10.0/9.0/1.1:1
Kenya (1) 11.3/8.0/1.4:1
Kenya (2) 12.0/8.0/1.5:1

S. aspera
Gambia 8.314.311.9:1
Cameron 0.9/5.3/1.7:1

Study of specimens of S. *hermonthica* in the Nairobi Herbarium confirmed that all specimens collected in Kenya, Tanzania and Djibouti were of the above "Kenya" type. Those from Uganda were mostly as Kenya but with some perhaps closer to the "typical".

As S. *aspera* is relatively scarce in Eastern Africa, there is no great cause for confusion there, but the actual length of the corolla tube above the bend might prove to be a useful character (less than 6 mm in S. *aspera,* and at least 7 mm in S. *hermonthica?).* Meanwhile I suggest that further more detailed measurements confirming these observations might throw useful light on the relationship between populations of *S. hermonthica* in different parts of Africa.

C. Parker

• *STRIGA* SPECIES FROM UPLAND RICE

In a recently completed MSc. study, the host range of *S. asiatica* from Zanzibar and S. *hermonthica* from Mali, each collected from plants parasitizing maize or upland rice, were examined. The results of a pot trial indicated that S. *asiatica* (ex maize) has a broader host range than the sample from rice. The maize sample emerged well (> 12 per host plant) on maize, sorghum, finger millet, *Rottboellia cochinchinensis* and rice cv. IAC 164. Emergence was moderate (2-4 per plant) on rice cv. BKN, and limited (up to 1 per plant) on pearl millet, rice cv. IDSA 6, *Zschaemum rugosum* and the wild rice, *Oryza punctata.* For the sample from rice, emergence was good on maize, moderate on BKN and IAC 164 and limited on R. *cochinchinensis* and IDSA 6. Other species were not attacked. The two *S. hermonthica* samples had a similar host preference, emerging moderately on the cereals other than rice which showed only low susceptibility. *Oryza punctata* was not attacked by S. *hermonthica.*

A number of upland rice varieties appeared more susceptible to *S. asiatica* than *S. hermonthica* in a screening trial. IDSA 6 was not attacked in this pot trial by S. *asiatica.* Emergence of *S. hermonthica* was limited and none was recorded on WAB21, LAC 23, Kihigo or Tox. It would be worthwhile testing the apparent resistance of these varieties under conditions of higher infestation and with *Striga* samples from other rice growing areas.

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■ Bibliographies of *Orobanche* on Tobacco and Sunflower

A collaborative project between Old Dominion University and the Institute for Tobacco and Tobacco Products, Plovdiv (Bulgaria) will attempt to list all references dealing with broomrape on tobacco on a world wide basis. Another collaborative effort for an exhaustive compilation of the world's literature dealing with broomrape on sunflower involves Old Dominion University and the Institute for Wheat and Sunflower "Dobrudja" (Bulgaria). Special efforts are being made to include non-western literature. Send any references to L. Musselman.

● STUDIES ON *FUSARIUM OXYSPORUM* FOR CONTROL OF SUNFLOWER BROOMRAPE

One of the most serious constraints in sunflower (*Helianthus annuus*) culture in Bulgaria is broomrape (*Orobanche cumana*). Studies of the culture, morphology, and possibility of biocontrol of *Fusarium oxysporum* f. sp. *orthoceras* were conducted at the Institute of Wheat and Sunflower, Dobrudja, near General Toshevo, Bulgaria. Results indicate that this fungus, isolated for the first time, is pathogenic to broomrape. Mycelial growth is best on potato dextrose agar and Czapeck agar but Houston's medium is best for its sporulation. Light has no effect on fungus growth and sporulation at 25 ° C. A technique using lemon leaves has been developed for the production of macro conidia by the fungus. Naturally infected plant debris of *O. cumana* increases disease incidence in *O. cumana* but not enough for control purpose. In the glasshouse, inoculum of the fungus prepared on barley grains or wheat straw amended with maize feed ("preparation F", 5%) gave more than 84% control of *O. cumana*. In the field, barley, preparation-F and soil amended with maize feed were best. Eighty grams inoculum on barley and preparation-F and 100g on soil amended with maize feed when applied per meter, gave more than 90% control during 1990 and over 80% control during 1991 in the fields artificially infested with broomrape. In the glasshouse and field, the fungus reduces broomrape attachment on sunflower roots and also affects the attached seedlings at all stages of their growth, killing them either underground or aboveground before they can flower and produce seeds. Broomrape emergence and infestations in the field with the fungus are less than the control. The number of seedlings infected increased throughout the vegetative season, possibly due to the build up of inoculum in the host rhizosphere and the resultant decrease in the number of healthy uninfected seedlings. During 1990, less than 10% of the seedlings escaped infection in the field but up to 20% of the broomrape seedlings remained healthy during 1991, probably due to more rainfall during 1991. Experiments conducted in the field naturally infested with broomrape had 74 to 90% efficacy of the above substrates of inoculum, in controlling *O. cumana* on sunflower, during 1991. In the laboratory and under natural field conditions the fungus survives for at least 420 days.

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• LOW WATER POTENTIAL AS A DETERRENT TO MISTLETOES

Host specificity level is relatively high among mistletoes occurring in temperate Australia. In an attempt to identify different factors affecting mistletoe host specificity, water potential of six potential host species and two mistletoe species, *Amyema preissii* and *Lysiana exocarpi*, in Brookfield Conservation Park (BCP) (24 ° 25'S, 139 ° 25'E), South Australia, was measured on a monthly basis during an 18-month period. While predawn and middleday water potential of the two mistletoe species was consistently lower than that of their hosts, the predawn and middleday water potential of one of the non-host species, *Geijera linearifolia* was consistently lower than that of the two mistletoes. *Geijera linearifolia* is a evergreen shrub species. It is common in arid South Australia. In BCP, *Geijera* is one of the most common woody species and is occuring in close proximity with other mistletoe bearing plants. During the study period, seeds of the two mistletoe species were innoculated on individuals of *Geijera* and other plant species at BCP. The development of mistletoe seedlings was followed for up to 48 months. During the first few months, development of seedlings on different potential hosts was similar. The first leaves emerged about 5-6 months after inoculation. While seedlings on their usual hosts continued to grow, leaves of seedlings on *G. linearifolia* exhibited little resistance to haustorial penetration of the two mistletoes. Haustoria of the two mistletoes growing on this species were usually able to penetrate through the bark and reach the host xylem within a few months. All *Amyema* seedlings on *Geijera* died within two years of innoculation, but 12% of *Lysiana* seedlings on their usual host species had grown into plants with branches reaching 40 cm or more in length by the end of the 48 month study period, seedlings on *Geijera* remained quiescently related to the inadequate water supply from the host. Mistletoes are water parasites. One of the prerequisites for a mistletoe to establish on a potential host is the existence of a negative water potential gradient from the mistletoe to the host. The inability of mistletoes to establish on *Geijera* supports the view of Harris' et al. that lower water potential of the potential host (lower than that of the mistletoe's) acts as a deterrent to mistletoe infection.

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● NOTE FROM THE EDITORS

Due to a lack of space we cannot include several notes, the report of the November 1993 Amsterdam ***Orobanche*** symposium, the Amman ***Orobanche*** workshop, the Zimbabwe ***Striga*** workshop, discussion of plans and venue for the next symposium, and considerable literature all of which will be in issue 29 which is planned for publication in March 1994.

● THE USES OF WITCHWEED (*STRIGA ASIATICA)* IN TRADITIONAL MEDICINE

Stnga asiatica is a parasitic weed on roots of gramineous hosts. It is known as witchweed in many parts of the world, but in Malaysia it is called *Jarum* ***Mas*** or "Golden Needle." The yellow-flowered ***Striga asiatica*** is said to have medicinal value and is being used by some local people as a herbal medicine. In the literature there is a report by Alvins in 1897 that the Chinese used the leaves of S. ***asiatica*** for sores and ulcers. In this short communication I shall relate some of the purported medical uses of S. ***asiatica*** in Malaysia. Readers are warned that these reports have not been scientifically verified. One story is that local people learnt of the medicinal value of this herb by observing the behavior of the cat. After giving birth, the mother cat seeks out *Jarum* ***Mas*** to eat. This observation has led to the use of *S.* ***asiatica*** as an after-birth tonic. In Penang I was once perplexed by the many people bending and searching the grassy area along the road, as *if* they were searching for some lost coins. They were looking for the "Golden Needles" (S. ***asiatica)*** which sells for RM 1.00 per plant. A kilogram of dried Jarum ***Mas*** can fetch between RM 600 - RM 800 (RM 2.50 = US $1). I was first introduced to ***S. asiatica*** by a friend whose elderly mother takes this herb as a health tonic prepared by placing one dried plant in 2-3 tea cups full of water which is then boiled down to about a cup. The resultant brew appeared like plain tea. Taking it makes her feel "warm or heaty." In addition, it relieves pain of the joints. It is very important that the dosage taken is not excessive. One case is reported of someone making a cupful of brew and after **drinking** it being taken to the hospital because his body became rigid due to muscular spasm. Excessive dosage can also cause mouth ulcer or a tremendous increase in body temperature. ***Striga asiatica*** is also said to be toxic to the nervous system. *Jarum* ***Mas*** is used by both sexes for various ailments, such as kidney problem, loss of appetite and nerve disorders and is also used as an aphrodisiac and after-birth tonic to help in the contraction of the uterus. There are also claims that Jarum ***Mas*** is good for the relief of muscular cramps and fevers.

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● *OROBANCHE CERNUA* ON CUMIN IN RAJASTHAN

Orobanche cernua Loefl. is a common parasite on tomato, eggplant, and mustard in the arid western plain of Rajasthan. During the 1992 winter cropping season, cumin (***Cuminum cyminum*** L.), an important spice and cash crop of the area, was infested at an incidence as high as 30%. In a nearby mustard crop, the rate of infestation was only 15-20%. More surveys are planned.

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FRANK G HAWKSWORTH

Readers of HAUSTORIUM will be saddened to hear that Frank G. Hawksworth died on 8 January 1993 in Fort Collins, Colorado--his home for many years. Frank was born in 1926 in Fresno, California and received a BS in forestry from the University of Idaho in 1949, and MS and Ph.D. degrees from Yale. For most of his professional career he was with the US Forest Service's Rocky Mountain Forest and Range Experiment Station. Frank authored over 200 scientific publications on forest diseases and was the world's authority on dwarf mistletoes, the most damaging parasites in forests of western North America. Frank's work on these pests did not stop with the publication of scientific information. He maintained constant contact with foresters, scientists, and practitioners at all levels of government, industry, universities, and private practice to assist them with on-the-ground management problems. His kindness, concern for others, and quality work were especially appreciated by Mexican foresters, who affectionately knew him as "Dr. Frank." Frank's unique combination of brilliance, humility, and endless wit earned him a special place in the hearts of forest scientists and managers internationally.

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HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Seed Plant Research Group

May **1994** .... Number **29**

● ● SIXTH INTERNATIONAL PARASITIC WEED SYMPOSIUM 1996

The next symposium is tentatively scheduled for **1996** in Cordoba, Spain. If you are interested in attending, fill out the enclosed insert and mail directly to the address on the insert. The first circular is scheduled for mailing in September **1993.** For further information contact:

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● THIRD INTERNATIONAL WORKSHOP ON OROBANCHE

Held in Amsterdam **8-12** November **1993,** the workshop had about **100** delegates from **23** countries who enjoyed an excellent third Orobanche workshop in the impressive surroundings of the Royal Tropical Institute. Sixty papers and 30 posters covered many aspects of both Orobanche and Striga. After introductory papers contributions on the basic biology and taxonomy of Orobanche included observations on the evolution of the Orobanchaceae as deduced from the plastid genome (Thalouarn). There was repeated discussion of the taxonomic status of *O. cernua* v. *O.* cumana and *O.* ramosa v. *O. aegyptiaca* but no resolution. Techniques based on pollen morphology (Abu Sbaiah) and chemotaxonomy (Andary) had been used to confirm distinctions between the sections Trinychon and Orobanche (Osproleon) of the genus but not for separating the species within them. The conditioning and germination processes of *O. aegyptiaca* were described in new detail (Mayer); a new in vitro technique for growing host roots should throw useful light on stimulant exudation (Croes); and the importance of primary and secondary dormancy was discussed (Pieterse). There were also new studies on the precise role of ethylene in Striga germination (Babiker; Fer; Thuring). For the latter study an elegant new ethylene-detection technique had been used. Ethylene is not apparently involved in Orobanche germination (Joel; Wegmann). Strigol has now been confirmed as the natural Striga-germinating stimulant from maize and proso millet (Butler). The Orobanche stimulants have still not been fully determined but are increasingly thought also to be members of the strigol family (Wegmann). Two groups have continued work on structure-activity relations of strigol analogues (Zwanwenburg; Welzel). Haustorial initiation in Orobanche remains to be explained but the penetration process into the host was well described (Joel; Doerr; Shomer-Elan; Losner-Goshen). Progress in host crop resistance was reported for sunflower. Workers in Spain (Melero-Vara), Bulgaria (Encheva) and Turkey (Petzoldt) reported development of immunity to all major pathotypes of '*O.* cumana' but further pathotypes were expected to develop and there was also a report from Israel of failure of resistance under low temperature conditions (Jacobsohn). There was reiteration of the hypothesis that resistance results from a lignification response in the pericycle (Antonova) but also an alternative suggestion that resistance is expressed primarily by development of an isolation layer in the cortex and that lignification is a later secondary effect (Doerr). The possible role of phytoalexins in resistance was discussed (Wegmann). Breeding and selection in faba bean has yielded lines with useful levels of resistance to *O.* crenata, often combined with relative tolerance, for use in Egypt (Zaitoun; Abdalla; Khalil), and in Spain (Cubero); and with resistance to *O.* foetida in Tunisia (Kharrat). Among other control measures, new imidazolinone herbicides, especially imazethapyr and imazaquin, show promise not only in faba bean but also in other legumes such as pea and perhaps in sunflower (Garcia-Torres; Saber; Jacobsohn; Castejon-Munoz). In discussion, however, there was a warning that resistance to this class of herbicides is likely to develop very rapidly (Gressel). Maleic hydrazide is still being used successfully in tobacco in Cuba (Labrada). Mechanical control by 'mini-spear' was again endorsed for use in tobacco (Krishna Murty). There were further encouraging indications of the potential for mycoherbicides based on Fusarium species from China and from Bulgaria and India (Bozoukov; Bedi); also a report of successful biocontrol of Striga hermonthica by *F. nygamai* (Sauerborn). Integrated systems involving rotation, delayed planting etc had been tested in Morocco, Syria and Spain (Kroschel; Schnell; Solh; Lopez-Granados) and useful information obtained on the fate of the seed bank under different regimes. Where fertilizer was being included it was generally assumed to be increasing crop tolerance rather than contributing directly to control. Reports of Orobanche problems and current research in different countries included papers from Chile, Cuba and Sudan, where O. ramosa is a problem in all three countries (Kogan; Labrada; Babiker), also from Bulgaria, Spain, India, Morocco, Tunisia, Egypt, Jordan and Israel. Reports on EC projects included several on *Striga*, from France (Salle; Raynal-Roques; Pari), Benin (Gbehounou), U.K. (Lane), Kenya (Ransom; Odhiambo; Baltus; Kuiper) and Netherlands (Verkleij). Ransom presented the first encouraging results from a longterm trial in which the effects of hand-pulling and other treatments were being monitored for their effects on the *S. her*monthica seed bank. In a final session of general papers, Dr Gressel presented an authoritative account of the potential for the application of genetic engineering to the problem of parasitic weeds, especially the development of herbicide-resistant crops. The potential had already been proven with crops engineered for resistance to sulphonyl urea and imidazolinone herbicides but he warned that resistance to these two groups is likely to break down rapidly, while that to glyphosate should be more durable. Chris Parker summarized the latest prospects for control and emphasised the need for integrated systems which eliminated or at least minimized the risks of breakdown of crop resistance and/or the development of herbicide resistance in the parasite. Dr Abu-Irmaileh reported on the conclusions from the FAO Orobanche meeting held in Amman, Jordan in October and emphasized the need to reduce the risks of new infestations which arose from careless use of unfermented manure and contaminated crop seed. Dr Labrada also outlined a new FAO proposal for a coordinated Orobanche research programme in the Near East Region. Finally Dr Pieterse announced plans for the creation of a research group on Parasitic Weeds to be set up in the framework of the European Weed Research Society (EWRS) (regrettably since rejected by EWRS - Ed.). Dr Pieterse and his colleagues are to be congratulated on the excellent facilities and organization provided for this workshop. The proceedings are expected to be available in a few months time. Details will be in the next issue of HAUSTORIUM or contact A. H. Pieterse, Royal Tropical Institute, Mauritskade 63, 1092 ED, Amsterdam, The Netherlands.

• *PYRULARIA PUBERA* AS A PATHOGEN OF CHRISTMAS TREES IN WEST VIRGINIA; *THESIUM* IN MONTANA

The Santalaceae is a small family in North America with five genera each with a single species. Although they are all root parasites, there has been no recorded host damage. A sixth genus, Thesium, was reported as a minor weed in the Great Plains several decades ago but has since been extirpated. Recently a species Thesium and a native shrub of the Santalaceae have been reported as weeds. During the 1993 growing season, the West Virginia forest authorities were notified of damage to Abies, Picea, and *Pinus* which are grown in plantations in the Appalachian Mountains of southern West Virginia as Christmas trees. Trees were losing leaves, stems were dying back, and in heavy infestations trees were killed. Examination of the roots revealed white swellings which were assumed to be nematodes but were later determined to be haustoria of an unknown parasitic plant. During a site visit in May, it was determined that the causative agent is the widespread and common Appalachian shrub, *Pyrularia pubera*, known locally as buffalo nut. This is the first report of this genus causing damage anywhere. Control measures are being developed but the strongly rhizomatous nature of the parasite makes control difficult. The genus Thesium has been introduced into the United States on several occasions and a new infestation has been discovered on range land in Montana. The tentative determination of this species is Thesium humile, a documented problem in some grain crops in the Middle East, but the Montana plant remains to be verified as the genus is a large one with considerable taxonomic difficulty.

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● AN IMPORTANT NEW BOOK ON PARASITIC PLANTS

Parasitic Weeds of the World: Biology and Control. C. Parker and C. R. Riches, **1993. 332** pages, **16** plates + **44** Figures. ISBN 0 **85198 873 3.** Price **45** pounds sterling. Available from CAB International Wallingford, Oxon OX10 8DE, UK; North America: 845 North Park Avenue, Tucson, AZ **85719,** USA. Price US $89.50. Copies may be available to developing country institutions at a reduced cost from Technical Centre for Agricultural and Rural Cooperation, P.O. Box **380,** 6700 AJ Wageningen, Netherlands. The book includes 16 colorful high quality plates. In sharp contrast to the plates, most of the nearly **44** line drawings fall short of textbook standard. Still, I found them very helpful in illustrating the general features and morphology. It is divided into six chapters: 1- ***Striga*** (9 spp); 2- ***Striga gesnerioides*** and ***Alectra*** (**3** spp); **3-** ***Orobanche*** (6 spp); *4*- Other root parasites in Scrophulariaceae, Orobanchaceae, Santalaceae, and Balanophoraceae; **5-** ***Cuscuta*** (**14** spp) and ***Cassytha;*** 6- the Loranthaceae and the Viscaceae. There are keys to species and each species is discussed separately as to its distribution, host range, variation, economic importance, biology and physiology, ecology, and control. The aspect of control has an interesting part to it- recommending different control measures for various levels of parasitic infestation. In addition, each chapter concludes with specific control strategy appropriate to the parasite stressing integrated control measures and improved extension services. The book draws from and integrates the vast literature on the various aspects of parasitic plants that have accumulated in the past **25** years ***(850*** references). Although not in great depth, it is one of the few publications that bring together all the major groups of parasitic plants and address the different aspects of their biology, ecology, physiology, and control. A comprehensive and up-to-date review of the control measures of the economically important parasitic weeds make this book special. Thus it will serve as one of the major sources of information to students and research workers.

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● *STRIGA* IN COTE D'IVOIRE 1992 AND 1994

A reconnaisance was undertaken in early September **1992** of rice areas north of Boundiali, Korhogo and Ferkessedougou. In the west of this zone S. ***aspera*** is conspicuous among wild grasses and locally as severe infestations in rice and maize. It is also common on "fonio" ***(Digitaria exilis***). ***Striga hermonthica*** occurs at low densities in rice and maize and associated also with sorghum and grass weeds, especially ***Digitaria horizontalis.*** In the vicinity of Korhogo and Ferkessedougou where S. ***aspera*** appears not to occur, severe infestations of S. ***hermonthica*** were seen in rice, maize, and sorghum. Patches of the yellow flowered morphotype of S. ***asiatica*** were also seen on rice. Further south in the forest/savannah transition zone, we found both red and yellow morphotypes of S. ***asiatica*** parasitic on wild grasses. Farmers had not seen this parasite on rice. ***Striga gesnerioides*** was observed on ***Ipomoea eriocarpa*** near Korhogo. No ***Striga*** was apparent in cowpea and farmers were not aware of the parasite on this crop so it seems likely that this area is south of the range of the cowpea strain of ***S. gesnerioides. Alectra vogellii***, on the other hand, is common on peanut in the Korhogo areas with noticeable damage at several sites, The Natural Resources Institute (NRI) is colloborating with the West African Rice Development Association (WARDA) in a search for ***Striga*** resistance for use in rice varieties suitable for savannah areas of West Africa.

C. R. Riches, D. E. Johnson, NRI, UK and R. Diallo, WARDA, Bouake

The results of our survey in mid-October **1993** are quite different from those reported above likely due to a later season. We found only one field of sorghum and maize severely infested with S. ***hermonthica,*** about 70 km west of Ferkessedougou. ***Striga brachycalyx*** is abundant in native grasslands. Several other species were found but no S. ***aspera.***

D. M. Berner, International Institute of Tropical Agriculture and L. J. Musselman

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HAUSTORIUM is edited by L. J. Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia **23529-0266** USA, electronic mail LJM100F at ODUVM.CC.ODU.EDU, fax **804-683-5283** and C. Parker, C/O Long Ashton Research Station, University of Bristol, Bristol, BS18 9AF, ENGLAND, fax **(0275)394007.** It is prepared by John Musselman and is usually published twice yearly by Old Dominion University and funded by grant **DHR-5600-G-00-1021-00** from the Agency for International Development. Unsigned articles and literature reviews are by the editors. Send material for publication to either editor. Complete sets of HAUSTORIUM are available for **US$30** postpaid. Make checks payable to Lytton J. Musselman and drawn on an American bank. Send requests for copies and sets to L. Musselman. If you have electronic mail, you may wish to receive your copies of HAUSTORIUM or the bibliographies in this manner. To do so, send a request via electronic mail to Lytton Musselman at the email address above. Issues **21-29** are available free via electronic mail.

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● ● SIXTH INTERNATIONAL PARASITIC WEED SYMPOSIUM CORDOBA, SPAIN 16-18 APRIL 1996

Plan to attend the symposium in beautfiul Cordoba, Spain where in addition to plenary sessions, papers, and posters there will be opportunity to see ***Orobanche, Cuscuta.*** and ***Viscum*** in the field. Like previous symposia, all groups of parasitic plants are included. For information contact:
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● BACTERIA THAT SCAVENGE GERMINATION STIMULANTS?

There is a microbiological principle stating no naturally occurring substance exists that cannot be broken down by a microorganism. ***Striga*** depends on the production of tiny seeds that are stimulated to germinate by chemical stimulants of which strigol is the best known. Strategy in the present research is to find a way to intervene into this process by interfering between the stimulant, whether strigol or one of its closely related analogs, and ***Striga*** seed. This project aims at finding a soil microorganism that could scavenge strigol as it exudes from the host root before it reaches the striga seed. Probability that such an organism can be found should be high because the microorganisms could have a number of other functions not confined to breaking down the probably recalcitrant heterocyclic strigol molecule. Simple techniques have been followed to test the hypothesis. Most of the work was carried out in sterile petri dishes with moistened filter papers on which sorghum grains were grown (3-6 days) into seedlings which presumably release the strigol related substance sorgolactone on the filter paper. In the control experiments, preconditioned (10-12 days at 25 ° C) *Striga* ***herrnonthica*** seeds on glass fiber filter paper were placed in the petri dish with the sorghum seedlings, incubated at room temperature and the germinated seeds counted. The soil microorganisms to be tested for their ability to nullify the effect of the stimulant are grown on nutrient agar plates, the cell population suspended in distilled water and the suspension used in the test experiment. Here the bacterial suspension (inhibitor carrier) was added together with the *Striga* seeds to the petri dish carrying the sorghum seedlings. The isolate most commonly used was a mucoid, yellowish bacterium (probably a *Xanthomonas* sp.), originally isolated as a sorghum seed pathogen and was routinely propagated on sorghum seedlings in petri dishes. The addition of the bacterial suspension to the stimulant source reduced the ability to germinate the ***Striga*** seeds. About 65% of the *Striga* seeds germinated in the absence of the bacterial suspension (control) while only 8.4% germinated in the presence of the microorganisms (Treated.) In a supportive experiment, sorghum grains were grown in sterile sand in plastic cups for one week and watered with test bacterial suspension or with distilled water. Then the water was removed by a vacuum pump and used to stimulate ***Striga*** seeds. Controls gave 55.5% germination while test experiments gave 27.4% germination. A few pot experiments were also carried out in which sorghum seedlings were transferred from the petri dishes to large clay pots containing garden soil infested with ***Striga*** seeds at the rate of 0.08 grams per pot. The sorghum was grown for 44 days and plants watered with bacterial suspensions or with distilled water. Then. the plants were uprooted and the attachments of the ***Striga*** to the sorghum roots were counted. The results obtained showed that when bacterial suspensions were added to the soil the attachments of striga to host roots averaged *36;* in the controls, they averaged 114 attachments. We have also tried to gather some preliminary information on the nature of the inhibitor. In one experiment, we separated the liquid from the cell mass in the suspension, using a 0.45 micron bacterial filter. and tested the ability of each to inhibit the germination stimulant. The effective ingredient resided in the filtrate not in the cell mass. Heat treatment destroyed the ability of the inhibitor to have any effect on the stimulant suggesting that the inhibitor is a volatile substance or a protein that is denatured by heat. From a biotechnological view point. once a suitable organism has been obtained and the mechanism of its action on the stimulant has been elucidated, the useful ingredient can be obtained by growing the organism in a suitable growth medium in bioreactors. If the cells themselves are to be mixed with the seeds of sorghum before sowing as a dressing, then they can be provided in dry powder form like any other commercial microbial preparation. Obviously microbes that are pathogenic (e.g., the strain used here) cannot be used. If a chemical produced by the organism is the effective ingredient, then it could be produced in pure form. Both preparations should pose no environmental problems. The technology needed for the production of large scale biomass or chemical is available today. The yields can be improved through modern techniques of process optimization, and the microbial strains could be improved using recombinant DNA technology. It may even be possible to transfer the genes concerned from the microorganism to the host plant itself to make it intrinsically resistant to ***Striga.*** We believe that this research could open an area of useful research in weed control as the technique could equally well be applied to the control of similar parasitic weeds.

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• SEX RATIO IN MISTLETOES

There are many dioecious mistletoes from the new and the old world. The sex ratio of many dioecious plants often deviates significantly from **1:1** with tendency towards a male bias. Earlier sex ratio surveys on mistletoes have reported a female-bias. ***Viscum album*** populations have a strongly female biased sex ratio in natural populations, but in other European and Asian species of ***Viscum*** sex ratios not differing from 1:1 have been found. Sex ratios were at unity in most dioecious African species of ***Viscum.*** but female biased ratios as low as 0.52 and male biased ratios as high as high 1.40 may occur in some species. Female biased sex ratios were found over all populations of ***Phoradendron tomentosum*** in Central Texas by Nixon and Todzia. Recently Marshall et al. stated that, unique among the mistletoes studied to date, the sex ratio of ***Phoradendron juniperinum*** populations is significantly male biased. In populations of ***Loranthus europaeus,*** parasitizing oaks ***(Quercus cerris*** and ***Q. petraea),*** I found male bias. Male plants prevailed: they formed **69.2% of** all living plants. This male biased sex ratio was in relation to the woodland coenopopulation of ***Loranthus.*** Biological and ecological causes of the variations in sex ratios in mistletoes are not known. Barlow found that in dioecious species of ***Viscum,*** males are normally heterozygous for sex associated chromosomal translocations, and in ***V. album*** male plants usually form a ring of eight to ten chromosomes at meiosis. Nixon and Todzia found that only the trees with one mistletoe exhibited a sex ratio near 1:1. Trees with two or more mistletoes generally showed female biased ratios. The authors suggested that a general trend of increased within tree female bias is associated with higher number of mistletoe per tree. But ***Loranthus europeaus*** showed similar sex ratios in both the woodland and within host tree populations. We need more information about sex ratios in several mistletoes species and in several environmental conditions. In mistletoe population dynamic studies it is important to accept the dioecy and sex ratio bias.

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• PROCEEDINGS OF THIRD *OROBANCHE* SYMPOSIUM

The proceedings can be obtained from: KIT Press, Royal Tropical Institute, Mauritskade **63, 1092** AD Amsterdam, NETHERLANDS. The cost is 55 US$ + **$12** for mailing surface mail and $24 for air. Payment is to be made upon receipt of the volume. When ordering, indicate mode of shipment. (See literature section below under Pieterse etc for complete citation. See HAUSTORIUM **29** for a report **on** the symposium.)

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● ● SIXTH INTERNATIONAL PARASITIC WEED SYMPOSIUM CORDOBA, SPAIN 16-18 APRIL 1996 † FINAL ANNOUNCEMENT †

The organizing committee of the symposium met in Cordoba in October to review papers and plan the sessions. Over 140 papers have been accepted for the symposium. There will be workshops on biocontrol; molecular techniques in parasitic plant research; and integrated management of parasitic weeds. The venue of the meeting is in a former palace that has been converted to a modern conference center retaining the charming ambience of ancient Spain. Early registration is advised especially to garner hotel rooms at a specially reduced rate. For further information contact:

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● BOOK REVIEW: EUROPEAN BROOMRAPES

Orobanche. The European Species. A Field Guide. 1. Central and Northern Europe. C. A. J. Kreutz, 1995. 159 pp. ISBN 90-74508-05-7. Price Deutchmark 59.00 (excluding postage). Available from Natuurhistorisch Genootschap in Limburg, Postbus 882, NL-6200 AW Maastricht, The Netherlands.

This beautiful volume, A4 in format and bilingual throughout in English and German, covers 26 Orobanche species. Each species has a page devoted to description plus comments on flowering time, habitat, hosts, distribution and nomenclature, a page with excellent line drawings of the complete flower and a cutaway to show stamens and ovary, combined with a distribution map covering all of Europe and some of W. Asia and N. Africa. There are also 2 pages of superb colour photographs, one full-page of the whole plant and four quarter-pages showing more detail. In addition there is an extended introductory section with general observations on systematics, taxonomy, nomenclature, biology, ecology, host range, agricultural significance and some brief comment (a little inadequate) on control, There is an illustrated glossary of the important morphological features (in Dutch as well as English and German) and a diagnostic key to the species. Finally there are a substantial bibliography and indices to the species as known in Latin, English, German and Dutch.

Arrangement of species is mainly alphabetical by specific name, but the sections Trionychon (4 spp.) and Orobanche (22 spp.) are treated separately, so at first it is puzzling not to find *O. ramosa* after *O.* picridis. Orobanche *cumana* is treated separately from *O.* cernua but there is no excessive tendency to splitting and with the benefit of the plates it is possible to be persuaded that most, if not all the taxa dealt with deserve specific status. A second volume dealing with species of Southern Europe is planned.

The author and publishers are to be congratulated on the production of a volume well worthy to join Johann Visser's 'South African Parasitic Flowering Plants' on the shelves of all dedicated students of parasitic angiosperms.

C. Parker

PUBLISHED BY OLD DOMINION UNIVERSITY

• OBITUARY: W. G. H. EDWARDS

We are sad to record the death earlier this year of Professor Bill Edwards who was instrumental in setting up the very first International Parasitic Weed Symposium in Malta in 1973. At that time he was Professor of Chemistry in the Royal University of Malta and responsible for a British Overseas Development- funded project on ***Orobanche crenata*** in fababeans. One of the main objectives was to identify the germination stimulant from the host. This proved and continues to prove elusive, but the project threw valuable light on other aspects of the biology and control of the weed while related work in UK led to the discovery of the selectivity of glyphosate against ***O. crenata*** in fababean. After leaving Malta in 1975 he became Visiting Professor at Royal Holloway College, London University, before joining the Gezira University at Wad Medani in Sudan as Professor of Chemistry from 1979 to 1984. Here he continued to encourage and contribute to local work on parasitic weeds, notably ***Striga hermonthica,*** up to his retirement in 1984. Those who knew him will remember his warm geniality and infectious enthusiasm.

• SCROPHULARIACEAE ON THE INTERNET!

The British Museum of Natural History has a Gopher site for Scrophulariaceae. The address is (gopher://157.140.2.2:70/00/botany/ scroph) or via the web (http://www.nhm.ac.uk/). There are plans to expand coverage of different aspects of the family. For further information, contact Dr David Sutton, email address: d.sutton @ nhm.ac.uk.

• WHITEVILLE PARASITE LAB CLOSED

For almost four decades, the U S Department of Agriculture witchweed laboratory near Whiteville, North Carolina was a leading facility in the development of novel control methods for parasitic weeds. In addition, a great deal of basic research was either done at Whiteville or in collaborative efforts with universities and government agencies around the world. During the summer of 1995 the witchweed laboratory was permanently closed. The number of employees was drastically reduced and the skeleton staff moved to Oxford, North Carolina. The new address is: USDA/APHIS/PPQ, Oxford Plant Protection Center, 901 Hillsboro Street, Oxford, North Carolina, 27565. Fax number: 919 693 3870.

• BRISTOL *STRIGA* WORKSHOP

The EU-sponsored Workshop, 30 May-2 June 1995, was the first to concentrate solely on the mechanisms of infection of Striga and ***Orobanche*** and crop resistance. It also aimed to assess the relevance of such studies to the development of control measures. The conference was organised by John Bailey and Athene Lane, with assistance from Drs Kroschel, Pieterse, Salle and Prof. Zwanenburg. The Workshop was held in the Victorian mansion of Burwalls which overlooks the Bristol suspension bridge. The setting, beautiful grounds, and congenial staff undeniably added to the success of the meeting.

There were over 40 participants who all presented papers or posters which reported many new advances. The chemistry of gemination stimulants is now well understood for Striga (but not ***Orobanche),*** and related chemical analogues have been synthesized (Butler, Zwanenburg). The description of the infection process is well established for both parasite genera. Emphasis was placed on the early events that determine the attachment of parasite seedlings to host roots and the role of primary and secondary parasite haustoria (Heide-Jorgensen, Riopel, Reiss).

Examples of highly effective resistance to ***Striga*** have been identified in cowpea, sorghum and upland rice (Ejeta, Lane, Riches, Singh). Several mechanisms of resistance were described for ***Orobanche*** and ***Striga*** species (Dorr, Joel, Lane, Timko, Verkleij). It was notable that resistance was expressed in many different crops and their relatives after an initially successful infection. The expression of resistance was described in some detail, but the actual mechanisms of resistance are unknown. The only exceptions are the low-stimulant sorghums (Butler) and the phytoalexins associated with the resistance of sunflowers to ***Orobanche*** (Wegmann).

Parasitic plants show great variability, and it was agreed that deployment of a new resistant variety will only be successful if there is an understanding of variability in parasite pathogenicity. However, apart from ***S. hermonthica*** and ***S. gesnerioides*** there has been no detailed characterization of parasite variability. The existence of variety-specific races is now well documented in ***S. gesnerioides*** and their distribution in W. Africa has been mapped (Lane). Some molecular analyses were reported for ***S. hermonthica*** (Koyama, Hess), and mentioned in discussion for *O. cernua* and *O. ramosa* (Joel).

Another important new aspect were the molecular initiatives. One report was that the infection of maize roots by S. hermonthica suppresses the normal host stress response genes (Mayer). The expression of genes in tobacco plants was also shown to be modulated by parasite infection (Thalouarn). Genes were activated during formation of *S. asiatica* haustoria, and pathogenesis related proteins were expressed during infection of host roots by Orobanche (Timko, Joel). The SRN39 gene for the low-stimulant type of resistance in sorghum has been mapped through analysis of recombinant inbred lines developed at Purdue University (Ejeta).

In addition, a visit to Long Ashton Research Station by the Workshop participants provided an opportunity to view the Institute Strigu research programme and an excellent forum for informal discussions. Participants saw examples of resistance of cereals and sorghum to *Striga* and the methods used for assessing the nature of resistance and the extent of variability of Striga species.

J. A. Lane, IACR-Long Ashton Research Station, Department of Agricultural Sciences, University of Bristol, Long Ashton, Bristol, BS18 9AF, UK.

● LITERATURE

Abbasher, A. A., J. Kroschel and J. Sauerborn. 1995. Microorganisms of *Striga hermonthica* in northern Ghana and approaches to their use as biocontrol agents. Biocontrol Science and Technology 5: 157-161. (Thirteen species isolated. *Fusarium* spp. commonest and present in 90% of Strigu samples.)

Abu Sbaih, H. A., D. M. Keith-Lucas, S. L. Jury and A. S. Tubaileh. 1993. Pollen morphology of the genus Orobanche L. (Orobanchaceae). Botanical Journal of the Linnean Society 116: 305-313. (Differences described between 6 main groups within the genus but not between closely related species.)

Afifi, M. S., M. F. Lahloub, S. A. El-Khayaat, C. G. Anklin, H. Ruegger and O. Sticher. 1993. Crenatoside: a novel phenylpropanoid glycoside from Orobanche *crenata*. Planta Medica 59: 359-362.

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Anonymous. 1994. Institute of Plant Protection Scientific Activities 1988- 1998. Special Publication No 255. Dept. of Scientific Publication, The Volcani Center, Bet Dagan, Israel. 468 pp. (In pp. 359-398 the Dept. of Weed Science reports on a wide range of studies on Orobunche, mostly now published elsewhere: also one report on excellent selective control of *Cuscuta campestris* in chickpea using prodiamine before dodder germination - much more effective than propyzamide.)

Ansari, A. A., P. G. Diwakar and P. Dwarakan. 1994. Studies on parasitic angiosperms of Shevaroy and Kalli Hills. (India) Journal of Economic and Taxonomic Botany 18: 297-300. (Including descriptions of 1 sp. in Balanophoraceae, 12 spp. in Loranthaceae and 2 Cuscuta spp.)

Aparicio, A., M. J. Gallego and C. Vasquez. 1995. Reproductive biology of *Viscum cruciatum* (Viscaceae) in Southern Spain. International Journal of Plant Sciences 156: 42-49.

Atokple, I. D. K., B. B. Singh and A. M. Emechebe. 1995. Genetics of resistance to Strigu and *Alectra* in cowpea. Journal of Heredity 86: 45-49. (Confirming that the Striga-resistance genes in B.301 and IT82D-849 are allelic or very closely linked, while that in Suvita-2 is at a different locus. Alectra-resistance is associated with two non-allelic dominant genes in B.301 and with a further non-allelic gene in IT81D-994.)

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Berner, D. K., K. F. Cardwell, B. O. Faturoti, F. O. Ikie and O. A. Williams. **1995.** Relative roles of wind, crop seeds, and cattle in the dispersal of ***Striga*** species. IITA Research **10: 1-6.** [Slightly modified from Plant Disease **(1994) 78:402-406.]**

Berner, D. K., J. G. King and B. B. Singh. **1995.** ***Striga*** research and control - a perspective from Africa. Plant Disease **79: 652-660.** (A well-illustrated general review with some emphasis on recent IITA work, including promising results from transplanting sorghum.)

Calvin, C. L. and C. A. Wilson. **1995.** Relationship of the mistletoe ***Phoradendron macrophyllum*** (Viscaceae) to the wood of its host. International Association of Wood Anatomists Journal **16(1): 33-45.** (Parenchyma contacts predominate at the interface of host and parasite. Direct tracheary contacts were more abundant in latewood than in earlywood.)

Cardwell, K. F. and J. A. Lane. **1995.** Effect of soils, cropping system and host phenotype on incidence and severity of ***Striga gesnerioides*** on cowpea in West Africa. Agriculture, Ecosystems and Environment **53: 253-262.** (Found to be associated mainly with sandy soils; but apparently absent where cotton rotated with cowpea.)

Ciotola, M., A. K. Watson and S. G. Hallett. **1995.** Discovery of an isolate of ***Fusarium oxysporum*** with potential to control ***Striga hermonthica*** in Africa. Weed Research **35: 303-309.** (Successful in pot tests and not pathogenic to sorghum.)

Cross, G. B. and T. C. Clark. **1995.** Clover broomrape ***(Orobanche*** minor Sm.) eradication effort in North Carolina. WSSA Abstracts, **1995** Meeting of Weed Science Society of America. p. **34.**

Dawoud, D. A. **1995.** Autecological studies on phytoparasites of the genera ***Alectra***, ***Orobanche*** and ***Striga*** with special reference to their early developmental stages. PLITS **13(1). 112** pp.

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Diana, G. and F. Castelli. **1994.** (Adversities to the tobacco crop : plants.) (In Italian) Informatore Fitopatalogico **44(6): 11-17.** ***(Orobanche*** and ***Cuscuta*** noted as damaging weeds of tobacco in Italy.)

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English, T. J., R. E. Eplee and R. S. Norris. **1995.** Successful witchweed eradication strategies employed in North and South Carolina. WSSA Abstracts, **1995** Meeting of Weed Science Society of America. p. **35.**

Furuhashi, K., M. Kanno and T. Morita. **1995.** Photocontrol of parasitism in a parasitic flowering plant, ***Cuscutajaponica*** Choisy, cultured in vitro. Plant and Cell Physiology **36: 533-536.** [Far-red light induced mutual (within species) parasitism and self- parasitism (within plant). Neither observed under white (fluorescent) or red light or in darkness. Blue light caused twining but very little haustorial development.]

Gal'vidis, I. **1993.** [Biological features of great dodder ***(Cuscuta europaea*** L.) in eastern Lithuania.] (In Russian) Ekologija **3: 65- 69. (34** host species recorded among which ***Urtica dioica*** is one the most favoured.)

Goldwasser, Y., Y. Kleifeld, D. Plakhine and B. Rubin. **1995.** Variation in vetch (***Vicia*** spp.) resistance to Egyptian broomrape ***(Orobanche aegyptiaca*** Pers.) WSSA Abstracts, **1995** Meeting of Weed Science Society of America. p. **84.**

Gomez, J. M. 1994. Importance of direct and indirect effects in the interaction between a parasitic angiosperm *(Cuscuta epithymum)* and its host plant (*Hormathophylla spinosa*). *Oikos:* 71: 97-106. (Noting only sporadic infestation and no significant effects on fruit or seed yield of the host, but some reduction in numbers and diversity of pollinators visiting the infected host.)

Grabias, B., S. Ofterdinger, L. Swiatek and A. Kurowska. 1993. Iridoid glycosides from *Lathraea squamaria.* Phytochemistry 32: 1489-1491. (Mentions incidentally that L. *squamaria* is used in Poland to treat epilepsy.)

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Karunaichamy, K. S. T. K., K. Paliwal and K. Natarajan. 1993. Diurnal course of leaf gas exchange of mistletoe (*Dendrophthoe falcata*) and its host (*Azadirachta indica*) in a semi-arid region of Southern India. Proceedings, Indian National Science Academy Part B, Biological Sciences 59: 505-510.

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Kelly, C. K. 1995. Thoughts on clonal integration: facing the evolutionary context. Evolutionary Biology 9: 575-585. (Includes reference to earlier work on *Cuscuta.)*

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Kreuz, C. A. J. 1995. *Orobanche.* The European Broomrape Species: 1. Central and Northern Europe. Natuurhistorisch Genootschaap in Limburg, Maastricht, The Netherlands. 159 pp. (See review elsewhere in this newsletter.)

Kumar, R. M. and S. M. Kondap. 1993. Response of green gram and black gram cultivars to *Cuscuta* infestation. Indian Journal of Plant Protection 21: 167-171. (Cv M2 of *Vigna radiata* and cv T9 of V. *mungo* less attacked than others.)

Kuoh, C. S. and G. I. Liao. 1993. Flower initiation and development in *Cuscuta australis* R. Br. (Convolvulaceae). Taiwania 38: 99-108.

Lagoke, S. T. O. and R. Hoevers, editors. 1995. *Striga* Newsletter. Number 5. 26 pages. (This excellent, comprehensive newsletter deserves wide circulation. It contains news of *Striga* meetings, national programs, networking, and a very helpful section entitled 'Scientific News' . This section has helpful abstracts of published work but, more helpfully, original reports of research. The newsletter is printed in color, attractive, and well edited. For information on how to receive the *Striga* Newsletter, contact: FAO Regional Office for Africa, Post Office Box 1628, Accra, GHANA.)

Lagoke, S. T. O., R. Hoevers, S. S. M'Boob and R. Traboulsi. 1994. Improving *Striga* Management in Africa, Proceedings, 2nd General Workshop of the Pan- African *Striga* Control Network (PASCON), Nairobi, 1991. FAO, (address above). 234 pp. (Including country reports and recommendations as well as 27 technical papers.)

Lal, R. J. **1994.** ***Orobanche cernua*** Loefl. (broomrape) on tobacco in India - a critical appraisal. Agricultural Reviews **(Karnal) 15(1): 31-42.**

Lanini, W. T. and G. Miyao. **1994.** Influence of rotation and management on the density of field dodder ***(Cuscuta campestris).*** In: **1994** Research Progress Report, Western Society of Weed Science. p. **VII-2.** (Serious infestations noted in tomato and safflower, but apparently controlled by preventing seeding in two successive seasons.)

Lanini, W. T. and **G.** Miyao. **1994.** Dodder (***Cuscuta campestris)*** biology and management in tomatoes. Proceedings, Western Society of Weed Science **47: 59.** (***Cuscuta campestris*** increasing as a problem in tomato in California; at harvest a single ***Cuscuta*** plant covers an average **3** m of crop row in which yields are reduced **27%.)**

Lehman, P. S. (Compiler) **1994.** Nematology. Triology Technical Report **33(5):** 7. (Reporting the occurrence of ***Meloidogyne javanica*** on roots of ***Striga gesnerioides*** in Florida, USA.)

Lehtonen, P. **P. 1995.** The National Environmental Policy Act and permits for noxious and parasitic plants. WSSA Abstracts, **1995** Meeting of Weed Science Society of America. p. **106.**

Logan, D. C. and G. R. Stewart. **1995.** Thidiazuron stimulates germination and ethylene production in ***Striga hermonthica*** - comparison with the effects of **GR-24,** ethylene and **1**-aminocyclopropane-**1**-carboxylic acid. Seed Science Research **5: 99-108.** (Thidiazuron is shown to act in the same way as **GR-24** and natural stimulant in stimulating ACC synthase activity and hence ethylene synthesis and germination, also in stimulating oxygen uptake in conditioned seeds.)

Matthies, D. **1995.** Parasitic and competitive interactions between the hemiparasites ***Rhinanthus serotinus*** and ***Odontites rubra*** and their host ***Medicago sativa.*** Journal of Ecology **83: 245-251.** (Including the unexpected observation that host root:shoot ratio was reduced by the parasites.

Miller, A. **E.** and R. G. Westbrooks. **1995.** ***Orobanche*** minor Smith survey and eradication in South Georgia. WSSA Abstracts, **1995** Meeting of Weed Science Society of America. p. **34.**

Naidoo, **L.** A. C., S. E. Drewes, F. E. Drewes, J. van Staden and M. E. **Aken. 1994.** When is a parasite no longer a parasite? The case of ***Sarcophyte sanguinea*** and exocarpic acid. South African Journal of Science **90: 359-360.** [Noting that exocarpic acid from ***S. sanguinea*** (Balanophoraceae), as well as inhibiting some bacteria, in keeping with its use in traditional medicine, also stimulated initiation and elongation of roots of the host ***Acacia*** karoo.]

Nandula, V. K., **C.** L. Foy and J. H. Westwood. **1995.** Effects of adjuvants, germination stimulants and nutrients on germination of ***Orobanche*** spp. In: Proc. Northeastern Weed Science Society, Boston, Mass., **1995.** p. **32.**

Olaniyan, G. **O.** and G. A. Iwo. **1993.** Field evaluation of sorghum varieties for reactions to witchweed ***Striga hermonthica*** (Del.) Benth. in Nigeria. Agricultura Tropica et Subtropica. **26: 79-84.** (Among sorghum varieties tested, ICSV **1001** BF and **1007** BF were 'immune' and the local check Fara fara was 'tolerant'.)

Pirani, V., G. Capriotti, A. del Gatto and M. Tiberi. **1993.** (Sowing date, anti-cryptogam treatments, ***Orobanche*** damage and losses at harvesting in dry pea crops.) (In Italian) Informatore Agrario **49(41): 30-37.** (Early planting and suitable rotation helped to reduce infestation and damage from undefined ***Orobanche*** sp.)

Popp, M. **1993.** Ecological aspects of nitrogen nutrition. Progress in Botany **54: 448-460.** (Including some specific reference to parasitic plants.)

Proctor, G. **1993.** IIRB weed control study group - Italy. British Sugar Beet Review **61: 12-14.** (***Cuscuta campestris*** recorded as a weed of sugarbeet in Italy.)

Qasem, J. R. and M. A. Kasrawi. **1995.** Variation of resistance to broomrape ***(Orobanche ramosa)*** in tomatoes. Euphytica **81: 109-114. (25** tomato varieties and one wild type compared; wide range in numbers of parasite attaching or emerging, but low correlation with damage caused.)

Raju, **C.** A., **G.** V. G. Krishna Murty, K. Hagarajan and **M.** S. Chari. **1995.** A new disease of ***Orobanche cernua*** parasitising tobacco, caused by ***Sclerotium rolfsii.*** Phytoparasitica **23: 235-237.**

Ransom, J. K. and G. D. **Odhiambo. 1995.** Effect of corn (Zea ***mays)*** genotypes which vary in maturity length on ***Striga hermonthica*** parasitism. Weed Technology **9: 63-67.** (Early-maturing varieties generally support less emerged *Striga* and may outyield longer-season types.)

Ransom, J. **K., G.** D. **Odhiambo** and J. Gressel. **1995.** Seed dressing maize with imidazolinone herbicides to control ***Striga hermonthica*** (Del.) Benth. WSSA Abstracts, **1995** Meeting of Weed Science Society of America. p. **5.** (Using herbicide-resistant maize.)

Reid, **N., Z.** G. Yan and J. Fittler. **1994.** Impact of mistletoes (***Amyema miquelii***) on host ***(Eucalyptus blakelyi*** and ***Eucalytpus melliodora***) survival and growth in temperate Australia. Forest Ecology and Management 70: 55-65. (Thorough pruning of parasite from individual trees in matched pairs resulted in 22-24% increase in foliage and 49-55% increase in radial growth after 33 months.)

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Rennenberg, H., R. Scupp and A. Schneider. 1994. Thiol composition of a xylem- tapping mistletoe and the xylem sap of its hosts. Phytochemistry 37: 975-977. (Observations from *Viscum album* on *Betula*, *Malus*, etc.)

Sanjay Mishra and G. G. Sanwal. 1994. Effect of *Cuscuta* infection on chloroplast lipid composition of *Brassica* leaves. European Journal of Plant Pathology 100: 61-70.

Schnell, H., K-H. Linke and J. Sauerborn. 1994. Trap cropping and its effect on yield and *Orobanche crenata* Forssk. infestation on following pea (*Pisum sativum* L.) crop. Tropical Science 34: 306-314. (In a pot experiment 14 crops averaged 31% reduction in *O. crenata* seed; faba bean best at 47% v. fallow 10%; peas yielded best after *Trifolium alexandrinum*.)

Schrader-Fischer, G. and K. Apel. 1993. The anti-cyclic timing of leaf senescence in the parasitic plant *Viscum album* is closely correlated with the selective degradation of sulfur- rich viscotoxins. Plant Physiology 101: 745-749. (Recording the disappearance of the mRNA for viscotoxin and breakdown of this one protein during senescence. Other proteins are lost at abscission.)

Schrader-Fischer, G. and K. Apel. 1993. cDNA-derived identification of novel thionin precursors in *Viscum album* that contain highly divergent thionin domains but conserved signal and acidic polypeptide domains. Plant Molecular Biology 23: 1233-1242.

Seel, W. E. and M. C. Press. 1994. Influence of the host on three sub-arctic annual facultative root hemiparasites. 11. Gas exchange characteristics and resource use-efficiency. New Phytologist 127: 37-44. (*Rhinanthus minor*, *Euphrasia frigida* and *Melampyrum silvaticum* showed highest photosynthesis on legume host and least when unattached. Carbon, nitrogen and water relations were all highly host dependent.)

Sibony, M., E. Lior, A. Fischler and B. Rubin. 1995. Resistance of *Amaranthus* spp., horseweed (*Conyza canadensis*) and field dodder (*Cuscuta campestris*) to acetolactate synthase (ALS) inhibitors. WSSA Abstracts, 1995 Meeting of Weed Science Society of America. p. 87. (Populations of *C. campestris* in Israel show resistance to sulfonylurea herbicides.)

Sissoko, M. 1994. (Integrated control of enemies of millet in the Banamba zone of Mali.) (in French) Sahel PV Info 60: 15-19. (Includes reference to *Striga hermonthica*.)

Smith, L. H., A. J. Keys and M. C. W. Evans. 1995. *Striga hermonthica* decreases photosynthesis in *Zea mays* through effects on leaf cell structure. Journal of Experimental Botany 46: 759-765. (Increase in permeability of cell walls in the bundle sheath lead to leakage of carbon dioxide and decreased effectiveness of C4 photosynthesis.)

Srivastava, S., A. Nighojkar and A. Kumar. 1995. Purification and characterization of starch phosphorylase from *Cuscuta reflexa* fdaments. Phytochemistry 39: 1001-1005.

Subramaniam, K., Jamuna Ranie, B. R. Srinivasa, A. M. Sinha and S. Mahadevan. 1994. Cloning and sequence of a cDNA encoding a novel hybrid proline-rich protein associated with cytokinin-induced haustoria formation in *Cuscuta reflexa*. Gene 141: 207-210.

Takeuchi, Y. 1994. Biology of parasitic weeds and their control. (in Japanese). Journal of Pesticide Science 19(4): 183-195.

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Wanek, W. and A. Richter. 1993. L-iditol: NAD'5-oxidoreductase in ***Viscum album:*** utilization of host-derived sorbitol. Plant Physiology and Biochemistry (Paris) 31: 205-211.

Weber, G., K. Elemo, S. T. O. Lagoke. 1995. Weed communities in intensified cereal-based cropping systems of the northern Guinea savanna. Weed Research 35: 167-178. (Noting that ***Striga hermonthica*** occurred in 47.5% of all the fields surveyed in Katsina and Kaduna States of N. Nigeria. There was some apparent association of ***S. hermonthica*** with ***Acalypha, Alysicarpus*** and ***Porphyrostemma*** spp.)

Weber, G., K. Elemo, S. T. O. Lagoke, A. Awad and S. Oikeh. 1995. Population dynamics and determinants of ***Striga hermonthica*** on maize and sorghum in savanna farming systems. Crop Protection 14: 283-290. (A valuable ***summary*** of in-depth surveys, including the observation that while intensive maize helps to suppress ***Striga,*** extensive maize crop management contributes to ***Striga*** increase.)

Weber, H. C. 1993. (Observations on the establishment and growth rates in the first stages of development of ***Viscum album*** L. (Viscaceae).) (In German) Beitrage zur Biologie der Pflanzen 67: 319-331. (Observations over a 6-year period of widely varying growth patterns.)

Whiteley, A., M. Grant and N. Simpson. 1995. ***Lathraea clandestina*** - digging deeper. The New Plantsman 2: 89-91. (Noting a range of hosts in U.K. and providing hints on propagation.)

Whitney, P. J. 1995. Broomrape and beans. Biologist 42: 162-164.

Yan, Z. 1993. Germination and seedling development of two mistletoes, ***Amyema preissii*** and ***Lysiana exocarpi;*** host specificity and mistletoe-host compatibility. Australian Journal of Ecology 18: 419-429. (Seeds of both species germinated normally on any host but subsequent development was unsatisfactory on non-preferred hosts due to unidentified incompatibility.)

Zaki, M. and J. Kuijt. 1995. Ultrastructural studies on the embryo sac of ***Viscum minimum.*** I. Megasporogenesis. Protoplasma 185: 93-105.

Zhiqian, L. 1994. (Mechanism of action of glyphosate on dodder control). (In Chinese) Acta Phytolacica Sinica 21: 369-372.

Zopfi, H. J. 1993. Ecotypic variation in ***Rhinanthus alectrolophus*** (Scrophulariaceae) in relation to grassland management. II. The genotypic bases of seasonal ecotypes. Flora (Jena) 188: 153-173.

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HAUSTORIUM

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Official Organ of the International Parasitic
Seed Plant Research Group

May 1997 .... Number 32

• • WHAT HAPPENED TO HAUSTORIUM?

The editors apologize for the delay in publishing HAUSTORIUM 32. The good news is that we have received support from the Food and Agriculture Organization for HAUSTORIUM. This has enabled us to upgrade computer capabilities and develop a home page. But we still very much need contributions from you! And we still need long term financial support.

• WE'RE ON THE WORLD WIDE WEB!!

HAUSTORIUM now has its own homepage! Find us at the Old Dominion University homepage: www.odu.edu Select College of Sciences, the Department of Biological Sciences, then faculty, then Musselman. At the end of the Musselman page click on HAUSTORIUM. This homepage will be updated regularly. You can contact us electronically at: ljm100f@viper.mgb.odu.edu.

• THE SEVENTH INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS

Possible venues and dates for the next parasitic weed symposium were discussed at Cordoba. Norfolk, Virginia was suggested as a possible site. The date is yet to be determined but is very tentatively planned for May 1999. Suggestions and offers for sponsorship are eagerly sought!

• ICRISAT *Strigu* Review

A Review of ***Strigu*** Control in Sorghum and Millet was held at ICRISAT, Samanko, Mali on 27-28 May 1996. Participants from National Agricultural Research Programs in West and Southern Africa; Universities and Research Institutes in UK, Germany and USA; as well as ICRISAT scientists from Africa and India attended the two-day meeting. The review was based on a series of papers which summarized and synthesized the present status of research on methodologies for control of ***Strigu*** in sorghum and millet. This was complemented by working groups which critically reviewed ICRISAT's past and present efforts on ***Strigu*** control and made priority recommendations on future research needs to improve the focus and organization of the research and collaboration with existing and new partners (NARS, IARCs, ARIs, NGOs etc.).

The main recommendations of the review included the reinforcement of ICRISAT's strategy to develop integrated control methodologies; the need for ICRISAT to place more emphasis on ***Strigu*** in sorghum; the need to enhance collaborative linkages for strategic research especially related to better understanding of variability within major ***Strigu*** spp. for developing sound strategies for resistance breeding and developing improved screening methodologies through the use of existing bioassays and molecular marker technology; the need to develop a well-balanced, multi-disciplinary team in West Africa; and the importance of supporting the Parasitic Weeds Theme of the System-wide IPM Initiative to foster collaboration with IITA and CIMMYT. A proceedings from the review is being prepared for publication by ICRISAT in 1997.

J. Lenne, ICRISAT, Patancheru, India

• A ROOT PARASITE FROM THE UPLANDS OF SRI LANKA

During a recent visit to Sri Lanka it was possible to travel to some of the higher altitude areas in the center of the island, where the world-famous tea industry is based. The natural sub-montane flora in the 2000-2500 m range bears a striking similarity to the Himalayan flora found at a similar altitude in Nepal some 1400 miles to the north. In both habitats the majestic ***Rhododendron arboreum*** is a dominant tree species and the large species of ***Magnolia*** of the middle Himalayas are mimicked by ***Michelia nilagirica*** in Sri Lanka. Among the sub-shrubs ***Berberis zeylanica*** is a reminder of the gaudy yellow flowered Himalayan species ***Mahonia napaulensis*** which has contributed so much to the genetic foundation of the varieties of ***Mahonia*** favored by horticulturalists.

This dwarf montane forest is engulfed by cloud for large parts of the year and it is thought to intercept significant amounts of precipitation. Experiments are currently underway to quantify the contribution of this interception to the soil water balance and its importance to the water economy of the upper Mahaweli river catchment. It was while inspecting the site of an experiment in this montane forest that the striking root parasite ***Christisonia bicolor*** was spotted. ***Christisonia*** has one of the largest and most spectacular flowers I have seen in the Orobanchaceae. The genus is confined to Asia and most records are from south India and Sri Lanka (the only Himalayan collection - a single collection from Sikkim - has been C. ***hookeri,*** interestingly) though it extends to China in the North to Burma, the Philippines and Peninsular Malaysia in the East. Clumps of ***Christisonia bicolor*** can be found among the dark understory of the mature forest. Trimen in the Handbook Flora of Ceylon records that it is parasitic on the roots of Acanthaceae. These are likely to be ***Strobilanthes*** species which are common sub-shrubs in the area. In India both ***C. calcarata*** and ***C. neilgherrica*** are reported to be parasitic on ***Strobilunthes*** spp. (Hooker, 1850). Very little has been published on the genus since it was first described by Gardner in 1847 who recognized seven species. Several additions have been made to the genus subsequently and at least three are endemic to Sri Lanka. There are two closely related parasitic genera ***Aeginetia*** and ***Campbellia*** and the taxonomic boundaries between them are not clear and similarly, there is no agreement on the species limits within ***Christisonia. Christisonia aurantiaca*** is considered synonymous with ***C. bicolor*** but this is not apparent from the illustrations in Wight or from Gardners original descriptions.

There appears to be almost no information on this group of plants in modern literature. There are illustrations of ***C. calcarata*** in Wight 1885 and of ***C. aurantiaca*** and ***C. lawii*** in Neilgherry Plants published in 1893. Wight was also impressed by the beauty of these plants and suggested that they could be as popular in cultivation as orchids were it not for their parasitic habit. He predicted that one day they would become popular horticultural subjects but to date this has not happened.

The stem is a flattened structure partially submerged in the soil but appearing cobbled and uneven from the numerous large flower buds on the surface. Flowers appear singly or in small groups. They are tubular up to 5 cm. in length opening to a weakly defined bilabiate mouth. The throat of the corolla is deeply purple fading to white at the margins. The style is very persistent with a large clavate, papillose stigma up to 75 mm broad. Styles remain erect from the flattened stem after the corolla has disappeared and the viscid stigma remains pendulous with several in various stages of maturity. Anthers are in two pairs with pronounced spurs articulating on the tips of the filaments at their centers. There appears to be no chlorophyll in any part of the plant. The pollination biology of this peculiar plant can only be guessed but the viscid persistent stigmata might be attractive to slugs or to snails.

[For beautiful line drawings of these plants, see HAUSTORIUM **32** on the Web]

Philip Bacon, Oxford Forestry Institute, University of Oxford, South Parks Road, Oxford, UK

● FOURTH INTERNATIONAL WORKSHOP ON *OROBANCHE* RESEARCH

This symposium is scheduled for **23-26** September 1998 in Albena, Bulgaria and is sponsored by the Institute for Wheat and Sunflower in Bulgaria. The institute is a leading center for ***Orobanche*** research in sunflower. Sessions will include germination, physiology, growth and development, resistance and other topics of interest to parasitic plant researchers. Albena is a small resort city on the beautiful Bulgarian Black Sea coast. For further information contact the Technical Secretariat for the sysymposium at fax number **(359)** 058 **26364.**

● SIXTH INTERNATIONAL PARASITIC WEEDS SYMPOSIUM

The Sixth International Symposium was successfully held in Cordoba from 16 to 18 April. About 150 delegates and their spouses attended from at least **30** countries, and enjoyed what must have been the cultural highlight of our series so far, as well as a scientific programme to equal any. The meetings were held in the exquisite atmosphere of the Palacio de Congressos only just outside the walls of the ancient mosque, but the facilities were very much up-to-date. Just over 100 papers were accepted for publication in the attractive Proceedings entitled 'Advances in Parasitic Plant Research' which was available on arrival. About half these were presented orally, the remainder as posters.

The meeting was opened by a representative of the main sponsors, the Directorate General of Agricultural Research, Consejero de Agricultura y Pesca, Junta de Andalucia. Professor Jose Cubero then treated us to a thought- provoking review of the progress and content of the six symposia so far.

The first invited lecture, presented by Dan Nickrent, showed how new molecular techniques using ribosomal RNA, could be used to clarify the evolutionary and phylogenetic relationships between and within different families of parasitic plants. Results have suggested a reappraisal of several of these relationships and confirmed many others. A number of other papers pursued the same theme, using both molecular and more traditional cladistic techniques. These tended to confirm the possible separation of the 'agrestal' ***Striga asiatica*** from other closely related taxa such as S. ***hirsuta*** and S. ***lutea,*** while suggesting a relatively close relationship between **S. *hermonthica*** and **S. *aspera,*** the former perhaps representing another 'agrestal species' derived from the latter (invited paper by Mohamed, Musselman and others). The concept of agrestal species might also be applied to the Old World ***Orobanche cernualcumana*** which has relatively recently evolved to attack New World species such as sunflower, tomato and tobacco. The separation of this pair of species, as well as the **O. *ramosalaegyptiaca*** pair appeared to be justified by several of the studies. A workshop devoted to the topic of molecular biology provided useful reminders of its potential but also of the need for careful selection of technique to match the objectives of the study. In the most detailed review of the subject to date, Jose Cubero came to valuable conclusions on the relationships within Orobanchaceae, based on cytogenetic studies.

Turning to more conventional morphology and development, there were welcome descriptions of less familiar parasites, including an excellent invited paper from Alfredo Cocucci on ***Prosopanche*** (Hydnoraceae) in Argentina. Other papers touched upon ***Rhamphicarpa, Thesium, Santalum*** and ***Arnyema,*** trichomes in ***Striga,*** tuberisation in ***Orobanche,*** predation and redistribution of ***Orobanche*** seeds by soil fauna, while a further novelty was a time-lapse video showing the strange circumnutations of ***Viscum album,*** as it arrives at the most efficient arrangement of its branches for light interception (R. Dorka).

Papers on host/parasite relationships were introduced by an invited lecture from Klaus Wegmann (not included in the Proceedings), followed later by one on nitrogen effects by Arnold Pieterse and that by Danny Joel on the haustorium and resistance mechanisms. The effects of nitrogen on germination continue to attract attention, while the work of Malcom Press and colleagues reinforces the idea of a role for N in protecting the host from damage. This team also demonstrated clearly how the influence of ***Striga*** on cereal hosts involves a great deal more than the mere removal of carbon metabolites (which can explain most of the effects of ***Orobanche*** on tobacco and tomato) though the relative importance of effects on host photosynthesis and re-partitioning of resources, is still not fully clear. Other papers concerned the transfer of S, N and alkaloids from various hosts to ***Cuscuta.*** Inge Dorr gave us further elegant demonstration of symplastic connections in several host/parasite systems and some new structures in the xylem connections of ***Striga hermonthica.***

Several papers reinforced the probable importance of phytoalexins in host resistance, while others showed correlations between peroxidase activity and resistance to ***Cuscuta*** in tomato, and between enzymes triggering lignin synthesis and the ***Cuscuta***-resistance of ***Phaseolus.*** A report on the induction by ***Orobanche*** of a defence-related gene in tobacco (by Westwood and others) seems likely to be followed by many more on this theme at future meetings.

In terms of selection and breeding for resistance, no outstanding advances were reported on resistance to ***Striga*** in maize or sorghum, though several Spanish groups reported valuable new sources of ***Orobanche*** resistance in wild species of ***Helianthus*** and ***Vicia*** while Riches reported encouraging progress in the search for resistance to ***Striga*** spp. in rice and Scharpf corresponding progress in the (very long) process of developing resistance to ***Arceuthobium*** in ponderosa pine.

Papers on biocontrol were discussed in a workshop session, at which serious doubts were expressed over the practicality and economics of the use of ***Fusarium*** spp. as mycoherbicides, whether for ***Striga*** or ***Orobanche.*** However, the importance of natural soil suppression (by bacteria, as well as fungi) was also emphasized and hopes expressed that ways could be found to enhance this phenomenon, which is presumed to be responsible for surprising declines in soil seed counts of S. ***hermonthica*** in some studies in Kenya.

For more direct control, the most novel results have been with herbicides applied as seed-dressings, using seeds of normal faba bean treated with imidazolinone herbicides such as imazapyr for control of ***O. crenata*** (Luis Garcia-Torres and colleagues) and seeds of genetically-engineered herbicide-resistant maize treated with imazapyr and sulphonylureas for control of S. ***hermonthica*** (Gordon Abayo, Joel Ransom and colleagues). In neither case is complete control achieved but the idea promises to provide the farmer with a relatively simple and inexpensive technique. An especially welcome report was that showing successful selective control of O. ***aegyptiaca*** in tomato with application of triasulfuron via sprinkler irrigation (Kleifeld and colleagues). 0ther papers reported promise from more conventional applications of chlorsulfuron to sorghum to control ***Striga*** in Sudan, imidazolinone herbicides to faba bean to control ***Orobanche foetida*** in Tunisia and for control of ***Cuscuta*** in carrots in Israel. Among papers on non-chemical methods, the transplanting of sorghum as a means of reducing ***Striga*** attack is confirmed as one more option to be considered. Trap-cropping to reduce the S. ***hermonthica*** seed bank gave disappointing results in Kenya, emphasizing the need for a better understanding of the factors affecting ***Striga*** germination in the field, including varietal differences within trap-crops. Another paper was the first to report on the potential for use of agro-forestry species for control of Striga, and we hope will be followed by many more as realization grows of the importance of longterm improvement in soil fertility.

In a final session on integrated control systems there were no outstanding new ideas, but a welcome increase in consideration of the role of extension and education in the development and delivery of ideas for integrated control systems.

Jose Cubero and Maria-Teresa Moreno are to be congratulated on their superb contributions to the success of this meeting and for arranging fascinating programmes for the evenings and for accompanying persons. All of us will remember Cordoba as a wonderfully colorful, convivial city.

Enquiries about the availability of the Proceedings should be addressed to:

D. Rafael Cantizano
Direccion General de Investigacion Agraria
Consejeria de Agricultura, Pesca y Alimentacion
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SPAIN

C. Parker

● POSTDOCTORAL RESEARCH POSITION IN MAIZE

The Rockefeller Foundation seeks a postdoctoral maize breeder to help implement a program supporting research on the production of African maize varieties with durable resistance to parasitic weeds of the genus Striga. The selected candidate will be assigned to a research institute in Africa that is a grantee of the Foundation. Write to:

Postdoctoral Search-Maize Breeder
Agricultural Sciences Division
The Rockefeller Foundation
420 Fifth Avenue
New York, NY 10018-2702
USA

● TWO EXCELLENT NEW BOOKS ON PARASITIC PLANTS

Dwarf Mistletoes: Biology, Pathology, and Systematics. 1996. F. G. Hawksworth and D. Wiens. Agriculture Handbook 709. United States Department of Agriculture, Forest Service. Washington, D.C. xiv + 410. Cost not given.

Dwarf Mistletoes is a wonderful book that will be THE resource on dwarf mistletoes for years to come. Beautifully laid out (except, inexplicably, for the front cover with a title difficult to discern against the mistletoe background), this world class monograph is carefully planned, thorough, well documented, and readable. .pp After the succinct introduction, the life cycle of Arceuthobium is discussed, emphasizing seedling establishment of the parasite. I find the diagram of the life cycle and the figure of the intriguing ballistic fruits (pages 8 and 9) to be especially useful for classes when discussing fruit dispersal and phanerogamic parasites. Following chapters discuss sexual reproduction, biogeography, host relationships (especially important since dwarf mistletoes are serious forest pathogens), ecology (including biotic relationships other than host-parasite), physiology?pathology, and control. In short, everything you want to know about dwarf mistletoes is here including a table documenting those established beyond their natural ranges, medicinal uses, etc, etc.

Approximately half of the book deals with taxonomy, including molecular systematics. The "formal taxonomy" section includes distribution maps, excellent color photographs (although some are too dark in my copy), and list of specimens examined. Most helpful, however, are the observations of the authors, both keen students of nature who convey their fascination with dwarf mistletoes even in the "formal taxonomy". The list of references is exhaustive and the indices functional.

This book is in memory of the first author, Frank Hawksworth, who died while the present book, a successor to a 1972 edition, was being written. Frank's enthusiasm, keen observation, and love of mistletoes is appropriately enshrined in this outstanding volume. (Adapted from a review to appear in ECONOMIC BOTANY)

■

Parasitic Plants. 1995. Edited by Malcom Press and Jonathan Graves. Chapman and Hall, London. xii + 292. Cost: L45.

"...an attempt to provide a baseline of information to fill the gap since Kuijt's [1968] text" is the raison d'aitre the editors give for this volume. Simply put, Kuijt's book can probably never be replaced by a single volume due to the tremendous advances made since, and in many cases because of, his Biology of Parasitic Flowering Plants. There are simply too many papers. As Press and Graves note, many of these papers are included in the proceedings of the symposia on parasitic weeds. While these volumes are readily available, they are not handled the same way as other archival literature and thus, alas, not utilized as they should be.

The present work should ameliorate this situation by providing a modern (at least up to 1995) treatment of parasitic angiosperms. Almost three decades have elapsed between Parasitic Plants and The Biology of Parasitic Flower Plants. Therefore, it is not surprising that the approach is different. The eleven chapters are organized more around how the parasites function rather than on taxonomy and morphology. There is an introductory chapter and two chapters on parasitic weeds. The remainder deal with germination, haustorial initiation, mineral nutrition, carbon and nitrogen relations, water relations, reproductive biology, genes and genomes, and host responses.

Press and Graves suggest that this book will find value as a textbook. The cost is prohibitive for general student use, especially when compared to the relatively inexpensive albeit less stringently edited symposia volumes. Considering the state of flux in the field of parasitic angiosperms, I felt it was better to use the book as a reference in my course in parasitic vascular plants and emphasize rather the primary archival and electronic literature.

This book is very carefully edited and contains useful tables and charts. However, the incredibly poor binding (at least on my copy) lessens its value.

L. J. Musselman

● PARASITIC PLANT INITIATIVE FOR THE INTERNATIONAL AGRICULTURAL CENTERS

On August 26 through August 30, 1996, the parasitic flowering plants task force met at IITA, Cotonou to develop a project proposal and formally launch this aspect of the CG system-wide IPM initative. During the course of the meeting, the participants focussed on developing a collaborative, CG system-wide project for integrated parasitic flowering plant management in West Asia and all of Africa. The outcome of the meeting was a logical framework for the project entitled Collaborative Integrated Parasitic Plant Management (CoIPPM). The logical framework contains 21 outputs and 67 activities centered around two project themes: research and implementation. In addition, the activities of the project were further focussed around development of 13 pilot sites in the ecoregions associated with the African Highlands Initiative (3 sites), the Desert Margins Initiative (3 sites), the Moist Savanna Consortium (3 sites), North Africa (3 sites), and West Asia (1 site).

It was decided that outputs should be allocated 52% to research and 48% to implementation. The outputs were prioritized within each of these two project themes, and projected funding was assigned to each output based on the prioritization. In addition, it was decided that the IARC to NARES split of the budget allocations would be 20% to 80%, respectively. This resulted from the conviction that this project was heavily oriented toward on-farm adoption and that NARES would need a larger share of the funds to accomplish this. Matching funds from the IARCs and NARES (based on current core and special project allocations) were estimated to be approximately equal to requested supplemental funding.

Dana K. Berner, International Institute for Tropical Agriculture, Ibadan, Nigeria.

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Georgieva, I. G. and H. G. Bozoukov. **1995.** Study on the properties of some pesticides to stimulate germination of the broomrape *(Orobanche* spp.) seeds. Bulgarian Journal of Agricultural Science **1(1): 13-17.** (Among **52** fungicides, herbicides and insecticides tested, active compounds included thiophanate-methyl, endosulfan, thiofanox and vernolate.)

Goldwasser, Y. **1995.** Spinach *(Spinacia oleracea* var. Attica) as a host of Egyptian broomrape *(Orobanche aegyptiaca).* Phytoparasitica **23: 357-358.**

Goldwasser, Y., Y. Kleifeld, S. Golan, A. Barguti and B. Rubin. **1995.** Dissipation of metham-sodium from soil and its effect on the control of *Orobanche aegyptiaca.* Weed Research **35: 445-452.**

Gomes, S. **1996.** (Cape Verde Flora. Vascular Plants. Orobanchaceae.) (in Portugese) Flora de Cabo Verde No **82. 7** pp. (Including description and illustrations of *Cistanche phelypaea.)*

Gomez, M.A., M.T. Saenz, M.D. Garcia, R. de la Puerta and M.C. Ahumada. **1996.** Effect of methanolic extract of parasitic *Viscum cruciatum* Sieber on mitosis in *Allium cepa* L. Cytobios **85(340): 59-63.**

Goncalves, M. L. **1995.** (Cape Verde Flora. Vascular plants. **73.** Cuscutaceae.) (in Portuguese). Flora de Cabo Verde No **73, 9** pp. (Describing *Cuscuta planiflora* vars. *approximata* and *planijlora* and *C. umbellata.)*

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Haidar, M. A., W. Bibi and N. Abdel-Khalek. **1995.** Effect of wheat and barley residues on branched broomrape *(Orobanche ramosa)* growth and development in potatoes. Proceedings, Brighton Crop Protection Conference - Weeds, Brighton, **1995.** pp. **871-876.** (Rates of **6,000-12,000** kg straw/ha, preferably incorporated, reduced O. *ramosa* emergence by at least 50% and increased potato yield in some cases.)

Haigh, S.L. **1996.** Saltcedar (*Tamarix ramosissima),* an uncommon host for the desert mistletoe *(Phoradendron californicum).* Great Basin Naturalist **56(2): 186-187.**

Hajta, T., K. Hostanska, J. Fischer and H. Lentzen. **1996.** Investigation of cellular parameters to establish the response of a biomodulator: galactoside-specific lectin from *Viscum album* plant extract. Phytomedicine **3: 129-137.** (The lectin showed to increase the priming of polymorphonuclear leukocytes in humans.)

Haynes, A.R., N.C. Coile and T.S. Schubert. 1996. Comparison of two parasitic vines: dodder *(Cuscuta)* and woe vine *(Cassytha)*. Botany Circular (Gainesville) No 30. 3 pp.

Hall, J. P. 1996. Forest insect and disease conditions in Canada 1994. 112 pp. (Including mistletoes.)

Harten, A. van. 1996. ***Sitobion loranthi***, a new aphid from Angola living on mistletoes (Homoptera: Aphididae). Entomologische Berichten 56: 76-79. (A new species occurring on several species of Loranthaceae in Angola.)

Haynes, S. C., W. L. MacDonald and L. J. Musselman. 1996. Oilnut parasitism of firs. U. S. Department of Agriculture, Forest Service, Northeastern Area, Southern Region. NA-PR-03-96. (A pest alert poster for oilnut, ***Pyrularia pubera***, Santalaceae, that attacks ***Abies balsamea*** and ***A. fraseri*** grown as Christmas trees in the Appalachian Mountains of West Virginia.)

Hershenhorn, J., Y. Goldwasser, D. Plakhine, G. Herzlinger, S. Golan, R. Russo and Y. Kleifeld. 1996. Role of pepper ***(Capsicum annuum)*** as a trap and catch crop for control of ***Orobanche aegyptiaca*** and ***O. cernua***. Weed Science 44: 948-951. (Pepper caused more germination of **O.** ***aegyptiaca*** than tomato but was less attacked; sweet peppers were less attacked than paprika or hot peppers; 3 pepper varieties caused germination of **O.** ***cernua*** but were not attacked at all.)

Hezewijk, M.J. van and J.A.C. Verkleij. 1996. The effect of nitrogenous compounds on in vitro germination of ***Orobanche crenata*** Forsk. Weed Research 36: 395-404. (Germination strongly inhibited by 4 mM ammonium sulphate, but only partially by 8 mM urea and not at all by 16 mM nitrate.)

Hibberd, J. M., W. P. Quick, M. C. Press and J. D. Scholes. 1995. Carbon fixation, partitioning and growth of cowpea parasitized by ***Striga gesnerioides.*** In: Physiological responses of plants to pathogens, Dundee, 1995. Aspects of Applied Biology 42: 117-124.

Hibberd, J. M., W. P. Quick, M. C. Press and J. D. Scholes. 1996. The influence of the parasitic angiosperm ***Striga gesnerioides*** on the growth and photosynthesis of its host ***Vigna unguiculata.*** Journal of Experimental Botany 47: 507-512. (***Striga gesnerioides*** causes no change in root:shoot ratio and inconsistent effects on photosynthesis. The main damage appears to result from its strength as a sink.)

Hillocks, R.J., J.W.M. Logan, C.R. Riches, A. Russell-Smith and L.J. Shaxson. 1996. Soil pests in traditional farming systems in sub-Saharan Africa - a review. Part 2. Management strategies. International Journal of Pest Management 42: 253-265. (Including discussion of host resistance and cultural methods for control of ***Striga*** and ***Alectra*** spp.)

Hoffman, G., C. Diarra and D. Dembele. 1994. ***Striga asiatica,*** new pest of maize in Mali. FAO Plant Protection Bulletin 42: 214-215. (First report of S. ***asiatica*** on crops in Mali.)

Hunt, R.S., J.N. Owens and R.B. Smith. 1996. Penetration of western hemlock, ***Tsuga heterophylla*** by the dwarf mistletoe, ***Arceuthobium tsugense,*** and the development of the parasite cortical system. Canadian Journal of Plant Pathology 18: 342-346.

Igbinnosa, I., K. F. Cardwell and S. N. C. Okonkwo. 1996. The effect of nitrogen on the growth and development of giant witchweed, ***Striga hermonthica*** Benth.: effect on cultured germinated seedlings in host absence. European Journal of Plant Pathology 102(1): 77-86. (In general nitrate enhanced seedling growth, while ammonium and urea suppressed it.)

Igbinnosa, I. and P. A. Thalouarn. 1996. Nitrogen assimilation enzyme activities in witchweed ***(Striga)*** in hosts presence and absence. Weed Science 44: 224-232.

Jeschke, W. D., P. Baumel and N. Rath. 1995. Partitioning of nutrients in the ***Cuscuta rejlexa-Lupinus albus*** association. Aspects of Applied Biology 42: 71-79.

Jeschke, W.R. and A. Hilpert. 1997. Sink-stimulated photosynthesis and sink-dependent increase in nitrate uptake: nitrogen and carbon relations of the parasitic association ***Cuscuta reflexa*** - ***Ricinus communis.*** Plant, Cell and Environment *20:* 47-56. (Exploring the relatively mild damage caused to the host in this combination, and the important role of N.)

Johnson, D.E., C.R. Riches, R. Diallo and M.J. Jones. 1997. ***Striga*** on rice in West Africa; crop host range and the potential of host resistance. Crop Protection 16: 153-157. (Rice was susceptible to S. ***aspera*** from maize and rice; to S. ***hermonthica*** from maize, sorghum and rice; and to S. ***asiatica*** from maize and ***Andropogon gayanus*** : 5 vars of **O. *glaberrima*** and 2 of **O. *sativa*** (IR 47255 -B-B-5-4 and IR 49255 -B-B-5-2) were partially resistant to S. ***aspera*** and S. ***hermonthica.)***

Jurado-Exposito, M., M. Castejon-Munoz and L. Garcia-Torres. 1996. Broomrape ***(Orobanche crenata)*** control with imazethapyr applied to pea ***(Pisum sativum)*** seeds. Weed Technology 10: 774-780. ***(Orobanche crenata*** well controlled (SO-SO%) and pea undamaged by seed dressing or seed soaking with imazethapyr equivalent to 20-40 g/ha, leading to significant increase of crop yield.)

Kadas, I., G. Arvai, K. Miklo, G. Horvath, L. Toke, G. Toth, A. Szollosy and M. Bihari. 1996. Novel approach to the potent germination stimulant strigol and its analogues. Journal of Environmental Science and Health. Part B, Pesticides, Food Contaminants, and Agricultural Wastes 31: 561- 566.

Kamlesh Mathur, R.B. Gurjar and K. Chitle. 1995. Onion and garlic - two new hosts of dodder. Indian Journal of Mycology and Plant Pathology 25:335. (Occurrence of unspecified ***Cuscuta*** in Rajhastan, India.)

Khalid, A.N. and S.H. Iqbal. 1996. Mycotrophy in a vascular stem parasite ***Cuscuta reflexa.*** Mycorrhiza 6(1): 69-71. (AM-inoculated plants of C. ***reflexa*** showed increased biomass and longevity.)

Kim, S.K. and V.O. Adetimirin. 1997. Responses of tolerant and susceptible maize varieties to timing and rate of nitrogen and ***Striga hermonthica*** infestation. Agronomy Journal 89: 38-44. [Yields of 8322-1 (tolerant) much greater than those of 8338-1 (susceptible) under high artificial infestation: benefits of N greatest at *2* weeks after planting.]

Kim, PyoungSu and Ahn WonYung 1996. Analysis of chemical constituents of saccharides and triterpenoids in the Korean native mistletoes. II Screening the extractives of Korean camellia mistletoe ***(Pseudixusjaponicus*** for cytotoxicity. Mogjae Gonghak = Journal of Korean Weed Science and Technology 24(1): 87-94.

Kroschel, J., A. A. Abbasher and J. Sauerborn. 1995. Herbivores of ***Striga hermonthica*** in northern Ghana and approaches to their use as biocontrol agents. Biocontrol Science and Technology 5: 163-164. (Noting that ***Smicronyx umbrinus*** commonly causes damage in Ghana but not in Tanzania, Malawi or Madagascar, while ***Junonia orithya*** occurs in all areas.)

Kroschel, J., A. Hundt, A.A. Abbasher and J. Sauerborn. 1996. Pathogenicity of fungi collected in northern Ghana to ***Striga hermonthica.*** Weed Research 36: 515-520. (Encouraging results with two isolates of ***Fusarium oxysporum*** and one of ***F. solani*** - ***S. hermonthica*** well controlled and no apparent pathogenicity to sorghum.)

Kuijt, J. 1996. Cataphylls and taxonomy in ***Phoradendron*** and ***Dendrophthora*** (Viscaceae). Acta Botanica Neerlandica 45: 263-277.

Kuijt, J. and E.A. Kellogg. 1996. Miscellaneous mistletoe notes, 20-36. Novon 6(1): 33-35. (Describing 11 new spp.; 4 ***Dendrophthora,*** 6 ***Phoradendron*** and 1 ***Psittacanthus*** and several new combinations in ***Dendrophthora*** and ***Phthirusa.)***

Kunjo, E.M. (1996) Practical results of ***Striga*** research in the Gambia. In: H. Brown, G.W. Cussans, M.D. Devine, S.O. Duke, C. Fernandez-Quintanilla, A. Helweg, R. Labrada, M. Landes, P. Kudsk and S.C. Streibig (Eds.) Proceedings, 2nd International Weed Control Congress, Copenhagen, Denmark, 1996, pp. 685-686.

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Kim, S. K. 1995. Genetics of maize tolerance of ***Striga hermonthica.*** IITA Research 11: 1-6. (Concludes that tolerance to ***Striga*** damage is inherited quantitatively.)

King, S. B. and S. Z. Mukuru. 1995. An overview of sorghum, finger millet and pearl millet in eastern Africa with special attention to diseases. In: Daniel, D. L. (ed.) Breeding for disease resistance with emphasis on durability. Proceedings of a regional workshop for eastern, central and southern Africa, Njoro, Kenya, 1994. pp. 24-34. (Work on ***Striga*** resistance is mentioned.)

Kutbay, H. G., F. Karaer and M. Kilinc. 1996. Nutrient relationships of ***Cuscuta epithymum*** var. ***epithymum.*** In: H. Brown, G. W. Cussans, M. D. Devine, S. O. Duke, C. Fernandez-Quintanilla, A. Helweg, R. Labrada, M. Landes, P. Kudsk and S. C. Streibeig (Eds.) Proceedings, 2nd International Weed Control Congress, Copenhagen, Denmark, 1996, pp. 91-94. (On host ***Heliotropium europaeum*** in Turkey; discusses active v. passive uptake theories.)

Ladley, J. J. and D. Kelly. 1995. Explosive New Zealand mistletoe. Nature 378: 766. (Suggesting a solution to Kuijt's 'unsolved mystery' -the reason for the flowers of some Loranthaceae opening from the base. This is shown to occur in ***Perixilla tetrapetala*** when flowers, normally opened by birds, are not visited.)

Ladley, J.J. and D. Kelly. 1996. Dispersal, germination and survival of New Zealand mistletoes (Loranthaceae): dependence on birds. New Zealand Journal of Ecology 20(1): 69-79. (Observations on the role of bellbirds, silvereyes and tui in the dispersal of ***Alepis flavida, Peraxilla tetrapetala, Ileostylis micranthus*** and ***Tupeia antarctica.)***

Lagoke, S. and R. Hoevers, editors. 1995. ***Striga*** Newsletter. Number 5. 26 pages.

Lagoke, S. and L. E. van der Straten, editors. 1996. ***Striga*** Newsletter. Number 6. 26 pages. (Both numbers 5 and 6 of the newsletter are an excellent source of information on current research and surveys.)

Lagoke, S.J.O., R. Labrada, S.S. M'Boob and L. van der Straten. 1996. ***Striga*** problem and its control in Africa south of the Sahara. In: H. Brown, G.W. Cussans, M.D. Devine, S.O. Duke, C. Fernandez-Quintanilla, A. Helweg, R. Labrada, M. Landes, P. Kudsk and S.C. Streibig (Eds.) Proceedings, 2nd International Weed Control Congress, Copenhagen, Denmark, 1996, pp. 761. (Outlining the activities of PASCON.)

Lane, J. A., T. H. M. Moore, D. V. Child and K. F. Cardwell. 1996. Characterization of virulence and geographical distribution of ***Striga gesnerioides*** on cowpea in West Africa. Plant Disease 80: 299-301. (Five races differentiated on the basis of their virulence on 5 descriminator varieties.)

Larson, D.L. 1996. Seed dispersal by specialist versus generalist foragers: the plant's perspective. Oikos 76(1): 113-120. (Studies on ***Phoradendron californicum*** and three bird species, the specialist mistletoe-feeder ***Phainopepla nitens*** and the generalists, Gila woodpecker ***(Melanerpes uropygialis)*** and mocking bird ***(Mimus polyglottus).***

Lechowski, Z. 1995. Element contents and guard cell physiology of the root hemiparasite ***Melampyrum arvense*** L. before and after attachment to the host plant. Journal of Plant Nutrition 18: 2551-2567. (P, Na, N, Cl etc measured in host, ***Capsella bursa-pastoris*** and parasite before and after attachment. Results include the interesting observation that stomata usually closed in the dark in the unattached parasite but remained open after attachment.)

Lechowski, Z. 1996. Gas exchange in leaves of the root hemiparasite ***Melampyrum arvense*** L. before and after attachment to the host. Physiologia Plantarum 38: 85-93. [Net photosynthesis on a leaf area basis is low-15 and 23% of that in the host *(Capsella bursa-pastoris)* before and after attachment respectively. Chlorophyll and carotenoids are low; respiration high - X1.8 and 2.6 before and after.]

Lechowski, Z. 1997. Stomata1 response to exogenous cytokinin treatment of the hemiparasite ***Melampyrum arvense*** L. before and after attachment to the host. Biologia Plantarum 39: 13-21. (Before attachment to host, cytokinin increased stomata1 aperture: after attachment, parasite insensitive to additional cytokinin and/or K.)

Lehtila, K. and K. Syrjanen. 1995. Compensatory responses of two ***Melampyrum*** species after damage. Functional Ecology 9: 511-517. (Studies on ***M.pratense*** and M. ***sylvaticum*** in Finland.)

Lobin, W. and B. Dull. 1996. [The genus ***Cistanche*** (Orobanchaceae) on the Cape Verde Islands with consideration of the species on the West African continent.] (In German) Willdenowia 25: 583-594. (All material from Cape Verde and Senegal designated ***C. phelypaea;*** delimitation from ***C. tubulosa*** and 2 other spp. outlined.)

Lock, G. M. and M. C. Press. 1995. Effects of elevated C02 on ***Agrostis capillaris*** infected with the hemiparasite ***Rhinanthus minor.*** In: Physiological responses of plants to pathogens, Dundee, 1995. Aspects of Applied Biology 42: 155-159.

Loffler, C., A. Sahm, V. Wray, F. C. Czygan and P. Proksch. 1995. Soluble phenolic constituents from ***Cuscuta reflexa*** and ***Cuscuta platyloba.*** Biochemical Systematics and Ecology 23: 121-128. (Phenolic content, highest in the haustorial region, was not influenced by the host on which they were growing.)

Lopez-Granados, F. and L. Garcia-Torres. 1996. Effects of environmental factors on dormancy and germination of crenate broomrape ***(Orobanche crenata).*** Weed Science 44: 284-289.

Lusson, N., P. Delavault and P. Thalouarn. 1995. The plastid rp120 gene from ***Lathraea clandestina*** (holoparasite) is conserved in a functional form. Comptes Rendus de l'Academie des Sciences. Serie III, Sciences de la Vie 318: 659-664. (Comparisons also with ***Melampyrum pratense, Epifagus*** and ***Digitalis purpurea.)***

Mansuetus, S.B.A. 1995. Sorghum diseases in Tanzania. African Crop Science Journal 3:203-207. ***(Striga*** included with 22 diseases as major constraints on sorghum production in Tanzania.)

Marshall, J. D., T. E. Dawson and J. R. Ehleringer. 1994. Integrated nitrogen, carbon, and water relations of a xylem-tapping mistletoe following nitrogen fertilization of the host. Oecologia 100: 430-438. (Work with ***Phoradendron juniperum*** on ***Juniperus osteosperma*** partially confirms the hypothesis that the gas-exchange characteristics of mistletoes are designed to ensure adequate nitrogen gain, but also suggests that the low water-use efficiency of the parasite is an inevitable consequence of an imbalance in C and N assimilation.)

Martinez, del Rio, C., M. Hourdequin, A. Silva and R. Medel. 1995. The influence of cactus size and previous infection on bird deposition of mistletoe seeds. Australian Journal of Ecology 20: 571-576. (Interesting observations on the interrelations of ***Tristerix aphyllus*** with ***Mimus thenca*** (the Chilean mockingbird), and the cactus hosts ***Echinopsis chilensis*** and ***Eulychnia acida*** in Chile.)

Martinez del Rio, C., A. Silva, R. Medel and M. Hourdequin. 1996. Seed dispersers as disease vectors: bird transmission of mistletoe seeds to plant hosts. Ecology 77: 912-921. (see Martinez et al., 1995.)

Marvier, M. A. 1996. Parasitic plant host interactions: plant performance and indirect effects on parasite-feeding herbivores. Ecology 77: 1398-1409. (Reporting varying interactions of ***Castilleja wightii*** with hosts ***Lupinus arboreus, Artemisi pycnocephala*** and ***Eriophyllum staechadifolium*** and the survival of aphid ***Nearctaphis bachena.)***

Maschadi, A.M., J. Sauerborn, J. Kroschel and M.C. Saxena. 1997. Effect of plant density on grain yield, root-length density and ***Orobanche crenata*** infestation in two faba bean genotypes. Weed Research 37: 39-49. (Crop density had only minor effects but var. 402/29/84 showed excellent resistance, associated with hypersensitivity, a smaller root system, and early flowering.)

Mathiasen, J. S. Beatty and C. M. Hildebrand. 1995. First report of larch dwarf mistletoe on Pacific silver fir and on mountain hemlock in the Cascade Mountains, WA. Plant Disease 79: 1249. ***(Arceuthobium larcis*** on ***Abies amabilis*** in Washington State, USA.)

Mathiasen, R.L., J.T. Hoffman, **J.C.** Guyon and **L.L.** Wadleigh. 1996. Comparison of two roadside survey procedures for dwarf mistletoes on the Sawtooth National Forest, Idaho. Great Basin Naturalist 56(2): 129-134. (Concludes that roadside-plot and transect-plot surveys give similar results for ***Arceuthobium americanum*** and ***A. douglasii*** in ***Pinus contorta*** and ***pseudotsuga menziesii*** respectively.)

Mathiasen, J. S., B. W. Geils, C. E. Carson and F. G. Hawksworth. 1995. Larch dwarf mistletoe not found on alpine larch. Fort Collins, Colorado, USA Research Note - Rocky Mountain Forest and Range Experiment Station, USDA Forest Service no RM-533, 4 pp. (Noting that previous reports of ***Arceuthobium laricis*** on ***Larix lyallii*** are erroneus, the host being re-identified as ***L. occidentalis.)***

Mathiasen, **J.** S. Beatty and C. M. Hildebrand. 1996. First report of lodgepole dwarf mistletoe on subalpine fir. Plant Disease 80: 342. ***(Arceuthobium americanum*** on ***Abies lasiocarpa*** var. ***lasiocarpa*** in Washington State, USA.)

Matthies, D. 1995. Host parasite relations in the root hemiparasite ***Melampyrum aruense.*** Flora 190: 383-394.

Matthies, D. 1995. Parasitic and competitive interactions between the hemiparasites ***Rhinanthus serotinus*** and ***Odontites rubra*** and their host ***Medicago sativa. Journal of Ecology 83: 245-251.***

Matthies, D. 1996. Interactions between the root hemiparasite ***Melampyrum aruense*** and mixtures of host plants: heterotrophic benefit and parasite-mediated competition. Oikos 75(1): 118-124. (Host damage and growth of parasite greatest on ***Medicago satiua,*** less on ***Linum usitatissimum*** and ***Lolium perennans.)***

Mburu, C. 1995. Research in production constraints of sorghum in Kenya. In: Daniel, D. L. (ed.) Breeding for disease resistance with emphasis on durability. Proceedings of a regional workshop for eastern, central and southern Africa, Njoro, Kenya, 1994. pp. 74-80. (Including ***Striga*** as a notable constraint.)

Mertzig, **C.** and S. Prien. 1996. (Occurrence of pine mistletoe in forest stands in Niederlausitz.) (in German) AFZ/Der Walt, Allgemneine Forst Zeitschrift fur Waldwirtschaft und Umweltvorsorge 51: 160-162. (Three forms of V. ***album*** ssp. ***laxum*** distinguished. Planting broad-leaved trees around stand margins suggested as a means of reducing incidence.)

Meti, S.S. and M.M. Hosmani. 1994. Broomrape control in **bidi** tobacco by soil solarization. Tobacco Research 20(**1**): 67-70. **(O.** ***cernua*** reduced 78% by clear polyethylene 0.05 mm thick for 40 days.)

Mishra, S. and G. G. Sanwal. 1995. Changes in lipid composition of ***Brassica siliquae*** upon infection by ***Cuscuta.*** Journal of Plant Physiology 146:303-306.

Molotkovskii, Yu. I. and A. A. Konnov. 1995. Some characteristics of the growth and water exchange in juniper affected by a plant parasite, ***Arceuthobium oxycedri*** (DC.) M.B. Russian Journal of Ecology 26:296-299. (Transpiration rate of ***A. oxycedri*** higher than that of hosts ***Juniperus turkestanica*** and ***J. semiglobosa.)***

Moore, T. H. M., J. A. Lane, D. V. Child, G. M. Arnold, **J.** A. Bailey and G. Hoffmann. 1995. New sources of resistance of cowpea ***(Vigna unguiculata)*** to ***Striga gesnerioides,*** a parasitic angiosperm. Euphytica 84: 165-174. (Reporting the identification of 2 lines of cowpea, APL-1 and 87-2, with resistance to S. ***gesnerioides*** in most W. African countries, but not to ***Alectra.)***

Musselman, L. J. **1996.** Parasitic weeds in the Southeastern United States. Castanea **61(3): 271-292.** (A review of the distribution, ecology, and host range of native and introduced parasites as well as a discussion of potential new problems.)

Murty, D.S., S.A. Bello and S.E. Eladele. **1995.** Screening sorghum for resistance to ***Striga*** under artificial field inoculation. International Sorghum and Millets Newsletter **36: 84-86.** (Three techniques used; Framida least attacked of **10** vars **in** all tests.)

Nandula, V. K., C. L. Foy and J. H. Westwood. **1995.** Effect of adjuvants, germination stimulants and nutrients on germination of ***Orobanche*** spp. Proceedings Northeastern Weed Science Society **49: 32.**

Nandula, V. K. and C. L. Foy. **1996.** Analysis of total amino acids in Egyptian broomrape ***(Orobanche aegyptiaca)*** and a host (carrot). Proceedings, Southern Weed Science Society **49: 154.**

Nimbal, C. **I.**, J. F. Pedersen, C. N. Yerkes, L. A. Weston and S. C. Weller. **1996.** Phytotoxicity and distribution of sorgoleone in grain sorghum germplasm. Journal of Agricultural and Food Chemistry **44: 1343-1347.** (Showing that sorgoleone comprises **85-90%** of all root exudates from sorghum; amounts vary 20-fold among genotypes; toxic effects - mainly on photosynthesis occur down to **10** micromolar in some species of ***Digitaria sanguinalis.)***

Norton, D. A., R. J. Hobbs and L. Atkins. **1995.** Fragmentation, disturbance and plant distribution: mistletoes in woodland remnants in the Western Australian wheatbelt. Conservation Biology **9: 426-438.** (Concerning the distribution of ***Amyema miquelii*** in ***Eucalyptus salmonophloia*** woodland.)

Nun, N. B., G. Ben-Hod, E. Lavi and A. M. Mayer, **1996.** Purification of a pectin methylesterase from ***Orobanche aegyptiaca.*** Phytochemistry 41: **403-406.**

Odasz, A.M. and O. Savolainen. **1996.** Genetic variation in populations of the arctic perennial ***Pedicularis dasyantha*** (Scrophulariaceae) on Svalberd, Norway. American Journal of Botany **83: 1379-1385. This** parasite shows more isozyme genetic variability than the 5 other species reported in this genus but less than other spp. with limited regional distribution. Noted this sp. self-compatible and has long-lived perennial habit.)

Olivier, A. **1995.** Le Striga, mauvaise herbe parasite des ciriales africaines: biologie et methodes de lutte. Agronomie **15: 517-525.** (General review.)

Olivier, A. **1996.** La relation entre le Striga hermonthica et ses hotes: une synthese. Canadian Journal of Botany **74: 1119-1137.** (Another general review.)

Orr, J.P. **1996.** Nightshade and dodder control in processing tomatoes. Proceedings, Western Society of Weed Science **49: 30-32.** ***(Cuscuta*** sp. controlled **95%** by application **of** rimsulfuron at cotyledon stage of crop; repeat application gave **100%** control season-long.)

Orr, G.L., M.A. Haidar and D.A. Orr. **1996.** Smallseed dodder ***(Cuscuta planiflora)*** gravitropism in red light and in red plus far-red. Weed Science **44: 795-796.** (In 4-hour spells of mixed red/far-red light, some positive gravitropism observed, but negative gravitropism resumed in **4-** hour spells of red only.)

Overton, J.McC. **1996.** Spatial autocorrelation and dispersal in mistletoes: field and simulation results. Vegetatio **125(1): 83-98.** (Studies of ***Phrygilanthus (= Notanthera) sonorae*** and ***Phoradendron californicum*** on ***Bursera microphylla*** and ***Cercidium microphyllum*** in Mexico.)

Pazy, B., U. Plitmann and O. Cohen. **1996.** Bimodal karyotype **in *Cynomorium coccineum*** L. and its systematic implications. Botanical Journal of the Linnean Society **120: 279-281.** (Chromosome number $2n = 28$; results support separation of Cynomoriaceae from Balanophoraceae.)

Pennings, S. C. and R. M. Callaway. **1996.** Impact of a parasitic plant **on** the structure and dynamics of salt marsh vegetation. Ecology **77: 1410-1419.** (Reporting that ***Cuscuta salina*** prefers host ***Salicornia virginica*** over ***Limonium californicum*** etc.)

Popovic, S. and M. Stjepanovic. 1995. (Production of alfalfa seed is limited by presence of ***Cuscuta*** spp.) (in Croatian) Sjemenarstvo 12: 135-149. (Propyzamide as Kerb, 3-4 kg/ha gave best control.)

Popp, M., R. Mensen, A. Richter, H. Buschmann and D. J. von Willert. 1995. Solutes and succulence in southern African mistletoes. Trees: Structure and Function 9: 303-310. (Studies on ***Tapinanthus oleifolius*** and ***Viscum rotundifolium*** on various hosts in Namibia. Succulence of older leaves a mechanism for diluting excess sodium?)

Press, M. C. 1995. How do the parasitic weeds ***Striga*** and ***Orobanche*** influence host carbon relations? In: Physiological responses of plants to pathogens, Dundee, 1995. Aspects of Applied Biology 42: 63-70. (Discussing the relative importance of i. transfer of carbon, ii. change in host architecture and iii reduced photosynthesis.)

Pundir, Y. P. S. 1995. Host range of ***Scurrula pulverulenta*** (Wall,) G.Don. (Loranthaceae) from Doon Valley and adjacent areas. Indian Journal of Forestry 18: 74-79. (Total hosts recorded in this area now 131 species from 58 genera, 34 plant families.)

Pujadas, A. and A. Lora. 1995. ***(Orobanche almeriensis*** A. Pujadas (Orobanchaceae), a new species from the southeast Iberian Peninsula.) (in Spanish) Anales del Jardin Botanico de Madrid 53(1): 47-53.

Pundir, Y.P.S. 1995. Two new hosts of ***Dendrophthoe falcata*** (L.f.) Ettingh (Loranthaceae). World Weeds 2: 1-2. ***(Terminalia alata*** and ***Bauhinia uahlii.)***

Pundir, Y.P.S. 1995. ***Scurrula parasitica*** L. (Loranthaceae), a new record for Garhwal and Kumaon Himalaya. World Weeds 2: 59-60. (On ***Quercus leucotrichophora*** and hyperparasitising ***Taxillus vestitus*** on the same host.)

Pundir, Y.P.S. 1995. Observations on the witches-broom formations in ***Scurrula pulverulenta*** (Wall.) G.Don (Loranthaceae). World Weeds 2: 63-68. (Brooms caused by insect ***Sumatrophis*** sp.)

Pundir, Y.P.S. 1995. Is ***Dendrophthoe falcata*** (L.f.) Ettingh (Loranthaceae) ascending in Garhwal Himalaya. World Weeds 3: 145-146. (On ***Quercus himalayana*** at 2410 m.)

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Ransom, J. K. 1996. Integrated management of ***Striga*** spp. in the agriculture of sub-Saharan Africa. In: H. Brown, G. W. Cussans, M. D. Devine, S. O. Duke, C. Fernandez-Quintanilla, A. Helweg, R. Labrada, M. Landes, P. Ludsk and S. C. Streibeig (Eds.) Proceedings, 2nd International Weed Control Congress, Copenhagen, Denmark, 1996, pp. 623-628. (A useful review of the potential IPM components and their combination for ***Striga*** control.)

Raynal-Roques, A. 1994. Repartition geographique et speciation dans le genre ***Striga*** (Scrophulariaceae parasites). Memoires de la Societe Biogeographiqe (3eme serie) IV, 83-94. (Commenting on characteristics and distribution of a total 41 species.)

Reichmann, S., J. Kroschel and J. Sauerborn. 1995. Distribution and infestation of ***Striga*** species in Shinyanga region of Tanzania and evaluation of control methods. Proceedings, Brighton Crop Protection Conference-Weeds, Brighton, 1995. pp. 151-156. (Over **50%** of fields were infested with S. ***hermonthica*** and 24% with S. ***asiatica. Striga passargei*** and ***S. densijlora*** also recorded. Farmers were generally unaware of the parasitic nature and seed propagation of ***Striga.)***

Reid, N., M. S. Smith and **Yan** ZhaoGui. 1995. Ecology and population biology of mistletoes. In: Lowman, M. D. and N. M. Nadkarni (Eds) Forest Canopies, Academic Press San Diego California. pp. 285-310. (A review based mainly on Australian mistletoes.)

Reiss, G., R. J. Pring, J. A. Lane and J. A. Bailey. 1995. ***Striga gesnerioides:*** mechanisms of infection and resistance. In: Physiological responses of plants to pathogens, Dundee, 1995. Aspects of Applied Biology 42: 301-306. (On the resistant B301, hyaline tissue failed to develop; a cytokinin helped initiate parasite growth but this factor could not explain continued failure to develop.)

Rhui-cheng, F., L. J. Musselman and U. Plitmann. 1995. ***Cuscuta.*** pp 322-325 in Zheng-yi, W. and P. H. Raven, Editors. Flora of China. Volume 16. Gentianaceae through Boraginaceae. Beijing: Science Press and St. Louis: Missouri Botanical Garden. (Eleven species are recorded including ***C. campestris.)***

Ribereau-Gayon, G., M. L. Jung, J. P. Beck and R. Anton. 1995. Effect of fetal calf serum on the cytotoxic activity of mistletoe ***(Viscum album*** L.) lectins in cell culture. Phytotherapy Research 9: 336-339.

Rivera, G.L., L. Galetto and L. Bernardello. 1996. Nectar secretion pattern, removal effects, and breeding system of ***Ligaria cuneifolia*** (Loranthaceae). Canadian Journal of Botany 74: 1996-2001. (From studies of L. ***cuneifolia*** on ***Acacia aroma*** in Argentina it is concluded that the reproductive system is 'primarily xenogamous, but reproductive success is related to flower age'.)

Rizzini, C.T. (1995) (Flora of the Serra do Cipo, Minas Gerais: Loranthaceae.) (in Portugese) Boletin de Botanica, Universidade de Sao Paulo 14: 207- 221. (Descriptions of 7 species of ***Phoradendron,*** 4 of ***Struthanthus*** and 1 each of ***Dendrophthora*** and ***Psittacanthus.)***

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Sauerborn, J., I. Dorr, A. Abbasher, H. Thomas, and J. Kroschel. 1996. Electron Microscopic Analysis of the Penetration Process of ***Fusarium nygamai,*** a Hyperparasite of ***Striga hermonthica.*** Biological Control 7: 53-59.

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Schaller, G., K. Urech and M. Giannattasio. 1996. Cytotoxicity of different viscotoxins and extracts from the European subspecies of ***Viscum album*** L. Phytotherapy Research 10: 473-477.

Schmitz, U. and R. Lvsch. 1995. (Occurrence and plant sociology of ***Cuscuta*** species in the riverside vegetation of the lower Rhine area.) (in German) Tuexenia No 15, pp. 373-385. (***Cuscuta lupuliformis*** and ***C. europaea*** common, ***C. gronovii*** rare.)

Schnell, H., M. Kunisch, M.C. Saxena and J. Sauerborn. 1996. Simulation of the seed bank dynamics of ***Orobanche crenata*** Forsk. in some crop rotations common in Northern Syria. Experimental Agriculture 32: 395-403. (Results suggest growing a susceptible crop every third year leads to high infestation, while growing it only every 12 years and replacing otherwise with ***Vicia villosa*** ssp. ***dasycarpa*** allows only low infestation.)

Seel, W.E. and M.C. Press. 1996. Effects of repeated parasitism by ***Rhinanthus minor*** on the growth and photosynthesis of a perennial grass, ***Poa alpina.*** New Phytologist 134: 495-502. (***Poa alpina*** infested in first season suffered at least 50% loss of biomass: effects of re-infestation in a second year, or infestation delayed to the second year also studied. Few direct effects on photosynthesis or root:shoot ratio.)

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Shan-Ting Chiu. 1996. Notes on the genus ***Taxillus*** Van Tieghem (Loranthaceae) in Taiwan. Taiwania 41: 154-167. (Discussing relationship of the genus ***Taxillus*** to ***Scurrula*** and ***Loranthus*** and recording 10 species of ***Taxillus*** including one new species, one newly recorded and several previously included in ***Scurrula.)***

Shivamurthy, G.R. 1996. The floral biology and pollination in ***Balanophora fungosa.*** Journal Swamy Botany 13: 19-22.

Showler, A. 1996. Mistletoe in Berkshire and Buckinghamshire. Botanical Society of the British Isles News 73: 31-32. (Noting some association of ***Viscum album*** with river valleys and water, also with old estates.)

Silva, A. and C.M. del Rio. 1996. Effect of the mistletoe ***Tristerix aphyllus*** (Loranthaceae) on the reproduction of its cactus host ***Echinopsis chilensis.*** Oikos 75: 437-442. (The mistletoe is considered a phloem-tapping parasite with little photosynthetic capacity, hence more damaging to host than most mistletoes.)

Smith, M. C. and M. Webb. 1996. Estimation of the seedbank of ***Striga*** spp. (Scrophulariaceae) in Malian fields and the implications for a model of biocontrol of ***Striga hermonthica.*** Weed Research 36: 85-92. (New data suggest that ***Smicronyx*** spp. could be somewhat more effective than was concluded in the earlier paper by Smith et al., 1993)

Smith, C.E., T. Rutledge, Zeng ZhaoXian, R.C. O'Malley and D.G. Lynn. 1996 A mechanism for inducing plant development: the genesis of a specific inhibitor. Proceedings of the National Academy of Sciences of the United States of America 93: 6986-6991. (Cyclopropyl-p-benzoquinone is shown to be a specific inhibitor of haustorial development.)

Smith, I.M. and A.S. Roy. 1996. Illustrations of Quarantine Pests for Europe. OEEP/EPPO/CABI, 241 pp. (This companion volume to 'Quarantine Pests for Europe' published in 1992, includes illustrations of ***Arceuthobium douglasii*** and ***A. vaginatum*** ssp. ***cryptopodium.*** All non-European species of ***Arceuthobium*** are prohibited, the only genus of weeds affected by European regulations.)

Snyder, M. A., B. Fineschi, Y. B. Linhart and R. H. Smith. 1996. Multivariate discriminator of host use by dwarf mistletoe ***Arceuthobium vaginatum*** subsp. ***cryptopodum:*** inter- and intra-specific comparisons. Journal of Chemical Ecology 22: 295-305. (Parasitism on the primary host, ***Pinus ponderosa*** and the occasional host ***P. contorta*** is to some degree correlated with chemical characteristics of oleoresins in the host phloem.)

Sproule, A. 1996. Impact of dwarf mistletoe on some aspects of the reproductive biology of jack pine. Forestry Chronicle 72: 303-306. ***(Arceuthobium americanum*** shown to reduce seed production of ***Pinus banksiana*** by up to 76%.)

Sproule, A. 1996. Branch age in jack pine at the time of dwarf mistletoe infection. Forestry Chronicle 72: 307. (Studies of ***Arceuthobium americanum*** on ***Pinus banksiana.)***

Stewart, H. M., S. C. Stewart and J. M. Canne-Hilliker. 1996. Mixed mating system in ***Agalinis neoscotica*** (Scrophulariaceae) with bud pollination and delayed pollen germination. International Journal of Plant Science 157: 501-508.

Stockey, R.A., H. Ko and P. Woltz. 1995. Cuticle micromorphology of ***Parasitaxus*** de Laubenfels (Podocarpaceae). International Journal of Plant Science 156: 723-730. (Cuticle of ***P. ustus*** is compared with that of ***Falcatifolium taxoides,*** the host, and that of other genera, all in Podocarpaceae.)

Stoffel, B., J. Beuth and G. Pulverer. 1996. Effect of immunomodulation with galactoside-specific mistletoe lectin on experimental listeriosis. Zentralblatt fur Bacteriologie 284: 439-442.

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Suwa, H., Y. Suzuki, Zhang YunHui, N. Murofushi and Y. Takeuchi. 1995. Endogenous gibberellins in ***Aeginetia indica,*** a parasitic plant, and its host, ***Miscanthus sinensis.*** Bioscience, Biotechnology and Biochemistry 59: 1712-1715.

Tada, Y., M. Sugai and K. Furuhashi. 1996. Haustoria of ***Cuscuta japonica,*** a holoparasitic flowering plant, are induced by the cooperative effects of far-red light and tactile stimuli. Plant and Cell Physiology 37: 1049-1053.

Takeuchi, Y., K. Yoenyama, M. Ogasawara, Y. Omigami, M. Konnai, T. Takematsu and A.D. Worsham. 1995. Effect of brassinosteroids on seed germination of weeds. Proceedings, 15th Asian-Pacific Weed Science Society, Tsukuba, Japan, 1995. pp. 781-786. (Brassinosteroids reduced time needed for conditioning, and increased germination of ***Orobanche minor;*** and increased germination of ***Aeginetia indica,*** a parasite of upland rice in Japan.)

Taylor, A., J. Martin and W. E. Seel. 1996. Physiology of the parasitic association between maize and witchweed ***(Striga hermonthica):*** is ABA involved? Journal of Experimental Botany 47: 1057-1065. (Infection by S. ***hermonthica*** caused drastic reduction in stomatal conductance but increases in ABA in 3 maize varieties were inconsistent.)

Taylor, J. E. 1995. Western larch dwarf mistletoe and ecosystem management. In: Ecology and Management of ***Larix*** Forests: a look ahead. Proceedings of an International Symposium, Whitefish, Montana, 1992. USDA Forest Service General Technical Report - Intermountain Research Station No INT-GTR-319. pp. 310-313. (Commenting that, in the context of ecosystem management, larch dwarf mistletoe should be valued as an individual biological species and recognized as a functional component of western larch forest ecosystems.)

Tennakoon, K. U. and J. S. Pate. 1996. Effects of parasitism by a mistletoe on the structure and function of branches of its host. Plant, Cell and Environment 19: 517-528. (Studying the mineral and water relations between ***Amyema preissii*** and ***Acacia acuminata*** as the distal parts of the host branch atrophy and the proximal parts are enhanced in thickness.)

Tennakoon, K. U. and J. S. Pate. 1996. Heterotrophic gain of carbon from hosts by the xylem-tapping root hemiparasite ***Olax phyllanthi*** (Olacaceae). Oecologia 105: 369-376. (Results varied depending on the hosts involved- ***Portulaca oleracea, Amaranthus caudatus*** and

Acacia littorea; parasite growth greatest on the N-fixing *Acacia.)*

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Thankamma, L. and J. G. Maratukalam. 1995. Dodder *(Cuscuta campestris* Yuncker) infestation in rubber plantations. Rubber Board Bulletin 27(2): 15-18. (The ground cover ***Pueraria phaseoloides*** was extensively, and the rubber and ***Mucuna bracteata,*** sporadically infested.)

Thijssen, R. 1995. Weeds and trees. ILEIA Newsletter 11(3): 20-21. (Noting suppression of ***Striga*** in maize in Kenya by use of the leguminous shrub ***Calliandra calothyrsus*** as a green manure.)

Thomson, A.J. and G.A. Sickle. 1996. Forest insect and disease diagnosis and management using expert system-guided hypermedia. A.I. Applications 10(2): 23-32. (Systems for pest and disease problems, including dwarf mistletoes in Canada.)

Thuring, J.W.J.F., N.W.J.T. Heinsman, W.A.W.M. Jacobs, G.H.L. Nefkens and B. Zwanenburg. 1997. Asymmetric synthesis of all stereoisomers of demethylsorgolactone. Dependence of the stimulatory activity of ***Striga hermonthica*** and ***Orobanche crenata*** seed germination on the absolute configuration. Journal of Food and Agricultural Chemistry 45: 507-513..

Tidwell, T. E. 1996. Index of phanerogamic parasites of California. Parts I and II. California Plant Pest and Disease Report 15(1-2): 23-64 and 15(3-4): 97-139. (This unique compendium of all the parasites in the large and diverse state of California could be a model for other states. All the parasites are listed but there is also what appears to be an exhaustive list of hosts based on information from herbaria, literature and quarantine intercepts the latter seldom being documented).

Traore, D., C. Vincent and R.K. Stewart. 1996. Life history of ***Smicronyx guineanus*** and ***Sm. umbrinus*** (Col: Cucurlionidae) on ***Striga hermonthica*** (Scrophulariaceae). Entomophaga 40: 211-221. (Valuable basic information and means of distinguishing these two species, almost equally frequent in the study area of Burkina Faso.)

Tuquet, C. and G. Salle. 1996. Characteristics of chloroplasts isolated from two mistletoes originating in temperate ***(Viscum album)*** and tropical ***(Tapinanthus dodoneifolius)*** areas. Plant Physiology and Biochemistry 34: 283-292.

Uhlich, H., J. Push, K. Barthel. 1996. Die Sommerwurzarten Europas. Gattung ***Orobanche.*** Westarp Wissenschaften, Magdeburgh, Germany

U.S. National Research Council. 1996. Lost Crops of Africa. Volume 1. Grains. National Academy Press, Washington D.C., 383 pp. (Including a very poor section on ***Striga*** in sorghum.)

Vannini, A., D. Cecca, L. Monaci and N. Anslemi. 1995. Main tree pathogens of western Himalayan forests in Nepal: description and risk of introduction. Bulletin Oepp/Eppo Bulletin 25: 455-461. ***(Arceuthobium minutissimum*** listed as occurring on ***Pinus wallichiana*** and risk of introduction to Europe noted.)

Veenendaal, E.M., I.K. Abebrese, M.F. Walsh and M.D. Swaine. 1996. Root parasitism in a West African rainforest tree ***Okoubaka aubrevillei*** (Santalaceae). New Phytologist 134: 487-493. (Effects recorded on a range of host trees: ***Pterygota macrocarpa*** and ***Pericopsis elata*** most seriously affected.)

Vogler, R.K., G. Ejeta and L.G. Butler. 1995. Integrating biotechnological approaches for the control of ***Striga.*** In: Environmental Impact and Biosafety: Issues of Genetically Engineered Sorghum. Nairobi, 1995 (Ed. by R. Frederiksen, S. Shantharam and K.V. J. Raman). African Crop Science Journal 3(2): 217-222.

Vogler, R.K., G. Ejeta and L.G. Butler. 1996. Inheritance of low production of ***Striga*** germination stimulant in sorghum. Crop Science 36: 1185-1191. (Concluding that low stimulant production in SRN-39 is associated with a single recessive gene, largely additive in action.)

Wang Changzeng and Jia Zhongjian. 1997. Lignan, phenylpropanoid and iridoid glycosides from ***Pedicularis torta.*** Phytochemistry 45: 159-166.

Webb, M. and M. C. Smith. 1996. Biology of ***Striga hermonthica*** (Scrophulariaceae) in Sahelian Mali: effects on pearl millet yield and prospects of control. Weed Research 36: 203-211.

Westwood, J. H. and C. L. Foy. 1995. Effect of sulfonylurea herbicides on Egyptian broomrape ***(Orobanche aegyptiaca)*** seed germination and development. Proceedings Southern Weed Science Society 48: 265.

Westwood, J. H. and C. L. Foy. 1996. Using PCR/RAPD fingerprinting to characterise infestations of small broomrape ***(Orobanche minor)*** in the US. Proceedings. Southern Weed Science Society 49: 156

Wiens, D., D.L. Nickrent, C.G. Shaw III, F.G. Hawksworth, P.E. Hennon and E.J. King. 1996. Embryonic and host-associated skewed adult sex ratios in dwarf mistletoe. Heredity 77(1): 55-63. (In ***Arceuthobium tsugense*** ssp. ***tsugense*** embryonic ratio was 1:1, but adult populations on ***Tsuga heterophylla*** were female-skewed. On secondary host ***Abies procera*** embryonic and adult ratios both 1:1, while on ***Pinus contorta*** adult ratio male-biased.)

Wu, A.M., Song ShuhChyung, Hwang PeiYi, J.H. Wu and U. Pfuller. 1995. Interaction of mistletoe toxic lectin-1 with sialog-lycoproteins. Biochemical and Biophysical Research Communications 214:396-402.

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Xi Qian. 1996. (Studies of the biological characteristics and control of ***Cuscuta chinensis*** in soyabean fields in the reclamation area of north Jiangsu.) (in Chinese) Soybean Science 15(1): 62-68. (Good control from dibutalin pre-emergence; linuron, diuron, glyphosate and alachlor also tested.)

Yan, Z. and N. Reid. 1995. Mistletoe (***Amyema miquelii*** and ***A. pendulum)*** seedling establishment on eucalypt hosts in eastern Australia. Journal of Applied Ecology 32: 778-784. (Germination high regardless of host; 5 month survival on dead branches; maximum 60% establishment; much predation by rosella parrot; desiccation in summer an important mortality factor.)

Yilmaz, H. A. and S. H. Emiroglu. 1995. [Broomrape resistance, yield, yield components and some chemical characteristics in breeding sunflower (***Helianthus annuus*** L.)] (in Turkish) Turkish Journal of Agriculture and Forestry 19: 397-406.

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Yohe, J., J. Frederick and D. Stoner. 1996. INSTORMIL-1996 Annual Report. 179 pages. (Some reference to ***Striga*** research in each report.)

Yong, J. W. H. and C. S. Hew. 1995. A report of mistletoes on pigeon orchids in Singapore. Lindleyana 10: 131-132. ***(Dendrophthoe pentandra*** on ***Dendrobium crumenatum.)***

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Zaitoun, F. M. F., M. E. Saleh and S. J. ter Borg. 1996. Effect of some trace elements on germination and seedling development of ***Orobanche.*** In: H. Brown, G. W. Cussans, M. D. Devine, S. O. Duke, C. Fernandez-Quintadla, A.

Helweg, R. Labrada, M. Landes, P. Kudsk and S. C. Streibeig (Eds.) Proceedings, 2nd International Weed Control Congress, Copenhagen, Denmark, 1996, pp. 735-742. (Some indication of toxic effects of copper on *O. crenata, O. aegyptiaca* and *O. oxyloba.)*

Zerman, N. and A.R. Saghir. 1995. (The genus *Cuscuta* in Algeria.) (In Arabic) Arab Journal of Plant Protection 13(2): 69-75. (12 species reported, including C. *campestris,* now widespread.)

Zonno, M.C., M. Vurro, R. Capasso, A. Evidente, A. Cutignano, J. Sauerborn and H. Thomas. 1996. Phytotoxic metabolites produced by ***Fusarium nyagamai*** from ***Striga hermonthica.*** In: V.C. Moran and J.H.J. Hoffman (Eds), Proceedings, 9th International Symposium on Biological Control of Weeds, Stellenbosch, 1996. pp. 223-226. (Main phytotoxins, fusaric and 9,10- dehydrofusaric acids, reduced germination at 10-6 M.)

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HAUSTORIUM IN NEED OF A HOST

Our apologies for the long delay in production of this issue of Haustorium due to sundry logistical difficulties and the fact that there are currently no official funds supporting the newsletter. This issue is being produced in Bristol UK, using some funds left over from an account established following the 4th International Symposium in 1984, when ICARDA generously donated 100 copies of the Proceedings to be sold by the IPSPRG. Those funds have been used periodically to bridge gaps in the funding from other sources and the balance is now sufficient to cover about half the cost of this mailing. Long Ashton Research Station has kindly provided assistance and the balance is being made up by private contributions. We have so far failed to identify a long-term source of funding for the future, and will welcome any suggestions, or financial contributions. The total needed is no more than a few hundred dollars per year, unfortunately too small a sum for most official donors to consider. Just a few generous individual donations could be enough!

Because of the long delay (nearly 12 months since the last issue) there is a heavy Literature section, while the uncertainties over publication have inhibited the canvassing of news items. We very much hope to change the balance towards more news in future issues.

Regrettably, due to loss of material in the mail, it has not been possible to access the most up-to-date mailing list, and this issue is being mailed to those listed in 1994, plus the most recent additions. If you know of colleagues who should have, but have not, received copies please let Chris Parker know.

THE HAUSTORIUM WEB SITE

Thanks to arrangements with the Institute of Arable Crops Reseach, Long Ashton Research Station, Bristol, the new web site is/will be:
www.lars.bbsrc.ac.uk/cropenv/haust.htm

The web site established via www.odu.edu in February 1997 is now closed. Please note that that was based on an early draft of Haustorium 32, and was not updated as intended. This means it did not include the full list of literature citations which appeared in the hard copy sent out in July 1997.

FOURTH INTERNATIONAL WORKSHOP ON *OROBANCHE*, ALBENA, BULGARIA, SEPTEMBER 23-26, 1998.

Arrangements for this meeting continue. For more information contact the organisers in Bulgaria at:

Institute for Wheat and Sunflower ‘Dobroudja’, near General Toshevo, Bulgaria 9520. Tel: (359)-58-870212 or 58-870204. Fax (359)-58-26364. Email iws@eos.dobrich.acad.bg

OR: Prof Dr Klaus Wegmann, Wladhauserstrasse 37, D-72076 Tubingen, Germany. Tel/Fax: (49)-707164658; email klaus.wegmann@uni-tuebingen.de

SEVENTH INTERNATIONAL PARASITIC WEED SYMPOSIUM

Preliminary arrangements are being made for the Seventh International Parasitic Weed Symposium to be held in Nantes, France, in 2001. If there are comments or suggestions on the format of this event please contact Haustorium editors, or Patrick Thalouarn, Laboratoire de Cytopathologie Vegetale, University de Nantes, 2, Rue de la Houssinière, BP 92208, F44322 Nantes Cedex 3 France. Email patrick.thalouarn@svt.univ-nantes.fr

REGIONAL *STRIGA* AND *OROBANCHE* WORKSHOPS IN GHANA AND MOROCCO

In collaboration with its national partners from Ghana and Morocco the supra-regional GTZ-project “Ecology and Management of Parasitic Weeds“ organised regional workshops in Ghana and Morocco, respectively. The aim of the workshops was to summarise and discuss important results of almost 10 years of interdisciplinary research towards combating parasitic weeds of the genus *Striga* and *Orobanche* in Africa and the WANA-region. They were intended to provide a forum for discussion for decision makers, researchers and extension agents interested or already involved in parasitic weed control.

The 1st workshop entitled **"Joint action to control *Striga* in Africa: experiences from Ghana"** was organised in close collaboration with the Savanna Agricultural Research Institute (SARI) and the Ghanaian Ministry of Food and Agriculture (MoFA), Tamale. The event took place from 6 to 9 October, 1997, in Sogakope, Ghana, a beautiful location on the Volta river. In total, 45 researchers and extension agents from 11 African countries (Burkina Faso, Cameroon, Ghana, Kenya, Mali, Niger, Nigeria, Tanzania, The Gambia and Togo) participated in the workshop. Thirty five papers were discussed in 5 main sessions, each introduced by a keynote speaker: 1) Analysis of the *Striga* problem (Dr. Kroschel, GTZ, Germany), 2) *Striga* biology versus control (Prof. Sauerborn, University of Giessen, Germany), 3) Status quo of *Striga* control (I) - prevention, mechanical and biological control methods and host plant resistance (Dr. Hess, ICRISAT, Mali), 4) Status quo of *Striga* control (II) - cultural, chemical and integrated aspects (Dr. Ransom, CIMMYT, Kenya), and 5) Joint action (Dr. Kachelriess, GTZ, Germany).

The importance of an analysis of the *Striga* problem (in particular, surveying the regional distribution and the severity of infestation, yield loss assessments, assessments on the perception of *Striga* by farmers and extension staff using questionnaires, the role of women in the control of *Striga* as well as the economics of *Striga* control) was discussed as a first step towards future control. Difficulties, which hinder the development of innovations in *Striga* control from biological and physiological point of views were demonstrated. The status quo of *Striga* control was critically discussed distinguishing between researchers' "control dreams" and "farmers situation and reality". Finally, "Joint Action" was discussed. Joint efforts and strong linkages between researchers, extension workers and farmers are needed if *Striga* control is to be successful in farmers' fields. The term "Joint Action" was preferred to the modern term "Technology Transfer" since there are no indications that *Striga* will be controlled by a single and/or simple "Technology" in the near future by small scale farmers.

The 2nd workshop was entitled "**Joint action to control *Orobanche* in the WANA-region: Experiences from Morocco"**. This workshop was organised in collaboration with the Institut National de la Recherche Agronomique (INRA), Meknes, and the Moroccan-German project "Amélioration de la Culture des Légumineuses Alimentaires", Rabat, Morocco. The workshop was held in Rabat from March 30 to 2 April, 1998. Ten countries including Algeria, Chile, Egypt, Germany, India, Israel, Morocco, the Netherlands, Spain and Tunisia were represented by 55 researchers and extension workers. 32 oral papers as well as 4 posters were presented. The structure of the programme was similar to that of the Ghana workshop. Keynotes papers were given on "*Orobanche* biology versus control" (Dr. ter Borg, Wageningen Agricultural University, the Netherlands), on "Cultural control" (Dr. Linke, Germany), on "Host plant resistance" (Prof. Petzoldt, Fachhochschule Nürtingen, Germany), and on "Chemical control" (Dr. Garcia-Torres, Institute for Sustainable Agriculture, Spain).

An excursion to the Saïs region closed the workshop. During the visit to the Douyet Experimental Station of INRA the biological control of *Orobanche crenata* using *Phytomyza orobanchia* in an inundative approach was demonstrated and discussed in detail. Furthermore, herbicide and breeding trials were shown. Finally, the use of a visualised extension programme was demonstrated by extension workers on the spot with a group of farmers. After that, excellent Moroccan hospitality was enjoyed while admiring the wonderful scenery of the Middle Atlas.

The conclusions from the workshop held in Ghana are already compiled. The workshop proceedings will be published in the next few months and can be ordered from Dr. J. Kroschel, University of Hohenheim (380), 70593 Stuttgart, Germany.

J. Kroschel

RHAMPHICARPA FISTULOSA ON RICE IN AFRICA

Rhamphicarpa fistulosa (Hochst.) Benth. is widespread in tropical Africa, occurring on moist soils particularly where there is seasonal flooding. Recently the parasite has been reported to cause serious localised losses in rice in West Africa, namely south-western Guinea and Benin, though it has also been observed in rice from the Casemence, Senegal, and southern Ghana. The distribution of the species in Guinea has been reported by Cisse *et al* (Sixth International Parasitic Weed Symposium, Cordoba, 1996). Recent observations indicate that the parasite is found in direct seeded rice in rain-fed lowlands and upland areas with high rainfall. Infestations appear to be increasing - in south-west Guinea, infested fields have an average density of 20 plants m^{-2}. Farmers have abandoned fields where infestations are particularly severe as no effective control measures are known for areas where there is no water control. Several years of fallow between rice crops does not prevent serious losses in subsequent crops, presumably because the parasite has a wide host range on wild grasses and sedges, and also because of longevity of the seed.

R. fistulosa also occurs on rice planted as an inter-crop with maize in vleis, seasonally flooded valley bottoms in Masvingo Province, southern Zimbabwe. In this system rice is broadcast between maize rows planted on residual moisture in late August and September. The rice crop matures after the maize crop has been harvested in mid-February. By this stage of the season low spots in the vlei, the areas usually selected for rice, may be flooded to a depth of 5-25 cm and it is under these conditions that the parasite appears to thrive and infested rice becomes stunted. As in West Africa farmers know of no control but have observed that if *R. fistulosa* is present the rice grows better following an application of manure.

Increasing levels of infestation are causing farmers to abandon otherwise productive lowland fields in Kyela District, Southern Tanzania. Called 'mbyoso', which means 'causing to rot', reflecting the damage to rice, the Nyakyusa people in the area identify *R. fistulosa* as their most serious wetland weed. This is of particular significance as yields of upland rice are in decline due to falling soil fertility and an increased incidence of *Striga asiatica*.

Rice production in West Africa has increased at an annual rate of 8.5% between 1983-92, a trend which is likely to continue. Much of the increase in production results from expanding the area in production. Low-lying areas are often favoured by farmers as the rice crop is at less risk from drought and the soils are fertile. In some areas intensification of production in these ecologies may be threatened by infestations of *Rhamphicarpa*. At present however, information about this parasite is very scarce and little is known about its host range or possible control measures.

David E Johnson, Natural Resources Institute, West Africa Rice Development Association, Bouake, Cote D'Ivoire; Charles R Riches, NRI, IACR-Long Ashton Research Station, Bristol, UK; M. Camara, PVI, Conakry, Guinea; and A.M. Mbwaga, Ilonga Agricultural Research and Training Institute, Tanzania.

MISTLETOES ON RUBBER TREES IN NIGERIA

As a result of growing concern over the menace of mistletoes (family Loranthaceae) on rubber trees in Nigeria, and the lack of information on this semi-parasitic plant, its biology was studied. A survey was also conducted to determine the level of Mistletoe infestation in three localities, representative of the three agro-ecological zones (south-east, south-west and south-south) in the Nigerian rubber belt. In addition, preliminary chemical control trials were conducted, since the only means of control currently practised involves pruning infested branches. This, however, is only feasible in very young rubber trees.

Two species of mistletoe were identified, the more common being the yellow-flowered *Loranthus incanus* Scum. (=*Phragmanthera incana* (Schum.) Balle), with pink tips to the corolla, encountered in all the infested plots. It flowers up to three times per year but usually twice. The red-flowered *Loranthus brunneus* Engl. (=*Agelanthus brunneus* (Engl.) van Tiegh.) has smaller flowers and smaller, narrower leaves, and was rarely seen. *L. brunneus* flowers once a year. Mistletoe is widespread in the rubber-growing belt and up to 70% of trees in a plot may be infested. The problem is first noticed in the field on trees 3-4 years old; nursery plants are not affected. There is evidence of clonal resistance to the parasite. Also there were differences in mistletoe incidence among rubber clones, based on geographic location. Highest infestation was observed in the south-west zone. This variability seems to be due to climatic and other environmental factors rather than geographic variability in virulence of the parasite. Two translocated herbicides (glyphosate and quizalofop) out of the six chemicals tested, showed some effect, particularly on juvenile mistletoes, when injected at rates of 10 ml per tree. No phytotoxic effects of the tested chemicals were observed on rubber leaves.

E.R. Begho, E.E. Aniamaka and E.O. Imarhiagbe, Rubber Research Institute of Nigeria, P.M.B. 1049, Benin City, Nigeria.

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Ackroyd, R.D. and J.D. Graves. 1997. The regulation of the water potential gradient in the host and parasite relationship between *Sorghum bicolor* and *Striga hermonthica*. Annals of Botany 80: 649-656. (Diversion of resources to the parasite depends on both higher transpiration rate in the parasite and resistance to hydraulic conductivity across the haustorium.)

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García-Torres, L., F. López-Granados, M. Castejón-Muñoz, M. Jurado-Expósito and J. Díaz Sánchez. 1997. (The present state of *Orobanche* spp. infestations in Andalucia and its management.) (in Spanish) Proc. Sociedad Española de Malherbologia Congresso, Valencia, 1997. Pp. 181-185. (32,000 ha of peas destroyed by *O. crenata* in in spite of resistant varieties; imazethapyr registered for use pre-emergence in sunflower.)

García-Torres, L., F. López-Granados, M. Jurado-Expósito and J. Díaz Sánchez. 1998. The present state of *Orobanche* spp. infestations in Andalusia and the prospects for its management. Sixth EWRS Mediterranean Symposium, Montpellier, 1998, pp. 141-145. (*O. crenata* destroyed 30, 000 ha of peas in 1996; *O. cernua* affecting 40,000 ha sunflower.)

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Goldwasser, Y., Y. Kleifeld, D. Plakhine and B. Rubin. 1997. Variation in vetch (*Vicia* spp.) response to *Orobanche aegyptiaca*. Weed Science 45: 756-762. (*V. sativa* susceptible; *V. atropurpurea* resistant, due to necrotic response.)

Gómez, M.A., M.T. Sáenz, M.D. García, M.C. Ahumada and R. de la Puerta. 1997. Cytostatic activity against HEp-2 cells of methanol extracts from *Viscum cruciatum* Sieber parasitic on *Crataegus monogyna* Jacq. and two isolated principles. Phytotherapy Research 11: 240-242.

Haidar, M.A., G.L. Orr and P. Westra. 1997. Effects of light and mechanical stimulation on coiling and prehaustoria formation in *Cuscuta* spp. Weed Research 37: 219-228. (Studies involved a mixture of *C. campestris* and *C. indecora* seedlings, exposed to combinations of red, far-red, ultra-violet and blue light, zeatin and mechanical stimulation.)

Haidar, M.A., G.L. Orr and P. Westra. 1998. The response of dodder (*Cuscuta* spp.) seedlings to phytohormones under various light regimes. Annals of Applied Biology 132: 331-338. (Coiling and pre-haustorium formation, stimulated by zeatin, was synergised by far red light and inhibited by IAA, suggesting phytochrome involvement; ethylene had no effect.)

Hassan, E.A. 1998. Broomrape species in Egypt, a recent survey in relation to geographical distribution. Sixth EWRS Mediterranean Symposium, Montpellier, 1998, p. 155.

Hayashi, S., E. Miyamoto, K. Kudo, K. Kameoka and H. Hanafusa. 1996. Comparison of the volatile components of three mistletoes. Journal of Essential Oil Research 8: 619-626. (Studies on *Viscum album* var. *coloratum* from China, *V. album* from Germany, and *Taxillus kaempferi* from Japan.)

Herrero Nieto, A., A. Escudero Alcántara and S. Pajarón Sotomayor. 1995. (Floristic notes from the Relumbrar Mountains (Abacete and Ciudad Real.) (in Spanish) Studia Botanica 14: 207-215. (Including information on *Cuscuta planiflora*.)

Hershenhorn, J, D. Plakhine, Y. Goldwasser, J.H. Westwood, C.L. Foy and Y. Kleifeld. 1998. Effect of sulfonylurea herbicides on Egyptian broomrape (*Orobanche aegyptiaca*) in tomato (*Lycopersicon esculentum*) under greenhouse conditions. Weed Technology 12: 115-120. (Comparing the effects of chlorsulfuron and 5 other sulfonylurea herbicides applied in various ways to *O. aegyptiaca* and tomato in pots, confirming selectivity when applied direct to the soil.)

Hershenhorn, J, D. Plakhine, Y. Goldwasser, J.H. Westwood, C.L. Foy and Y. Kleifeld. 1998. Effect of sulfonylurea herbicides on Egyptian broomrape (*Orobanche aegyptiaca*) in tomato (*Lycopersicon esculentum*). Weed Technology 12: 108-114. (Comparing the effects of chlorsulfuron and 6 other sulfonylurea herbicides applied to *O. aegyptiaca* at various stages in petri dish and polybag.)

Hibberd, J.M., W.P. Quick, M.C. Press and J.D. Scholes. 1998. Can source-sink relations explain responses of tobacco infection by the root hemiparasitic angiosperm *Orobanche cernua*? Plant, Cell and Environment 21: 333-340. (Tobacco biomass reduced 29% - all accounted for by dry weight of *O. cernua*. Changes associated with greater specific leaf area and delayed senescence of tobacco leaves.)

Hincha, D.K., U. Pfüller and J.M. Schmidtt. 1997. The concentration of cryoprotective lectins in mistletoe (*Viscum album* L.) leaves is correlated with leaf frost hardiness. Planta 203: 140-144.

Hoffman, G., C. Diarra, I. Ba and D. Dembele. 1997. (Parasitic plant species of food crops in Africa: biology and impact, study in Mali. 1. Identification and biology of parasitic plants. 2. Impact of parasitic plants based on the results of a study in Mali (1991-1994).) (in French) Agriculture et Développement 13(March 1997): 30-51. (Species recorded in Mali include *Buchnera hispida, Alectra vogelii, Rhamphicarpa fistulosa* and 8 spp.of *Striga*. Severity of each species in 7 villages surveyed and linked to cropping practices, field history etc.)

Hoffman, G., P. Marnotte and D. Dembele. 1997. (The use of herbicides to control *Striga hermonthica*.) (in French) Agriculture et Développement 13(March 1997): 58-62. (2,4-D applied 30 days after sowing maize or sorghum reduces *Striga* infestation and a second application almost eliminates it.)

Hood, M.E., J.M. Condon, M.P. Timko and J.L. Riopel. 1998. Primary haustorial development of *Striga asiatica* on host and non-host species. Phytopathology 88: 70-75. (Haustorial development and penetration of cortex occurred on all non-hosts, but further penetration into lettuce, *Tagetes erecta* and cowpea arrested by necrosis of host cortex tissue.)

Hunt, R.S., J.N. Owens and R.B. Smith. 1996. Penetration of western hemlock, *Tsuga heterophylla*, by the dwarf mistletoe *Arceuthobium tsugense*, and development of the parasite cortical system. Canadian Journal of Plant Pathology 18: 342-346.

ICARDA. 1997. Forage legumes resistant to parasitic weeds. ICARDA Annual Report 1996, p. 11. (*Vicia narbonensis* resistant to *O. aegyptiaca* but susceptible to *O. crenata*; *V. sativa* 1448 resistant to *O. crenata*; *Lathyrus ochrus* resistant to both species.)

ICRISAT. 1997. *Striga* control: a new way forward. ICRISAT Report 199, pp. 42-46. (Emphasising hopes and possible techniques for the control by *Fusarium* spp., including *F. nygamai* and *F. oxysporum*.)

IITA. 1996. Research highlights. International Institute of Tropical Agriculture Annual Report, 1996. p.8. (Research approaches include seed treatment with bacterial isolates and progeny from *Zea diploperennis*.)

IITA. 1997. Maize wild relatives get a stranglehold on *Striga*. International Institute of Tropical Agriculture Annual Report, 1997, pp 6-7. (also Research Highlights pp. 58-59.) (Describing use of molecular markers to help in the transfer of resistance from *Zea diploperennis* to maize. A further new approach is the use of ethylene-producing *Pseudomonas* spp. to stimulate suicidal germination.)

Jain, R. and C.L. Foy. 1997. Translocation and metabolism of glyphosate in Egyptian broomrape (*Orobanche aegyptiaca*)-infested tomato (*Lycopersicon esculentum*) plants. PGRSA Quarterly 25(1): 1-7. (Glyphosate translocated intact to all parts of host and parasite, mostly within the first 3 days; greater accumulation in parasite than in host meristem.)

Jeffree, C.E. and E.P. Jeffree. 1996. Redistribution of the potential geographical ranges of mistletoe and Colorado beetle in Europe in response to the temperature component of climate change. Functional Ecology 10: 562-577. (Projected warming not likely to have substantial impact on distribution of *Viscum album*.)

Jeschke, W.D., A. Baig and A. Hilpert. 1997. Sink-stimulated photosynthesis, increased transpiration and increased demand-dependent stimulation of nitrate uptake: nitrogen and carbon relations in the parasitic association *Cuscuta campestris* - *Coleus blumei*. Journal of Experimental Botany 48: 915-925.

Joel, D.M. 1998. Key developmental processes in parasitic weeds as potential targets for novel control methods. Sixth EWRS Mediterranean Symposium, Montpellier, 1998, pp. 135-140.

Joel, D.M., K. Kleifeld and J. Gressel. 1997. Parasitic weed control using transgenic herbicide-resistant crops. In: R. De Prado, J. Jorrin and L. García-Torres (eds) Weed and Crop Resistance to Herbicides. (Proceedings, International Symposium, Cordoba, 1995) pp. 275-279. (Brief summary of successful results with chlorsulfuron v. *Orobanche* on tobacco and glyphosate v. *Orobanche* on rape; moderate success with asulam on tobacco. Caution expressed re development of herbicide tresistance in the parasite.)

Joel, D.M. and V.H. Portnoy. 1998. The angiospermous root parasite *Orobanche* L. (Orobanchaceae) induces expression of a pathogenesis related (PR) gene in susceptible roots. Annals of Botany 81: 779-781. (Defence reactions detected in transgenic tobacco (with PRB-11 promoter fused to the GUS reporter gene) suggest that the host is not a compatible partner, even though showing normal susceptiblity.)

Joel, D.M., V. Portnoy and N. Katzir. 1996. Identification of single tiny seeds of *Orobanche* using RAPD analysis. Plant Molecular Biology Reporter 14: 243-248. (Seeds of 5 different *Orobanche* spp. could be identified.)

Joel, D.M., J.C. Steffens and D.E. Matthews. 1995. Germination of weedy root parasites. In: J. Kigel and

G. Galili (eds) Seed Development and Germination. Marcel Dekker, New York. pp. 567-597.

Joller, P.W., J.M. Menrad, T. Schwarz, U. Pfüller, M.J. Parnham, R. Weyhenmeyer and H. Lentzen. 1996. Stimulation of cytokine production via a special standardized mistletoe preparation in an *in vitro* human skin bioassay. Arzneimittel Forschung 46: 649-653. (Involving the mistletoe - *Viscum album* preparation Lektinol.)

Jost, A. 1997. Intergrieter Getreideanbau in Nord-Ghana unter besonder Berücksichtung der *Striga*-problematik. PLITS 15(4) 127 pp. (Problem reduced by use of short-season sorghum varieties. Also seed reserves of *S. hermonthica* reduced 48% under legume fallows.)

Juan, R., J. Pastor and I. Fernández. 1996. (Observations of fruits and seeds in three species of *Odontites* Ludwig (Scrophulariaceae).) (in Spanish) Acta Botanica Malacitana No 21: 91-97. (Morphological and anatomical studies showed *O. tenuifolia*, *O. longiflora* and *O. foliosa* could be distinguised by fruit and seed features.)

Jurado-Expósito, M., L. García-Torres, M. Castejón-Muñoz. 1997. Broad bean and lentil seed treatments with imidazolinones for the control of broomrape (*Orobanche crenata*). Journal of Agricultural Science 129: 307-314. (Selective control achieved with imazethapyr on broad bean and imazapyr on lentil.)

Kabir, M., D. Faure, T. Heulin, W. Achouawk and R. Bally. 1996. *Azospirillum* populations in soils infested by a parasitic weed (*Striga*) under sorghum cultivation in Mali, west Africa. European Journal of Soil Biology 32: 157-163.

Katzir, N., V. Portnoy, G. Tzuri, M. Castejón-Muñoz and D.M. Joel. 1996. Use of random amplified polymorphic DNA (RAPD) markers in the study of the parasitic weed *Orobanche*. Theoretical and Applied Genetics 93: 367-372. (Results support the taxonomic separation of *O. ramosa* from *O. aegyptiaca* and of *O. cernua* from *O. cumana*.)

Kepczynski, J. and E. Hepczynski. 1997. Ethylene in seed dormancy and germination. Physiologia Plantarum 101: 720-726. (No mention of *Striga* but a useful review relating mainly to work on *Amaranthus caudatus*.)

Khalaf, K.A. 1997. Isolation and properties of *Orobanche crenata* germination stimulants from the root extracts of *Vicia faba*. Tropical Agriculture 74: 128-131. (At least 3 stimulatory compounds detected in ether extracts of 45-day old roots, but not chemically identified.)

Kim, J.S., H.H. Kwak, B.C. Kim and K.Y. Cho. 1997. (Study on the biosynthetic characteristics of photosynthetic pigments in dodder (*Cuscuta australis* R.Br.) plant.) (in Korean) Korean Weed Journal of Weed Science 17: 314-324. (Chlorophyll content only one fiftieth of that in the leaf of *Convolvulus arvensis*; mainly present near apices; herbicides inhibiting photosynthesis show poor control but paraquat active.)

Kim, S-K., S.T.O. Lagoke and C. Thé. 1997. Observations on field infection by witchweed (*Striga* species) on maize in West and Central Africa. International Journal of Pest Management 43: 113-121. (At a range of sites, 5 years of repeated cropping with maize, fertilized with high nitrogen (120 kg N/ha) resulted in striking reductions in levels of *S. hermonthica*.)

Kim, S-K. and V.O. Adetimirin. 1997. *Striga hermonthica* seed inoculum rate effect on maize hybrid tolerance and susceptibility expression. Crop Science 37: 1066-1071. (Comparing responses of tolerant (8322-13) and susceptible (8338-1) hybrids to *S. hermonthica* seed placed in planting hole. At higher rates tolerant showed 25% less emergence and double yield of susceptible. Yields comparable in absence of *Striga*.)

Kim, S-K., V.O. Adetimirin and A.Y. Akintunde. 1997. Nitrogen effects on *Striga hermonthica* infestation, grain yield, and agronomic traits of tolerant and susceptible maize hybrids. Crop Science 37: 711-716. (At artificially infested sites, at least 120 kg N/ha required to reduce *Striga* levels. Yields of \`tolerant' hybrids 8322-13 and 8425-8 reduced about 40% by *Striga* at low N levels but still substantially out-yielded susceptible hybrids.)

Koncalova, M.N. and Z. Kropac. 1996. Host-parasite relationship during the germination phase in *Orobanche crenata* and *O. minor*. Presilia 68: 329-339. (Describing the use of an agar medium for germination studies.)

Kovar, P. E.A. Hassan and E. Brabec. 1997. Is *Vicia faba* population affected by parasitism from *Orobanche crenata* more than by competition from non-parasitic weeds? Presilia 69:185-190. (In a pot experiment *V. faba* more damaged by non-parasitic weeds than by *O. crenata*.)

Kuiper, E. 1997. Comparative studies on the parasitism of *Striga aspera* and *Striga hermonthica* on tropical grasses. PhD thesis, Free University, Amsterdam. 144 pp. (A finely produced volume with sections on primary dormancy, germination, genetic variability, host range, resistance and effects on hosts, of the two species. Suggesting a close relationship between the two species, but somewhat different host range, especially in the post-attachment resistance of sorghum to *S. aspera*. Effects on the host comparable.)

Kutbay, H.G., F. Karaer and M. Kilinc. 1996. The relationships of some nutrients between *Cuscuta epithymum (L.) L. var. epithymum* and *Heliotropium europaeum* L. Turkish Journal of Botany 20: 515-518.

Lane, J.A., D.V. Child, T.H.M. Moore, G.M. Arnold and J.A. Bailey. 1997. Phenotypic characterisation of resistance in *Zea diploperennis* to *Striga hermonthica*. Maydica 42: 45-51. (10-15% of *Z, diploperennis* showed failure of normal development of *S. hermonthica* after mainly normal penetration.)

Lane, J.A., T.H.M. Moore, D.V. Child and J.A. Bailey. 1997. Variation in virulence of *Striga gesnerioides* on cowpea: new sources of crop resistance. In: Singh, B.B., D.R. Mohan Raj, K.E. Dashiell and L.E.N. Jackai (eds) Advances in Cowpea Research, Proc. 2nd World Cowpea Research Conference, Accra, 1995. pp. 225-230. (A useful review of geographical variation in virulence of *S. gesnerioides;* cowpea lines 87-2 and APL-1 resist some biotypes but not those from Niger/N. Nigeria.)

Langbehn, A. and H-C. Weber. 1995. (Further observations of growth rates and the development of *Viscum album* L. (Viscaceae) growing on apple trees (*Malus* sp.).) (in German) Beiträge zur Biologie der Pflanzen 69(1): 141-154. (After 3 years development as endophytes, female flowers developed after a further 4 years: new shoots also developed from the endophyte about this time.)

Lanini, W.T. and G. Miyao. 1997. Field dodder control with a biocontrol organism and rimsulfuron in tomatoes. Proceedings, Western Society of Weed Science 50: 49. (*Alternaria conjuncta/infectoria* and *Fusarium tricinctum* singly or together reduced *C. campestris* at least 50% when applied on granules pre-emergence, but not as a post-emergence spray. Tomato yields increased from 61 to 83 T/ha. Rimsulfuron 15 g/ha only partially effective. Var. Heinz 9492 50% less attacked than Halley 3155.)

Lechowski, Z. 1996. Gas exchange in leaves of the root hemiparasite *Melampyrum arvense* L. before and after attachment to the host plant. Biologia Plantarum 38: 85-93. (Net photosynthesis in *M. arvense* only 15 and 23% of that in host *Capsella bursa-pastoris* before and after attachment respectively. Chlorophyll contents only 33 and 49% but respiration 1.8 and 2.6 times higher.)

Lechowski, Z. 1996. Abscisic acid content in the root hemiparasite *Melampyrum arvense* L. before and after attachment to the host plant. Biologia Plantarum 38: 489-494. (ABA levels showed diurnal fluctuation in the host *Caspella bursa-pastoris*, but remained constant in *M. arvense*, at a lower level before attachment, at a higher level after.)

Lechowski, Z. and J. Bialczyk. 1996. Cytokinins in the hemi-parasite *Melampyrum arvense* L. before and after attachment to the host. Biologia Plantarum 38: 481-488. (Levels of cytokinin in parasite xylem sap massively higher after attachment to host *Capsella bursa-pastoris*.)

Lei, S.A. 1997. Host-parasite relationship between *Juniperus osteospermum* (Utah juniper) and *Phoradendron juniperus* (desert mistletoe) in the Mojave Desert. (Abstract) American Journal of Botany 84(6): 104.

Lolas, P. 1996. Sub-group collaborative study on broomrape. 1995-1996 report. Bulletin de'Information - CORESTA 1996(3/4): 47-51. (Reviewing activities relating to *Orobanche* spp. in tobacco.)

Löffler, C. F.C. Czygan and P. Proksch. 1997. Phenolic constituents as taxonomic markers in the genus *Cuscuta* (Cuscutaceae). Biochemical Systematics and Ecology 25: 297-303. (Nine species of *Cuscuta* each showed a characteristic pattern of phenolics which could be used as taxonomic markers.)

López-Granados, F and L. García-Torres. 1997. Modelling the demography of crenate broomrape (*Orobanche crenata*) as affected by broad bean (*Vicia faba*) cropping frequency and planting date. Weed Science 45: 261-268.

López-Granados, F., L. García-Torres and J. Díaz Sánchez. 1997. (A bioeconomic model for crenate broomrape (*Orobanche crenata*) in broad bean (*Vicia faba*) under different management strategies.) (in Spanish) Proc. Sociedad Española de Malherbologia Congresso, Valencia, 1997. (Suggested best strategy early sowing, mid October, plus herbicide – imazethapyr 75 g/ha pre-emergence and glyphosate 40g/ha post-emergence.)

López-Sáez, J.A. 1996. (Chorology and ecology of *Viscum cruciatum* Sieber ex Boiss. in the Iberian Peninsula.) (in Spanish) Boletin de Sanidad Vegetal, Plagas 22: 601-611. (Ecology, distribution, biology, hosts etc reviewed: above 800 m *V. album* predominates.)

Losner-Goshen, D., G. Ben-Hod, A.M. Mayer and D.M. Joel. 1996. Aseptic broomrape infection of tomato root culture. Israel Journal of Plant Sciences 44: 89-94.

Losner-Goshen, D., V.H. Portnoy, A.M. Mayer and D.M. Joel. 1998. Pectolytic activity by the haustoria of the parasitic plant *Orobanche* L. (Orobanchaceae) in host roots. Annals of Botany 81: 319-326. (Involvement of enzymes in haustorium penetration confirmed by the presence of pectin methylesterase in intrusive cells of *O. cumana* and *O. aegyptiaca* and lack of pectin in middle lamellae of adjacent cells of hosts sunflower and tomato respectively.)

Ma YongQing, A.G.T. Babiker, I.A. Ali, Y. Sugimoto and S. Inanaga. 1996. *Striga hermonthica* (Del.) Benth. germination stimulant(s) from *Menispermum dauricum* (DC.) root culture. Journal of Agricultural and Food Chemistry 44: 3355-3359. (The root culture technique produced 2-3 highly active stimulant compounds with chromatographic properties different from those of strigol.)

Ma, Y. A.G.T. Babiker, Y. Sugimoto and S. Inanga. 1998. Effect of the medium composition on production of *Striga hermonthica* (Del.) Benth. germination stimulant(s) by *Menispermum dauricum* (DC.) root cultures. Journal of Agricultural and Food Chemistry 46: 1587-1592. (Excised roots of *M.*

dauricum grew best and produced best *Striga* germination when cultured in a modified B5 medium. Such culturing suggested as possible means of producing good quantities of stimulant for analysis.)

Mabasa, S. 1996. Screening sorghum cultivars for resistance to witchweed (*Striga asiatica*) in Zimbabwe. In: K. Leuschner and C.S. Manthe (eds) Drought-tolerant Crops for Southern Africa. Proceedings of the SADC/ICRISAT regional sorghum and pearl millet workshop, Gaborone, 1994, pp. 201-209. (Vars SAR-29, -33, -35, and -37 supported least *S. asiatica* but yielded poorly: vars DC-75, SV-1, SV-2 and MMSH-413 showed tolerance.)

Mabsoute, L. and E.M. Saadaoui. 1996. (Overview of research work on parasites of food legumes in Morocco.) (in French) Al Awamia 92: 55-67. (Including observations on *Orobanche*.)

McPartland, J.M. 1996. A review of *Cannabis* diseases. Journal of the International Hemp Association 3(1): 19-23. (including *Orobanche ramosa*.)

Manoharan, M., C.S.S. Vidya and G.L. Sita. 1998. Introduction and expression of marker genes in sandalwood (*Santalum album* L.) follows *Agrobacterium*-mediated transformation.??????

Manschadi, A.M., J. Kroschel and J. Sauerborn. 1996. Dry matter production and partitioning in the host-parasite association *Vicia faba-Orobanche crenata*. Angewandte Botanik 70: 224-229. (Loss of dry weight from the host accounted for fully by dry weight of the parasite: *O. crenata* at the bud stage prevented seed set in the host.)

Manschadi, A.M., J. Sauerborn, J. Kroschel and M.C. Saxena. 1997. Effect of plant density on grain yield, root-length density and *Orobanche crenata* infestation in two faba bean genotypes. Weed Research (Oxford) 37: 39-49. (Breeding line 402/29/84 proved highly resistant due to a range of host characters.)

Marko, M.D. and F.R. Stermitz. 1997. Transfer of alkaloids from *Delphinium* to *Castilleja* via root parasitism. Norditerpenoid alkaloid analysis by electrospray mass spectrometry. Biochemical Systematics and Ecology 25: 279-285. (The major alkaloids were all transfered from *D. occidentale* to *C. sulphurea*.)

Mathiasen, R.L., J.R. Allison and B.W. Geils. 1998. Western dwarf mistletoe parasitising Colorado blue spruce and Norway spruce in California. Plant Disease 82: 351. (New record for *Arceuthobium campylopodium* on *Picea pungens* and second record on *P. abies*.)

Matthies, D. 1997. Parasite-host interaction in *Castilleja* and *Orthocarpus*. Canadian Journal of Botany 75: 1252-1260. (*C. integra, C. miniata, C. chromosa* (perennials) and *O. purpurascens* (annual) all facultative but attachment to hosts increased weight by X3-X41. *Medicago sativa* better host than *Lolium perenne*. Response of host, in terms damage and root:shoot ratio depended on host/parasite combination.)

Mayer, A.M. and N. Bar Nun. 1997. Germination of *Orobanche* seeds: some aspects of metabolism during preconditioning. In: R.H. Ellis, M. Black, A.J. Murdoch and H.D. Hong (eds) Basic and Applied Aspects of Seed Biology. Proc., Fifth International Workshop on Seeds, Reading, 1995. Kluwer, Dordrecht. pp. 633-639.

Mayer, M.J., J. Steel, D.V. Child, J.A. Hargreaves and J.A. Bailey. 1997. Early stages of infection of maize (*Zea mays*) and *Pennisetum setosum* roots by the parasitic plant *Striga hermonthica*. European Journal of Plant Pathology 103: 815-827. (In maize, some thickening of endodermal cell walls in response to infection but penetration unhindered. In the resistant species *P. setosum* endodermal cell walls naturally much thicker, further thickened in response to infection, and rarely penetrated.)

Mbwaga, A.M. 1996. Status of *Striga* species in Tanzania: occurrence, distribution, and on-farm control packages. In: K. Leuschner and C.S. Manthe (eds) Drought-tolerant Crops for Southern Africa. Proceedings of the SADC/ICRISAT regional sorghum and pearl millet workshop, Gaborone, 1994, pp. 195-200. (In-row mixed cropping with spreading cowpea suppressed *Striga* and increased cereal yield. 2,4-D twice at 2 kg/ha also effective. Sorghum vars Serena, SAR-29 and Weijita show resistance to *S. asiatica* and *S. forbesii*: Serena also least affected by *S. hermonthica*.)

Mishra, J.S., V.P. Singh and V.M. Bhan. 1996. Response of lentil to date of sowing and weed control in Jabalpur, India. Lens Newsletter 23: 18-23. (Delayed sowing increased incidence of *Cuscuta* sp.(unspecified) on lentil.)

Monteiro, W.R., M. de M. Castro and M. Venturelli. 1996. Anatomical and histochemical aspects of the primary haustorium of *Struthanthus vulgaris* Mart. (Loranthaceae). Revista Brasiliera de Botanica 19(1): 25-34.

Muleba, N., J.T. Ouedraogo and J.B. Tignegre. 1997. Cowpea yield losses attributed to *Striga* infestations. Journal of Agricultural Science 129: 43-48. (Studies in Burkina Faso suggest at least 30% yield loss in susceptible cowpea varieties.)

Mumera, L.M. and F.E. Below. 1996. Genotypic variation in resistance to *Striga* parasitism of maize. Maydica 41: 255-262. (Suggesting a strong host-plant ear sink to be an important component of resistance.)

Murasheva, V.N. 1996. (Influence of *Fusarium oxysporum* var. *orthoceras* (Appel et Wr.) Bilai toxic properties on its vitality in soil and pathogenicity.) (in Russian) Mikalogiya i Fitopatalogiya 29: 53-58.

(Three strains of *F. oxysporum* shown to persist in soil and infect crop species - hence not suitable for use against *Orobanche* spp.)

Musselman, L.J. 1996. Parasitic weeds in the southern United States. In: Invasion of the South: the Ecological Impact and Control of Exotic Weeds in the Southeastern United States. Symposium, Knoxville, 1996. Castanea 61(3): 271-292.

Nandula, V.K. and C.L. Foy. 1997. Absorption, translocation and fate of ^{14}C-glyphosate in broomrape-infected common vetch (*Vicia sativa*). Proceedings Southern Weed Science Society 50: 156-157.

Nefkens, G.H.L., J.W.J.F. Thuring, M.F.M. Beenakkers and B. Zwanenburg. 1997. Synthesis of a phthalloylglycine derived strigol analogue and its germination stimulatory activity towards seeds of the parasitic weeds *Striga hermonthica* and *Orobanche crenata*. Journal of Agricultural and Food Chemistry 45: 2273-2277. (Describing the synthesis and activity of strigol analogue Nijmegen 1 in racemic and optically active forms.)

Norton, D.A. and M.A. Carpenter. 1998. Mistletoes as parasites: host specificity and speciation. Trends in Ecology & Evolution 13: 101-105. (Discusses evolutionary biology of mistletoes in relation to that of animal parasites.)

Norton, D.A. and N. Reid. 1997. Lessons in ecosystem management from management of threatened and pest loranthaceous mistletoes in New Zealand and Australia. Conservation Biology 11: 759-769.

Olivier, A., J.C. Glaszmann, C. Lanaud and G.D. Leroux. 1998 Population structure, genetic diversity and host specificity of the parasitic weed *Striga hermonthica* (Scrophulariaceae) in Sahel. Plant Systematics and Evolution 209: 33-45. (Comparison of 14 populations of *S. hermonthica* from a number of hosts in West Africa, by gel electrophoresis, showed little genetic divergence between populations.)

Omunyin, M.E. and M.N. Wabule. 1996. Occurrence of African mistletoe *Erianthemum ulugurense* on *Toona ciliata* and other trees in Kenya. Plant Disease 80: 823. (*E. ulugurense* observed to cause branch die-back on at least 9 tree species.)

Onder, F., Y. Karsavuran and S. Tezcan. 1995. (Some investigations on heteropteran fauna as potential biocontrol agents for weeds in Turkey.) (in Turkish) Bitki Koruma Bülteni 33(1/2) 15-22. (Listing some insects with potential for biocontrol of parasitic plants.)

Onu, I., P.S. Chindo, A.A. Adeoti and L.J. Bamaiyi. 1996. Preliminary report on the insect pests of *Striga* species in the Northern Guinea and Sudan Savanna of Nigeria. Journal of Sustainable Agriculture 8(1): 73-78. (*Alcidoides marramus, Junonia orythia, Helicoverpa armigera* and *Smicronyx* identified as having most potential as biocontrol agents.)

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Malacitana No 21: 199-220. (A botanical survey recording 16 *Orobanche* spp. including two new for the province, *O. schultzii* and *O. foetida* ssp. *broteri*.)

Pujadas, A. and P. Thalouarn. 1998. *Orobanche cernua* Loefl. and *O. cumana* Wallr. In the Iberian peninsula. Sixth EWRS Mediterranean Symposium, Montpellier, 1998, pp. 159-160. (Describing *O. cumana* from sunflower, and *O. cernua* from wild hosts in Compositae, *Artemisia* spp. and *Launaea lanifera* (but no Solanaceae), and characters for separating them.)

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Vouzounis, N.A. 1997. Review for 1996. Agricultural Research Institute, Nicosia, Cyprus. pp. 40-41. (*Orobanche* well controlled by polyethylene sheeting put down at time of sowing tomato and eggplant. Rimsulfuron showed selectivity in tomato only: imazaquin in both crops.)

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Weston L.A., C.I. Nimbal and M.A. Czarnota. 1997. Activity and persistence of sorgoleone, a long-chain hydroquinone produced by *Sorghum bicolor*. The 1997 Brighton Crop Protection Conference – Weeds: 509-516. (No reference to Striga, but exploring the allelopathic potential of sorgoleone and the similarity of its action to that of some photosynthesis-inhibiting herbicides.)

Westwood, J.H. and C.L. Foy. 1997. Ammonium inhibits parasitism of carrot by Egyptian broomrape (*Orobanche aegyptiaca*). Proceedings Southern Weed Science Society 50: 146-147. (Ammonium sulphate only selective at 25 mM applied 4-5 weeks after carrot planting.)

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Woldewahid, Gebremedhin, Beyenesh Zemichael and Ibrahim Fitiwy. 1998. The status of the *Striga* problem in Tigray. Arem 4: 28-36. (*S. hermonthica* apparently expanding its host range in Tigray, Ethiopia, to attack tef, barley and wheat.)

Woldewahid, Gebremedhin, Fasil Reda and Beyenesh Zemichael. Indigenous *Striga* management systems of farmers in Tigray: an overview. Arem 4: 37-45. (Local methods of rotation, tillage, planting, fertilization etc are partially successful in containing the *S. hermonthica* problem, but limited by farmers' lack of understanding of *Striga* biology.)

Yang-Chang Wu, Ya-Chiek Chao, Fang-Rong Chang and Yuan-Yng Chen. 1997. Alkaloids from *Cassytha filiformis*. Phytochemistry 46: 181-184. (Describing 2 new and 6 already known alkaloids.)

Yeshanew Ashagrie, Alemayehu, P. Ramanagowda and Minale Liben. 1996. Distribution and importance of *Cuscuta campestris* on noug (*Guizotia abyssinica* Cass.) in northwestern Ethiopia. In: Rezene Fessehaie (Ed.) Proceedings 1st Annual Conference of the Ethiiopian Weed Science Society Conference, 1993, Addis Abeba. Arem 1: 27-30. (26-90% of fields infested in the Bahir Dar and neighbouring locations sampled.)

Yoneyama, K., Y. Takeuchi, M. Ogasawara, M. Konnai, Y. Sugimoto and T. Sasso. 1998. Cytolenins and fisicoccins stimulate seed germination of *Striga hermonthica* (Del.) Benth. and *Orobanche minor* Smith. Journal of Agricultural and Food Chemistry 46: 1583-1586. (Fungal metabolites cytolenin, from *Cladosporium* sp., and fusicoccin, from *Fusicoccum amygdala,* stimulate germination of both spp. at 10^{-5}M. Ethylene in involved in germination of *Striga* but not of *Orobanche*.)

Young, N.D., K.E. Steiner and C.W. Depamphilis. 1997. A revolutionary view of the parasitic Scrophulariaceae/Orobanchaceae. (Abstract) American Journal of Botany 84(6): 247.

Zaki, M.A., H.S. El Metwaly and R.A. Hassan. 1998. Studies on dodder (*Cuscuta* spp.) control. Sixth EWRS Mediterranean Symposium, Montpellier, 1998, pp. 147-152. (*Phaseolus vulgaris* beans resistant to *Cuscuta (?)planiflora*.)

Zhuk, A.V. 1997. (Haustoria morphogenesis and origin in *Cuscuta* species (Cuscutaceae).) (in Russian) Botanicheskii Zhurnal 82(5): 1-15. (Observations on several *Cuscuta* spp. on several hosts convince the author that the haustoria have not evolved from roots.)

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SEVENTH INTERNATIONAL PARASITIC WEED SYMPOSIUM

Arrangements are continuing for the Seventh International Parasitic Weed Symposium to be held in Nantes, France, 3-8 June, 2001. A first circular will be sent to all 'subscribers' to Haustorium in April. If you know of others who would be interested, or if there are any comments or suggestions on the format of this event please contact Haustorium editors, or Patrick Thalouarn, Laboratoire de Cytopathologie Vegetale, University de Nantes, 2, Rue de la Houssinière, BP 92208, F44322 Nantes Cedex 3 France. Email patrick.thalouarn@svt.univ-nantes.fr

4TH INTERNATIONAL WORKSHOP ON OROBANCHE RESEARCH

About 90 delegates from 19 countries gathered in the Black Sea resort of Albena, Bulgaria, from 23rd to 26th September. The programme included 30 oral presentations and 27 posters. After an introductory review by Klaus Wegmann which included news of serious new occurrences of Orobanche problems in Germany, there were sessions covering Germination, Physiology and Biochemistry, Molecular studies, Growth and Development, Resistance breeding, and Progress in Orobanche control.

An early paper by Binnie Zwanenberg provided a lucid account of the chemistry and development of strigolactones, including Nijmegen -1. Unfortunately, the prospects for commercial development of the latter remain doubtful. A paper and poster reported parts of Ermias Kebreab's detailed PhD work on the germination and secondary dormancy of Orobanche spp. We look forward to more. Barakat Abu-Irmaileh showed evidence that some of the influence of nitrogen fertilizers in inhibiting Orobanche could be due to a salinity effect. Interesting posters by H. Bozukov and by H Chalakov presented intriguing evidence for the stimulation of germination of Orobanche seeds by surprisingly low doses of metham-sodium and dazomet.

Gea Boelhouwer and Jos Verkleij showed that the damaging effects of O. aegyptiaca in the rapeseed host were proportional to the biomass of the parasite, though there was proportionally greater reduction of host roots than of host shoots. A very interesting development, reported by Jim Westwood and Larry Foy, is the successful infection of Arabidopsis thaliana by O. aegyptiacca and O. ramosa. A total of 303 lines from 22 countries have so far all proved susceptible, but we look forward to further results from work on this important test plant.

Several papers reported the use of molecular techniques, that by A. Ljubenova and I. Minkov using RFLP and RAPD methods to distinguish between different populations of O. aegyptiaca and O. ramosa, while that by Danny Joel and others explored the narrow differences between O. cernua and O. cumana.

A review paper by Edouard Teryokhin explored some evolutionary aspects of the Orobanche genus, in particular the gradation from purely annual to tuber-bearing perennials and the ability to develop new plants from the perennial system in e.g. O. cernua.

A masterly review by Luis Carlos Alonso covered the history of sunflower resistance breeding and the development of virulence in O. cernua/O. cumana in superb detail. The present situation is the occurrence of up to 5 levels of virulence in many countries with an additional 1 or 2 in Spain. Resistance in sunflower to forms A-E is still thought to be mainly due to single dominant genes, though there is some conflicting evidence, suggesting at least some cytoplasmic influence. The mechanisms of resistance differ at each level, perhaps explaining some of the conflicting claims on this topic. The only resistance to the new forms F and G may be recessive, and not confer resistance to 'lower' virulence levels. Resistance in faba bean was also well summarised.

Among other papers on resistance, there was evidence for useful degrees of resistance in some wild Lycopersicon spp. (by O.A.Al-Menoufi), and in tobacco (by C.A. Raju). Y. Goldwasser and others suggested that the mechanism of resistance to O. aegyptiaca in Vicia atropurpurea may be due to a phytoalexin type of response.

On control, several papers from Israel, by Y. Kleifeld, R. Jacobsohn and others summarised promising developments in the use of imidazolinone and sulphonylurea herbicides which allow good selective control in an increasing range of crops, including tomato, sunflower, peas, potato and parsley. In Jordan, B. Abu-Irmaileh reported extensive use of solarization.

Two contributions described the serious problems from Orobanche spp. in Nepal, in both tobacco and in brassica crops. G.B. Kattril reported promising results from use of glyphosate in Brassica campestris reducing the parasite by 95% and increasing yields by up to 50%.

Further work on biocontrol by Fusarium oxysporum, originally isolated in Bulgaria, was presented by J.S. Bedi, showing that chlamydospores have advantages of greater longevity in storage than other propagules. And V. Valkov and others, working in Bulgaria, have confirmed the potential usefulness of genetically modified varieties of tobacco, resistant to glufosinate, chlorsulfuron and asulam, though the prospects for their commercial development and clearance for use remain some way off.

There were two purely discussion sessions, the first explored the specific problems of increasing Orobanche problems in tobacco, while a final review session attempted to identify gaps in Orobanche research and control activities and some possible ways of addressing these gaps.

Apart from the formal sessions there was a brief visit to the local laboratory complex of the Institute for Wheat and Sunflower 'Dobroudja' and a range of lively social events. Warm thanks are due to our local hosts from that Institute for their generous hospitality, along with Klaus Wegmann for his catalytic role in organisation. The Proceedings are being prepared and should be available early in 1999.

Chris Parker.

THE CUSCUTA PROBLEM IN URUGUAY

In Uruguay, four species of Cuscuta occur: C. pentagona (= C. campestris), C. suaveolens, C. cristata and C. epithymum. Cuscuta spp. mainly affects the cultivation of alfalfa (lucerne) and red clover and their seed production. On Feb. 15, l985, a decree No. 76/985 with the force of law, was issued declaring Cuscuta an agricultural pest. It establishes that:

a) seedbeds and seeds where Cuscuta is detected are to be discarded, they are not to be used commercially.

b) it is compulsory to control this weed by destroying it.

At the moment there are three ways in which this problem is managed:

a. by preventive action using only Cuscuta-free seed.

b) when the plant is established but seed is not yet formed, by applying the desiccating agent paraquat. This agent does not seriously damage the leguminous plants, though a careful check is essential to ensure the Cuscuta has been completely eliminated.

c) when the Cuscuta has developed seeds, by applying paraquat in the same way, but when the foliage dries up two or three days later, it should be burned with the help of dry hay and gasoline.

A project is now in progress in the Bioengineering Department to study the possibility of using a biological control agent, such as the spores of a fungus, instead of using chemical desiccants. Colletotrichum gloeosporioides has been collected from banana and is being used in the study of fermentation in solid state systems and the development of biotechnology methods for production of inoculum as a biocontrol agent.

Further work is planned, to determine the specificity and pathogenicity of the fungal strain against various Cuscuta species and to conduct screening of the fungus in the field.

Alejandro Bossio, Adriana Giachero, Ana Laura Ortega and Juana González, University of Uruguay, Montevideo, Uruguay.

LISTSERVE FOR PARASITIC PLANTS

The global computer network provides us with a very simple tool for easy communication between those who are interested in parasitic weeds. Further to my announcement in Albena, I would like to introduce you to the "Parasitic Plant (PP) mailing list", which is administered by an automatic listserve programme that enables each of us to send questions, comments, notes etc. for immediate distribution by Email to all subscribers (it is not a website). With this system, one can easily initiate a discussion, get helpful tips, find colleagues who may collaborate on specific matters, or just keep reading the discussions of others that may be interesting, helpful, or challenging. This gives an easy access to many others who are interested in parasitic plants.

If you wish to subscribe, send the command: SUBSCRIBE PP <your name>

(e.g. SUBSCRIBE PP John Smith) to the address: listserv@opus.hpl.hp.com (NB not listserve@). If you later wish to discontinue, you can de-subscribe by sending the command UNSUB PP to the same address.) The command should be in the message space (not the subject line) and should not be followed by any further text or signature. Soon after, you will get an acknowledgement message and your Email address will be added to the mailing list. You will then receive copies of all messages that are sent to the listserve, including group discussions.

You may contribute your own messages by sending them by Email to the distribution address: pp@opus.hpl.hp.com (note this is different from that above). All information regarding future workshops, conferences and other meetings on parasitic plants (including weeds) will be distributed via this channel, which saves postage and is much more efficient than ordinary mail. We therefore encourage all subscribers of Haustorium to subscribe to the PP List. Please distribute this information also to those who do not get Haustorium.

For those with internet access, you may be interested in checking out the PP WEB page at: http://www.hpl.hp.com/bot/pp_home. Another site is "The Parasitic Plant Connection" (see next item). Good luck!

Daniel M. Joel, Newe Ya'ar Research Centre, P.O.Box 1021, Ramat-Yishay 30095, Israel.

WEBSITE - THE PARASITIC PLANT CONNECTION

During the spring and summer of 1997, I created a web site called "The Parasitic Plant Connection" and placed it on the College of Science web server at: http://www.science.siu.edu/parasitic-plants/index.html

Since that time the site has continued to grow and evolve. As explained on the "Why the Parasitic Plant Connection?" page, the motivation to assemble this series of pages was both self-serving and altruistic. For myself, I would like to use these pages as a repository of information on parasitic plants as an aid to my research program. Parasitic plants are found in approximately 18-22 families representing 230 genera and 3100 species. A group of this size requires real effort to keep the information organized (something systematists are compelled to do). I began organizing information about parasitic plants over three years ago using a program called HyperCard. From this came a series of "stacks" (files) containing graphical images (B & W), species lists, distribution maps, etc. for all groups in Santalales, Balanophorales s. lat. and Rafflesiales s. lat. that I named "HyperParasite." This series of stacks is still available from me (send five formatted disks) or via the FTP server h ere at SIUC. HyperParasite is still extremely useful for me, but it requires a MacIntosh platform to run, hence its use was limited to that crowd. By posting these pages on the web, the number of "users" will hopefully increase. In addition, the black and white images do not do justice to the beauty of many of the parasitic plants. The spectacular flower of Rafflesia must be seen in color to be fully appreciated! Such is also the case for many other plants such as the flamboyant flowers of Loranthaceae or the subtle beauty of a mistletoe seed. During the course of traveling to the far corners of the earth to collect parasitic plants, I have assembled a rather sizable collection of photographs of these unusual plants. With these, and hopefully with others made available by colleagues, I hope to share with others the joy of viewing these fantastic plants. In addition to aesthetic appreciation, I hope these pages will also be of use to those interested in learning some science about these plants. As a systematis t, links to current nomenclature and bibliographic sources are very important. As a molecular systematist, I also require ready access to DNA sequence data on these plants. For this reason, I have made available links to sequence information, ribosomal RNA secondary structure diagrams, and multiple sequence alignments to all parasitic flowering plants.

The success of the PPC can be judged from the fact that there have been 3500 visits to the site since December 1997. The web site has also generated many questions from users ranging from research scientists to the general public. Finally, the visibility of the site has been increased by links to it from other major web sites and databases, including the following:

The Plant Pathology Internet Guide Book:

http://www.ifgb.uni-hannover.de/extern/ppigb/ppigb.htm Scott's Botanical Links: http://www.floridaplants.com/Scott/

The Botany Site (the Mining Company, Bryan Ness: http://botany.miningco.com/ BioMedLink database: http://biomedlink.com/

Dan Nickrent, Dept. of Plant Biology, Southern Illinois University, Carbondale, Illinois, USA.

STRIGA-RESISTANT COWPEAS

In the paper by Touré et al., 1998, listed in the Literature section (see below), there is a comment that 'the low quality of the seeds (of B 301) seems to be transmitted to the progenies, and farmers in West Africa still lack well-adapted high-yielding, good quality cowpea cultivars with resistance to S. gesnerioides'. We asked Dr B.B. Singh of IITA for his reaction to this comment and he writes as follows:

'Dr Touré's observations about B 301 seed quality being poor is true but there is no linkage between seed quality and Striga resistance. Therefore, we have transferred the gene for Striga resistance from B 301 into a diverse set of new cowpea varieties with white as well as brown seeds which are quite acceptable in West Africa. Most of these varieties have combined resistance to all the 5 known strains of Striga including the one at Zakpota (Benin Republic). The most promising lines are:

1. IT93K-513-2 (white)

2. IT93K-693-2 (brown)

3. IT94K-437-1 (white

4. IT94K-440-3 (white)

5. IT95K-1090-12 (brown)

6. IT95-627-34 (white)
7. IT96K-748 (white)
8. IT96D-757 (white)
9. IT96D-759 (white)

All these varieties have combined resistance to Striga, aphid, bruchid and major diseases. In addition, a large number of advanced breeding lines with Striga resistance are in preliminary trials. You may also be aware that from the earlier Striga resistant lines derived from crosses with B 301, IT90K-76 (brown), has been released in Nigeria and IT90K-59 (brown) in South Africa.

B.B. Singh, IITA, Kano, Nigeria Email .'

POLLEN MORPHOLOGY OF VISCUM SPP. IN SPAIN:

ITS APPLICATIONS TO HOLOCENE PALAEOECOLOGY

The thermal-limit curve for mistletoe (Viscum album) indicates it is not restricted by temperature in oceanic western Europe. It appears to tolerate more cold than the ivy (Hedera helix) or holly (Ilex aquifolium); the two other species that are normally mentioned in the palaeopalynological papers along with the mistletoe. In Denmark and Great Britain, pollen grains of Viscum have been found in Boreal, Atlantic and Sub-boreal times in deposits beyond its present range, suggesting that it preferred warmer conditions. This applies only to V. album, not to V. cruciatum which is restricted in Europe to the Iberian Peninsula. The ecology of each species in the Iberian Peninsula is quite different: V. album parasitises at least 24 species in Spain including Abies alba, Pinus spp., Malus communis, Pyrus communis, Robinia pseudoacacia, Sorbus aucuparia, Sorbus aria, Salix spp., Acer spp., Tilia spp., Quercus robur, Corylus av ellana, etc. It is recorded in 15 regions and 35 provinces in the north and centre of the country, but in the south (Andalusia) it is known only in mountainous zones. V. cruciatum, on the other hand has a different ecology. V. cruciatum grows at lower altitudes with a mean warm mountain climate (subtropical) in 8 provinces of Andalusia on different hosts such as Retama spp., Olea europaea, Hedera helix or Rhamnus lycioides. The chorological maps of both species clearly show that they are vicarians. There are two different pollen types. Both are 3-colporates, spheroidals, rounded triangulars, with a sexine about 1.5-2 m m thick, that in V. album is finely bacculate with distantly spaced blunt spinules. The V. cruciatum type has a sexine with a different ornamentation, with big spines about 3-5 m m.

J.A. López-Sá ez, Laboratorio de Arqueobot« nico, 28014 Madrid, Spain.

CHANGES OF HOST IN GERMANY

Jurgen Kroschel left Hohenheim at the end of 1998 and is now with the Institute for Crop Science, University of Kassel, Steinstr. 11, 37213 Witzenhausen, Germany. His new Email address is: kroschel@wiz.uni-kassel.de

Meanwhile, Jachim Sauerborn has returned to Hohenheim, joining the Institute of Plant Production and Agroecology in the Tropics and Subtropics (380), University of Hohenheim, 70593 Stuttgart, Germany. His new Email addres is: sauerbn@uni-hohenheim.de

OBITUARY - LARRY BUTLER

14 December 1933-19 February 1997.

Professor Larry Butler died suddenly after surgery and will be greatly missed by Striga researchers and others who knew this generous, kindhearted, self-deprecating biochemist. Born on a farm, he received his BS in chemistry from Oklahoma State University in 1960 and his Ph.D. in 1964 at the University of California Los Angeles. For a year he was chairman of a science department at a church school reflecting his long interest in the Bible and church related activities. In the 1980s he began his research on polyphenol metabolism in sorghum. It was not surprising that this led to studies of germination stimulants produced by cereals that signal the Striga seeds to germinate. In 1986, he was the first to identify the host-produced germination signal, sorgholeone with a complex molecular structure.

His love of people and science endeared him to people around the world. Not only his colleagues at Purdue University but those of us who had only occasional interaction with him mourn his loss.

Lytton Musselman

TWO NEW BOOKS ON OROBANCHE FROM GERMANY

Increased interest in the holoparasitic root parasites of the Orobanchaceae is evidenced by a series of books published during the past several years. Like that by Kreutz, reviewed in Haustorium 31, the following two volumes centre on European species.

Die Sommerwurzarten Europas. Gattung Orobanche. Holger Uhlich, Jürgen Pusch, Klaus-Jörg Barthel. (1995). Westart Wissenschaften, Wolf Graf von Westarp, Uhlichstrasse 6, 39108, Magdeburg, Germany. 235 pp. (paperback). DM45, SF44. ISBN 3-89432-444-9.

Die Sommerwurzarten Europas appears to be an updating of the mammoth monograph of Beck von Mannagetta. Published in 1930 as part of Pflanzenreich, this detailed and taxonomically byzantine work culminated four decades of research. Subspecific taxa, including forms, were named with little restraint, obscuring the inherent variation in a group usually considered as rapidly evolving. Sommerwurzarten, then, must be read through the lenses of this earlier work and the resultant fog of names. Ideally this classical work should be examined in the light of contemporary work. Significant systematic research on Orobanche using cladistics and molecular methods have been published in the last five years. Virtually none of these are cited.

The book is divided into nine parts beginning with an overview of the family followed by a detailed discussion of the names, ecology, and anatomy and morphology. This latter section is of particular value for its detailed discussion of floral parts used in taxonomy. Figure 2 (page 27) is one of the best descriptions of the terminology of the floral parts I have seen. Typewritten and difficult to read labels detract.

The bulk of the book is in section four, The European Species of the Genus, which takes almost half the book. Again, the irritating splitting is bothersome. But a great deal of information is available for each species with especially detailed host lists (although I am suspect of the reliability of some of these reports). Helpful color photographs, well reproduced, as well as black and white pictures and figures (from Beck von Mannagetta?) enhance this part.

There is a section on chromosome numbers, hybridization and culture that grossly omits published reviews and other papers. This is followed by a section on the nutrition of the parasite. Section eight deals with East German species and includes a helpful illustrated key. The last section treats of conservation. An extensive host list, glossary, references and maps of species distribution conclude the book.

The cost is reasonable for a well produced book. Despite its shortcomings and already being out of date, I am glad to add this volume to my collection of Orobanche literature. Anyone dealing with the flora of Europe or parasitic plants will be interested in this book.

Weed Broomrapes. Systematics, ontogenesis, biology, evolution. Edward S. Teryokhin. (1997). Aufsteig CmbH, Isarweg 37, D-84028 Landshut, Germany. x+182 pp. (paperback). DM 39. ISBN 3-7612-0254-7.

Teryokhin's volume is a helpful compilation of the author's research spanning several decades. It is, in many ways, representative of an earlier era, with much classical typology of the German school. I am glad that so much of this work first published in Russian is now in English--of a sort. If I were not familiar with the author and his work I would have difficulty comprehending some of the writing. Further, there is a plethora of spelling errors as well which reflect more a lack of editing than a language problem.

The main corpus of the book is based on Teryokhin's many and diverse publications on the Orobanchaceae. He presents a new taxonomy of the subfamily Orobanchoideae. This includes several new taxa. Weed scientists will chaff (as they often do when dealing with botanical nomenclature) at his splitting of the widespread and important parasitic weed Orobanche ramosa and its relatives into the genus Phelipanche and the new names that result. While I will probably continue to use the old name, Teryokhin gives reasonable evidence for recognizing these plants as a separate genus.

Botanists will gain much from the first English presentation of his detailed studies on inflorescence morphology, seed development, embryology, dissemination, germination, seedling development, and vegetative propagation. The final chapter deals with broomrape evolution and selection and could have been combined with a truncated earlier chapter on evolution. One of the very informative aspects of the evolution chapter is a discussion of race development summarizing the well known work of Pustovoit who first pointed out this phenomenon while working with sunflower (Helianthus anuus). Pustovoit showed that the broomrape Orobanche cernua developed races in response to sunflowers bred for resistance.

Weed Broomrapes is a worthwhile contribution to our understanding of the genus Orobanche. Despite its defects, it should be in the library of any scientist or organization working with parasitic weeds. At less than $20 it is a bargain. Figures and drawings are well reproduced but the binding in my copy is already disintegrating in the arid Middle East.

(These reviews are adapted from those published in Economic Botany)

Lytton Musselman

OTHER NEW BOOKS AND PROCEEDINGS

Mistletoes of Africa. Roger Polhill and Delbert Wiens. (1998). Royal Botanic Gardens, Kew, Richmond, TW9 3AB, UK. 370 pp. (hardback) £70.00. ISBN 1 900347 56 3.

This magnificent new volume has three main sections. The introductory section has a series of excellent in-depth chapters on The Parasitic Habit etc (see below). The second section is the Systematic part, while the third includes References and a comprehensive List of Specimens studied.

The main section amounts to a masterly, almost monumental, monograph of the African mistletoes in Loranthaceae (21 genera) and Viscaceae (3 genera). There is happily no re-arrangement or re-naming of genera, but an immensely erudite and thorough re-appraisal of the taxa in each genus and a substantial number of new species described, perhaps 40 in all. Of 45 Viscum species, no less than 10 are newly described; of 59 Aelanthus spp., 7 are new; of 30 Tapinanthus and 25 Englerina spp., 4 are new in each; of 34 Phragmanthera spp. just 1 is new. One may ask, do we have splitters at work here? But the answer seems to be no. The new species sound to be quite distinct, and are mostly very restricted in distribution.

There is a lengthy introduction to each genus (and section, where necessary), followed by clear keys which appear to use generally accessible characters. The treatment of individual species provides detailed synonymy and description, often supported by excellent line drawings by Marguerite Scott and Christine Grey-Wilson, showing comparison of key features in groups of species. There are colourful photographs of about 50% of the species. There is no systematic attempt to illustrate all species, and some have neither drawing nor photograph. Distribution of all species is shown on beautifully clear, coloured relief maps of Africa, usually 2 or 3 species per map. Information on host range is somewhat sporadic - presumably reflecting the information, or lack of it, recorded on herbarium sheets.

The introductory chapters provide valuable, up-to-date reviews of a range of background topics. The first, on the Parasitic Habit, covers the haustorium, host relations, physiological aspects, and mimicry. Under host range it is shown that 70% of species have a wide host range, 12% are limited in host range and 18% very limited. The chapter on Origins and Evolution includes reference to some of the latest evidence from DNA studies (e.g. Nickrent, 1996). That on Comparative Morphology (by Clyde Calvin and Carol Wilson) describes the different types of haustorial connection with the host, showing the gradation from a single point of contact ('wood rose') through the 'clasping union' to the presence of 'epicortical roots' and 'bark strands' (endophyte) from each of which additional adventitious shoots may or may not occur. It is illustrated with many photographs of haustoria from the substantial haustorium collection at Portland State University. That on Pollination Mechanisms (by Donald Kirkup) discuss es the many different explosive and non-explosive pollination mechanisms involved, and the relationship with birds. This is illustrated with many excellent photomicrographs of the critical tissues involved in explosive opening. Chapters on Generic Classification and Biogeography are both detailed, and again refer to the most recent molecular data, quoting websites for the latest unpublished information. That on Economic Importance is relatively brief but provides a useful overview of the genera and species causing economic damage, including Tapinanthus bangwensis damaging cocoa in West Africa not only directly, but also by encouraging certain ant species and hence the mealy bugs responsible for transmission of swollen shoot disease. Also Phragmanthera capitata, prevalent on rubber and teak in Cameroon, and Tapinanthus spp. on rubber in Nigeria, on shea butter nut in Burkina Faso and on citrus and guava in Sudan.

It is noted that this book 'serves as a precursor for the Flora of Tropical East Africa and Flora Zambesiaca'. It seems possible that this may account for the price being kept to £70, a relatively modest price for such an important volume so beautifully produced and illustrated. A must for all mistletoe workers and a potential inspiration to many others working on parasitic plants.

Chris Parker.

Striga Research Methods--A Manual. D. K. Berner, M. D. Winslow, A. E. Awad, K. F. Cardwell, D. R. Mohan Raj, and S. K. Kim (1997) International Institute of Tropical Agriculture, Oyo Road, PMB 5320, Ibadan, Nigeria. 81 pages (paperback). No price given.

Farmers in sub-Saharan Africa often suffer the devastating effects of Striga species (known as witchweed in English) on their cereal and legume crop yields. Despite the well documented losses inflicted by these parasitic weeds, research in Africa during the past three decades has lacked a clear focus that would use a diversity of approaches rather than just breeding for resistance. This changed when the International Institute of Tropical Agriculture (IITA) established a Striga Research Group and, later, a parasitic weed research initiative that would co-ordinate research on parasitic weeds for all of the centres associated with the Consultative Group on International Agricultural Research. This manual is a benchmark of the success of this very productive and innovative group. The value of the manual lies in the detailed, hands on approach to setting up experiments and giving information on how to interpret and analyse the results. Its audience is African researchers. Topics include the colle ction and preservation of seed for research purposes; ways to infest pots and fields; techniques to extract seeds from the soil, essential in measuring the efficacy of methods to reduce the seed bank; maize breeding for Striga resistance; and a systems approach to Striga research. Looked at another way, the manual guides the worker from the collection of the seed, through the laboratory and field to systems modelling. All of this in clear, simple language with helpful pictures, drawings, glossary, and even computer programs for analysing data. Ten years ago, I edited a volume that attempted to provide a single source for the researcher who needed both to understand Striga as well as the methods needed for research. I am pleased to say that this compact volume is more than a suitable successor because it incorporates so much up-to-date data. Weed researchers, plant pathologists, and agronomists outside Africa will also want a copy of this work!

(This review is adapted from that published in Economic Botany)

Lytton Musselman

New Zealand's Loranthaceous Mistletoes. 1997. Proceedings of a workshop hosted by Threatened Species Unit, Department of Conservation, Cass, 17-20 July, 1995. Edited by de Lange, P.J. and Norton, D.A. Published by Department of Conservation, P.O. Box 10-420 Wellington, New Zealand.

Contents (with some abbreviation):

Historical distribution of New Zealand loranthaceous mistletoes.

Status of loranthaceous mistletoes in (13 Conservancy districts)

An annotated checklist of New Zealand mistletoe (Loranthaceae) hosts.

Host specificity and spatial distribution patterns of mistletoes.

Reproductive ecology of the loranthaceous mistletoes of New Zealand.

Some aspects of reproduction and possum control of five loranthaceous mistletoes…

Mistletoe moths.

Population biology of Australian mistletoes. (see Bibliography below - Reid, 1997)

Evidence of the impacts of possums on mistletoes.

An assessment of possum (Trichosurus vulpecula) impacts on loranthaceous….

Decline of New Zealand loranthaceous mistletoes - a review of non-possum threats

Discussion of threats to mistletoes.

Conservation status of New Zealand loranthaceous mistletoes: a comment on the application of IUCN Threatened Plant Committee Red Data Book Categories.

Discussion on status of mistletoes

Mistletoe management, Tongariro-Taupo Conservancy.

Mistletoe protection and monitoring strategies on the West Coast.

Propagation of mistletoes in the central North Island.

Discussion of management techniques.

Discussion on the development of a mistletoe strategy.

Annotated bibliography for New Zealand viscaceous and loranthaceous mistletoes.

Chris Parker

LITERATURE

Abayo, G.O., English, T., Eplee, R.E., Kanampiu, F.K., Ransom, J.K. and Gressel, J. 1998. Control of parasitic witchweeds (Striga spp.) on corn (Zea mays) resistant to acetolactate synthase inhibitors. Weed Science 46: 459-466. (Imazapyr applied to Pioneer 3245 IR (resistant to ALS-inhibiting herbicides) at about 30 g/ha, either post-emergence, directed, or in a 1 ml drench per planting hole greatly delayed emergence of Striga asiatica and S. hermonthica in USA and Kenya respectively and improved crop growth. Other imidazolinone or sulfphonylurea herbicides were less effective, or damaging.)

Abdel-Hameed, M. T. 1996. Effects of watering regimes on the relationship between faba bean and Orobanche crenata. MSc Thesis, Cairo University. (In pot experiments, reducing water availability by 60% did not consistently increase the damaging effect of O. crenata. In the field, reduced irrigation reduced the numbers of O. crenata attacking the crop, but resulted in significantly more damaging effect. There were varying responses among the 4 varieties tested - Giza 3, Giza 402, Asssiut 104 and Cairo 241.)

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Al-Khatib, K., Baumgartner, J.R., Peterson, D.E., Currie and R.S. 1998. Imazethapyr resistance in common sunflower (Helianthus annuus). Weed Science 46: 403-407. (Repeated - 7 year - use of imazethapyr to control wild H. annuus in USA led to development of a biotype with x170 resistance. Could be useful for Orobanche?)

Anderson, R. 1997. Orobanche minor Smith on sea holly (Eryngium maritimum) at Inishmaan, Aran Islands. Irish Naturalists' Journal 25: 456.

Appiah, A.A. and Owusu, G.K. 1997. Cocoa mistletoes - a review. Proceedings, First International Cocoa Pests and Diseases Seminar, Accra, 1995: 272-279.

Avdeev, Y.I. 1998. (The variety 'Astrakhan' is resistant to broomrape.) (in Russian) Kartofel' I Ovoshchi, 1998 No 2: 40. (Field observations in the Astrakhan region suggest that tomato varieties 'Astrakhan' and 'Bakhtemir' may be resistant to Orobanche aegyptiaca.)

Aydin, A. and Korkut, K.Z. 1998. Broomrape resistance of some backcross derivatives of HA-89 and their hybrids. Helia 21(28): 29-34. (Male-sterile sunflower HA-89 backcrossed with different Orobanche resistant lines, yielded 7 resistant combinations, 6 of which retained resistance after crossing with Orobanche-susceptible restorers.)

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Barney, C.W., Hawksworth, F.G. and Geils, B.W. 1998. Hosts of Viscum album. European Journal of Forest Pathology 28: 187-208. (V. album has more recorded hosts than any other mistletoe species - 452 taxa in 96 genera of 44 families.)

Berner, D.K. and Williams, O.A. 1998. Germination stimulation of Striga gesnerioides seeds by hosts and nonhosts. Plant Disease 82: 1242-1247. (Species other than cowpea, capable of germinating S. gesenerioides, and of potential value as trap crops include other Vigna spp. and some selections of sorghum, pigeon pea, Lablab purpureus and Sphenostylis stenocarpa.)

Berner, D.K., Winslow, M.D., Awad, A.E., Cardwell, K.F., Mohan Raj, D.R. and Kim, S.K. 1997. Striga research methods - a manual. IITA, Nigeria. 81 pp. (See review above.)

Briggs, J. 1997. Mistletoe survey. Spring 1997 update. Botanical Society of the British Isles News 75: 31-33.

Calder, M. (ed.) 1997. (Sixteen papers on mistletoe ecology and management) The Victorian Naturalist 114(3). (see e.g. Reid, 1997 below)

Caldwell, J.S., Touré , G.K., Erbaugh, M., Dembélé , B., Edwards, C.R. and Diarra, A. 1998. Merging farmer knowledge and priorities with scientific knowledge and research methods for participatory development of IPM technology for control of blister beetles and Striga parasitic weed in Mali, West Africa. Proceedings 15th International Symposium, Association for Farming Systems Research and Extension, Pretoria, 1998. 1030-1037. (Blister beetles and Striga were predominant problems identified by farmers: inter-cropping (cowpea) plus fertilizer more acceptable than late weeding for Striga management.)

Carsky, R.J., Nokoe, S., Lagoke, S.J.O. and Kim, S.K. 1998. Maize yield determinants in farmer managed trials in the Nigerian Northern Guinea Savanna. Experimental Agriculture 34: 407-422. (Complex statistical analysis of 52 variables from 37 farmer trials: the tolerant maize hybrid 8321-18, known as Oba Super 1, yielded siginficantly better than the local variety: the Striga-resistant synthetic STR Syn-W was no better than the local.)

Crackles, E. 1998. Thistle broomrape apparently behaving as a saprophyte. Botanical Society of the British Isles News 79: 53. (Orobanche reticulata apparently thriving after death of hosts Cirsium eriophorum and C. arvense.)

Dale, H. and Press, M.C. 1998. Elevated atmospheric CO2 influences the interaction between the parasitic angiosperm Orobanche minor and its host Trifolium repens. New Phytologist 140: 65-73. (Higher CO2 alleviated the damaging effect of O. minor on its host, but did not increase parasite growth.)

Davies, D.M. and Graves, J.D. 1998. Interactions between arbuscular mycorrhizal fungi and the hemiparasitic angiosperm Rhinanthus minor during co-infection of a host. New Phytologist 139: 555-563. (Infection of Lolium perenne by R. minor reduced host growth by c. 50% and reduced AM colonization apparently via reduced C availability. Colonization of the host by AM increasaed numbers of secondary haustoria and weight of R. minor by c. 50%.)

Davies, D.M., Graves, J.D., Elias, C.O. and Williams, P.J. 1997. The impact of Rhinanthus spp. on sward productivity and composition: implications for the restoration of species-rich grassland. Biological Conservation 82: 87-93. (On 5 sites in Britain and N. Italy, productivity reduced by Rhinanthus: grasses reduced, dicots increased.)

Debrah, S.K., Defoer, T. and Bengaly, M. 1998. Integrating farmers' knowledge, attitude and practice in the development of sustainable Striga control intervention in southern Mali. Netherlands Journal of Agricultural Science 46: 65-75. (Soil fertility and farming practices identified as the main factors influencing Striga abundance; and emphasising improvement of soil fertility as the most important route towards control.)

De Lange, P.J. and Norton, D.A. (eds.) 1997. New Zealand's Loranthaceous Mistletoes. Proceedings of a Workshop Hosted by the Threatened Species Unit, Department of Conservation, Cass. Wellington, 1995. (see Contents list above)

Determann, R., Kirkman, L. and Nourse, H. 1997. Plant conservation by propagation. The case for Macranthera and Schwalbea. Tipularia a Botanical Magazine 12: 2-12. (Presenting protocols for the growth and maintenance of Macranthera flammea and Schwalbea americana, both parasitic Scrophulariaceae and rare in SE USA. S. americana is a federally endangered species: M. flammea is one of the most spectacular members of the family with large orange flowers pollinated by humming birds.)

Dimitrova, T.S. 1998. (Study of the herbicide Pivot 100 EK for Cuscuta spp. control in an alfalfa stand establishment.) (in Bulgarian) Plant Science, Sofia 35: 651-655. (Imazethapyr 100-150 g/ha applied at the 2-4 trifoliate leaf stage controlled Cuscuta and other weeds and increased yield X 2.6.)

Duff, R.J. and Nickrent, D.L. 1997. Characterization of mitochondrial small-subunit ribosomal RNAs from holoparasitic plants. Journal of Molecular Evolution 45: 631-639.

Ebel, J. and Mithöfer, A. 1998. Early event in the elucidation of plant defence. Planta 206: 335-348. (No mention of parasitic plants, but potentially relevant discussion of the role of elicitor-binding proteins and their role in defence signalling.)

Gagne, G., Roeckel-Drevet, P., Grezes-Besset, B., Shindova, P., Ivanov, P., Vear, F., Tourevielle de Labrouche, D., Charmet, G. and Nicolas, P. 1988. Study of the variability and evolution of Orobanche cumana populations infesting sunflower in different European countries. Theoretical and Applied Genetics 96: 1216-1222. (Populations from Bulgaria, Romania, Turkey and Spain studied using RAPD markers. Apparently self-pollinating, little intra-population variability. E. European populations distinct from the Spanish.)

Gardner, S.N., Gressel, J. and mangel, M. 1998. A revolving dose strategy to delay the evolution of both quantitative vs major monogene resistance to pesticides and drugs. International Journal of Pest Management 44: 161-180. (A highly mathematical treatise proposing that a cycle of low and high doses of pesticide will tend to delay development of pesticide resistant species (including weeds) compared with constant doses. No mention of parasitic weeds but presumably relevant to potential herbicide resistance in Orobanche.)

Gbèhounou, G. 1998. Seed ecology of Striga hermonthica in the Republic of Bénin: host specificity and control potentials. Doctoral thesis. Vrije University, Amsterdam. 126 pp. (Seeds of S. hermonthica from different sites had a variable primary dormancy lasting 0-7 months; stored in moist soil, seeds apparently lost viability in 2 years; delayed sowing greatly reduced Striga infestation, but failed to increase sorghum yields; cowpea IT 90k-56 was shown to have a beneficial trap-crop effect when sown early.)

Ghosh, R.B. and Das, D. 1998. Cassytha filiformis - a census on its host range in the district of Midnapore, West Bengal. Environment and Ecology 16: 485-486. (24 host species noted, in 22 genera.)

Hagenah, W., Dörges, I., Gafumbegete, E. and Wagner, T. 1998. (Subcutaneous appearance of a centrocytic non-Hodgkin lymphoma at the site of a misteltoe preparation.) (in German) Medizinische Wochenschrift 123: 1001-1004. (High concentrations of mistletoe preparation promoted growth of lymphoma cells, perhaps due to liberation of interleukin -6 from the skin.)

Hall, P.J., Bowers, W.W. and Hirvonen, H. 1998. Forest insect and disease conditions in Canada 1995. Canadian Forest Service, 72 pp. (Arceuthobium americanum, discussed.)

Hartmann, T. 1997. (Pine mistletoe contrary to ecological silviculture?) (in German) AFZ/Der Wald, Allgemene Forst Zeitschrift fur Waldwirtschaft und Umweltvorsorge 52(1): 52-53. (Arguing for V. laxum in Pinus sylvestris in Germany to be treated as a natural component, not as a weed.)

Hassan, R.M. and Ransom, J.K. 1998. Determinants of the incidence and severity of Striga infestation in maize in Kenya. In: Hassan, R.M. (ed.) Maize Technology Development and Transfer: a GIS Application for Research Planning in Kenya. CABI, Wallingford, UK: 163-174.

Hebbar, K.P., Lumsden, R.D., Lewis, J.A., Poch, S,M, and Bailey, B.A. 1998. Formulation of mycoherbicidal strains of Fusarium oxysporum. Weed Science 46: 501-507. (No mention of parasites, but technology of relevance to work on Striga, Orobanche.)

Herrman, I. 1998. Seed population dynamics of Striga hermonthica (Del.) Benth. on maize (Zea mays L.) in Southern Benin, with special emphasis on maize root induced S. hermonthica seed losses in the soil. PLITS 16(1): 181 pp. + appendices. (Tolerant maize 8322-13 averaged 1 t/ha higher yield than susceptible 8338-1: 2-12% of seeds in soil stimulated by crop roots per season: many other detailed observations.)

Hershenhorn, J., Goldwasser, Y., Plakhine, D., Ali, R., Blumenfeld, T., Bucsbaum, H., Herzlinger, G., Golan, S., Chilf, T., Eizenberg, H., Dor, E. and Kleifeld, Y. 1998. Orobanche aegyptiaca control in tomato fields with sulfonylurea herbicides. Weed Research 38: 343-349. (Repeated application of chorsulfuron and triasulfuron by sprinkler irrigation, followed by clean water, gave up to 90% control and substantial yield increases.)

Hershenhorn, J., Goldwasser, Y., Plakhine, D., Lavan, Y., Herzlinger, G., Golan, S., Chilf, T. and Kleifeld, Y. 1998. Effect of sulfonylurea herbicides on Egyyptian broomrape (Orobanche aegyptiaca) in tomato (Lycopersicon esculentum) under greenhouse conditions. Weed Technology 12: 115-120. (Rimsulfuron at 25 g a.i./ha sprayed 10 days after planting gave good selective suppression; chlorsulfuron and triasulfuron also gave excellent selective control when applied to the soil at 3.75-15 g a.i./ha in irrigation water.)

Hershenhorn, J., Plakhine, D., Goldwasser, Y., Westwood, J.H., Foy, C.L. and Kleifeld, Y. 1998. Effect of sulfonylurea herbicides on early development of Egyyptian broomrape (Orobanche aegyptiaca) in tomato (Lycopersicon esculentum). Weed Technology 12: 108-114. (Bensulfuron, chlorsulfuron, nicosulfuron, primisulfuron, rimsulfuron, thifensulfuron and triasulfuron all reduced O. aegyptiaca seedlings in vitro; only rimsulfuron caused selective suppression of the parasite after attachment.)

Hibberd, J.M., Bungard, R.A., Press, M.C., Jeschke, W.D., Scholes, J.D. and Quick, W.P. 1998. Localization of photosynthetic metabolism in the parasitic angiosperm Cuscuta reflexa. Planta 205: 506-513. (Photosynthesis shown to be restricted to cells adjacent to vascular bundles, but otherwise normal in character, presumably using internally respired CO2, and making a positive contribution to the carbon budget.)

IITA 1998. Researchers take the risk out of growing food crops. International Agricultural Development Sept/Oct 1998: 14-15. (A brief summary of current activities on Striga in maize.)

Joel, D.M., Portnoy, V.H. and Katzir, N. 1998. In: Champion, G.T., Grundy, A.C., Jones, N.E., Marshall, E.J.P. and Froud-Wiulliams, R.J. (eds.) Weed Seedbanks: Determination, Dynamics and Manipulation. Aspects of Biology 51: 23-27. (Identification of seeds of 5 species of Orobanche by DNA analysis, using PCR-based markers.)

Karadavut, U., Can, E., Divanli, A. and Gemalmaz, N. 1998. Weed survey of faba bean (Vicia faba L.) fields in Hatay province. Turkish Journal of Field Crops 3(1): 33-35. (Orobanche crenata one of the 3 commonest weeds of faba bean on the Amik Plain.)

Kelly, P., Reid, N and Davies, I. 1997. Effects of experimental burning, defoliation, and pruning on survival and vegetative resprouting in mistletoes (Amyema miquelii and Amyema pendula). International Journal of Plant Sciences 158: 856-861. (Experiments with pruning and flaming suggest that browsing and periodic fires are natural control agents.)

Kharrat, M., Halila, M.H. and Ait-Abdallah, F. 1998. (Distribution, biology and control of Orobanche in food legumes in Mediterranean countries.) (in French) In: Tivoli, B. and Caubel, G. (eds.) Les légumineuses alimentaires méditerranéennes. Contraintes biotiques et potentialités de développment, Rennes, 1997. Colloques de l'INRA. No. 88: 65-80. (A review covering distribution, importance, temperature effects and control measures, especially by herbicide.)

Kim, S.K., Fajemisin, J.M., Thé, C., Adepoju, A., Kling, J., Badu-Apraku, B., Versteeg, M., Carsky, R. and Lagoke, S.T.O. 1998. Development of synthetic maize populations for resistance to Striga hermonthica. Plant Breeding 117: 203-209. (Claiming the development of populations of both white and yellow maize with combined resistance to S. hermonthica, maize streak and other constraints.)

King, V. 1997. Mistletoe on the move. Plant Life, Summer 1997: 17. (Reviewing distribution of Viscum album in the British Isles in 1970 and now.)

Kipfmueller, K.F. and Baker, W.L. 1998. Fires and dwarf mistletoe in a Rocky Mountain lodgepole pine ecosystem. Forest Ecology and Management 108(1/2): 77-84.

Kroschel, J. 1998. Striga - how will it affect African agriculture in the future? - an ecological perspective. PLITS 16(2): 137-158. (Considering five hypotheses concerning the apparently beneficial effects of organic matter and concluding that no one is clearly responsible. Effects may include the encouragement of microbial degradation of Striga seeds, suicidal germination, and maintenance of higher nitrogen levels.)

Lazarides, M., Cowley, K. and Hohnen, P. 1997. CSIRO Handbook of Australian Weeds. Collingwood, Australia: CSIRO. (Simple maps show distribution of weeds including Cuscuta, Striga, Amyema spp. etc, with references.)

Lolas, P. 1997. Sub-group collaborative study on broomrape. Bulletin d'Information - CORESTA No. 3: 79-85. (Summarises herbicide trials for control of Orobanche in 7 countries. Good results reported in at least some countries with chlorsulfuron, imazaquin, imazapyr, pre-transplanting; glyphosate, sulfosate, imazaquin and MH post-emergence.)

Lolas, P.C. 1998. Methods and strategies for control of broomrape in tobacco. In: 1998 Tobacco Symposium, Indian Tobacco - Problems and Prospects, Rajahmundry 1998: 33-42. (General review, relating especially to Orobanche in Greece.)

López-Granados, F. and García-Torres, L. 1998. Short- and long-term economic implications of controlling crenate broomrape (Orobanche crenataForsk.) in broad bean (Vicia faba L.) under various management strategies. Crop Protection 17: 139-143. (Suggesting that annual herbicide application is a highly desirable option.)

Manners, D. 1998. More toothwort management. Botanical Society of the British Isles News 79: 63. (Lathraea squarrosa associated with abundant suckering of host Tilia x europaea - cause or effect?)

Mapongmetsem, P.M., Mompea Motalindja and Nyoma, H. 1998. Eyes on the enemy. Identifying parasitic plants of wild fruit trees in Cameroon. Agroforestry Today 10(3): 10-11. (Tapinanthus globiferus ssp. apodanthus most frequent, occurring especially on Syzigium guineense,Vitellaria paradoxa and Vitex doniana. Hymenodictyon floribundum (Rubiaceae) and Ficus spp. also treated as 'parasites'.)

Mathiasen, R.L. 1998. Infection of young western larch by larch dwarf mistletoe in northern Idaho and western Montana. Western Journal of Applied Forestry 13(2): 41-46. (Larix occidentalis mainly infected by Arceuthobium laricis after 7 years old. Appropriate management suggested.)

Matthies, D. 1998. Influence of the host on growth and biomass allocation in the two facultative root hemiparasites Odontites vulgaris and Euphrasia minima. Flora (Jena) 193: 187-193. (O. vulgaris grew better on Medicago sativa than on Lolium perenne (= without a host); conversely E. minima only grew better on L. perenne. E. minima did not reduce either host, but O. vulgaris reduced both.)

Mauch-Mani, B. and Métraux, J-P. 1998. Salicylic acid and systemic aquired resistance to pathogen attack. Annals of Botany 82: 535-540. (No mention of parasitic plants but presumably of potential relevance re resistance mechanisms. Concludes 'there is now good evidence that both salicylic acid-dependent and SA-independent pathways are involved in systemic signalling for defence responses.')

Melero Vara, J.M. 1997. (Broomrape (Orobanche cernua): evolution and development of resistance.) (in Spanish) Agricultura, Revista Agropecuaria 66: 872-874. (Reporting development of a race overcoming available resistance genes in sunflower in Spain; and reduced attack at higher temperatures.)

Mohamed, A.H., Ejeta, G., Butler, L.G. and Housley, T.L. 1998. Moisture content and dormancy in Striga asiatica seeds. Weed Research 38: 257-265. (Detailed exploration of the influence of moisture on after-ripening - primary dormancy lost as seeds dried to 11% moisture - and on induction of secondary dormancy. Importantly demonstrates that the tetrazolium test indicates germinability rather than viability - negative results after prolonged moisture had induced secondary dormancy were reversible with exposure to dry conditions.)

Molnár, F., Gyulai, B. and Czepó, M. 1998. (A new possibility of controlling dodder (Cuscuta spp.) in the field.) (in Hungarian) Növényegészsédelem 34: 379-383. (Cuscuta 'spp.' in 'various crops' controlled by Roundup and Roundup Bioforce at 0.6 l/ha.)

Mori, K., Matsui, J., Bando, M., Kido, M. and Takeuchi, Y. 1997. Synthesis and biological evaluation of the four racemic stereoisomers of the structure proposed for sorgolactone, the germination stimulant from Sorghum bicolor. Tetrahedron Letters 38: 2507-2510.

Mullen, R.J., Orr, J.P., Caprile, J., Viss, T.C. and Whiteley, R.W. 1997. Preemergence and postemergence studies with rimsulfuron for the control of Solanum and other weed species in processing tomatoes. In: Proceedings, 1st International Conference on the Processing Tomato, and Proceedings, 1st International Symposium on Tropical Tomato Diseases, Recife, 1996: 63-66. (Rimsulfuron applied to tomatoes in California, USA, as three sequential post-emergence applications, 10-12 days apart, caused some toxicity but controlled 'Cuscuta spp.' and greatly increased yields.)

Murray, J. 1997. Lathraea clandestina. Botanical Society of the British Isles Scottish Newsletter 19: 31. (Describing the spread of L. clandestina in Scotland.)

Murty, D.S., Diarra, M. and Dembele, B. 1997. New sources of resistance to Striga hermonthica in sorghum. International Sorghum and Millets Newsletter 38: 76-77. (128 lines assessed as low stimulant for S. asiatica were screened against S. hermonthica: least affected by Striga in 2 years of field trials in Mali were IS16005, IS14844 and CMDT48.)

Neumann, U., Paré, J., Raynal-Roques, A., Sallé, G and Weber, H-C. 1998. Characteristic trichomes and indumentum specialisation in African and European parasitic Scrophulariaceae. Botanica Acta 111: 150-158. (Trichomes described from Striga, Buchnera, Rhamphicarpa, Euphrasia, Melampyrum and Rhinanthus species.)

Neumann, U., Vian, B. and Sallé, G. 1998. (Haustoria of two African parasitic Scrophulariaceae: ontogeny and interface.) (in French) Comptes Rendus des Séances du Biologie et de ses Filiales 192(1): 37-51. (Reporting on the origin and structure of haustoria of Buchnera hispida and Rhamphicarpa fistulosa growing on pearl millet.)

Nickrent, D.L., Duff, R.J. and Konings, D.A.M. 1997. Structural analyses of plastid-derived 16S rRNAs of holoparasitic angiosperms. Plant Molecular Biology 34: 717-729.

Nickrent, D.L., Ouyang, Y., Duff, R.J. and dePamphilis, C.W. 1997. Do nonasterid holoparasitic flowering plants have plastid genomes? Plant Molecular Biology 34: 731-743.

Nickrent, D.L., Duff, R.J., Colwell, A.E., Wolfe, A.D., Young, N.D., Steiner, K.E. and dePamphilis, C.W. 1998. In: Molecular phylogenetic and evolutionary studies of parasitic plants. Soltis, D., Soltis, P. and Doyle, J. (eds.) Molecular Systematics of Plants II. DNA Sequencing. Kluwer Academic Publishers, Boston, MA.: 211-241

Nirenberg, H.I., O'Donnell, K., Kroschel, J., Andrianaivo, A.P., Frank, J.M. and Mubatanhema, W. 1998. Two new species of Fusarium: Fusarium brevicatenulatum from the noxious weed Striga asiatica in Madagascar and Fusarium psudoanthophilum from Zea mays in Zimbabwe. Mycologia 90: 459-463.

Nof, E, Rubin, B. and Dinoor, A. 1998. Colletotrichum sp. - a potential, specific biological control agent for dodder (Cuscuta campestris). (abstract) Phytoparasitica 26: 355. ('Colletotrichum sp.' ex China damaged C. campestris without affecting 19 crop spp. on which it was growing. Molecular study suggested it was C. acutatum rather than C. gloeosporioides as reported in Chinese literature.)

Norton, D.A., Ladley, J.J. and Owen, H.J. 1997. Distribution and population structure of the loranthaceous mistletoes Alepis flavida, Peraxilla colensoi and Peraxilla tetrapetala within two New Zealand Nothofagus forests. New Zealand Journal of Botany 35: 323-336. (A. flavida mainly on outer branches, and P. tetrapetala on inner branches and trunk of N. solandri; P. colensoi on inner branches of N. menziesii.)

Olivier, J-F., 1998. Cartographie de Viscum album L. ´ Bruxelles et dans les environs. Adoxa 20/21: 1-14. (60 sites mapped and hosts indicated. Most on Populus, Robinia and Tilia, one on Quercus rubra.)

Onu, I., Chindo, P.S., Adeoti, A.A. and Bamaiyi, L.J. 1996. Preliminary report on some arthropod enemies of Striga spp. on sorghum in Nigeria. Noma 12: 30-33. (Listing 9 species/genera, of which those of greatest interest included Alcidodes marramus (Coleoptera; fruit galler), Junonia orythia,Helicoverpa armigera and Smicronyx spp.)

Pageau, K., Simier, P., Naulet, N., Robins, R. and Fer, A. 1998. Carbon dependency of the hemi-parasite Striga hermonthica on Sorghum bicolor determined by carbon istopic and gas exchange analyses. Australian Journal of Plant Physiology 25: 695-700. (Concludes that photosynthetic capacity is 3-5 times respiration. 40-60% of parasite carbon is of autotrophic origin.)

Panossian, A., Kocharian, A., Matinian, K., Amroyan, E., Gabrielian, E., Mayr, C. and Wagner, H. 1998. Pharmacological activity of phenylpropanoids of the mistletoe, Viscum album L., host: Pyrus caucasia Fed. Phytomedicine 5(1): 11-17. (V. album in Armenia has been used for treatment of cardiovascular disease and stimulation of the immune system. It is suggested that anti-tumour effects of ethanolic extracts could be associated with inhibition of kinase C.)

Paré, J. and Pronier, I. 1998. (Embryology of Striga. Application to methods of control: action of herbicide, biological control.) (in French) . In: Les phanérogames parasites. Séance du décembere 1997. Comptes Renus des Séances de la Sociétéde Biologie et ses Filiales 192(1): 91-100. (Reporting effects of 2,4-D in preventing seed development, and possible interactions with Smicronyx spp.)

Pazy, B. 1998. Diploidization failure and apomixis in Orobanchaceae. Botanical Journal of the Linnean Society 128: 99-103. (Meiosis in Cistanche found to be irregular, as in Orobanche: as a result, polyploidy is not a likely mechanism of speciation suggesting that parthenogenesis and pseudogamy play a role in seed production.)

Petzoldt, K. 1998. Success and failure in breeding resistance to broomrape, Orobanche spp. In: Martin, K, Mò ther, J. and Auffarth, A. (eds.) Agroecology, Plant Protection and the Human Environment: Views and Concepts. PLITS 16(2): 37-55. (Resistance successful in sunflower varieties for oil, but not in open-pollinated confectionery types; in Vicia faba, some more-or-less tolerant small-seeded types, but little progress in the most important var. major.)

Polhill, R. and Wiens, D. 1998. Mistletoes of Africa. Royal Botanic Gradens, Kew, UK. 370 pp. (A magnificent new volume: see review elsewhere in this newsletter.)

Press, M.C. 1998. Dracula or Robin Hood? A functional role for hemiparasities in nutrient poor ecosystems. Oikos 82: 609-611. (It is suggested that root hemiparasites facilitate nutrient cycling and the maintenance of species richness.)

Pundir, Y.P.S. 1997. Leafy mistletoe - Taxillus vestitus loss assessment in Chakrata oak forests. World Weeds 4(1/2): 1-8. (58% of Quercus leucotricophora and Q. himalayana trees infected at 6 sites in N. India. Apparently less than 1% of host trees died, but this thought to be an underestimate.)

Pundir, Y.P.S. 1997. First report of Scurrula pulverulenta (Wall.) G. Don. (Loranthaceae) on gymnosperms. World Weeds 4(1/2): 9-10. (Occurrence recorded on Taxodium mucronatum.)

Pundir, Y.P.S. 1997. 'Banj' and 'Moru' oaks and their mistletoes in western Himalayas. World Weeds 4(1/2): 69-75. (Quercus leucotricophora and Q. himalayana parasitised by 10 spp. of mistletoe, but not by Helixanthera ligustrina.)

Reid, N. 1997. Behaviour, voice and breeding of the mistletoebird Dicaeum hirundinaceum in arid woodland. The Victorian Naturalist 114(3): 135-142. (Description of many aspects of the behaviour of D. hirundinaceum which feeds on fruits of many mistletoes including Amyema quandang, Lysiana exocarpi, although it also eat insects.)

Reid, N. 1997. Control of mistletoes by possums and fire: a review of the evidence. The Victorian Naturalist 114(3): 149-158. (Greater abundance of mistletoes, Amyema, Muellerina and Dendrophthoe spp. in agricultural areas, compared with forestry areas, is attributed to both the reduction of arboreal marsupials, and lack of prescribed or wild fires in the former.)

Reid, N. 1997. Population biology of Australian mistletoes. In: de Lange, P.J. and Norton, D.A. (eds.) In: New Zealand's Loranthaceous Mistletoes. Proceedings of a Workshop Hosted by the Threatened Species Unit, Department of Conservation, Cass. Wellington, 1995: 133-137. (Noting that Australia has 86 mistletoe spp., reviewing their reproductive biology and population ecology, and emphasising the importance of birds in dispersal, germination and host selection.)

Ronewicz, P. 1997. (The mistletoe Viscum album L. on the area of Miedzyodrze in Szczecin.) (in Polish) Zeszty Naukowe Akademii Rolniczej w Szczecinie Rolnictwo 66: 63-68. (Tabulation of tree and shrub hosts, of which Populus nigra the most frequent.)

Ruggutt, J.K. and Berner, D.K. 1998. Activity of extracts from nonhost legumes on the germination of Striga hermonthica. Phytomedicine 5: 293-299.

Sallé, G., Tuquet, C. and Raynal-Roques, A. 1998. Biologie des phanérogames parasites. In: Les phanérogames parasites. Séance du décembere 1997. Comptes Renus des Sésnces de la Sociétéde Biologie et ses Filiales 192(1): 9-36. (A comprehensive review of most aspects of parasitic plants biology, ecology, morphology, physiology and control.)

Scmuttere, H. 1998. Some arthropod pests and a semi-parasitic plant attacking neem (Azadirachta indica) in Kenya. Anzeiger für Schädlingskunde, Pflantzenschutz 71(2): 36-38. (Cassytha filiformis very common near the coast, and able to kill trees growing under unfavourable conditions.)

Shaxson, L. and Riches, C.R. 1998. Where once there was grain to burn: a farming system in crisis in eastern Malawi. Outlook on Agriculture 27: 101-105. (Reporting results of a survey and fertilizer trials on Striga asiatica in maize and showing excellent response to low (30 kg/ha) doses of N applied in the ridge before planting.)

Simier, P., Robert, S., Pageau, K., Giraudeau-Rassinoux, I. and Fer, A. 1998. (Physiological and metabolic particularities exhibited by parasitic angiosperms: biological significance and interest for chemical control.) (in French) . In: Les phanärogames parasites. Séance du décembere 1997. Comptes Renus des Séances de la Sociétéde Biologie et ses Filiales 192(1): 75-90. (Reviewing work mainly on germination and physiology of Striga hermonthica.)

Soltis, D.E., Soltis, P.S., Nickrent, D.L., Johnson, L.A., Hahn, W.J., Hoot, S.B., Sweere, J.A., Kuzoff, R.K., Kron, K.A., Chase, M.W., Swensen, S.M., Zimmer, E.A., Chaw, S-M., Gillespie, L.J., Kress, J.W. and Sytsma, K.J. 1997. Angiosperm phylogeny inferred from 18S ribosomal DNA sequences. Annals of the Missouri Botanical Garden 84: 1-49.

Solymosi, P. 1998. (Biology of broomrape (Orobanche ramosa L.).) (in Hungarian) Növényvédelem 34: 469-475. (A range of volatile vegetable oils were effective against O. ramosa in a greenhouse experiment.)

Thé, C. 1997. Breeding for Striga tolerance in maize: accomplishments under project Garoua II. In: Seiny Boukar, L., Poulain, J-F. and Faure, G.J. (eds.) Agriculture des savannas du Nord-Cameroun: vers un dévoloppment solidaire des savanes d'Afrique centrale. Actes de l'Atelier d'échange, Garoua, 1996: 295-303. (Reporting the successful development of 7 hybrids, combining tolerance and resistance, with superior performance to that of the IITA standard 8322-13.)

Thomas, H. 1998. Das Potentil von Pilzwen zur Kontrolle von Orobanche spp. unter Berò cksichtigung von Anbausystemen in Terai, Nepal. PLITS 16(4): 110 pp. (Orobanche occurrence decreased by rice, increased by maize. On average 40% toria (Brassica campestris) fields infested, 75% tobacco, all by O. aegyptiaca. 21 fungus spp. collected but none pathogenic on O. aegyptiaca.)

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Interactions 11: 530-536. (Infection of tobacco by O. aegyptiaca induces expression of hmg2, a defence-related isogene of HMGR within 1 day, but parasite continues to develop normally.)

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Zielinski, J. 1997. (The mistletoe Viscum album L. on the left bank of the river Szczecin.) (in Polish) Zeszty Naukowe Akademii Rolniczej w Szczecinie Rolnictwo 66: 69-87. (A list of hosts includes 66 species in 13 families.)

HAUSTORIUM 34 has been edited by Chris Parker, 5 Royal York Crescent, Bristol BS8 4JZ, UK (Email chrisparker5@compuserve.com) and Lytton J Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk Virginia 23529-0266, USA (fax 757 683 5283; Email lmusselm@odu.edu). Send material for publication to either author.

Preparation of this issue and maintenance of the website have been assisted by John Terry, Tropical Weeds Group, Mikhail Semenov and others at Long Ashton Research Station, Bristol.

// HAUSTORIUM

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SPONSORSHIP

The preparation and distribution of this (and the next) issue of Haustorium has been made possible by funds from the Crop Protection Programme (CPP) of the UK Department for International Development (DFID). The CPP funds a wide range of research activities in developing countries including work on parasitic weeds. In this issue, two projects on *Striga* are briefly reviewed. Further items will be included in the next issue. For more information please contact the individual authors.

Perhaps in future, Haustorium will be funded in a new way? See item below on proposals for the establishment of a new International Parasitic Plant Society.

HAUSTORIUM BY EMAIL AND THE WEB

Although we have funding for this and the next issue of Haustorium, we still have no long-term security and wish to reduce costs as much as possible. The great bulk of our costs are for mailing. Many readers are already helping us by receiving Haustorium by Email. We believe many others could do so but we do not have their Email addresses. If you are one of those, do please let Chris Parker know (Email address on the last page). If you cannot receive Email, or for any reason wish strongly to go on receiving hard copy, you will continue to receive by airmail.

Thanks to arrangement with the Institute of Arable Crops Research, Long Ashton Research Station, Bristol, UK, Haustorium 35 will also be available on the web site: www.lars.bbsrc.ac.uk/cropenv/haust.htm

SEVENTH INTERNATIONAL PARASITIC WEED SYMPOSIUM

Arrangements are continuing for the Seventh International Parasitic Weed Symposium to be held in Nantes, France, 3-8 June, 2001. A first circular has been sent to all recipients of Haustorium. If you know of others who would be interested, or if there are any comments or suggestions on the format of this event please contact Haustorium editors, or Patrick Thalouarn, Laboratoire de Cytopathologie Vegetale, University de Nantes, 2, Rue de la Houssinière, BP 92208, F44322 Nantes Cedex 3 France. Email patrick.thalouarn@svt.univ-nantes.fr

STRIGA PROJECTS FUNDED BY DFID/CPP

Integrated control of *Striga* species in Tanzania.

The infestation of staple cereals by *Striga* species is a widespread problem in Tanzanian smallholder cropping systems, particularly in semi-arid areas where farmers can afford few inputs and continuous cultivation has led to a near catastrophic decline in soil fertility. The DFID Crop Protection Programme has been funding field studies in a number of areas of Tanzania since 1996, aimed largely at using existing knowledge to develop integrated *Striga* management systems through participatory research implemented in collaboration with extension and farmers. This work is being co-ordinated in Tanzania by Ilonga Agricultural Research and Training Institute in collaboration with the UK Natural Resources Institute. Sorghum systems are the major focus of the project, targeting *S. hermonthica* in the north of the country in the Lake Victoria basin and *S. asiatica* in Dodoma Region in central Tanzania. On-station and on-farm trials have been used to identify the most resistant lines currently available. The project has undertaken seed multiplication so that participating farmers could be provided with at least half a kilogram of seed for the 1998/99 season to allow them to plant large enough areas for assessment of variety preference. No lines have been found to be completely resistant to either *Striga* species but the ICRISAT line SAR 29, SRN39 and particularly P9405, bred by Purdue University, USA, support lower numbers of emerged parasite stems than local landraces or the very susceptible improved local cultivars Tegemeo or Pato and, are productive under smallholder management. Pot trials in UK have also shown that parasite emergence is considerably later on the partially resistant lines than on susceptible checks. Farmers in Dodoma have been particularly impressed by SAR 29 and P9405 as these mature in less than 80 days and are perceived to be more productive than the local tall landraces which are only just flowering by this stage. Initial tastings indicate that P9405 produces a sweet porridge, comparable with that made from local sorghums. It also appears to have some resistance to *S. forbesii* which is a local problem on heavy soils around Morogoro. Both participating and neighbouring farmers are very keen to obtain more seed of P9405 for planting next season. Perhaps the greatest challenge will be securing sustainable supplies of planting seed – currently less than 2% of the sorghum area in Tanzania is currently planted to improved cultivars of sorghum. The main ways farmers in Dodoma obtain seed is through barter with neighbours or small local purchases. Village based seed production, supported by NGOs, will probably have an important role to play in the future dissemination of *Striga* resistant cultivars. The project has also been investigating with farmers how to integrate cultural practices which also reduce *Striga* emergence with the production of these selected lines. Inter-cropping with cowpea in the Lake Zone and with groundnut in Dodoma, where local cowpea lines are particularly susceptible to *Alectra vogelii,* has also been selected by farmers for further testing. Targeted use of kraal manure on infested fields has also been demonstrated to improve sorghum growth substantially, despite *Striga* infestation of the crop. Many farmers, however, lack the transport to move substantial quantities of manure to their fields. The project is therefore moving on to investigate improving soil fertility by the use of *Crotalaria juncea (*sunn hemp*)* planted as an inter-crop at second weeding of sorghum.

Although production is in decline due to high labour requirements, finger millet is still an important crop in mid-altitude areas of Mara region in northern Tanzania. Farmers report that *S. hermonthica* commonly infests the crop and the project has undertaken some work, both in the field and in the glasshouse, to screen germplasm. Although no resistance has been identified, sufficient variability in susceptibility has been noted among the 30 or so lines evaluated to suggest that further work with a larger collection of genotypes will be worth while.

Upland rice is an important cash crop in southern Tanzania where farmers are all too well aware of the association of increasing infestation of the widely grown cultivars Kilombero, Super India and Zambia by *S. asiatica* and declining soil fertility. The project is working in collaboration with Kyela district extension staff to conduct trials with farmer groups in two villages, primarily aimed at cost effective soil fertility improvement. Top dressing with 25 to 50 kg ha^{-1} nitrogen as urea has resulted in reduced S*triga* stands and yield increases of 40% and 70% respectively. While urea use is profitable many farmers lack the cash liquidity to purchase seasonal inputs and not prepared to join credit schemes. Kyela receives 2,500 to 3,000 mm rainfall per year and sunn hemp grows particularly well and may well provide a low-cost alternative to fertiliser; project work has also confirmed that it has the added benefit of being a *Striga* trap crop. Farmers are showing considerable interest in planting this as a green manure crop in rotation with rice on the most severely infested portions of land. Plots sown to sunn hemp last season will be cropped with a test crops of rice in 1999/2000 . The project has also begun to involve the farmers in participatory variety selection aimed at evaluating rice lines for resistance. An early maturing local line "wahi wahi" appears to support low numbers of emerged *Striga* and will be evaluated further at a number of sites next season. Farmers require tall plant types with aromatic grains.

As research has shown elsewhere in Africa, the project has observed that farmers in Tanzania have little knowledge of *Striga* biology and control. Providing farmers with information about the life cycle of the parasite, at village seminars, has allowed them to appreciate the rationale behind potential *Striga* management practices and participate more fully in planning and evaluation of field trials.

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Genetic variability of *S. hermonthica* and stability of resistance in sorghum.

Striga hermonthica is the most important parasitic weed attacking cereal crops in the semi-arid tropics, causing severe reductions in yield. The development of resistant crop varieties has been hampered by the occurrence of variation within and between *S. hermonthica* populations. This, together with its out-breeding behaviour, threatens durability of resistance. An understanding of the patterns of variability within and between *S. hermonthica* populations, and the effects of host selection on populations, is of utmost importance if breeding programmes are to target sources of resistance in different areas.

Very few molecular studies on the genetic variation of *S. hermonthica* have been carried out. This study provided evidence of both geographical differentiation and strong sorghum varietal selection by five sorghum varieties on four *S. hermonthica* populations, by surveying polymorphisms at the molecular level using isoenzyme and RAPD technologies. The data was subject to multivariate analysis in order to detect the trends of variation, which were found to be consistent between the isoenzyme and RAPD data.

Samples of *S. hermonthica* from West African sites were found to be more closely related to each other than to one from East Africa. The highest degree of similarity existed between two sites sampled within Mali. Selection pressures increased from the susceptible sorghum varieties, through the tolerant to the resistant varieties. No specific markers identified selection by a particular sorghum variety or a particular population/region.

A degree of genetic analysis with the isoenzyme data revealed deviations from Hardy-Weinberg equilibrium as expected, with a high selection for heterozygotes and particular homozygotes. The high frequency of null alleles detected for two enzyme systems may indicate their importance in the maintenance of polygenic variation.

To date, no sorghum varieties exist that are completely resistant to *S. hermonthica*. As long as a few *S. hermonthica* plants can successfully complete their life cycle on their host, the durability of resistance is threatened. In view of the high levels of variability existing in *S. hermonthica* populations that allows the parasite to quickly adapt to new crops/varieties, the target should be to produce multigenic resistant varieties with a broad selection pressure together with the use of multilocation trials to verify resistance in the field. Integrated approaches to the control of *S. hermonthica* using treatments and cultural methods which eliminate or minimize parasite seed production, leading to reduction of the seed bank, and which improve soil quality are discussed. Farmer training is also important in the acceptance of an integrated approach by the farming community in the struggle against this very successful parasitic plant.

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Acknowledgement The above two items are based on research partially or completely funded by the UK Department for International Development's Renewable Resources Knowledge Strategy. However, DFID can accept no responsibility for any information provided or views expressed.

A NEW PARASITIC PLANTS SOCIETY?

The informal Parasitic Seed Plant Research Group has been active for many years in publishing the newsletter Haustorium, and in organizing international symposia and workshops. Lytton Musselman and Chris Parker who led this group for more than twenty years have brought the group to great success and many important achievements. For some time we were thinking of the need to establish a formal international Society for parasitic plants, that would continue this important task and extend activities.

As some of you may recall, I raised this issue during the general discussion in the Albena *Orobanche* Workshop last summer, and a significant number of participants were supportive of the idea. Thereafter a core of interested scientists started the procedures that are necessary for formally establishing the Society.

The objectives of the proposed International Parasitic Plant Society will be:

1. To promote the study of parasitic plants.
2. To form and maintain an international network for the advancement of parasitic weed control.

The executive goals of the Society will be:

1. Obtaining financial support from companies and international/national organizations, and from membership fees.
2. Organizing/supporting the International Parasitic Plant Symposia/Conferences.
3. Organizing/supporting workshops on specific groups or specific problems of parasitic plants.
4. Establishing a scientific board, for reviewing, editing and publishing proceedings.
5. Establishing an interdisciplinary web site on parasitic plants.
6. Establishing an internet Discussion Network.
7. Publishing a newsletter.

Of course, officers need to be elected for the executive committee of the Society. This will be done before or during the International Parasitic Plant Symposium in Nantes. In the meantime, the ad-hoc executive committee includes Andre Fer as president, Jos Verkleij as treasurer, and myself as secretary. Additional members of the executive committee are Jim Westwood and Dana Berner. We are now working on the constitution, aiming to formally register the Society before the International Symposium on Parasitic Plants in Nantes.

At the moment it is highly important for us to have an idea who is interested in becoming a member of the new International Society for Parasitic Plants. **We therefore kindly ask you to send, with no obligation, your name, address, Email, and fields of interest, to me at the Email below, or to Dr Jos A.C.Verkleij, Free University, De Boelelaan 1087, 1081 HV Amsterdam, The Netherlands**

Looking forward to fruitful collaboration in the new Society, we thank you in advance for your co-operation and help. Please bring our request also to the attention of others who may be interested.

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ROCKEFELLER FOUNDATION COLLABORATIVE RESEARCH

A substantial body of research on *Striga* is being funded by Rockefeller Foundation. This is described in two papers by J.D. De Vries and others in the International Weed Science Society Newsletter (see DeVries *et al*. 1998, 1999 in Literature section). The Foundation has, in collaboration with CIMMYT, IITA, the Kenya Agricultural Research Institute (KARI) and a number of other research institutions initiated a research effort focused on the development of *Striga*-resistant maize for Africa. It involves breeding, biotechnology, cropping systems and technology transfer. Projects at a range of sites in Africa, associated with back-up projects at four universities in USA, are co-ordinated by a *Striga* Working Group. The first paper reviews the work in Africa, including (i) collaboration between IITA, CIMMYT and KARI in the crossing of maize with teosinte, *Tripsacum* and *Zea diploperennis* and testing of resistant progeny, and the use of molecular markers in the identification and transfer of resistance genes; (ii) collaboration between CIMMYT, KARI and the Weizmann Institute of Science, Israel, in the use of imidazolinone herbicides in conjunction with ALS-resistant maize varieties and the transfer of herbicide-resistance to locally suitable cultivars. The collaborating Institutes in USA include (i) Purdue University, where molecular maps are being developed and used to locate and clone genes for low-stimulant resistance and other resistance mechanisms, and to engineer the introduction of genes which could trigger a hyper-sensitive response to *Striga* infection; (ii) University of Chicago, where the objective is to understand the biosynthetic pathway for the germination stimulants, and to engineer mutants in which their production is minimised (or exaggerated); (iii) University of Virginia , where investigations are concentrated on the specific biochemical factors and gene products involved in rejection of *Striga* in the cortex of host and non-host roots, and the possible cloning and transfer of genes; (iv) University of California, where the related hemi-parasite *Triphysaria* is being used as a substitute for *Striga*. It is hoped that maize mutants with resistance to *Triphysaria* will also show resistance to *Striga*.

Chris Parker.

STRIGA IN MOZAMBIQUE

During January 1998 a participatory technology review on plant protection problems was undertaken together with farmers on the Lichinga plateau which covers two districts (Lichinga and Sanga) in Niassa province, northern Mozambique. The plateau farming system is based on a maize-common bean (*Phaseolus vulgaris*) intercrop sown on large ridges (1.4 m between ridges which are normally from 0.3 to 0.5 m high). The rainy season runs from November to April, maize being planted shortly after rains become established in November or early December. Beans are normally planted twice, in December and March, firstly as an intercrop with the maize and then as a relay crop.

As part of the review, discussions were held with farmers, in their fields, about common weeds and their control. At least five different weeding operations, with local names, were identified in the main rainy season, the actual operations carried out depending on rainfall pattern and soil type. A range of common "weed" species were identified together with farmers, most with local names, although some were also useful to farmers either as relish or feed for animals (for example rabbits, guinea pigs and goats). Among the weeds species identified was *Striga asiatica* which was present in one field in Lichinga district (in border rows only) and most fields in Sanga district (throughout fields). In Sanga district farmers were very aware of *Striga* whose local name was given as "chicungulo" and affirmed that if it was not removed early the maize suffered a drastic yield reduction. Most of these farmers had the opinion that in most years it was not a problem as it was controlled in the first weeding operation on the ridges. Other than hand weeding (hoeing) no farmers had any specific measures to control *Striga*.

Recommendations were made to monitor the situation and evaluate the impact of *Striga* over a number of seasons in Sanga district. The main difference between Lichinga and Sanga districts was the greater age of fields in Sanga district, and from this perspective it might be expected that *Striga* will become more of a problem on the plateau in general as farmers are becoming more settled and using the same fields for longer periods as compared to the past where a more shifting type of agriculture with long fallows (50 years or more) was practised.

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OROBANCHE IN KENYA

A survey aiming at weed identification, distribution and mapping was carried out beginning June 1997 covering Machakos, Makueni, Mwingi, Kitui, Kajiado, Narok, Nakuru, Nyandarua and Laikipia districts on behalf of National Dryland Farming Research Centre, Katumani and National Plant Breeding Research Centre, Njoro. In June 1998, *Orobanche cernua* was identified in Kajiando South (agro-ecological zone, Lower Midland 6). The infestation was severe on tomato (Val Cal J) grown under furrow irrigation.

A second survey in December 1998 showed that on the neighbouring farm a half acre of tomato was severely infested resulting in zero yield. The crop was abandoned and was dying, leaving the weed to mature. This is a serious issue because many thousand of seeds would have been banked into the soil. The contact farmer observed that the field had previously been planted with onion, which was not attacked, but there had been some infection of *Galinsoga parviflora*, while a crop of peppers (C*apsicum annuum)* was completely destroyed after severe infestation. The parasite has also been observed on *Sonchus oleraceus.*

This weed, referred to as 'kiama' (= magic or wonder) by the local farmers, needs to be controlled if not eradicated before it spreads, because farmers in this region depend entirely on the income generated from the tomatoes, onions and pepper production now under threat. Adequate crop rotation is impossible because the crop farming land is limited, unfenced and crops are selected to meet production cost in a predominantly livestock keeping zone. This weed is known from the Middle East, The Mediterranean countries, and eastern Europe.

Hottensiah Mwangi., National Agricultural Research Laboratories, P.O. Box 14733, Nairobi, Kenya.

WEB SITES

For this newsletter (in full), see: www.lars.bbsrc.ac.uk/cropenv/haust.htm

We are asked to point out that the web site address for the Yoder Lab in California is now: http://veghome.ucdavis.edu/Yoder/YoderLab/Index.html

http://www.idrc.ca/nayudamma/striga_e.html gives information on IDRC-funded work on biocontrol of *Striga* with *Fusarium oxysporum*.

http://pest.cabweb.org/cpc/report.htm uses the data sheet for *Striga hermonthica* as a sample to illustrate the new CAB International Crop Protection Compendium, Global Module CDRom.

PROCEEDINGS OF MEETINGS

Proceedings of the 16th Biennial Weed Science Conference for Eastern Africa. 1997. Edited by Adipala, E., Tusiime, G. and Okori, P. Weed Science Society for Eastern Africa, P.O. Box 30321, Nairobi. 310 pp.

Contents include:

Kasembe, E. and Chivinge, O.A. Effect of time of ridging on witchweed growth and maize grain yield in the smallholder farming sector of Zimbabwe. (pp. 131-136) (Ridging at 3 or 5 weeks after crop emergence greatly reduced *S. asiatica* and improved yields.)

Ransom, J.K. *et al.* An update on *Striga* control research in Africa. (pp. 215-219)

Esilaba, A.O. *et al.* Factors affecting the incidence of *Striga* and its control in northern Ethiopia: results of a survey. (pp. 221-229)

Abayo, G.O. *et al.* Stimulation of *Striga hermonthica germination by plant species indigenous to Eastern Africa.* (pp. 231-239)

Chanyowedza, R.M. *et al.* Effect of sorghum variety and leaf extracts from multi-purpose trees on the germination and emergence of *Striga asiatica*. (pp. 241-246.)

Ariga, E.S. *et al.* Potential of using cotton and other trap crops for *Striga hermonthica* management in cereals in Kenya. (pp. 247-253) (Response of *S. hermonthica* to cotton shown to be complex, depending on cotton variety, *Striga* seed source, and other factors.)

Kanampui, F.K. *et al.* Advantages of seed-primed imazapyr for *Striga hermonthica* control on maize bearing target-site resistance. (pp. 255-259) (Herbicide-resistant maize seeds primed with 0.2-0.33 mg imazapyr/seed (11-18 g/ha) and planted dry resulted in excellent control of *Striga* (added artificially to seed hole) and good yield.)

Oswald, A. *et al.* Intercropping – an option for *Striga* control. (pp. 261-266) (Good results with cowpea and sweet potato in one trial, not in another, possibly due to difference in soil type – better result on a sandy soil.)

Combating Parasitic Weeds through Horizontal Resistance. 1998. Proceedings of an International Workshop organised by the International Agricultural Research Institute (IARI), Kyungpook National University (KNU) and the International Corn Foundation (ICF), South Korea with the support of KOICA, Samsung, PASCON, FAO, SAFGRAD, Brussels, Belgium, 1997. Published by IARI, KNU and ICF (1998) ISBN 89-7180-091-7. Edited by Kim, S.K., Robinson, R.A., Atkinson, V.O., Th, C. and Sall, G. 66 pp.

Contents:

Robinson, R.A. Theory of horizontal resistance and its application in parasitic weed control.

Kim, S.K. Horizontal resistance in maize.

Sall, G. EEC Project: experiences on *Striga* control in Africa.
Kroschel. J. Summary of GTZ's experiences in parasitic weed research.
Th, C. Breeding for *Striga* tolerance in Cameroon.
Adetimirin, V.O. Genetics of maize tolerance to *Striga hermonthica*.
Kim, S.K. Misconcepptions about horizontal resistance in *Striga* and *Orobanche* research.
Kim, S.K. *et al.* On-farm demonstration guidelines for testing maize varieties with horizontal resistance to *Striga hermonthica*.
Kim, S.K. Horizontal resistance: misunderstandings, approach and importance.

Review:

The main purpose of this workshop was to review past research on managing *Striga* spp. with a view to expediting the development of appropriate host plant resistance breeding strategies for parasitic weeds, particularly horizontal resistanc. This aim was based on the premise that most past work on breeding for resistance to parasitic weeds had been hampered by a lack of appreciation of the potential contribution of horizontal resistance and an apparent fixation on parameters such as parasite attachment and emergence as the main components of host plant resistance. The workshop was attended by a small group of researchers, many from Korean institutes or foundations. Participation by most of the active parasitic weeds research groups e.g. IITA, ICRISAT, CIMMYT, ICARDA, Long Ashton Research Station, UK and the University of Purdue, USA was mysteriously lacking for such an international workshop.

The workshop was organised in four sections, each comprising technical papers presented and main points discussed. A general discussion is also included. The proceedings are well-presented with high quality colour plates in section IV.

Section I considers the theory of horizontal resistance and its application to managing parasitic weeds by Dr R Robinson and the use of horizontal resistance in maize by Dr S K Kim. Dr Robinson has written several books on the theory and application of horizontal resistance in managing important pathogens of several tropical crops. The examples given in his paper are not referenced and no proof is provided that either the advances made were due to horizontal resistance or the failures due to vertical resistance. Alternative explanations have been published in refereed journals for at least some of the examples e.g. the increase in severity of coffee berry disease on coffee in Eastern Africa has been strongly linked to overuse of fungicides that have destroyed the natural antagonistic flora to *Colletotrichum kahawae*. Dr Kim introduces his paper with examples of the breakdown of vertical resistance to pathogens in a number of tropical crops and follows this with an account of the success of breeding for horizontal resistance to maize streak virus. On p.13 he cites a 'breakdown' of resistance of cowpea B301 to *Striga gesnerioides* though this occurred when it was when first tested in Benin, due to the existence of an unusual, very localised strain of *S. gesnerioides*, and he fails to add that the same line continues to show 'durable multi-strain resistance' in all other areas and countries in which it has been tested in West Africa. Such resistance is the best available to poor cowpea farmers in West Africa at present and is making a substantial contribution to food production. In contrast on pp.14-15, Dr Kim cites the success of *Striga* tolerant and resistant maize lines such as 8322-13 with 'horizontal resistance to *Striga* which gives 90-95% control', but no references are given to support this claim.

Section II presents papers on EEC and GTZ project experiences on managing parasitic weeds in Africa from Drs. Sallé and Kroschel, respectively, as well as papers on breeding for tolerance to *Striga*. The EEC and GTZ papers summarise various approaches to managing *Striga* in cereal and cowpea systems and emphasise the complexity and enormity of the task. Both highlight the importance of host plant resistance, the need to work closely with local partners, the need to enhance farmers awareness and understanding of the parasitic nature of *Striga* and the need for different management strategies in different situations. Various promising tolerant maize lines have been developed from the breeding programme for tolerance in Cameroon but these lines need to be more widely tested (p.28). Tolerant maize lines have also been developed in Nigeria but higher levels of tolerance are considered necessary prior to wider field testing (p.30).

Section III includes two papers by Dr Kim on misconceptions about horizontal resistance in *Striga* and *Orobanche* research and on-farm guidelines for testing maize varieties with horizontal resistance. The paper on misconceptions is a rather bizarre historical account by Dr Kim of the difficulties he has had getting various papers accepted by international journals, all of which are cited in the accompanying bibliography. After reading it, I am none the wiser as to what are the key misconceptions researchers have about horizontal resistance to *Striga* in maize. On p.41 Dr Kim states that *Striga* emergence and tolerance of the parasite in the horizontally resistant maize lines are under the control of different genes but no evidence is given for this. It is also a surprising statement in the light of earlier statements in the discussions that knowledge of the genetic and biochemical bases of horizontal resistance to *Striga* is not necessary for developing horizontally resistant lines.

Section IV returns to misundertandings on horizontal resistance and suggests that the horizontal resistance approach is definitely the most sustainable solution to the *Striga* problem in sub-Saharan Africa that will guarantee the poor people of Africa much needed food and nutrition. Results of studies from 1982-1995 including over 50,000 maize lines, crosses and families are claimed to support the view that the most appropriate *Striga* control strategy would be to identify or develop genotypes that have a high 'tolerance' to *Striga*. I remain to be convinced with sound, wide scale field results. Dr Kim believes that tolerance is a type of horizontal resistance against parasitic weeds. Tolerant lines appear to be defended in the guise of horizontal resistance. However, throughout the proceedings as a whole there is an almost total lack of any attempt to distinguish between tolerance and resistance.

The insistence that all efforts by other groups such as ICRISAT (p.60) were strictly focused on vertical resistance and that horizontal resistance was dismissed as irrelevant is quite unjustified. The sorghum cultivar Framida was used by ICRISAT as one of its main sources of resistance to *Striga*. If it is true as stated on p.18 that "Framida shows a high level of tolerance to *Striga* and the expression of horizontal resistance in this cultivar is similar to that in the maize cultivar 8322-13", ICRISAT can hardly be accused of ignoring horizontal resistance.

The discussions at the end of each section are marred by frequent efforts to stifle open exchange about the need to develop a range of different management strategies for parasitic weeds and often border on ideological preaching (see pp.45-50 and pp.58-62). We are asked to believe without any convincing field evidence that the only way to manage parasitic weeds of major food crops in Africa is through horizontal resistance alone. The proceedings are a forum for a selected group to criticise much of the past progress on breeding for resistance to parasitic weeds, rather than a useful contribution to further progress on management of one of the most difficult biotic problems affecting food crops in Africa.

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Current Problems of *Orobanche* Researches. 1998. Proceedings of the 4th International *Orobanche* Workshop, September 23-26, 1998, Albena, Bulgaria. Edited by Wegmann, K., Musselman, L.J. and Joel, D.M. Published by Institute for Wheat and Sunflower, General Toshevo, 9520, Bulgaria.

Contents (with some abbreviation):

morphological and biochemical indices of sunflower…
Ivanov, P. *et al.* An isoenzyme analysis of the NE Bulgarian *O. cumana* population.
Bozukov, H. Influence of exposure period duration on the germination of broomrape seeds in the presence of synthetic stimulants.
Slavov, S. and Batchvarova, R. Stimulants for *Orobanche* seeds germination.

Session 2. Penetration of the germ tube and haustoria establishment:
Joel, D.M. *et al.* The haustorium of *Orobanche*.
Boelhouwer, G.J. and Verkleij, A.C. A study of the interaction between *O. aegyptiaca* and *Brassica napus*.
Joel, D.M. *et al.* Molecular markers for *Orobanche* species – new approaches and their potential uses.
Ljubenova, A. and Minkov, I. Five *Orobanche* ecotypes – what is the difference.?
Ljubenova, A. and Minkov, I. Conservative spots in the chondriome and plastome of five *Orobanche* ecotypes.
Antonova, T.S. The interdependence between sunflower resistance and broomrape virulence.
Westwood, J.H. and Foy, C.L. *Arabidopsis thaliana* can be a model host for *Orobanche* research.
Atanasova, S. *et al.* An artificial system for monitoring of *Orobanche* spp./host interactions.

Session 3. Growth and development of the parasite:
Teryokhin, E.S. Ontogenesis of *Orobanche* as the sum of adaptation to the parasitic mode of life.
Eplee, R.E. *et al.* Mitigating epidemiology of *Orobanche*.
Dhanapal, G.N. and Struik, P.C. Natural plant oils: do they kill broomrape spikes?
Scuchardt, B. *et al.* A new species of weed broomrapes in the community of parasitic plants on tobacco plantations in Bulgaria.
Eizenberg, H. *et al.* Effect of seasonal conditions on host-parasite relationship in *O. crenata* and *O. aegyptiaca.*
Dale, H. and Press, M.C. How will elevated concentrations of atmospheric carbon dioxide influence *Orobanche* species and their hosts?
Fawaz Azmeh, M. and Musselman, L.J. *Cistanche phelypaea*, a native root parasite attacking introduced shrubs.
Romanova, V.O. *et al.* The intraspecies taxonomy of *O. cernua* Loefl. 1. The system of Beck-Mannagetta (1930) and the data of seed morphology.
Ibrahim, H.M. *et al.* ES – Parasitic Weeds: a computerised expert system for parasitic weed identification and management with special reference to *Orobanche* spp.
Deif, H.A.R. and Ahmed, M.F. A taxonomic study on the populations of three common species of the genus *Orobanche* L. in Egypt. 1. Macro- and micromorphology of the pollen and their taxonomic implication.
Hassenein, E.E. *et al.* Estimation of number of chromosomes in *Orobanche* spp. in Egypt.

Session 4. Resistance to *Orobanche* and resistance breeding:
Alonso, L.C. Resistance to *Orobanche* and resistance breeding: a review.
Al-Menoufi, O.A. and Adam, M.A.Susceptibility/resistance of some wild *Lycopersicon* accessions to *O. ramosa.*
Raju, C.A. and Nagarajan, K. Performance of tobacco germplasm accessions to *Orobanche* incidence.
Zemrag, A. Critical threshold of *O. crenata* Forsk. in faba bean…
Slusar, E.L. *et al.* The susceptibility of sunflower to broomrape biotypes of different geographical origin.
Alvarodo-Aldea, J. *et al.* Interactions of host genotype and planting time in the infection of sunflower by *O. cernua*.
Saber, H.A. *et al.* A new Egyptian source for *Orobanche* resistance in faba bean.
Iliescu, H.C. *et al.* Response of some sunflower hybrids to the attack of the parasitic phanerogame *O. cumana* Wallr.
Nikolova, L. *et al.* New sunflower forms, resistant to *O. cumana* Wallr., originating from interspecific hybridization.
Venkov, V. and Shindrova, P. Development of sunflower form with partial resistance to *O. cumana* Wallr. By seed treatment with nitrosomethylurea.
Petakov, D. *et al.* Combining ability of new sunflower lines that are resistant to broomrape.
Svetkova, F. *et al.* Breeding of fertility restorer lines resistant to broomrape (*O. cumana* Wallr.) and inheriting the resistance in F1 sunflower hybrids.
Christov, M. *et al.* New sunflower forms, resistant to broomrape.
Goldwasser, Y. *et al.* Factors involved in resistance of *Vicia atropurpurea* to *O. aegyptiaca*.

Session 5. Progress in *Orobanche* control:

Garca-Torres, L. Reflections on parasitic weed control: available or needed technology?
Kleifeld, Y. Progress in *Orobanche* control.
Jacobsohn, R. *et al.* Crenate broomrape control in garden and field peas with foliarly applied imazethapyr.
Jacobsohn, R. *et al.* Broomrape control in sunflowers with foliar applied herbicides.
Khalaf, K.A. Effect of glyphosate and fosamine-ammonium phosphorous herbicides on controlling *Orobanche* spp. in faba bean and tomato.
Raju, C.A. and Nagarajan, K. Propects of control of *Orobanche* in tobacco in India.
Kleifeld, Y. *et al.* Selective control of *Orobance* spp. with imazamethapyr.
Nandula, V.K. *et al.* Effect of glyphosate on amino acid composition of *O. aegyptiaca* and two of its hosts.
Valkov, V. *et al.* Broomrape control by transgenic tobacco plants.
Bedi, J.S. and Sauerborn, J. Survival and virulence of different propagules of *Fusarium oxysporum* f. sp. *orthoceras* on storage, against *O. cumana.*
Garca-Torres, L. *et al.* Chemical control of *Orobanche* in legumes: achievements and constraints.
Chalakov, H. Present situation and prospects for solving the tobacoo broomrape problem in Bulgaria.
Weinberg, T. *et al.* Carotenoids biosynthesis inhibitors and their effects on field dodder (*Cuscuta campestris* Yuncker).
Thomas, H. *et al.* Impact and management of *Orobanche* in cropping systems in Nepal.
Iliev, I. *et al.* A possibility for industrial production of a bioherbicide for control of *O. cumana*.
Abu-Irmaileh, B.E. Present status of *Orobanche* control in the Near East.
Vouzounis, N. and Americanos, P. Control of *Orobanche* in tomato and eggplant.
Zaitoun, F.M.F. and Ibrahim, H.M. Effect of planting date and faba bean genotypes on *O. crenata* growth.
Khattril, G.B. *et al.* Agronomic problems and control of broomrape (*Orobanche* spp.) in Nepal.
Murdoch, A. Long-term integrated control strategies for *Orobanche* based on a life cycle model.

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Advances in Parasitic Weed Control at On-Farm Level. Volume 1. Joint Action to Control *Striga* in Africa. 1999. Edited by Kroschel, J., Mercer-Quarshie, H. and Sauerborn, J. GTZ/University of Hohenheim. 324 pp. (Selected papers from a Regional Workshop held in Ghana, October, 1997.)

List of Contents:

Kroschel, J. Analysis of the *Striga* problem, the first step towards future joint action.
Albert, H. Farmers in northern Ghana and the problem of *Striga.*
Gehri, A. *et al.* Assessing women's needs in *Striga* control.
Sauerborn, J. *Striga* biology versus control.
Hess, D.E. and Haussmann, B.I.G. Status quo of *Striga* control: prevention, mechanical and biological control methods and host plant resistance.
Adetimirin, V.O. and Kim, S.K. Farm level options for controlling *Striga* on maize in Africa.
Diarra, C. Biological control of *Striga hermonthica* in the Sahel.
Kroschel, J. *et al.* Insects for *Striga* control - possibilities and constraints.
Ransom, J. The status quo of *Striga* control: cultural, chemical and integrated aspects.
Kombiok, J.M. and Clottey, V.A. On-farm verification of *Striga hermonthica* control using some trap crops in rotation with cereals.
Kanton, R.A.L. *et al.* Evaluation of *Striga*-resistant sorghum varieties and effect of leguminous trap
crop rotation with millet/sorghum intercrop on cereals in northern Ghana.
Sauerborn *et al.* Parasitic weed infestation of maize and sorghum as influenced by crop rotation.
Oswald, A. *et al.* Intercropping - an option for *Striga* control.
Oswald, A. *et al.* Developing a catch-cropping technique for small scale subsistence farmers.
Kureh, I. *et al.* On-farm verification of agronomic packages for the control of *Striga* in sorghum.
Traore, H. and Yonli, D. Study of farmers' perception of the *Striga* problem and inventory of indigenous *Striga* control methods in Burkina Faso.
Tarfa, B.D. *et al.* Effect of nitrogen and phosphorus levels on the reaction of soybean cultivars to A*lectra vogelii* Benth.
Kachelrieis, S. Facilitating conscious choices: sharing information, learning and generation of knowledge as joint action.

Fischer, P.A. *et al.* The "*Striga* control programme" - development, use and impact of a communication aid.
Fischer, P.A. *et al.* Putting it into practice - experiences with farmer experimentation.
Kunjo, E.M. Extension options for the management of *Striga hermonthica* in small holdings: the Gambia experience.
Ayongwa, G.C. and Ngawa, L. Report of the *Striga* project during the 1994/95 cropping seasons.
Agunda, J. Community participation in *Striga* weed control in western Kenya region.
Kachelreiss, S. *et al.* Sharing information between research and extension - training courses for
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List of Contents:

Yazough, A. and Klein, O. Problème et gestion de l'*Orobanche* au Maroc.
Ait Abdallah, F. *et al.* Le problème de l'*Orobanche* en Algérie.
Hassenein, E. and Salim, A. Country paper about *Orobanche* and its control in Egypt.
Mller-Stver, D. *et al.* Importance of *Orobanche* spp. in two regions of Egypt - farmers' perceptions, and difficulties, and prospects of control.
Kleifeld, Y. *Orobanche* management and control in Israel.
Bourarach, K. *et al.* La participation du genre dans la protection de la fève contre l'*Orobanche* au Maroc.
Manschadi, A.M. *et al.* A model for simulation of growth and development in faba beans (*Vicia faba*)
infected with *Orobanche crenata*.
Linke, K-H. Status quo of *Orobanche* management: preventive, cultural, and physical control.
Kroschel, J. and Klein, O. Biological control of *Orobanche* spp. with *Phytomyza orobanchia* Kalt., a review.
Klein, O. *et al.* Éfficacité de lachers supplementaires de *Phytomyza orobanchia* Kalt. [Diptera: Agromyzidae] pour la lutte biologique contre l'*Orobanche* au Maroc.
Zermane, N. Prospects for biological control of the parasitic weed *Orobanche* in Algeria.
Zaitoun, F.M.F. and Al-Aryan, M. Loss assessment and forecasting work on plant diseases: 2. prediction of *Orobanche crenata* seed yield and its reduction due to *Phytomyza orobanchia* and rot fungi.
Norambuena, H. *et al.* Introduction of *Phytomyza orobanchia* for biocontrol of *Orobanche* spp. in Chile.
Abdalla, M.M.F. and Darwish, D.S. Breeding faba bean for *Orobanche* tolerance using the concept of breeding for uniform resistance.
Nawar, A.I. *et al.* Variation among three *Orobanche crenata* accessions in their virulence in relation to growth and yield characters of the faba bean cultivars Giza 3 and Giza 429.
Saber, H. *et al.* Performance of a newly bred faba bean line (X-843) resistant to *Orobanche* in Egypt.
Garca-Torres, L. *et al.* Chemical control of *Orobanche* spp. in legumes: achievements and constraints.
Kleifeld, Y. *et al.* Selective control of *Orobanche* spp. in various crops with sulfonylurea and imidazolinone herbicides.
Kharrat, M. and Halila, M.H. Evaluation d'autres moyens de lutte contre l'*Orobanche foetida* Poir. sur *Vicia faba* L.
Zemrag, A. Lutte integrée contre l'*Orobanche* (*Orobanche crenata* Forsk.) dans la culture de fève (*Vicia faba* L.) au Maroc.
Dhanapal, G.N. and Struick, P.C. Reduction of infestation of broomrape on tobacco by metabolic inhibition using maleic hydrazide.
Chattou, Z. and El-Amrani, M. Analyse des constraintes au transfert de la technologie de lutte chimique contre l'*Orobanche*.
Loudie, N. *et al.* Développement du matériel didactique pour le contrôle de l'*Orobanche* au Maroc (Bloc d'images).
El-Idrissi, R.M. *et al.* Situation du contrôle phytosanitaire de l'*Orobanche* sur fève dans les régions du Saïs et Zaer (Maroc).
Betz, H. La vulgarisation de la lutte chimique contre l'Orobanche (*Orobanche crenata* Forsk.) sur fève (*Vicia faba* L.) avec la matière active 'Glyphosate': Quelques problèmes rencontrés.
El-Idrissi, R.M. *et al.* Développement d'un système de formation participative sur la biologie et les méthodes de lutte contre l'*Orobanche* au Maroc.

The 15th Conference of the Weed Science Society of Israel, Bet Dagan, Israel, March 1998.

Abstracts of papers presented at this meeting are included in Phytoparasitica 1999. Vol. 27. Relevant papers (pp. 109-115) are:

Eizenburg, H. *et al.* B. Effect of carrot sowing date on parasitism of *Orobanche crenata* and *O. aegyptiaca.*
Eizenburg, H. *et al.* B. Effect of temperature on host-parasite relationship in *Orobanche* spp.
Portnoy, V.H. *et al.* Diagnosis of soilborne *Orobanche* seeds.
Goldwasser, Y. *et al.* Studies of the resistance of *Vicia atropurpurea* to *Orobanche aegyptiaca*.
Shomer-Ilan, A. Proteolytic activity of germinating *Orobanche aegyptiaca* seeds controls the degrading level of its own excreted pectinase and cellulase.
Mayer, A.M. *et al.* Involvement of pectinases in plant infection by parasitic weeds.
Kleifeld, Y. *et al.* Control of *Orobanche* in tomatoes with sulfonylurea herbicides.
Kleifeld, Y. *et al.* Selective *Orobanche* control with imadazolinones herbicides in various host crops.
Amsellem, Z. *et al.* Isolation of mycoherbicidal pathogens from juvenile broomrape plants.
Cohen, B. *et al.* J. Green fluorescent protein (gGFP) as a marker in a phytopathogenic fungus, *Fusarium oxysporum*, on *Orobanche.*
Joel, D.M. *et al.* Grafting for *Orobanche* resistance.
Weinberg, T. *et al.* Effects of herbicide inhibitors of carotenoid biosynthesis on field dodder (*Cuscuta campestris*).
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Adipala, E., Tusiime, G. and Okori, P. (eds.) 1997. Proceedings of the 16th Biennial Weed Science Society Conference for Eastern Africa, Kampala, 1997. 310 pp. (Includes 8 papers on *Striga* – see item under Proceedings of Meetings above.)

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Alonso, L., Rodriguez-Ojeda, M.I., Fernndez-Escobar, J. and L[illegible]pez-Ruiz-Calero, G. 1998. Chemical control of broomrape (*Orobanche cernua* Loefl.) in sunflower (*Helianthus annuus* L.) resistant to imazethapyr herbicide. Helia 21(29): 45-53. (Imazethapyr post-emergence at 40 days completely prevented emergence of *O. cernua* on naturally resistant wild sunflower. cf. reference to Al-Khatib *et al.* in Haustorium 34!)

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Borsics, T., Bakos, ., Hunyadi, K. and Lados, M. 1999. (Investigation of genetic background of plant parasitism in the model system of alfalfa (*Medicago sativa*) and dodder (*Cuscuta trifolii*).) (in Hungarian) Nvnyvdelem 35(1): 3-8. (Some putative parasitism-specific cDNAs isolated.)

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Dey, D.K. and Pati, B.R. 1998. Record of parasitism of *Cuscuta reflexa* Roxb. on *Digitaria ciliaris* Pers. Journal of Economic and Taxonomic Botany 22: 235-236.

Dzerefos, C.M., Witkowski, E.T.F. and Shackleton, C.M. 1998. Seedling survival, post-harvest recovery and growth rates of woodrose-producing mistletoe *Eranthemum dregei* (Loranthaceae) on *Sclerocarya birrea*. South African Journal of Botany 64: 303-307. (*E. dregei* harvested for ornamental woodroses estimated to be 40-50 years old: discussion of sustainable harvesting limits in relation to (low) germination rates and ability to recover after shoot removal.)

Egley, G.H. 1999. Reflections on my career in weed seed germination research. Seed Science Research 9: 3-12. (Interesting personal review of early research on *Striga* seed germination.)

El-Ghazali, G.E.B. and Tsuji, S. 1998. Intra-specific pollen morphological variations in ten tropical species growing in Sudan. Arab Gulf Journal of Scientific Research 16(1): 97-112. (Includes description of pollen grains of *Striga hermonthica*.)

Elssser-Beile, U., Lusebrink, S., Grussenmeyer, T., Wetterauer, U. and Schultze-Seeman, W. 1998. Comparison of the effects of various clinically-applied mistletoe preparations on peripheral blood leukocytes. Arzneimittel Forschung 48: 1185-1189. (Detailed comparison of preparations from different subspecies of *Viscum album*.)

Garca, M.A. 1998. *Cuscuta rausii* (Cuscutaceae), a new species from Greece. Annales Botanici Fennici 35: 171-174. (A species with pedicillate flowers in sub-genus *Cuscuta*, occurring on Karpathos island.)

Gebisa Ejeta. 1998. *Striga* biotechnology development and technology transfer. Project PRF-213. INTSORMIL Sorghum/Millet Collaborative Research Support Programme (CRSP). 1997 Annual Report, pp. 20-24. (see next entry.)

Gebisa Ejeta. 1998. *Striga* biotechnology development and technology transfer. Project PRF-213. INTSORMIL Sorghum/Millet Collaborative Research Support Programme (CRSP). 1998 Annual Report, pp. 24-28. (Summarising laboratory studies on inheritance of low-stimulant character, effects of prolonged moist storage of seeds, interpretation of tetrazolium tests, screening techniques for other resistance mechanisms, and field testing of promising lines in Africa.)

Goldwasser, Y., Hershenhorn, J., Plakhine, D., Kleifeld, Y. and Rubin, B. 1999. Biochemical factors involved in vetch resistance to *Orobanche aegyptiaca*. Physiological and Molecular Plant Pathology 54: 87-96. (Resistance of *Vicia atropurpurea* var. Popany shown to be due to elevated induction of phenypropanoid pathway upon infection, leading to 4-fold higher phenolic and 2-fold higher lignin than in a susceptible variety.)

Guo FengGen, Li YangHan and Deng FuZhen. 1998 (Screening biological control fungi for dodders on woody hosts.) (in Chinese) Chinese Journal of Biological Control 14: 159-162. (*Fusarium semitectum, F. solani, Pestalotiopsis guepinii* and *Alternaria tenuis* isolated from *C. reflexa* were able to re-infest and kill *C. reflexa* and *C. japonica*.)

Guyot, J. and Omanda, E.N. 1998. Note on the susceptibility of six *Hevea* clones to *Phragmanthera capitata*. Plantations, Recherche, Dveloppement 5: 356-361. (Rubber clones varied in susceptibility, RRIM 600 the most tolerant. Other mistletoes occurring on rubber in Gabon include *Globimetula braunii* and *Helixanthera manii*.)

Haidar, M.A., Iskandarani, N., Sidahmed, M. and Baalbaki, R. 1999. Response of field dodder (*Cuscuta campestris*) seeds to soil solarisation and chicken manure. Crop Protection 18: 253-258. (Scarified seed at soil surface killed by 10 days solarisation but non-scarified seed required 6 weeks, reduced to 2 weeks in the presence of chicken manure.)

Haidar, M.A. and Orr, G.L. 1999. The response of *Cuscuta planiflora* seedlings to red and far-red, blue light and end-of day illuminations. Annals of Applied Biology 134: 117-120.

Hassan, R.M., Onyango, R. and Rutto, J.K. 1998. Relevance of maize research in Kenya to maize production problems perceived by farmers. In: Hassan, R.M. (ed.) Maize Technology Development and Transfer. A GIS Application for Research Planning in Kenya. CAB International, Wallingford, UK, pp. 71-88. (*Striga* the main constraint listed by farmers in the moist mid-altitude zone. Local maize variety Nyamula regarded as tolerant.)

Hassan, R.M. and Ransom, J.K. 1998. Determinants of the incidence and severity of *Striga* infestation in maize in Kenya. In: Hassan, R.M. (ed.) Maize Technology Development and Transfer. A GIS Application for Research Planning in Kenya. CAB International, Wallingford, UK, pp. 163-174. (*S. hermonthica* estimated to occur on 39% of moist mid-altitude zone, causing 50% yield loss, and to be spreading. Tobit analysis used to assess the influence of a number of variables. This failed to confirm the supposed tolerant behaviour of local varieties.)

Hassanein, E.E., Fayad, Y., Shalaby, F.F. and Kkolosy, A.S. 1998. Natural role of *Phytomyza orobanchia* Kalt., a beneficial fly against the parasitic weeds *Orobanche* spp. infesting legumes and carrot in Egypt. Annals of Agricultural Science (Cairo) 43(1): 201-206. (Infestation of *O. crenata* plants varying from 24-100%.)

Hudu, A.I. and Gworgwor, N.A. 1998. Preliminary results of evaluation of trap crops for *Striga hermonthica* (Del.) Benth. control in sorghum. International Sorghum and Millet Newsletter 39: 118-121. (In pot experiments all 6 inter-planted 'trap crops' reduced numbers and vigour of *S. hermonthica* and increased vigour of sorghum, the most effective being sesamum and bambara, least effective soyabean and okra; intermediate cotton and sunflower.)

Hussein, A.H.A., ElDeeb, M.A. and Saleib, S.R. 1998. Effect of number and timing application of glyphosate on *Orobanche* infestation and faba bean yields in middle Egypt. Arab Universities Journal of Agricultural Sciences 6: 437-444. (*O. crenata* reduced 80-90% by application of glyphosate at 34 g a.i./ha, half recommended dose, 75 days after planting, combined with NPK.)

Hussey, B.M.J., Keighery, G.J., Cousens, R.D., Dodd, J. and Lloyd, S.G. 1997. Western Weeds. A Guide to the Weeds of Western Australia. Plant Protection Society of Western Australia. 245 pp. (Includes *Cuscuta campestris, C. epithymum, Orobanche minor, Bellardia trixago, Parentucellia viscosa* and *P. latifolia.*)

Jurado-Expósito, M., Castejón-Muñoz, M. and García-Torres, L. 1999. Uptake and translocation of imazethapyr in peas as affected by parasitism of *Orobanche crenata* and herbicide application methods. Weed Research 39: 129-136. (Accumulation of radioactivity by the parasite was higher after treatment of crop seed than after pre- or post-emergence treatments.)

Kebreab, E. and Murdoch, A.J. 1999. A quantitative model for loss of primary dormancy and induction of secondary dormancy in imbibed seeds of *Orobanche* spp. Journal of Experimental Botany 50: 211-219. (Loss of primary dormancy ('conditioning') in *O. aegyptiaca, O. crenata* and *O. cernua* more rapid at higher temperatures (25-30^{o}C) but induction of secondary ('wet') dormancy generally more rapid at low temperatures (10^{o}C); the processes independent of each other. Also data on loss of viability when continuously imbibed at 30^{o}C, plus further valuable analysis and discussion.)

Kebreab, E. and Murdoch, A.J. 1999. Modelling the effects of water stress and temperature on germination rate of *Orobanche aegyptiaca* seeds. Journal of Experimental Botany 50: 655-664. (Reporting results at variance with previous assumptions and proposing a new thermal time model which accounted for 78% of variation in the data.)

Kebreab, E. and Murdoch, A.J. 1999. Effect of temperature and humidity on the longevity of *Orobanche* seeds. Weed Research 39: 199-211. (Longevity of 3 *Orobanche* spp. compared under wide range of temperature and moisture conditions. Imbibed seeds of *O. crenata* and *O. aegyptiaca* lost viability, according to tetrazolium test, after about 100 days under hot (40°C), moist (50% equilibrium RH) conditions: *O. minor* apparently dead after 50 days. Equation devised for prediction of longevity.)

Khalaf, K.A. Ali, A.M., Youssef, K.A. and Abd-Alaziz, S.A. 1999. Studies on the control of *Orobanche crenata*. I. Use of *Azotobacter* spp. and *Escherischia coli* transformants to break dormancy of *Orobanche crenata*. FABIS Newsletter 40: 25-30. (see following item.)

Khalaf, K.A., Youssef, K.A., Ali, A.M. and Abd-Alaziz, S.A. 1999. Studies on the control of *Orobanche crenata*. II. Effectiveness of *Azotobacter* spp. and *Escherischia coli* transformants in biological control of *Orobanche crenata* on *Vicia faba* under soil conditions. FABIS Newsletter 40: 31-35. (Cultures of *A. chroococcum* and *E. coli* 'transformed' by exposure to crude DNA extracts from *V. faba* shown to induce germination of *O. crenata,* not induced by untransformed cultures.)

Khalil, S. and Saxena, M.C. 1998. More faba bean, less pollution. ICARDA Caravan No 9, Summer/Autumn, 1998: 7-9. (Rising production of faba bean in Egypt attributed partly to the availability of *Orobanche*-resistant cultivar 'Giza 402'.)

Kim, S.K., Robinson, R.A., Atkinson, K., Adetimirin, V.O., Th, C. and Sall, G. (eds.) 1998. Combating Parasitic Weeds through Horizontal Resistance. Proceedings, International Workshop, Brussels, 1997. Kyungpook National University and International Corn Foundation, Republic of Korea. 66 pp. (see contents and review elsewhere.)

Kranz, B., Fugger, W.D., Kroschel, J. and Sauerborn, J. 1998. The influence of organic manure on *Striga hermonthica* (Del.) Benth. infestation in Northern Ghana. In: Towards sustainable land use. Furthering cooperation between people and institutions. Volume 1. Proceedings of the International Soil Conservation Organization, Bonn, 1996. Advances in Geoecology No. 31: 615-619. (Lower infestation by *S. hermonthica* in regularly manured fields associated with higher nutrients and microbial activity.)

Kroschel,, J., Mercer-Quarshie, H. and Sauerborn, J. (eds.) 1999. Advances in Parasitic Weed Control at On-Farm Level. Volume 1. Joint Action to Control *Striga* in Africa. GTZ/University of Hohenheim. 324 pp. (Selected papers from a Regional Workshop held in Ghana, October, 1997. See report in Haustorium 33 and list of contents elsewhere in this issue.)

Kroschel,, J., Abderabihi, M. and Betz. H. (eds.) 1999. Advances in Parasitic Weed Control at On-Farm Level. Volume 2. Joint Action to Control *Orobanche* in the WANA Region. GTZ/University of Hohenheim. 347 pp. (Selected papers from a Regional Workshop held in Morocco, April, 1998. See report in Haustorium 33 and list of contents elsewhere in this issue.)

Kubus, M. 1998. (The mistletoe *Viscum album* L. on the area of the right-side part of Szczecin.) (in Polish) Folia Universitatis Agriculturae Stetinensis, Agricultura 71: 51-62. (Survey to east of R. Odra, Poland, recorded *V. album* on 9 genera of trees in 5 families.)

Kuiper, E., Groot, A., Noordover, E.C.M., Pieterse, A.H. and Verkleij, J.A.C. 1999. Tropical grasses vary in their resistance to *Striga aspera, S. hermonthica* and their hybrids. Canadian Journal of Botany 76: 2131-2144. (Grasses resistant to one or other *Striga* sp. included *Chloris pycnothrix, Pennisetum pedicellatum, Rhynchelytrum repens, Sporobolus pyramidalis, Aristida adscensionis* and *Digitaria longiflora*. Sorghum resistant to all samples of *S. aspera* and *Pennisetum* millet susceptible to only one. Resistant spp. stimulated germination but did not allow penetration of the endodermis.)

Kurkin, K.A. 1998. Interaction of plants in meadow phytocenoses: peculiarities, types and mechanisms. Russian Review of Ecology 29: 375-379. (translated from Ekologya 29:419-423.) (Interaction of grasses with *Rhinanthus angustifolius* is discussed.)

Lados, M. Effect of temperature, pH and host plant extracts on the germination of *Cuscuta trifolii* and *C. campestris*. Acta Agronomia Hungarica 46: 317-325.

Linke, K-H. 1998. Vernacular names of *Orobanche*. In: Martin. K, Mther, J., Auffarth, A.J. (eds.) Agroecology, Plant Protection and the Human Environment: views and concepts. PLITS 16(2): 57-67. (Over 200 vernacular names of *Orobanche* are given.)

Lodoen, D. 1999. Two agroforestry innovations for richer soils and bountiful harvests. Agroforestry Today Jan-Jun '99: 22-23. (Noted that *Sesbania sesban* fallow for 12-18 months reduces seed bank of *Striga hermonthica* in W. Kenya.)

Lohan, A.J. and Wolfe, K.H. 1998. A subset of conserved tRNA genes in plastid DNA of nongreen plants. Genetics 150: 425-433. (Comparisons made between *Epifagus virginiana* and *Orobanche minor*.)

López-Granados, F. and Garca-Torres, L. 1999. Longevity of crenate broomrpae (*Orobanche crenata*) seed under soil and laboratory conditions. Weed Science 47: 161-166. (*O. crenata* stored in the field, undisturbed, showed an annual cycle of germinability and apparently lost viability almost completely after 6-9 years.)

Lundborg, G. 1998. Lifting the curse of witchweed. African Farming, November/December 1998: 33. (A review of the progress in development of cowpea varieties resistant to *Striga gesnerioides* and suggesting that they will be of value also as trap crops for *Striga* spp. attacking cereals.)

Lusson, N.A., Delavault, P.M. and Thalouarn, P.A. 1998. The *rbcL* gene from the non-photosynthetic parasite *Lathraea clandestina* is not transcribed by a plastid-encoded RNA polymerase. Current Genetics 34: 212-215.

Maass, E. 1999. A comparative study on the germination requirements of some economically important *Striga* species. PhD Thesis, University of Stellenbosch, South Africa. 178 pp. plus Addendum. (Studies on *S. hermonthica, S. asiatica* and *S. gesnerioides*, giving useful results on optimum times and temperature for conditioning and germination, incidence of secondary dormancy, inhibition by light, etc.)

Manschadi, A.M. 1999. Modelling the growth and development of faba bean (*Vicia faba* L.) infested with the parasitic weed *Orobanche crenata* Forsk. Agroecology 1: 1-128. (Doctoral thesis, the first in a new series replacing PLITS. A model, VIFOR, has been developed and a copy is provided on floppy disc attached to the volume.)

Marley, P.S., Ahmed, S.M., Shebayan, J.A.Y. and Lagoke, S.J.O. 1999. Isolation of *Fusarium oxysporum* with potential for biocontrol of the witchweed (*Striga hermonthica*) in the Nigerian savanna. Biocontrol Science and Technology 9: 159-163. (Isolate PSM-197 from *S. hermonthica* controlled the weed when used as a foliar spray or when incorporated into soil (at a massive dose).)

Marvier, M.A. 1998. Parasite impacts on host communities: plant parasitism in a California coastal prairie. Ecology 79: 2616-2623. (*Triphysaria pusilla* grew 3-6 times better on grass species, and had correspondingly more damaging effect, than on *Hypochaeris glabra* or *Lupinus nanus.* Removal increased grass component of natural community.)

Mathiasen, R.L. 1998. Comparative susceptibility of conifers to larch dwarf mistletoe in the Pacific Northwest. Forest Science 44: 559-568. (Extensive survey established the principal host of *Arceuthobium laricis* to be *Larix occidentalis;* secondary hosts to be *Tsuga mertensiana* and *Pinus contorta*; occasional hosts to be *Abies lasiocarpa* and *Pinus ponderosa*; rare hosts to be *Picea engelmannia* and *Abies grandis*, and probably also *Tsuga heterophylla*, *Abies amabilis* and *Pinus albicaulis*; uninfected were *Pseudotsuga menziesii* and *Thuja plicata*.)

Mathiasen, R.L. 1999. Comparative susceptibility of subalpine firs to Douglas-fir dwarf mistletoe. Canadian Journal of Plant Pathology 21: 45-51. (On the basis of infection of trees close to infected *Pseudotsuga menziesii*, *Abies lasiocarpa* classified as a secondary host of *Arceuthoboium douglasii* and *Abies bifolia* as an occasional host.)

Molvray, M., Kores, P.J. and Chase, M.W. 1999. Phylogenetic relationships within *Korthalsella* (Viscaceae) based on nuclear ITS and plastid *trn L-F* sequence data. American Journal of Botany 86: 249-260. (Study of 25 populations suggest the need for some revision of the genus, currently based on branching characters, but still difficulty in delimiting species.)

Morozov, I.V., Foy, C.L. and Westwood, J.H. 1998. Comparison of small broomrape (*Orobanche minor* Sm.) and Egyptian broomrape (*Orobanche aegyptiaca* Pers.) parasitization of red clover (*Trifolium pratense* L.). (Abstract) Proceedings, Southern Weed Science Society 51: 247. (Infestation of *T. pratense* by *O. minor* increased in the presence of rhizobial inoculum; no corresponding increase of *O. aegyptiaca* infestation.)

Naithani, H.B. 1998. Epiphytes/parasite. Indian Forester 124: 265-266. (*Ficus religiosa* parasitized by *Dendrophthoe falcata.*)

Nandula, V.K. and Foy, C.L. 1998. Effect of parasitization by Egyptian broomrape (*Orobanche aegyptiaca* Pers.) on aminoacid composition of carrot. (Abstract) Proceedings, Southern Weed Science Society 51: 246-247.

Neumann, U., Sall, G. and Weber, H.C. 1998. Development and structure of the haustorium of the parasite *Rhamphicarpa fistulosa* (Scrophulariaceae). Botanica Acta 111: 354-365. (A detailed study and description of the initiation and development of the xylem bridge in roots of *Pennisetum* millet.)

Nierhaus-Wunderwald, P.D. and Lawrenz, P. 1998. (A note on the biology of mistletoe.) (in French) Fort 51(2): 5-9. (A short account of the 3 forms of *Viscum album* in Switzerland.)

Nun, N.B. and Mayer, A.M. 1999. Culture of pectin methylesterase and polyphenoloxidase in *Cuscuta campestris*. Phytochemistry 50: 719-727. (Enzymes obtained from *C. campestris* in aseptic culture and partially characterised.)

Obilana, A.B. 1998. Sorghum improvement. International Sorghum and Millet Newsletter 39: 4-17. (Reviews 15 years work of SADC/ICRISAT Sorghum and Millet Improvement Program, including screening and development of *Striga*-resistant cultivars.)

Oliver, J. 1999. Dodder on bramble. BSBI News 81: 32. (*Cuscuta epithymum* observed causing damage to *Rubus ?ulmifolius*.)

Oudraogo, O., Neumann, U., Raynal-Roques, A., Sall, G., Tuquet, C. and Dembl, B. 1999. New insights concerning the ecology and the biology of *Rhamphicarpa fistulosa* (Scrophulariaceae). Weed Research 39: 159-169. (*R. fistulosa* is shown to be a facultative parasite which can mature without a host but grows much better with one. Germination does not require a host but does require light. Maize and *Pennisetum* millet can be severely damaged.)

Overfield, D., Riches, C.R., Amasoah, M., Sarkodie, O. and Baah, F. 1998. A farming systems analysis of the mistletoe problem in Ghanaian cocoa. Cocoa Growers' Bulletin No. 51, June, 1998: 42-53. (A detailed study of the serious problem of *Tapinanthus banguensis* on cocoa in Ghana, proposing the provision of long-handled pruning devices as the most viable solution.)

zge, N., Mehmet, H.N., Byk, H. and Da, S. 1998. (Investigations on the effect of imazapic on broomrape (*Orobanche* spp.) in sunflower and tobacco fields.) (in Turkish) In: Nemli, Y. and Demirkan, H.J. (eds.) Proceedings, Second Turkish Weed Science Congress, Bornova, 1997, pp. 269-278.

Park WonBong, Ju YeunJin and Han SeonKyu 1998. Isolation and characterization of -galactoside specific lectin from Korean mistletoe (*Viscum album* var. *coloratum*) with lactose-BSA-Sepharose 4B and changes of lectin conformation. Archives of Pharmacal Research 21: 429-435.

Pazy, B. 1998 Diploidization failure and apomixis in Orobanchaceae. Botanical Journal of the Linnean Society 128: 99-103. (Concludes that facultative apomixis is common in Orobanchaceae.)

Pickett, J. 1999. Pest control that helps to control weeds at the same time. BBSRC Business No. 7, April 1999: 16-17. (Some combinations of trap crops *Sorghum sudanensis* and *Pennisetum purpureum,* and intercrops *Melinis minutiflora* and *Desmodium uncinatum,* effective against stem borers in maize, also apparently reducing *Striga hermonthica*, but detail far from clear.)

Pohl, P., Antonenko, Y.N., Evtodienko, V.Y., Pohl, E., Saparov, S.M., Agapov, I.I. and Tonevitsky, A.G. 1998. Membrane fusion mediated by ricin and viscumin. Biochimica et Biophysica Acta, Biomembranes 1371(1): 11-16. (A hypothesis is proposed to explain the toxicity of ribosome-inactivating plant proteins (RIPs), including viscumin from *Viscum album,* on the basis of their vesicle-vesicle fusion activity.)

Pronier, I., Par, J., Traor, D., Vincent, C. and Stewart, R.K. 1998. A histological study of the effect of feeding by *Smicronyx* spp. (Coleoptera: Curculionidae) larvae on seed production by *Striga hermonthica* (Scrophulariaceae). Biological Control 13: 152-157. (Field study in Burkina Faso showed synchronous development of seeds and larvae.)

Pundir, Y.P.S., Dhan Singh and Hamant Singh. 1997. Three new hosts of Garhwal Himalayan mistletoes. World Weeds 4(3/4): 77-80. (Reporting *Dendrophthoe falcata* on *Cassia siane, Scurrula pulverulenta* on *Juglans regia* and *S. cordifolia* on *Holoptelea integrifolia*.)

Radomiljac, A.M., McComb, J.A. and Pate, J.S. 1999. Gas exchange and water relations of the root hemi-parasite *Santalum album* L. in association with legume and non-legume hosts. Annals of Botany 83: 215-224. (Results 'reinforce earlier conclusions that *Santalum* transpiration rate perpetuates a favourable water potential gradient from its host.')

Radomiljac, A.M., McComb, J.A. and Shea, S.R. 1998. Field establishment of *Santalum album* L. – the effect of time of introduction of a pot host (*Alternanthera nana* R.Br.). Forest Ecology and Management 111(2/3): 107-118. (Establishment of *S. album* on *A. nana* in the nursery substantially improved growth and survival of *S. album* when subsequently planted out in the field.)

Rao, M.R. 1998. Prospects of agroforestry for *Striga* management. In: Edwards-Jones, G. and Sinclair, F.L.J. (eds.) Special issue on Pests, Diseases and Weeds of Agroforestry Systems. Agroforestry Forum 9(2): 22-27. (Agroforestry techniques useful in reducing *Striga* include short-duration fallows and biomass transfer of tree foliage.)

Raynal-Roques, A. and Par, J. 1998. (The biodiversity of phanerogamous parasities: their place in the classification system.) (in French) Adansonia 20: 313-322. (Discusses the difference between 'direct parasitism' occurring mainly in the more advanced plant families, and the less common 'mycoparasitism' involving an endotropic fungus, which appears to be a more ancient phenomenon.)

Richael,, C. and Gilchrist, D. 1999. The hypersensitive response: a case of hold or fold? Physiological and Molecular Plant Pathology 55: 5-12. (No specific mention of parasitic plants, but useful commentary: preceding editorial, pp. 1-3, also relevant.)

Robert, S., Simier, P. and Fer, A. 1999. Purification and characterisation of mannose 6-phosphate reductase, a potential target for the control of *Striga hermonthica* and *Orobanche ramosa*. Australian Journal of Plant Physiology 26: 233-237. (The enzyme, important in both spp. in production of mannitol, shown to differ in only very small detail – encouraging if one were to develop an inhibitor aimed at this parasite-specific target.)

Rothe, K., Diettrich, B., Rahfeld, B. and Luckner, M. 1999. Uptake of phloem-specific cardenolides by *Cuscuta* spp. growing on *Digitalis lanata* and *Digitalis purpurea*. Phytochemistry 51: 357-361. (Cardenolides in *C. reflexa*, *C. platyloba* and *C. europaea* are apparently derived from those in the host by deglucosylation.)

Rubiales, D., Sillero, J.C. and Cubero, J.I. 1998. Broomrape (*Orobanche crenata* Forsk.) resistance in peas (*Pisum sativum* L.). In: 3rd European Conference on Grain Legumes. Opportunities for high quality, healthy and added-value crops to meet European demands, Valladolid, Spain, 1998, p. 238. (Over 700 lines of *P. sativum* and wild relatives screened, of which about 50 showed low infection.)

Salem, I.E.M. 1998. Resistance of faba bean to the African bean aphid *Aphis craccivora* Koch. (Hom.: Aphididae) caused by parasitic broomrape *Orobanche crenata*. Mededelingen-Facukteit Lanbouwkundige en Toegpaste Biologische Wetenschappen, Universiteit Gent 63(2a): 329-332. (Resistance of parasitised faba bean plants to aphids attributed to the development of alkaloids.)

Sandri, G., Sandri, A. and Martini, G. 1998. (Protection of tobacco against *Orobanche*.) (in Italian) Informatore Agrario 54(26): 74-75. (Glyphosate in 2-4 doses totalling 400 g/ha controlled *O. ramosa* without reducing crop yield.)

Sassa, T., Ooi, T., Nukina, M., Ikeda, M. and Kato, N. 1998. Structural confirmation of cotylenin A, a novel fusicoccane-diterpene glycoside with potent plant growth-regulating activity, from *Cladosporium* fungus sp. 501-7W. Bioscience, Biotechnology and Biochemistry 62: 1815-1818. (Cotylenin A referred to as a 'potent plant growth stimulant with known seed germination stimulating activity towards parasitic weeds'.)

Schaller, G., Urech, K., Grazi, G. and Giannattasio, M. 1998 Viscotoxin composition of the three European subspecies of *Viscum album*. Planta Medica 64: 677-678. (Viscotoxin composition differed between the subspecies *album, abietis* and *austriacum*.)

Shamoun, S.F. 1998. Development of biological control strategy for management of dwarf mistletoes. In: Sturrock, R. (compiler) Proceedings of the 45th Western International Forest Disease Work Conference, Prince George, Canada, 1997, pp. 36-42. (Describing the collection of a wide range of fungi from *Arceuthobium tsugense*, and tests with 2 of these – *Colletotrichum gloeosporioides* and *Nectria neomacrospora* – which are considered to have practical potential for treating established infestations on trees bordering new plantings.)

Shimi, P. 1998. Hope for effective biological control of *Cuscuta monogyna* in Iran. Near East Working Group for Improved Weed Management Newsletter Issue 18: 16-17. (Unidentified gram-negative bacterium severely damaging *C. monogyna* in a grape and pomegranate orchard near Tehran.)

Shindrova, P., Ivanov, P. and Nikolova, V. 1998. Effect of broomrape (*Orobanche cumana* Wallr.) intensity of attack on some morphological and biochemical indices of sunflower (*Helianthus annuus* L.). Helia 21(29): 55-62. (Recording reductions in height, head diameter, seed weight, and oil and protein content.)

Simmons, E.G. 1998. *Alternaria* themes and variations (224-225). Mycotaxon 68: 417-427. (A new species *A. destruens* is described from *Cuscuta gronovii*.)

Soler, M.H., Stoeva, S. and Voelter, W. 1998. Complete amino acid sequence of the B chain of mistletoe (*Viscum album*) lectin I. Biochemical and Biophysical Research Communications 246: 596-601.

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Modest support for the future production and distribution of Haustorium now appear to be secure, so we look forward to maintaining our twice-yearly publication. News items for Haustorium 37 will thus be welcome.

HAUSTORIUM BY EMAIL AND THE WEB

Haustorium still has no significant source of funding and we need to reduce costs as much as possible. The great bulk of our costs are for mailing. Many readers are already helping us by receiving Haustorium by Email. We believe many others could do so but we do not have their Email addresses. If you are one of those, do please let Chris Parker know (Email address on the last page). If you cannot receive Email, or for any reason wish strongly to go on receiving hard copy, you will continue to receive by airmail.

Thanks to arrangement with the Institute of Arable Crops Research, Long Ashton Research Station, Bristol, UK, Haustorium 36 will also be available on the web site: www.lars.bbsrc.ac.uk/cropenv/haust.htm

PARASITIC WEED PROJECTS FUNDED BY DFID/CPP[1]

The control of *Striga* on maize and sorghum: nitrogen *x* crop genotype interactions

Striga hermonthica and *S. asiatica* are important weeds of cereals in semi-arid tropical farming systems. There is an urgent need to develop control strategies consistent with the agronomic and socio-economic environments that prevail in the areas where the parasites pose major threats to food production. The inverse relationship between the incidence of *Striga* infection and soil fertility has resulted in the development of control strategies that aim to improve soil fertility through a number of approaches. In this DFID-funded project we have examined the role of nitrogen in modifying the interaction between parasite (*S. hermonthica*

[1] DFID/CPP – UK Department for International Development/Crop Protection Programme.

and *S. asiatica*) and host (maize and sorghum). We have taken a laboratory- and field-based approach, the latter using both on-station and on-farm studies, in Tanzania and Kenya. The project has shown that the success of nitrogen fertilisers in both reducing the density of emerged *Striga* plants and in improving grain yield has been equivocal, varying greatly both geographically (e.g. between countries) and spatially (between cropping seasons) and also as a function of crop species (sorghum and maize) and genotype. Thus, we believe that there is not a universal relationship between the minimum amount of nitrogen, its form and time of application, that is required to elicit economic benefits. For this reason, it is essential to understand how nitrogen alters the interaction between *Striga* and its cereal hosts, so that it can be used more efficiently with regard to interactions between genotype and environment.

In a previous DFID-funded project it was demonstrated that nitrogen depresses the germination and subsequent attachment of *Striga* to the host root system. It is less clear how nitrogen exerts its effects after parasite attachment but recent work on the current project shows that these may arise through disturbance of host nitrogen metabolism by the parasite. Infected cereals maintain very high levels of free amino acids in their leaves and sap, particularly those amino acids that are commonly transported. How the parasite causes this change is unclear, but one consequence for the host is that rates of amino acid incorporation into proteins are lower than those for control plants, thus potentially depressing growth and production of photosynthetic machinery.

Our earlier studies showed that *Striga* also lowers the capacity of infected cereals to fix carbon, through both direct effects on photosynthesis and indirect effects on allometry and plant architecture. *Striga* causes stomatal closure, thus restricting the influx of carbon dioxide to the mesophyll cells, and thereby lowering rates of photosynthesis. Infected plants also have lower leaf surface areas, again resulting in less carbon fixation, coupled with greater self-shading in the canopy that results from the failure of internodes to elongate. Recent field studies in Tanga, Tanzania, on maize cultivars, in collaboration with Dr Mbwaga (Agricultural Research Institute, Ilonga), suggest that the parasite also predisposes the cereal to photoinhibition during periods of high irradiance. The techniques used here (chlorophyll fluorescence) provide a rapid and early screen for the presence of *Striga* long prior to emergence of the parasite above-ground and allow some assessement of the likely impact of the parasite on crop yield.

The differential sensitivity of species and genotypes to infection may result partially from the extent to which carbon and nitrogen metabolism in the host are perturbed. There is certainly some evidence to support this assertion, for example, in on-station trials at Kibos, Kenya (in collaboration with KARI and CIMMYT), the sorghum variety 'Ochuti' appears to show some tolerance that is correlated with an ability to maintain higher rates of canopy carbon fixation when infected with *S. hermonthica*. Similarly, we have obtained promising results with the Tanzanian maize cultivar Staha, which yielded well in the presence of *Striga* and also showed positive yield responses to low additions of N (25 kg ha^{-1} urea). Understanding the mechanisms underlying the impact of *Striga* on its host and how these interact with components of the abiotic environment is important if control measures are to be applied in a directed way.

In contrast with associations between crops and *Orobanche* and *Cuscuta*, we have shown that the demands made by *Striga* for resources do not account for 'lost' productivity. This can be seen very clearly in our studies of the impact of *Striga* density on host response, where a very large reduction in density is required before any significant impact on the host is observed. This is one of our major findings, since it shows that while mechanisms that lower numbers of emerged *Striga* may be effective in reducing the density of seeds in the soil seed bank in the medium to long term, they are unlikely to have any short term impact on crop yield. It seems that the metabolic perturbations caused by the parasite outweigh the direct loss of resources to the parasite.

A second source of variation observed between species and genotypes in response to *Striga* arises from differences in attachment time of the parasite to the host root system. We have demonstrated unequivocally during this project that later attachment greatly alleviates the impact of the parasite on the host (Gurney *et al*. 1999). Further, we suspect it is not just the time of attachment, *per se*, that is important but the proportion of the lifecycle that the cereal has completed prior to attachment. Thus, the combination of delayed attachment and the use early cropping varieties may hold promise as part of an integrated control programme.

Molecular techniques may allow us to both understand further the mechanisms through which *Striga* perturbs host growth and also to identify resistant genotypes. In collaboration with Dr Grimanelli and his colleagues at CIMMYT, we have conducted laboratory screening and physiological studies on crosses of maize with wild relatives that show resistance to *Striga hermonthica* under field conditions in Kenya. We hope to continue this collaboration to study resistance in transposon tagged populations of maize that CIMMYT have been screening in Kenya. These lines offer the possibility of understanding the mechanistic basis of resistance to *Striga* in maize and this information may also allow development of resistant genotypes in other cereals.

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Mistletoes on cocoa in Ghana

Mistletoes, (Loranthaceae) are common parasites of trees in the humid forest zone of West Africa. While it has been recognised for many years that a number of species are widespread in cocoa in Ghana, little recent information has been available about the problem or the extent to which farmers attempt any control. A DFID-funded evaluation, using rapid rural appraisal techniques including farmer focus group discussions, was therefore undertaken in 19 villages in cocoa growing areas of Eastern and Ashanti Regions during 1997 in collaboration with the Cocoa Research Institute of Ghana.

Tapinanthus bangwensis was found to be an almost ubiquitous component of the cocoa canopy on all but the most recently planted farms in all areas studied. It is also common in forest shade trees of cocoa and in associated species of the tree crop system including avocardo, citrus and kola (*Cola nitida*). In the areas we visited cocoa remains the most important source of household cash income despite a decline in productivity since the 1960s. Growers ranked mistletoe, weeds, the capsid insects and black pod disease as the most important production constraints. Mistletoe is perceived in most villages as the number one problem which has been on the increase during the past 20 years. This has been principally due to the decline in the availability of serviceable pruners (last sold in 1991), ageing tree stocks (mistletoe is difficult to remove from tall trees) and an inflexible land tenure system which provided few opportunities for younger growers to control cocoa farms. Share croppers have had little incentive to maintain cocoa farms to their full potential due to poor returns from the widespread system of share-cropping and poor producer prices. Mistletoe removal with a cutlass, while using a ladder or climbing the infested tree, is the only alternative to using a pruner, but is perceived to be a dangerous, unpleasant task. In consequence labour hired for this purpose attracts a significant premium. Growers are well aware of the link between mistletoe infestation and the long term decline in viability of their farms. The study therefore identified a widespread demand for pruners. Future work needs to examine the re-establishment of the local manufacture of an inexpensive, robust and easily maintained pruner. The likely cost of a new pruner is relatively high compared to current returns from cocoa production and would probably be beyond the means of many growers, particularly as there are few sources of affordable credit available for cocoa farming in Ghana. Some enthusiasm was however found among growers for group participation in pruner ownership.

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Potential resistance to *Striga* in upland rice

As a result of previous DFID-funded glasshouse studies in UK, and field trials completed in Cote d'Ivoire, we have previously reported on potential sources of resistance to *Striga aspera* and *S. hermonthica* in both Asian (*Oryza sativa*) and African (*O. glaberrima*) rice germplasm (see Johnson *et al.,* 1997. Crop Protection 16: 153-157). In comparison to the complete resistance seen in pots, a number of *O. glaberrima* accessions and two *O. sativa* lines were found to offer partial resistance in the field. Interestingly the *O. glaberrima* lines not only supported lower numbers of emerged parasite stems than the *O. sativa* susceptible check, a widely grown cultivator in Cote d'Ivoire, but their growth was also less affected by *Striga* suggesting they may possess a high level of tolerance to *Striga.* A breeding programme at WARDA has sought to combine some of the beneficial characteristics of *O. glaberrima* with the higher yielding *O. sativa*. However, in pot screening the observed *S. aspera* and *S. hermonthica* resistance of *O. glaberrima* line CG14 was not expressed in the F7 generation of progeny from the cross with a susceptible *O. sativa.* In order to increase the fertility of these inter-specific crosses it is necessary to backcross the F1 generation twice to the *O. sativa* parent, a process in which the resistance to *Striga* appears to be lost.

Subsequently crosses were made between a range of cultivars or breeding lines and the resistant *O. sativa* lines IR47255-B-B-5-4 and IR49255-B-B-5-2 as male parents, with more promising results. In screening of 23 F1 progenies the susceptible Iguape Cateto supported a mean of 15.3 emerged *S. aspera* and 4.3 *S. hermonthica* per plant. No more than one parasite stem of either species was observed per plant of the resistant parents; IR49255-B-B-5-2 remained free of *S. aspera* until the trial was terminated 120 days after sowing. Four progenies, all derived from crosses in which IR49255-B-B-5-2 was used as the male parent were not attacked by either species. On the other hand, progeny of the corresponding crosses in which IR47255-B-B-5-4 was used as male parent proved susceptible to both *S. aspera* and *S. hermonthica*. The selected progenies now need to be evaluated in the field in order to seek confirmation that IR49255-B-B-5-2 is a useful source of resistance for use in future breeding programmes.

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Alectra vogelii resistance in common bean and cowpea in Malawi

A. vogelli is a widespread problem on a number of leguminous crops in Malawi including common bean (*Phaseolus vulgaris)* and cowpea. Using pot trials, undertaken in UK, variability in susceptibility to a sample of the parasite collected from the the Blantyre Shire highlands has been identified in beans. Mhkalira, a line recently introduced to Malawi from the Mesoamerican gene pool, supported on average the emergence of less than one *A. vogelii* stem per host plant compared to more than 20 on the most susceptible local cultivars. Field trials are now needed to examine the significance of this variation in bean susceptibility in terms of grain yield.

Cowpea line B359, a land race originating from Botswana was confirmed to be resistant to *A. vogelii* from Malawi, supporting no development of the parasite. This is an indeterminate, long duration line but would provide a useful source of resistance for incorporating into early maturing cultivars in future breeding programmes. In this study B311, which has been used as a source of resistance to both *Striga gesnerioides* and *A. vogelii* in improved cultivars released in west Africa, did support the emergence of *Alectra*. A mean of less than four stems emerged per B311 host compared to more than 60 on three local lines collected in Malawi. Emergence of parasite stems on B311 was however 10 to 15 days later than on the local materials.

Parasite seed germination assays indicated that the resistance identified in Mhkalira and B359 is not related to low germination stimulant production by the host plants compared to susceptible lines. This study also indicated that sun hemp (*Crotalaria ochrelucra*) and fish bean (*Tephrosia vogelii)* are potent sources of A*lectra* germination stimulant. There is considerable interest in Malawi, and other A*lectra* infested areas of Eastern and Southern Africa, in promoting these legume species as green manures for improving soil fertility. Our pot trials have shown that they are not hosts of the parasite and so would act as trap crops.

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Striga workshop, Dar-es-Salaam, Tanzania, September 1999

The DFID-funded *Striga* research project Integrated Control of *Striga* in Tanzania described by Riches *et al.* in Haustorium 35 completed three years of activity in March 1999 and a 2-day stakeholder workshop also funded by DFID was held in September. It was attended by 25 participants variously involved in both the Tanzania project and that at Sheffield (see article above by Press *et al*.).

Objectives were given by Dr A.M. Mbwaga, the organiser of the workshop as:

a) to review the status of *Striga* problems in small-holder farming in Tanzania
b) to present approaches to the solution of these problems
c) to present the research findings to date
d) to discuss strategies for future work.

The Workshop confirmed that there is a serious, often severe, and generally increasing problem from *Striga* species on sorghum in at least four of the seven Zones of Tanzania, with somewhat less extensive problems in maize and a locally acute problem in rice in one district. Results presented suggest that the introduction of selected new varieties of sorghum would have the greatest impact, with or without other inputs such as farmyard manure. However, there is a particular need for problems of seed production to be addressed, while a further selection of new varieties continues to be critically evaluated for their ability to yield well under *Striga* attack, with the help of physiological techniques developed by the Sheffield project. Other work which could usefully be continued or initiated includes studies on the optimum methods for use of manure, inter-cropping, relay inter-planting with green manures, seed priming, etc, while socio-economic techniques continue to be employed to increase farmers' awareness and understanding of *Striga* biology, and ensure that any new techniques are fully acceptable to them. There was strong pressure from participants for the project to introduce parallel work on *Striga* in maize, while continuing with work in rice. In maize there are promising leads to pursue in terms of apparent varietal tolerance, while in both maize and rice, urea appears to provide economic response.

The workshop papers are due to be prepared as a Proceedings within a few months. Meanwhile, work is in progress to develop new phases of both projects.

Chris Parker.

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ANALYSIS OF A NEW *OROBANCHE* SPECIES FROM TASMANIA

An unknown *Orobanche* species was found in Tasmania, Australia, two years ago heavily infecting a commercial carrot field. The infested crop was approximately 4 ha, with about 40% of all carrots infected. Flowering commenced within two weeks of emergence. Subsequent inspections revealed further *Orobanche* plants growing on pyrethrum in the neighborhood that may have been present in the area for several years escaping detection. Due to limited experience with *Orobanche* in Australia identification of the specimens was difficult.

Species identification is very difficult from morphological features, especially when the species related to *O. minor* (subsection minores) are concerned. We therefore analyzed the DNA extracted from the Tasmanian *Orobanche* (sample 1), and compared it with *Orobanche* samples from other sites in Tasmania (samples 2-4), and with samples of known species from South Australia (samples 5-6) as well as with samples from France, Israel, and the U.S.

Two questions were addressed: (a) species identification, based on the plastid genome, and (b) similarity to broomrape populations of known species, based on the nuclear genome.

Analysis of the rbcL gene and rbcL-atpB region of the plastid genome revealed that the nucleotide sequence of samples 1,2 and 3 was identical to that of *O. minor* collected in France, whereas the sequences of samples 4 and 5 were identical to those known for *O. loricata*. Therefore, molecular results based on plastid DNA strongly suggest two possibilities: either that all the Australian samples 1-3 and 4-5 belong respectively to the European species *O. minor* and *O. loricata*. One should, however, appreciate that the markers that were developed for the French populations of the above species have not previously been studied for O*robanche* elsewhere. Precise identification of the Australian samples will be possible only after a thorough study of all *O. minor* group throughout the world.

For the analysis of nuclear genome we used two methods, i.e. RAPD and ISSR. With RAPD we found more than 270 polymorphic bands, which gave interesting results as follows:

Each one of the samples 1, 5 and 6, and of *O. minor* from the U.S were very different from the samples of all known species in France and Israel. The Tasmanian samples 2,3 and 4 were found to be slightly closer, in terms of electrophoretic band similarity, to the French subsection minores and to *O. cernua* and *O. cumana* from Israel. ISSR analysis of these samples leads to similar result, i.e. that Australian samples differ largely from Mediterranean samples belonging to species of subsection minores.

Based on these results we can conclude that the Tasmanian *Orobanche* samples do not directly originate from any known weedy *Orobanche* population in the Mediterranean and European area. Although the molecular results do not allow precise species identification, they do mean that the new Tasmanian population on carrot surely does not originate from the other known populations in Tasmania and South Australia that were examined in this study.

A more detailed study of *Orobanche* is required in order to understand the inter-relations between the broomrapes in Australia and the known broomrapes in Euroasia.

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WORKSHOP ON BREEDING FOR STRIGA RESISTANCE IN CEREALS

A workshop on breeding for *Striga* resistance in cereals was held at the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria, from 18 to 20 August 1999. The meeting was organized by IITA, ICRISAT, the University of Hohenheim, Eberhard-Karls University of Tübingen, and the Rockefeller Foundation. Funding was provided by the Bundesministerium für wirtschaftliche Zusammenarbeit (BMZ), Germany, The Rockefeller Foundation, and the International Fund for Agricultural Development (IFAD). The 56 participants comprised 26 cereal breeders or weed specialists from 17 African countries, and 30 scientists or representatives from IITTA, ICRISAT, CIMMYT, WARDA, PASCON, CIRAD (France), John Innes Centre, UK, Natural Resources Institute , UK (NRI), ProAgro Seed Company, the Rockefeller Foundation, Cornell University, University of Hohenheim, Purdue University, University of Sheffield, University of Tübingen, and the Weizmann Institute of Science.

Objectives of the workshop were two-fold, 1) to summarise the "state of the art" of cereal breeding for *Striga* resistance (including biotechnological approaches) and 2) to develop with African scientists future strategies for *Striga* control in sorghum, maize, millet and rice, emphasizing host plant resistance. The workshop included presentations related to: physiology of the host/parasite interaction; resistance mechanisms; inheritance of resistance; new sources of resistance in wild relatives of sorghum; actual breeding programs for *Striga* resistance in maize, sorghum, millet, and rice; molecular markers for *Striga* resistance; identification of *Striga* tolerance genes in maize using transposable elements; other biotechnological approaches for *Striga* control; diversity of *Striga* populations and consequences for resistance breeding; and breeding towards integrated *Striga* control. Since so many presentations dealt with molecular markers, the workshop was preceded by a two-day training course on the application of molecular markers in plant breeding programs (16-17 August). Participants visited the IITA screenhouses at Ibadan, and several field trials (on-station and on-farm) at Mokwa. On the final day, working groups discussed future strategies in *Striga* research and developed the following recommendations.

Strategies essential for efficient **conventional breeding** for *Striga* resistance include:
- careful definition of target environments;
- determination of the most important selection traits for each target environment;
- identification of adapted parents for use in a back-cross program;
- training of NARS scientists to use both laboratory and field screening methods;
- transfer of available resistance into farmer-selected varieties, through combined use of laboratory (e.g., agar-gel and paper-roll assay) and field screening methodologies;
- combining different resistance mechanisms **and** tolerance to *Striga* in individual varieties;
- networking and exchange of useful plant genotypes.

Population improvement through development of a random-mating population combining several different resistance genes could be very useful, but would have to be carried out on a large scale by a dedicated, able breeder.

Targeted searches for new resistance sources in pearl millet, sorghum, and their **wild relatives** are important using recently perfected field and laboratory screening methodologies.

Marker technology and Quantitative Trait Locus(QTL) analyses were considered to be potentially very useful. Verification of results is essential, as preliminary results suggest complex QTL patterns and low repeatability of individual QTL across environments and different mapping population samples.

Future research efforts should continue to
- develop universal marker systems, especially allele-specific markers;
- develop isogenic lines to quantify QTL effects for *Striga* resistance;
- create an integrated, PCR-based sorghum reference map (begin by integrating *Striga* resistance mapping populations);
- identify adapted sorghum parents for use in marker-assisted selection programs;
- determine whether the low-stimulant genes in SRN 39 and IS 9830 are identical;
- develop a sorghum data base (ICRISAT leadership).

Once resistance genes have been identified, efforts should be made to exploit from **synteny** (overlapping genetic maps) in sorghum, maize, rice and millet. Transfer of resistance genes from cowpea into cereals was not considered a priority.

The continued **search for resistance mechanisms** and their genetic basis, should always run parallel to the marker approach, with a final aim of identifying allele-specific markers. Enhanced knowledge of the physiology of the host/parasite interaction is urgently required to:
- examine interactions between host root exudates and exudates from the *Striga* radicle;
- determine how *Striga* induces its strong sink reaction;
- study how early host plant flowering minimises the "bewitching" effect of *Striga* on its host;
- clarify the role of ABA;
- study mechanisms of antibiosis.

An unconventional approach to *Striga* control would **reduce *Striga* vigour by genetic engineering**. When enzymes are identified which reduce the vigour of *Striga*, use deleterious transposons (DTs) to reduce *Striga* vigour. (First model studies are underway at the Weizmann Institute of Science). (see separate item below 'TAC-TICS for *Striga* control' on this topic, Editors)

The development of cultivars with target site **resistance to acetolactate synthase (ALS) inhibiting herbicides** was considered to be (probably) appropriate for maize in Africa, and pearl millet and sorghum in Asia (i.e., in regions where the crops do not have feral or weedy relatives). It seems less appropriate for rice in Asia and Africa; pearl millet in West Africa, and sorghum in Africa (i.e., in crop/region combinations where feral or weedy relatives are present).

Transposon-based mutation breeding may allow researchers to:
- find resistant phenotypes that previously did not exist, due to transposon insertion into relevant genes;
- tag genes that are involved in host response to *Striga* (forward genetics);
- isolate and clone the gene;
- use the cloned gene in both the host and other host plant species.

Future research related to ***Striga* variability** should:
- study inheritance of isoenzyme and DNA markers; analyze linkage between markers;
- perform cytological studies on *Striga* chromosome number and degree of polyploidy;
- develop 10 to 15 micro-satellites for *Striga* diversity studies;
- estimate polymorphism in *Striga hermonthica* populations that are naturally adapted to different hosts; test more populations from wide geographic sites across Africa, and from a variety of different resistant and susceptible hosts; extend host range tests; standardize sampling procedures; include farmer consultation on field history;
- create genetic stocks of various *Striga* strains by developing full-sib families;
- develop a set of host plant differential lines;
- elucidate mechanisms and inheritance of *Striga* virulence; focus on: *Striga* sensitivity to germination stimulants;

Striga penetration into host roots, role of exoenzymes.

Inter-Center collaboration is highly encouraged in this respect.
With respect to **integrated *Striga* control**, methodologies immediately available for technology transfer/extension services include:

- Maize/legume (groundnut, soybean, cowpea) intercropping plus weeding and fertilization: 100 – 120 kg N, 50 – 60 kg P_2O_5 - for moist savannas;
- sorghum/cowpea intercropping: two rows sorghum – four rows cowpea, strip planting;
- rotations of cereals and legumes;
- tied ridges for the Sahel.

Further research on integrated *Striga* control should focus on:

- location-specific laboratory screening of cultivars of non-host species for their ability to germinate *Striga* (cowpea, soybean, groundnut, cotton, pigeon pea, P*haseolus* beans, cassava, sorghum, millet, maize, S*tylosanthes*, sesame);
- participatory, on-farm development of individual, integrated *Striga* control packages, adapted to each target area; especially consider rotation or intercropping of sorghum/maize with legumes (soybean, cowpea, ground nut, P*haseolus* bean);
- impact studies.

Individuals/organizations have been identified to carry forward on most of the above topics. Proceedings of the workshop will be published by Margraf Verlag in early 2000.

Bettina Haussmann, University of Hohenheim, D-70593 Stuttgart, Germany; Dale Hess, ICRISAT, BP 320, Bamako, Mali; Miki Koyama, John Innes Centre, Norwich NR4 7UH, UK; Joe DeVries, Rockefeller Foundation, P.O. Box 47543, Nairobi, Kenya; J.G. Kling and A. Melake-Berhan, IITA, Ibadan, Nigeria; and H.H. Geiger, University of Hohenheim.

TAC-TICS FOR *STRIGA* CONTROL

The following is a verbatim extract from the paper presented by Dr Jonny Gressel at the recent BCPC Weeds Conference at Brighton (see Gressel, 1999 in Literature). It is reproduced by kind permission of Dr Gressel and of the British Crop Protection Council.

'*Striga hermonthica*, the major *Striga* spp. attacking maize is not a wild species; it is a truly co-domesticated man-made contrivance, just like maize. In its present evolutionary state it is not more competent than maize to exist in the wild as it can only grow on crops; it has few wild hosts. There is ample evidence that it evolved recently from *S. aspera*, a parasite of many wild species, but is not a pernicious weed. It would be useful to reverse evolution i.e. to force *Striga* back to being an innocuous wild plant. We propose that it is possible, using genetic engineering to debilitate *Striga* (Gressel and Levy, 1999). If this solution is successful, it will integrate with and facilitate other successful control mechanisms, leading to more durable control. It is proposed to disperse genes that will be deleterious when turned on; genes that mimic herbicide action; that inhibit plant growth; that render super-susceptibility to herbicides; that participate in host-recognition; or modulate hormone levels. The seminal concept by Pfeiffer and Grigliatti (1995) proposed a means for controlling pests withTAC-TICs; 'Transposons with Armed Cassettes for Targeted Insect Control'. They suggested transforming insects with a gene which, if activatred by a chemically-induced promoter, would debilitate the insect. We termed these assisted-suicide genes as '*kev*' (Kevorkian) genes. They postulated that releasing a few transgenic pests would be sufficient if the transgenes are coupled in a multicopy transposon. They suggested that the farmers use their normal methods of pest control during the period of transposon transmission throughout the population, and then chemically activate the promoter. The concept modelled for insects seems to be appealing for *Striga* if the proper *kev* genes and/or promoters can be found; the transposons available; the weeds can be easily engineered; and most importantly, id safety considerations can be met. *S. hermonthica* is singularly appropriate for this technology as it must be cross pollinated.

The Ac/Ds transposon family, originally found in maize, has been shown to be active in all heterologous plant systems where it has been introduced (see Kunze, 1996). Ac is preferentially transposed during DNA replication, increasing its copy number while it transposes. The dominant *kev* genes can be introduced into a transposon cassette in high copy number and transformed into *Striga* to generate debilitated weeds after the chemical induction. These *kev* parents can be sown together with maize. There are many possible *kev* genes available that, when partially inhibited, cause the accumulation of lethal metabolites in plants, and are targets for known herbicides. Antsensing or overexpressively co-suppressing the gene encoding the enzyme can kill the plant when turned on (Hfgen *et al*., 1995).

Chemically-induced genes that cause pollen sterility a generation hence have been proposed for protecting crop varieties (the 'terminator' genes of the popular press), could be considered as *kev* genes. When disseminated by transposons, they would prevent seed set but *Striga* would damage the crop. This approach could be used in conjunction with a herbicide-resistant maize; to eliminate late season *Striga* escapes that cause little damage as well as any herbicide-resistant *Striga* that evolves. The competition among *Striga* plants is quite fierce, both to fertilize and during the self-thinning' period when seedlings establish. Individuals bearing genes that are essentially unfit would be rapidly eliminated from the population.

Known antiweediness genes that limit competitiveness between weed and weed, and weed and crop are described in Gressel (1999) and gave been proposed for use in tandem with useful genes for rice (see below). Such genes under chemically induced promoters could be used as part of *kev* constructs.

A wide variety of promoters are available for chemically inducing the expression of genes in plants (Gatz and Lenk, 1998). No good chemical inducers of plants genes are known as yet that would fulfill all the requirements of the original TAC-TIC concept for *Striga*. An applied *kev* inducer would have to be translocated through the plant from the foliage to the *Striga* attached to the roots. The best known inducers are not translocated, or would affect the crop.'

References:

Gatz, C and Lenk, I. 1998. Trends in Plant Science 3: 352-358.

Gressel, J. 1999. Trends in Biotechnology 17: 361-366.

Gressel, J. and Levy, A. 2000. In: Breeding for *Striga* Resistance in Cereals. Margraf Verlag (in press).

Hfgen,, R., Laber, B., Schuttke, I., Streber, W. and Pohlenz, H.D. 1995. Plant Physiology 107: 469-477.

Kunze, R. 1996. In: Saedler, H. and Gierl, A. (eds.) Transposable elements. Springer, Berlin, pp. 161-194.

Pfeiffer, T.A. and Grigliatti, T.A. 1996. Journal of Invertebrate pathology 67: 109-119.

GOLDEN BOUGH

Roger Polhill writes that he has now retired and will not be attempting to resume publication of the mistletoe newsletter 'Golden Bough'. The last issue was No. 12. Haustorium will continue to cover mistletoes along with other parasitic plants, and literature and news items on them are always welcome.

SEVENTH INTERNATIONAL PARASITIC WEED SYMPOSIUM

Arrangements are continuing for the Seventh International Parasitic Weed Symposium to be held in Nantes, France, 3-8 June, 2001. A first circular has been sent to all recipients of Haustorium. If you know of others who would be interested, or if there are any comments or suggestions on the format of this event please contact Haustorium editors, or Patrick Thalouarn, Laboratoire de Cytopathologie Vegetale, University de Nantes, 2, Rue de la Houssinière, BP 92208, F44322 Nantes Cedex 3 France. Email patrick.thalouarn@svt.univ-nantes.fr

THE INTERNATIONAL PARASITIC PLANT SOCIETY

We thank all colleagues who sent us encouraging messages, and who already expressed their wish to become members of the International Parasitic Plant Society. In fact the list of interested people now includes people from more than a dozen different countries, including Tanzania, Bulgaria, India, Japan, USA, UK, Germany, France, Israel, China, Spain, Australia and the Netherlands. The list is gradually growing, with agronomists, botanists, chemists, weed experts, molecular biologists and taxonomists united to try and extend the activities that have so nicely been carried out by the informal Parasitic Seed Plant Research Group for so many years. The ad-hoc executive committee of the Society includes Andre Fer as president, Jos Verkleij as treasurer, and myself as secretary. Additional members of the executive committee are Jim Westwood and Dana Berner. The Society will be formally registered before the International Symposium on

Parasitic Plants in Nantes, when a new executive committee will be elected.

At the moment it is highly important for us to have an idea who is interested in becoming a member of the new Society. We therefore kindly ask those of you who have not responded yet, to send us, with no obligation, your name, address, Email, and fields of interest. **A cut-out form is printed at the end of this newsletter**. We thank you in advance for your cooperation and help. Please bring our request also to other colleagues who may be interested.

Looking forward to fruitful collaboration in the new Society.

Danny Joel, Ad-hoc Secretary, International Parasitic Plant Society; Dept. of Weed Research, Newe-Ya'ar Research Center, P.O. Box 1021, Ramat-Yishay 30095, Israel. (**N.B.** The editors apologise that Danny Joel's address was given incorrectly in Haustorium 35.)

WEBSITES

For information on the 7th International Parasitic Weed Symposium at Nantes, 2001 see:
http://www.sciences.univ-nantes.fr/scnat/biologie/GPPV.web
(N.B. not ….biologie/scnat…as indicated in the first circular.)

For information on biology and control of parasitic weeds, and the relevant activities of the University of Hohenheim see:
http://www.uni-hohenheim.de/~www380/parasite/start.htm

For IITA *Striga* Research Methods: a Manual, see: http://cgiar.org/iita

PROCEEDINGS OF MEETINGS

Report on the ICRISAT Sector Review for *Striga* Control in Sorghum and Millet. ICRISAT-Bamako, Mali 27-28 May 1996.

1999. Edited by Hess, D.E. and Lenn, J.

ICRISAT. 138 pp. ('An ICRISAT semi-formal publication issued for limited distribution without formal review.') Contents include:

An overview of the *Striga* control sector review.

Obilana, A.B. and Reddy, B.V.S. Host-plant resistance to *Striga* in sorghum and millet.

Hess, D.E. and Dembel, B. Cultural manaement of *Striga* on cereals.

Hess, D.E. and Grard, P. Chemical control of *Striga*.

Kroschel, J. *et al.* Possibilities and constraint in implementing *Striga* control methods in African agriculture.

Riches, C.R. Sorghum and millet *Striga* research in UK: contributions to international programs.

Butler, L.G. and Ejeta, G. INTSORMIL-supported research on *Striga*.

Traor, H. and Oedraogo, O. Research activities in integrated *Striga* management of pearl millet and sorghum in Burkina Faso – 1990 to 1995.

Bengaly, M. and Defoer, T. Farmer perception of the *Striga* problem in southern Mali.

Traor, D. *et al. Smicronyx guineanus* Voss and *Sm. umbrinus* Hustache (Coleoptera: Curculionidae): potential biocontrol agents of *Striga hermonthica* Del.) Benth. (Scrophulariaceae).

Mbwaga, A.M. *Striga* research in Tanzania.

Mabasa, S. and Obilana, A.B. *Striga* research in sorghum in Zimbabwe.

Berner *et al. Striga hermonthica* management in sub-Saharan Africa.

Recommendations.

The 15th Conference of the Weed Science Society of Israel, Bet Dagan, Israel, March 1998.

Abstracts of papers presented at this meeting are included in Phytoparasitica 1999. Vol. 27. Relevant papers (pp. 109-115) are:

Eizenburg, H. *et al.* B. Effect of carrot sowing date on parasitism of *Orobanche crenata* and *O. aegyptiaca.*

Eizenburg, H. *et al.* B. Effect of temperature on host-parasite relationship in *Orobanche* spp.

Portnoy, V.H. *et al.* Diagnosis of soilborne *Orobanche* seeds.

Goldwasser, Y. *et al.* Studies of the resistance of *Vicia atropurpurea* to *Orobanche aegyptiaca*.

Shomer-Ilan, A. Proteolytic activity of germinating *Orobanche aegyptiaca* seeds controls the degrading level of its own excreted pectinase and cellulase.

Mayer, A.M. *et al.* Involvement of pectinases in plant infection by parasitic weeds.
Kleifeld, Y. *et al.* Control of *Orobanche* in tomatoes with sulfonylurea herbicides.
Kleifeld, Y. *et al.* Selective *Orobanche* control with imadazolinones herbicides in various host crops.
Amsellem, Z. *et al.* Isolation of mycoherbicidal pathogens from juvenile broomrape plants.
Cohen, B. *et al.* J. Green fluorescent protein (gGFP) as a marker in a phytopathogenic fungus, *Fusarium oxysporum*, on *Orobanche.*
Joel, D.M. *et al.* Grafting for *Orobanche* resistance.
Weinberg, T. *et al.* Effects of herbicide inhibitors of carotenoid biosynthesis on field dodder (*Cuscuta campestris*).
Joel, D.M. *et al.* Treatment of transgenic herbicide-resistant seeds for broomrape control.

Resistance to *Orobanche*: The state of the art. 1999. Edited by Cubero, J.I., Moreno, M.T., Rubiales, D. and Sillero, J. Congresos y Jornados 51/99. Junta de Andalucia. Direcion General de Investigacion y Formacion Agraria, 199 pp. Contents:

Cubero, J.I. and Moreno, M.T. Studies on resistance to *Orobanche crenata* in *Vicia faba*.
Cubero, J.I. and Rodriguez, M.F. Resistance to *Orobanche*: genetics and breeding.
ter Borg, S. Broomrape resistance in faba bean: what do we know?
Gil, J. Resistance in *Vicia sativa*L to *Orobanche crenata* Forsk.
Sillero, J.C. *et al.* New sources of resistance to broomrape (*Orobanche crenata*) in a collection of *Vicia* species.
Rubiales, D. *et al.* Resistance to *orobanche crenata* in chickpea.
Khalil, S. and Erskine, W. Breeding for *Orobanche* resistance in faba bean and lentil.
Kharrat, M. *Orobanche* research activities on faba bean in Tunisia.
Rubiales, D. *et al.* Broomrape (*Orobanche crenata*) as a major constraint for pea cultivation in southern Spain.
Joel, D. Understanding the biology of broomrape is required for manipulation of host resistances.
Roman, B. and Rubiales, D. Molecular analysis of *Orobanche crenata* populations from southern Spain.
Manschadi, A.M. *et al.* VIFOR – a simulation model that aids management decisions for *orobanche* control.
Dominguez, J. Inheritance of the resistance to *Orobanche cumana* Wallr. in sunflower: a review.
Alonso, L.C. Resistance to *Orobanchje* in sunflower: mechanisms of resistance in the host-plant/*Orobanche* system.
Gonzlez-Carrascosa, R. New races of *Orobanche cumana* on sunflower.
Fernndez-Martnez, J.M. Development of broomrape resistant sunflower germplasm ultilizing wild *Helianthus* species.
Melero-Vara, J.M. Pathogenic variability in *Orobanche cumana* Wallr.
Press, M.C. Impacts of *Orobanche* on host source-sink relations.
Jorrin, J. *et al*. How plants defend themselves against root parasitic angiosperm: molecular studies with *Orobanche* spp.
Klein, O. *et al.* Potential of *Phytomyza orobanchia* for the biological control of *Orobanche* spp. and its possible application.
Salv, A.J.P. Species of the family Orobanchaceae parasitic on cultivated plants and its relatives growing on wild plants in the south of the Iberian Peninsula.
Rubiales, D. Eating broomrape?

Availability of volumes listed in Haustorium 35:

'Advances in Parasitic Weed Control at On-farm Level' Volumes 1 and 2 are available from Margraf Verlag, P.O. Box 1205, D-97985 Weikersheim, Germany (Fax 49-79-348156; Email margraf@compuserve.com), price DM45.00 each (or approx 34 US dollars) plus postage and handling.

'Current problems of Orobanche Researches' – we have recently learnt that the Proceedings of the Albena meeting are exhausted and regrettably no longer available.

LITERATURE

Anon. 1998. Forest insect and disease conditions in the United States, 1997. USDA Forest Service, Washington. 81 pp. (Including information on *Arceuthobium* spp.)

Anon. 1999. Bericht 1999 Verein fr Krebsforschung Asrlesheim Scweiz. (This annual report marks 50 years for the Hiscia Institute, where followers of Rudolf Steiner use extracts from mistletoe ('Iscador') to treat cancer. There is an article on mistletoe research as well as a helpful summary of publications including several dealing with the efficacy of mistletoe extracts in cancer treatment.)

Bannister, P., King, W.M. and Strong, G.L. 1999. Aspects of the water relations of *Ileostylus micranthus* (Hook.f.) Tieghem, a New Zealand mistletoe. Annals of Botany 84: 79-86. (Concluding that *I. micranthus* operates at higher water potentials and contents than other mistletoes and has less capacity to adjust to the water potential of its hosts – *Kunzea ericoides, Ribes sanguineum, Teline monspessulana* and *Coprosoma propinqua*.)

Berner, D.K., Schaad, N.W. and Vlksch, B. 1999. Use of ethylene-producing bacteria for stimulation of *Striga* seed germination. Biological Control 15: 274-282. (In a 10-month experiment strains of *Pseudomonas syringae* caused germination of *S. hermonthica, S. aspera* and *S. gesnerioides* comparable to that from GR24 and superior to that from cowpea roots or ethylene gas.)

Besufekad Tadesse, Admassu Tadesse and Rezene Fessehaie. 1999. *Orobanche* problem in south Wollo. In: Fasil Reda and D.G. Tanner (eds.) Arem 5: 1-10. (A virulent form of *Orobanche*, possibly *O. crenata*, causes extensive and severe damage to faba bean in the Dessie district of Ethiopia, and is continuing to spread.)

Bewick, T.A. 1999. A bioherbicide for dodder: the long winding road. (Abstract) Proceedings North East Weed Science Society 53: 138. (Outlining the 15 year history of development of a fungus (*Colletotrichum gloeosporioides*?) from first observation to product registration in 1999.)

Bewick, T.A., Porter, J.C. and Warwick, D. 1999. Evaluation of raking as a means of mechanical control of dodder (*Cuscuta gronovii* L.) in cranberry. (Abstract) Proceedings North East Weed Science Society 53: 88. (Raking at flowering and/or at seed set reduced vines but failed to reduce seeding of *C. gronovii* (should be *C. gronovii* Willd., not L.) or to increase crop yield.)

Buen, L.L. de and Ornelas, J.F. 1999. Frugiforous birds, host selection and the mistletoe *Psittacanthus schiedeanus*, in central Veracruz, Mexico. Journal of Tropical Ecology 15: 329-340. (*Liquidamber styraciflua* was main host species, apparently because most visited by the three bird species responsible fro spread. Other hosts included *Persea americana* and *Crataegus mexicana*.)

Choudhury, N.K. and Sahu, D. 1999. Photosynthesis in *Cuscuta reflexa*: a total parasite. Photosynthetica 36(1/2): 1-9. (Reviewing the photosynthetic structures and processes in *C.reflexa*.)

Cornell, S.J., Desdevises, Y. and Rigby, M.C. 1999. Evolutionary biology of host-parasite relationships: reality meets models. Trends in Ecology and Evolution 14: 423-425. (Reporting on a workshop of the same title, held in France in May, 1999, to be published by Elsevier in 2000. Relevance of contents to parasitic plants not known.)

Cubero, J.I., Moreno, M.T., Rubiales, D. and Sillero, J. (Eds.) 1999. Resistance to *Orobanche*: The State of the Art. Congresos y Jornados 51/99. Junta de Andalucia. Direcion General de Investigacion y Formacion Agraria, 199 pp. (Proceedings of a meeting held in Cordoba in December, 1998 including 22 mostly quite short papers - see list of contents above.)

Dhopte, A.M. 1998. Inhibition of *Cuscuta* growing on *Parthenium*. Annals of Plant Physiology 12(1): 80-81. (*Cuscuta* 'sp.' apparently unable to survive on *P. hysterophorus*.)

Dzomeku, I.K. and Murdoch, A.J. 1999. Implications of seed dormancy for control of *Striga hermonthica* in Ghana. The 1999 Brighton Conference – Weeds, pp. 573-574. (Reporting the effects of temperature and moisture on conditioning and germination of *S. hermonthica*.)

Dutukner, I. 1999. (A study on the morphological features of Loranthaceae family within the Marmara region.) (in Turkish) Turkish Journal of Agriculture and Forestry 23(Suppl. 4): 983-989. (Giving distribution and host plants of

Viscum album, Loranthus europaeus and *Arceuthobium oxycedri*.)

Efthymiou, M.L. 1999. (Toxicity of berries in public amenities. Species and their associated actions.) (in French) Dossier: Espaces verts. Phytoma 517: 28-29. (Listing *Viscum album* as having moderate toxicity.)

Gosheh, H.Z., Hameed, K.M., Turk, M.A. and Al-Jamali, A.F. 1999. Olive (*Olea europea*) jift suppresses broomrape (*Orobanche* spp.) infections in faba bean (*Vicia faba*), pea (*Pisum sativum*), and tomato (*Lycopersicon esculentum*). Weed Science 13: 457-460. (Jift, a solid by-product of olive oil processing incorporated at 25% of soil reduced *O. crenata* on faba bean and pea, and *O. lavandulacea* on tomato.)

Gressel, J. 1999. Herbicide resistant tropical maize and rice: needs and biosafety considerations. The 1999 Brighton Conference – Weeds, pp. 637-645. (Reviews progress so far with use of herbicide-resistant maize in control of *Striga* and outlines future possibilities for use of transposons in a programme of debilitation of *Striga*. See extract above under 'TAC-TICs for *Striga* control'.)

Gurney, A.L., Press, M.C. and Scholes, J.D. 1999. Infection time and density influuence the response of sorghum to the parasitic angiopserm *Striga hermonthica*. New Phytologist 143: 573-580. (Variety Ochuti, grown in infested and non-infested soil following fumigation, showed less damage than var. CSH-1: this was associated with delayed emergence of the parasite and attributed at least partly to delayed attachment. The latter was not directly demonstrated but pot experiments confirmed it could be important.)

Hammerschmidt, R. 1999. Induced disease resistance: how do induced plants stop pathogens? Physiological and Molecular Plant Pathology 55: 77-84. (No mention of parasitic higher plants but useful commentary on latest understanding of the processes involved.)

Hess, D.E. and Lenn, J. (eds) 1999. Report on the ICRISAT Sector Review for *Striga* Control in Sorghum and Millet. ICRISAT-Bamako, Mali, May, 1996. (A belated compilation – see contents under Proceedings of Meetings above.)

Hibberd, J.M., Quick, W.P., Press, M.C., Scholes, J.D. and Jeschke, W.D. 1999. Solute fluxes from tobacco to the parasitic angiosperm *Orobanche cernua* and the influence of infection on host carbon and nitrogen relations. Plant, Cell and Environment 22: 937-947. (Carbon fixation 20% higher in infected than in uninfected tobacco. 80-90% of N, K, Na and S derived via the phloem; only Mg mainly from xylem. Plus much more on N metabolism, etc.)

Hudu, A.I. and Gworgwor, N.A. 1998. Preliminary results on evaluation of trap crops for *Striga hermonthica* (Del.) Benth. control in sorghum. International Sorghum and Millet Newsletter 39: 118-121. (In pots, growing bambara groundnut or sesame with sorghum markedly reduced *S. hermonthica* numbers and increased crop vigour: soyabean, cotton, sunflower and okra also showed moderate benefits.)

IITA. undated. Research highlights, Project 8. Integrated Management of *Striga* and other parasitic plants. Annual Report 1998 International Institute for Tropical Agriculture, pp. 55-56.

Karunaichamy, K.S.T.K., Paliwal, K. and Arp, P.A. 1999. Biomass and nutrient dynamics of mistletoe (*Dendrophthoe falcata*) and neem (*Azadirachta indica*) seedlings. Current Science 76: 840-842, (Concentrations of N, P, K, Mg, Na, and Ca all higher in the parasite than in the host. Prolonged infestation resulted in death of the host, and parasite.)

Kebreab, E. and Murdoch, A.J. 1999. A model of the effects of a wide range of constant and alternating temperatures on seed germination of four *Orobanche* species. Annals of Botany 84: 549-557. (Optimum temperatures for *O. cernua, O. crenata, O. aegyptiaca* and *O. minor* all in range 18-21°C. Alternating temperatures tend to reduce germination, due to adverse effect of higher temperatures.)

Klein, O. and Kroschel, J. (eds.) 1999. Rappport final d'activits du projet suprargional Ecologie et Gestion des Plantes Parasites 1992-1999. Description du projet, rsum des activits, recommandations et liste de publications. Projet suprargional Ecologie et Gestion des Plantes Parasites, Fès, Morocco, 136 pp. (Including 19 technical chapters, mainly on *Orobanche* but one on *Cuscuta*, covering survey, research, development and extension of techniques involving herbicides,cultural and biological control.)

Kuiper, E., Groot, A., Noordopver, E.C.M., Pieterse, A.H. and Verkleij, J.A.C. 1998. Tropical grasses vary in their resistance to *Striga aspera, Striga hermonthica,* and their hybrids. Canadian Journal of Botany 76: 2131-2144. (14 wild grass species all caused germination of both *Striga* spp but some showed resistance after attachment. The two species varied in their host range, while hybrids were intermediate in behaviour.)

Kunjo, E.M. and Murdoch, A.J. 1999. Integration of socio-economically appropriate management strategies for *Striga hermonthica* in The Gambia. The 1999 Brighton Conference – Weeds, pp. 575-576. (Tethering livestock on infested fields shown to be especially helpful.)

Lavorel, S. Smith, M.S. and Reid, N. 1999. Spread of mistletoes (*Amyema preissii*) in fragmented Australian woodlands: a simulation study. Landscape Ecology 14: 147-160. (Results support the hypothesis that fragmentation of *Acacia* woodlands in Northern Territory promotes infestation of *A. preissii,* assisted by the mistletoe bird *Dicaeum hirundinaceum*.)

Lei, S.A. 1999. Age, size and water status of *Acacia greggii* influencing the infection and reproductive success of *Phoradendron californicum*. American Midland Naturalist 141: 358-365. (*P. californicum* most abundant on older, larger trees. Infestation resulted in increased water stress.)

Looney, M.M. 1998. Differentiation of mistletoes (Santalales) on the basis of geographical origin. Texas Journal of Science 50: 315-326. (Results of gas chromatographic analysis of extracts from *Phoradendron tomentosum* and *P. serotinum* suggested this technique could be of taxonomic value.)

Lu YunHai, Gagne, G., Grezes-Besset, B. and Blanchard, P. 1999. Integration of a molecular linkage group containing the broomrape resistance gene *Or5* into an RFLP map in sunflower. Genome 42: 453-456. (Showing that the *Or5* linkage group could be integrated with the linkage group 17 of the GIE Cartisol RFLP map.)

Maiti, A. and Chauhan, A.S. 1998. A preliminary census on the host-plants of *Cuscuta reflexa* Roxb. in Gangtok, Sikkim. Indian Journal of Forestry 21: 267-269. (Host plants included 53 species in 27 families, including some young woody species but no fully grown trees.)

Matiyas Mekuria. 1999. Major weed species in the Southern Nations, Nationalities and Peoples Region. In: Fasil Reda and D.G. Tanner (eds.) Arem 5: 11-13. (*Striga asiatica* widespread and damaging in Konso and Derashe districts in S. Ethiopia.)

Matthies, D. and Egli, P. 1999. Response of a root parasite to elevated CO_2 depends on host type and soil nutrients. Oecologia 120: 156-161. (Complex interactions recorded between *Rhinanthus alectrolophus, Lolium perenne* and *Medicago sativa*, grown in all combinations and at different levels of nutrient and CO_2. The presence of the parasite reduced the total productivity of the system, regardless of CO_2 level: growth of all components, especially the parasite, increased by high CO_2 level, but only at high nutrient level.)

Mika, J.S. and Caruso, F.L. 1999. The use of *Colletotrichum gloeosporioides* to control swamp dodder (*Cuscuta gronovii* Willd.). (Abstract) Proceedings North East Weed Science Society 53: 56. (*C. gloeosporioides* more pathogenic than *C. acuatum*.)

Mukherjee, A. and Banerjee, G. 1999. Ecological studies on the forests of Midnapore district, West Bengal: assessment of angiospermic parasites. Environment and Ecology 17(1): 214-221. (14 parasite spp. of 5 families identified in *Shorea robusta* forest, among which *Dendrophthoe falcata* the most important.)

Neumann, U. 1999. (Ontogenetic, structural and immunocytochemical investigations of haustoria of three African parasitic Scrophulariaceae.) (in French) PhD Thesis Universit Pierre et Marie Curie, Paris. Volume 1; 144 pp, Volume 2; 44 plates. (Studies on *Striga hermonthica*, *Buchnera* *hispida* and *Rhamphicarpa fistulosa*. See other listings, e.g. the following, for detail.)

Neumann, U., Vian, B., Weber, H.C. and Sall, G. 1999. Interface between haustoria of parasitic members of the Scrophulariaceae and their hosts: a histochemical and immunocytochemical approach. Protoplasma 207: 84-97. (Studies in all three species (see above) suggest that, even in susceptible hosts, there are defence reactions in the form of lignin, phenolics and HRGPs.)

Norton, D.A. and de Lange, P.J. 1999. Host specificity in parasitic mistletoes (Loranthaceae) in New Zealand. Functional Ecology 13:552-559. (Host range was narrowest for *Alepis flavida, Peraxilla colensoi* and *P. tetrapetala* (mainly on *Nothofagus* spp.) widest for *Tupeia antarctica* (on a wide range of hosts), intermediate for *Ileostylus micrantha*. Degrees of host specificity discussed in relation to relative host availability.)

Norton, D.A. and Smith, M.S. 1999. Why might roadside mulgas be better mistletoe hosts? Australian Journal of Ecology 24: 193-198. (*Acacia aneura* along roadsides more heavily infected by mistletoes , apparently associated with higher foliar water content.)

Nun, N.B., Mor, A. and Mayer, A.M. 1999. A cofactor requirement for polygalacturanose from *Cuscuta reflexa*. Phytochemistry 52: 1217-1221.

Obilana, A.B. 1998. Sorghum improvement. International Sorghum and Millet Newsletter 39: 4-17. (Screening in Botswana, Zimbabwe and Tanzania gave promising indications of *Striga* resistance in SAR lines 16, 19, 29, 33 and 35, but yields were poor.)

Pronier, I., Par, J., Vincent, C. and Sall, G. 1998. Impact of *Smicronyx* spp. (Coleoptera: Curculionidae) on fruit development of the parasitic weed *Striga hermonthica* (Scrophulariaceae): histological study and prospects for biological control. Acta Biologica Cracoviensia. Series Botanica 40: 9-13. (Observing development of galls with or without larval development, and sometimes larval development without formation of galls.)

Pundir, Y.P.S. and Dhan Singh. 1998 More unrecorded hosts of *Scurrula pulverulenta* (Wallr.) G.Don (Loranthaceae) from Doon Valley and adjacent areas. World Weeds 5(1/2): 147-148. (*S. pulverulenta* recorded vigorous on *Colebrookea oppositifolia* but weak on *Bauhinia retusa*.)

Rao, P.N., Neelai, K.K. and Basava Raju, G. 1999. *Quisqualis indica* L.; a reliable biosuppressor of the parasite China dodder, *Cuscuta chinensis* Lamarck. Abstracts, 8th Biennial Conference of the Indian Society of Weed Science, Varanasi, 1999, p. 136. (The ornamental climber *Q. indica* is resistant to *C. chinensis* and apparently reduces its spread.)

Rao, P.N., Neelai, K.K. and Basava Raju, G. 1999. Certain interesting aspects of utility of the parasitic weed *Cuscuta chinensis* Lamarck. Abstracts, 8th Biennial Conference of the Indian Society of Weed Science, Varanasi, 1999, p. 152. (Analysis of *C. chinensis* indicated ascorbic acid, alkaloids and a flavoured oil of conceivable commercial value.)

Robert, S., Dubreuil, D., Simier, P., Praderre, J-P and Fer, A. 1999. Inhibition studies on mannose 6-phosphate reductase purified from *Orobanche ramosa*. Carbohydrate Letters 3: 231-238.

Seel, W.E. and Jeschke, W.D. 1999. Simultaneous collection of sap from *Rhinanthus minor* and the hosts *Hordeum* and *Trifolium*: hydraulic properties, xylem sap composition and effects of attachment. New Phytologist 143: 281-298. (Hydraulic resistance high in unattached *R. minor*; much lower when attached to *H. vulgare* or *T. alpestre*, showing improved access to water. Asparagine the main amino acid transferred from host to parasite: this is naturally present in *T. alpestre*, but is induced in *H. vulgare.* Plus lots more.)

Sherman, T.D., Pettigrew, W.T. and Vaughn, K.C. 1999. Structural and immunological characterization of the *Cuscuta pentagona* L. chloroplast. Plant Cell Physiology 40: 592-603.

Stein, G.M., Schaller, G. Pfller, U., Wagner, M., Wagner, B. Schietzel, M and Bssing, A. 1999. Characterisation of granulocyte stimulation by thionins from European mistletoe and from wheat. Biochimica et Biophysica Acta, General Subjects 1426(1) 80-90.

Taylor, G.S. 1999. New species of *Acizzia* Heslop-Harrison (Hemiptera: Psyllidae) from Australian mistletoe (Loranthaceae). Australian Journal of Entomology 38(2): 66-71. (Three new species described, from *Amyema* spp. on eucalypts, but not on *Acacia*.)

Thomas, H., Sauerborn, J., Mller- Stver, D. and Kroschel, J. 1999. Fungi of *Orobanche aegyptiaca* in Nepal with potential as biological control agents. Biocontrol Science and Technology 9: 379-381. (21 fungal species of 12 genera isolated from *O. aegyptiaca* on mustard and tobacco, *Fusarium* spp. being the commonest. No results yet on pathogenicity.)

Thomas, H., Sauerborn, J., Mller- Stver, D., Ziegler, A., Bedi, J.S. and Kroschel, J. 1998. The potential of *Fusarium oxysporum* f.sp. *orthoceras* as a biological control agent for *Orobanche cumana* in sunflower. Biological Control 13: 41-48. (Pot experiments confirm damaging effects of *F. oxysporum* applied either pre-planting or post-emergence but most beneficial response of sunflower followed pre-planting inoculation of the soil. *O. aegyptiaca* was not damaged.)

Wigchert, S. 1999. Chemical studies on germination stimulants for seeds of the parasitic weeds *Striga* and *Orobanche*. PhD Thesis University of Nijmegen, Netherlands. 135 pp. (Including studies on the mechanism of action of sorgolactone, the range of activity of GR24 and Nijmegen 1, and detail of the synthesis and relative activity of stereoisomers of sorgholactone and GR-24. An impressive volume of work

Wilson, J.P., Hess, D.E., Ciss, B., Hanna, W.W. and Youm, O. 1998. *Striga hermonthica* infection of wild *Pennisetum* germplasm is related to timing of flowering and downy mildew incidence. International Sorghum and Millet Newsletter 39: 149-150. (*S. hermonthica* emergence on 275 accessions of *P. glaucum* in the field were lower on early maturing lines and those with downy mildew infection.)

Wondimu WoldeHanna, Shemelis Hassen and Ayenalem Ayele. 1999. The distribution of *Striga* in Oromia region. In: Fasil Reda and D.G. Tanner (eds.) Arem 5: 75-84. (*Striga* spp., especially *S. hermonthica* continuing to spread in eastern Ethiopia.)

Yohannes Lemma, Taye Tessema, Ransom, J.K. and Beayneh Admassu. 1999. Incidence and distribution of *Striga* on maize in Ethiopia. In: Fasil Reda and D.G. Tanner (eds.) Arem 5: 66-74. (The first systematic survey of *Striga* on maize in Ethiopia reveals generally high and increasing infestations, mainly of *S. hermonthica*.)

HAUSTORIUM 36 has been edited by Chris Parker, 5 Royal York Crescent, Bristol BS8 4JZ, UK (Email chrisparker5@compuserve.com) and Lytton J Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk Virginia 23529-0266, USA (fax 757 683 5283; Email lmusselm@odu.edu). Send material for publication to either author.

Preparation of this issue and maintenance of the website have been assisted by John Terry, Harry Anderson, Michail Semenov and others at Long Ashton Research Station, Bristol, UK.

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// HAUSTORIUM

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HAUSTORIUM BY EMAIL AND THE WEB

We are pleased to acknowledge that Old Dominion University is once again contributing to the printing and mailing of Haustorium but apart from this modest assistance the newsletter still has no significant source of funding and we need to reduce costs as much as possible. The great bulk of our costs are for mailing. Many readers are already helping us by receiving Haustorium by Email. We believe many others could do so but we do not have their Email addresses. If you are one of those, do please let Chris Parker know (Email address on the last page). Bear in mind that having an electronic version of the newsletter enables you to 'search'. If you cannot receive Email, or for any reason wish strongly to go on receiving hard copy, you will continue to receive by airmail.

Thanks to arrangement with the Institute of Arable Crops Research, Long Ashton Research Station, Bristol, UK, Haustorium will continue to be available on the web site: www.lars.bbsrc.ac.uk/cropenv/haust.htm

SEVENTH INTERNATIONAL PARASITIC WEED SYMPOSIUM

The 7th International Symposium will be held in Nantes, France from 5-8 June, 2001. Although the title refers to 'Weed', all aspects of parasitic plants will, as always, be covered, including academic and non-agricultural topics. Those who have not already received a copy of the second circular for this major meeting should contact Patrick Thalouarn, Laboratoire de Cytopathologie Vegetale, University de Nantes, 2, Rue de la Houssinière, BP 92208, F44322 Nantes, Cedex 3, France. Email patrick.thalouarn@svt.univ-nantes.fr

PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

The proposal under this title, for a 5-year 25 million ECU programme to be funded from the COST budget of the European Commission is to be considered shortly by the COST Technical Committee in Vienna. If approved, the project will involve a wide range of research and co-ordination activities across a number of European countries.

STRIGA CONTROL BY INTERCROPPING WITH *DESMODIUM* SPECIES

Resource-poor cereal farmers in Kenya are testing intercropping and trap cropping strategies to control damage by stem boring larvae of moth species such as the indigenous noctuid *Busseola fusca* and the introduced pyralid *Chilo partellus*. They are using two grass species, Sudan grass (*Sorghum sudanensis*) and Napier grass (*Pennisetum purpureum*), that act as "traps" by attracting the pests to lay eggs, and two resistant plants, molasses grass (*Melinis minutiflora*) and the legume silverleaf (*Desmodium uncinatum*), which repel adult stem borers. This "push-pull" strategy is being developed as part of a collaborative programme between IACR-Rothamsted and the International Centre of Insect Physiology and Ecology (ICIPE) at Nairobi and Mbita Point on the banks of Lake Victoria.

In 1997, it was noticed that maize intercropped with silverleaf (*D. uncinatum*) or greenleaf (*D. intortum*) suffered far less *Striga hermonthica* infestation than maize in monoculture. These trials were repeated, comparing *Desmodium* species with plants widely recommended as intercropping solutions to *Striga* problems, for example sunn hemp, *Crotolaria* spp., soya bean and cowpea. With the conventional intercrops, either S*triga* infestation was not significantly different from the maize monoculture, as with soya bean, or the S*triga* rating was only reduced by about 50%, as with sunn hemp and cowpea. However, when maize was intercropped with either of the *Desmodium* species, the S*triga* rating was reduced from 2-3 to 0.1 or less. At the same time, there was a statistically significant increase in maize yield of *ca.* 2 tonnes/hectare.

Desmodium species are nitrogen-fixing legumes and contribute to the nutrition of the crop. If allowed to grow uncontrolled they may compete with the crop, but this can easily be controlled by regular cutting. The mechanism by which these plants, as intercrops, reduce S*triga* infestation so dramatically is now under investigation, with clear evidence of allelopathic effects. It is now imperative to identify the exact mechanisms by which *Desmodium* species interfere with S*triga* development, to ensure that control measures based on these intercropping strategies are robust and reliable and with a view to exploitation in the longer term by means of plant molecular genetics. It can already be seen that *D. uncinatum* is producing germination stimulation cues in the rhizosphere, and also that there are compounds interfering with haustorial development and colonisation of the maize host.

The intercropping and trap cropping studies are funded by the Gatsby Charitable Foundation, with new support from the Rockefeller Foundation to fund further mode of action studies on the influence of *Desmodium* species on prevention of S*triga* development. The chemistry involved will be elucidated in the near future by collaborators from ICIPE and Rothamsted: A. Hassanali, A.M. Hooper, T.M. Khamis, Z.R. Khan, J.A. Pickett and L.J. Wadhams.

John A. Pickett, IACR-Rothamsted, Harpenden, Herts AL5 2JQ, UK.

A NEW VIRULENT RACE OF *OROBANCHE CRENATA*

Some vetch varieties are known to resist *O. crenata*. In recent years we have noted a few cases where resistant vetch was attacked by *O. crenata*. One could ask whether this happened as a result of the loss of resistance in the vetch, or as a result of the appearance of a new *Orobanche* race that is capable of attacking the resistant varieties. We have confirmed the botanical identity of the *Orobanche* plants using morphological markers and specific DNA markers that are known to be characteristic of *O. crenata.* Further, the susceptibility of three vetch varieties was checked in the lab against normal *O. crenata* populations, and against the crenate broomrape that was collected on resistant vetch. The results were very clear. The two varieties 'sadot' and 'popany' that are commonly known as *Orobanche* resistant were attacked only by *Orobanche* developing from the seeds collected in the resistant field, not by the 'ordinary' *O. crenata*. This is the first recorded evidence of an *O. crenata* race that overcomes known *Orobanche* resistance.

Daniel M. Joel and Vitaly H. Portnoy, Newe-Ya'ar Research Center, Israel.

SOUTHERN AFRICA *STRIGA* WORKING GROUP

Striga researchers from Botswana, Malawi, Mozambique, Tanzania and Zimbabwe met in Dar es Salaam in May, 2000, to establish a *Striga* Working Group in Southern Africa. *Striga* infestation is a widespread constraint to cereal productivity in the twelve member states of the Southern Africa Development Community (SADC). The species of economic importance are *S. hermonthica* which occurs in northern Tanzania, *S. asiatica* which is distributed through out the SADC region, and *S. forbesii* which is of local significance in Malawi, Tanzania and Zimbabwe. The meeting, co-ordinated by the

SADC/ICRISAT Sorghum and Millet Improvement Program, formulated national action plans for future research and proposed a regional plan involving the working group in a co-ordinated approach to the development, testing and promotion of appropriate *Striga* management options. It was recognised that considerable progress has been made by individual countries to develop *Striga* control components and it was agreed that the emphasis should now be on using available technologies on parasite infested land in integrated crop management which is tested and promoted by farmers themselves. Specific topics which still need attention include filling in gaps in knowledge of *Striga* distribution, and raising awareness further of the importance of the pest at a number of levels of the agricultural community including research managers. Exchange of germplasm and in particular the exposure of farmers to resistant cereal lines needs to be accelerated and attention given to sustainable systems of seed multiplication and distribution. Work is also needed to develop appropriate 'learning tools' which can assist in the dissemination of what tend to be 'knowledge intensive' technologies for *Striga* management, for example improvement of soil fertility or inter-cropping. Such tools should be aimed at farmers and in-service or college training of extension department or NGO agricultural support staff. The working group also hopes to establish a bibliography of previous work on *Striga* in Southern Africa as a resource for researchers in the region. The proceedings of the meeting will be available later in the year.

Charlie R. Riches, Natural Resources Institute, IACR-Long Ashton Research Station, Bristol, BS18 9AF, UK.

STRIGA BIOCONTROL - OBSTACLES OVERCOME?

This is the title of a very encouraging paper presented at the 3rd International Weed Science Congress by Alan K. Watson, Marie Ciotola and Roger R. Maclean. The following is the full abstract (number 371) reproduced with kind permission of the authors, from pp. 176-177 of the Congress Abstracts (see below for a full listing of relevant abstracts, under Proceedings of Meetings.)

'*Fusarium oxysporum* isolate M12-4A is currently being evaluated for the biological control of *Striga hermonthica*. In field trials, chlamydospore powder harvested from small-scale fermentors reduced *S. hermonthica* emergence by 92%. Complete inhibition of *S. hermonthica* emergence occurred when the chlamydospore powder was added to the soil at sowing and when sorghum seeds coated with chlamydospores were sown. Effective biological control of *S. hermonthica* was achieved using a simple fermentation system with sorghum straw as the inoculum using arabic gum as the adhesive. This simple delivery system permits a uniform inoculation of the field as well as the proper positioning of the inoculum in the immediate environment of sorghum roots, where *S. hermonthica* attaches to its host. To facilitate broad usage of *F. oxysporum* M12-4A for the biocontrol of *S. hermonthica*, we are promoting an inoculum production strategy based on a cottage industry model that utilizes a liquid fermentation process and inexpensive locally available substrates including sorghum straw and arabic gum. To assure quality control, primary inoculum is produced centrally and encapsulated in small gelatin capsules as starter cultures. Each capsule contains 0.001 g of inoculum and a kg box of capsules is sufficient to produce *Fusarium* inoculum for treating up to 8,000 hectares of land infested with *Striga*. In the villages traditional cooking pots filled with water and a small amount of ground sorghum straw are sterilized over a fire, allowed to cool, and the starter culture added. The mixture will ferment for 10-14 days, the product is then air-dried and ground, and can be stored for several months. When planting season arrives, the farmers' cereal seeds are coated with a thin film of arabic gum solution and the dry powdered *Fusarium* inoculum sprinkled onto the seed surface. The biocontrol becomes a 'seed technology'. The farmer plants his seeds and at the same time protects his crop from the ravages of *Striga*. The application rate of *Fusarium* is equivalent to approximately 80 grams per hectare. The village-level manufacture of *Fusarium* will give women in rural communities more economic and social power. The preparation of the dried inoculum both fits into women's traditional sphere of work and provides a new source of income. This year, field testing of the *Fusarium-Striga* biocontrol process is occurring in six Malian villages. We plan to phase this technology in gradually, from village to village and then from country to country, to include all regions afflicted with *Striga.*'

WEBSITES

For information on the 7th International Parasitic Weed Symposium at Nantes, 2001 see:
http://www.sciences.univ-nantes.fr/scnat/biologie/GPPV.web
(N.B. not ….biologie/scnat…as indicated in the first circular.)

For information on biology and control of parasitic weeds, and the relevant activities of the University of Hohenheim see:
http://www.uni-hohenheim.de/~www380/parasite/start.htm

For IITA *Striga* Research Methods: a Manual, see: http://www.cgiar.org/iita (N.B. www omitted in last issue.)

For news from Canada of progress with biocontrol techniques for *Striga* see:
http://www.mcgill.ca/media/releases/1999/december/weedkiller/

PROCEEDINGS OF MEETINGS

Breeding for Striga Resistance in Cereals. Proceedings of a Workshop held at IITA, Ibadan, Nigeria, from 18-20 August 1999. 2000. Edited by Haussmann, B.I.G., Hess, D.E., Koyama, M.L., Grivet, L., Rattunde, H.F.W. and Geiger, H.H. Available from Margraf Verlag, P.O. Box 105, 97985 Welkersheim, Germany (Email margraf@ compuserve. com) at DM 50.- per copy.

Contents:

(see Haustorium 36, pp. 6-8, for a detailed report of this meeting.)

***Striga* distribution and management in Tanzania. Proceedings of a stakeholder workshop, Dar es Salaam, September 1999. 2000.** Edited by C.R. Riches. Available from Pest Management Dept., Natural Resources Institute, Chatham, Kent ME4 4TB, UK.

Contents:

Riches, C.R. Stimulant production by potential trap crops. p. 52.
Press, M.C. *et al.* Control of *Striga* on maize and sorghum: nitrogen x crop genotype interactions. pp. 53-55.
Mbwaga, A.M. On-farm evaluation on the use of animal manure to control *Striga*. pp. 56-57.
Ley, G.L. Opportunities for enhancing soil fertility in smallholder systems in Tanzania. pp. 58-60.
Lamboll, R. Options for *Striga* control in rice cropping systems in Kyela. pp. 61-64.
Mbwaga, A.M. Screening of local and exotic rice germplasm for *Striga asiatica* in upland rice. pp. 65-66.
Kayeke, J. On farm evaluation of the use of urea to control *Striga asiatica* in upland rice. pp. 67-68.
Kaswende, J. Development of *Striga* control options in maize. pp. 69-74.
Scholes, J.D. *et al.* Novel sources of resistance to *Striga* spp. in sorghum and maize. pp. 75-79.
Riches, C.R. Future *Striga* research priorities for Tanzania. pp. 80-85.

XIVth International Plant Protection Congress – Plant Protection towards the Third Millenium: when Chemistry meets Ecology. Jerusalem, July 1999.

Relevant abstracts include:

Joel, D.M. Long-term approach for parasitic weeds control: manipulation of specific developmental mechanisms of the parasite. (p. 44)
Plakhine, D. *et al.* Effect of imidazolinone herbicides on early development stages of *Orobanche aegyptiaca*. (p. 126)
Kleifeld, Y. Management and control of *Orobanche* and *Cuscuta*. (p. 45)
Antonova, T.S. Review of common traits in sunflower resistance to different pathogens. (p. 45)
Eizenberg, H. *et al*. Resistance mechanisms of sunflower (*Helianthus annus*) to *Orobanche cumana*. (p. 77)
Goldwasser, Y. *et al.* Anatomical studies of *Vicia atropurpurea* resistance to *Orobanche aegyptiaca*. (p. 81)
Ransom, J. Cultural, chemical and biological control of *Striga* in sustainable agriculture. (p. 45)
Oswald, A. *et al.* On-farm research and training of farmers' groups on *Striga* control using a participative approach.
Oswald, A. *et al.* Crop rotation to reduce *Striga* and increase overall productivity in maize-based cropping systems. (p. 74)
Odhiambo, G.D. and Ransom, J. Effect of organic and inorganic sources of nitrogen on control of *Striga hermonthica* and on soil fertility for higher maize productivity in Western Kenya. (p. 73)
Abayo, G.O. *et al.* Effect of short-term improved fallow on *Striga* infestation in maize. (p. 103)
Kanampui. F.K. *et al.* Herbicide seed dressings of corn bearing ALS target-site resistance with ALS-inhibiting herbicides for witchweed control. (p. 122)
Bedi, J.S. *et al.* Efficacy of a *Fusarium oxysporum* formulation for the control of *Orobanche cumana*. (p. 70)
Weinberg, Ts. *et al.* Response of *Cuscuta campestris* to herbicide inhibitors of carotenoid biosynthesis. (p. 117)
Nof, E. *et al.* Biological control of field dodder by a pathogenic fungus. (p. 109)

N.B. Abstracts of these papers are usefully reprinted in Phytoparasitica (2000) 28: 171-177.

Third International Weed Science Congress – IWSC. Foz do Iguassu – June 6 to 11, 2000. Abstracts.

Edited by Anne Lgère. 301 pp.

Relevant abstracts include:
(abstract number in brackets)

Goldwasser *et al.* Control of *Orobanche* spp. in potato. (278) pp 131-132.
Kanampui *et al.* Herbicide seed dressing of corn as an appropriate treatment for *Striga* control while allowing intercropping. (282). pp. 133-134.
Canevari, M. and Colbert, D. Post emergence control of *Cuscuta pentagona* in alfalfa hay. (288). pp. 136-137.
Kroschel, J. and Klein, O. Natural impact and potential for biological control of two selected antagonists of the parasitic weeds *Orobance* spp. and *Cuscuta* spp. (366). p. 174.

Watson, A.K. *et al.* *Striga* biocontrol - obstacles overcome. (371). pp. 176-177. (NB. see full abstract above.)

Elzein, A. *et al.* Effect of storage temperature, granule size, and inoculum type on the viability of *Fusarium oxysporum*, a pathogen of *Striga hermonthica*, encapsulated in wheat-kaolin ("Pesta") granules. (377). pp. 179-180.

Braghouthi *et al.* Effect of bacteria on broomrape seed germination. (385). pp. 183-184.

Riches, C.R. Improved weed management for resource poor farmers: constraints and opportunities. (392). p. 187.

Kroschel, J. *Striga*: a joint challenge to science, extension and farmers. (395). pp. 188-189.

Eplee, R.E. and Norris, R. Eradication of *Striga asiatica* from the United States. (442). p. 212.

Labrada, R. An overview of parasitic weed control. (538). p. 260.

Gbèhounou, G. – *Striga* control by restoring soil fertility. (539). pp. 260-261.

Odhiambo, G.D. Progress on *Striga hermonthica* control in East Africa. (540) p. 261.

Joel, D.M. Prospects for *Orobanche* control in the 21st century. (541). pp. 261-262.

Oswald, M. *et al*. Interaction of plant growth promoting rhizobacteria (PGPR) with maize and *Striga hermonthica* (Del.) Benth. seeds. (543) p. 262.

Oswald, A. *et al.* Linking research, extension and farmers: *Striga* control strategies for western Kenya. (544.) p. 263.

Saghir, A.R. New possibilities for *Cuscuta* management in some vegetable crops. (545). p. 263.

Babiker, A.G.T. *et al.* Conditioning, CO_2 and GR24 influence ethylene biosynthesis and germination of *Striga hermonthica*. (546). p. 264.

Ndung'u, D.K. *et al.* Effect of fodder legumes on stimulation, attachment and emergence of *Striga hermonthica* on maize. (547). p. 264.

LITERATURE

Abanvou, L. and Doku, E.V. 1998. Heritability of traits associated with striga (*Striga hermonthica* (Del.) Benth.) resistance in an open-pollinated maize population. African Crop Science Journal 6: 129-135.

Adler, L.S. 2000. Alkaloid uptake increases fitness in a hemi-parasitic plant via reduced herbivory and increased pollination. The American Naturalist 156: 92-99. (*Castilleja indivisa* grown on near-isogenic lines of *Lupinus albus* with low and high levels of alkaloid. Presence of lupanine in *C. indivisa* growing on high-alkaloid *L. albus* reduced damage from larvae of *Junonia coenia* and other moth larvae and increased seed set by 50% due to preference of the pollinating humming bird for undamaged plants.)

Aigbokhan, E.I., Berner, D.K., Musselman, L.J. and Mignouna, H.D. 2000. Evaluation of variability in *Striga aspera, Striga hermonthica* and their hybrids using morphological characters and random amplified polymorphic DNA markers. Weed Research 40: 375-386. (Results confirm that the two species are genetically distinct. Hybrids are morphologically intermediate but closer to the maternal parents genetically. Some evidence for existence of naturally occurring hybrids in Nigeria.)

Albrecht, H., Yoder, J.I. and Phillips, D. 1999. Flavonoids promote haustoria formation in the root parasitie *Tryphysaria versicolor*. Plant Physiology 119: 585-591.

Amsellem, Z., Zidack, N.K., Quimby, P.C. and Gressel, J. 1999. Longterm dry preservation of viable mycelia of two mycoherbicidal organisms. Crop Protection 18: 643-649. (Studies on *Fusarium oxysporum* and *F. arthosporioides*.)

Arditti, J. and Ghani, A.K.A. 2000. Tansley Review No. 110. Numerical and physical properties of orchid seeds and their biological implications. New Phytologist 145: 367-421. (No mention of parasitic plants but the beautiful illustrations show remarkable parallels with *Orobanche* and *Striga* in their ornamentation and especially with *Alectra* in their tubular structure. See also refs to McKendrick *et al.* in the same issue.)

Babiker, A.G.T., Ma, Y., Sugimoto, Y. and Inanaga, S. 2000. Conditioning period, CO_2 and GR24 influence ethylene biosynthesis and germination of *Striga hermonthica*. Physiologia Plantarum 109: 75-80. (Results are consistent with a model in which conditioning removes a restriction on the ethylene biosynthetic pathway in *S. hermonthica* seeds: GR24 modulates the key enzymes in ethylene biosynthesis: germination results from joint action of GR24 and the ethylene it induces.)

Barandiarn,, X., Moral, R., Gil, J. and Moreno, M.T. 1999. (The effect of the reduced form of glutathione (GSH) on the germination and growth of *Orobanche crenata*.) (in Spanish) In: SEMh Congreso Sociedad Espa⁄ola de Malherbologa, Actas, Logro⁄o, Spain 1999: 145-149.

Baumgartner, J.R., Al-Khatib, K. and Currie, R.S. 1999. Cross-resistance of imazethapyr-resistant common sunflower (*Helianthus annuus*) to selected imidazolinone, sulphonylurea and triazolopyrimidine herbicides. Weed Technology 13: 489-493. (Reporting that the naturally occurring imazethapyr resistant sunflower shows high resistance also to imazamox. cf refs to Alonso *et al.* in Haustorium 35 and Al-Khatab *et al.* in Haustorium 34.)

Benharrat, H., Delavault, P., Theodet, C., Figureau, C. and Thalouarn, P. 2000. *rbcL* plastid pseudogene as a tool for *Orobanche* (subsection Minores) identification. Plant Biology 2(1): 34-39. (Studies of the pseudogene and associated morphological characters lead to a new key for separation of *O. hederae, O. minor, O. amethysta* and *O. loricata*.)

Bhan, V.M. and Sushi Kumar. 1998. Weed science research in India. Indian Journal of Agricultural Science 68: 567-582. (Briefly reviews the limited work in India on management of parasitic weeds by solarisation, cultural, chemical and biological control.)

Box, J.D. 2000. Mistletoe *Viscum album* L. (Loranthaceae) on oaks in Britain. Watsonia 23: 237-256. (Detailed history of *V. album* records on *Quercus* spp. in Britain. Currently just 11 examples are known, mainly on *Q. robur*.)

Briggs, J. 1999. Kissing goodbye to mistletoe? The results of a national survey aimed at discovering whether mistletoe in Britain is in decline. A joint report from Plantlife – The Wild-Plant Conservation Charity and the Botanical Society of the British Isles. Plantlife, London, 20 pp. (A summary will be included in the next issue.)

Bringmann, G., Schlauer, J., Rckert, M., Wiesen, B., Ehrenfeld, K., Proksch, P. and Czygan, F.C. 1999. Host-derived acetogenins involved in the incompatible parasitic relationship between *Cuscuta reflexa* (Convolvulaceae) and *Ancistrocladus heyneanus* (Ancistrocladaceae). Plant Biology 1: 581-584. (The naphthoquinone plumbagin demonstrated to be one of the factors involved in dieback of *C. reflexa* after attachment to *A. heyneanus*.)

Calladine, A. and Pate, J.S. 2000. Haustorial structure and functioning of the root hemiparasitic tree *Nuytsia floribunda* (Labill.) R.Br. and water relationships with its hosts. Annals of Botany 85: 723-731. (Describing in new detail the structure and function of the 'cutting device' of *L. floribunda* and demonstrating uptake of water from the xylem of the host *Acacia acuminata*.)

Calladine, A., Pate, J.S. and Dixon, K.W. 2000. Haustorial development and growth benefit to seedlings of the root hemiparasitic tree *Nuytsia floribunda* (Lobill.) R.Br. in association with various hosts. Annals of Botany 85: 733-740. (Over a 12 month period *N. floribunda* growth was roughly proportional to the number and weight of haustoria developing on roots of a range of 23 woody host species. Some evidence for uptake of N from the nodulated hosts *Acacia cyclops* and *C. acuminata*.)

Carsky, R.J., Berner, D.K., Oyewole, B.D., Dashiell, K. and Schulz, S. 2000. Reduction of *Striga hermonthica* parasitism on maize using soybean rotation. International Journal of Pest Management 46: 115-120. (In 2 out of 3 field trials, soyabean grown in year 1 resulted in 50-70% lower *S. hermonthica* numbers in maize in year 2 compared with sorghum in year 1. Some evidence for greater effect of soyabean at higher densities and with added P to increase root development but as *Striga* was allowed to seed in sorghum, exact benefit difficult to judge.)

Caruso, C.M. and Alfaro, M. 2000. Interspecific pollen transfer as a mechanism of competition: effect of *Castilleja linariaefolia* pollen on seed set of *Ipomopsis aggregata*. Canadian Journal of Botany 78: 600-606.

Chatterjee, U. and Sanwal, G.G. 1999. Purification and properties of a protein from *Lantana camara* activating *Cuscuta reflexa* cellulase. Phytochemistry 52: 361-366.

Chou ChengJen, Ko HauChieh and Len LieChwen. 1999. Flavonoid glycosides from *Viscum alniformosanae*. Journal of Natural Products 62: 1421-1422. (Two new flavonoid glycosides identified from *V. alniformosanae* in Taiwan.)

Ciotola, M., Ditommaso, A. and Watson, A.K. 2000. Chlamydospore production, inoculation methods and pathogenicity of *Fusarium oxysporum* M12-4A, a biocontrol for *Striga hermonthica*. Biocontrol Science and Technology 10: 129-145. (Reporting studies on production, longevity and germination of *F. oxysporum* isolate from Mali, as influenced by nutrients, sorghum root exudate, etc. Successful reduction of *Striga* by use of 0.5-1 g chalmydospore powder per hill.)

Conaghan, J. 1998. *Orobanche hederae* Duby. in East Donegal (H34). Irish Naturalists' Journal 269(3/4): 136.

Cullings, K. 2000. Reassessment of phylogenetic relationships of some members of the Monotropoideae based on partial 28S ribosomal RNA gene sequencing. Canadian Journal of Botany 78: 1-2. (Reporting results at variance with the author's previous conclusions on the subject.)

Debabrata Das, Ghosh R.B. Avik Dutta and Maji, U.K. 1999. A census on the hosts of *Cuscuta reflexa* Roxb. in the district of lateritic Bankura, West Bengal. Environment and Ecology 17: 763-764. (Fifteen host species listed.)

Debabrata Das, Ruma Hazra, Avik Dutta and Maji, U.K. 1999. Systematic enumeration and taxonomic survey of host-plants of *Cuscuta reflexa* Roxb. in Purulia district, West Bengal. Environment and Ecology 17: 479-480. (Of 32 hosts listed from 22 families, most were trees or shrubs and only one a monocot.)

Deeks, S.J., Shamoun, S.F. and Punja, Z.K. 1999. Tissue culture of parasitic flowering plants: methods and applications in agriculture and forestry. In Vitro Cellular Development and Biology – Plant 35: 369-381. (A comprehensive review of the literature covering tissue culture of parasitic plants from 23 genera in 7 families and discussing the potential value of such studies.)

Deliorman, D., Calis, I., Ergun, F. and Tamer, U. 1999. The comparative studies on phenylpropanoid glycosides of *Viscum album* subspecies by high performance liquid chromatography. Journal of Liquid Chromatography and Related Technologies 22: 3101-3114. (Comparing content of syringin, coniferin and kalopanaxin D in the 3 subspecies *album, abietis* and *austriacum* of *Viscum albium* in Turkey.)

de Luque, A.P., Galindo, J.C.G., Macias, F.A. and Jorrin, N. 2000. Sunflower sesquiterpene lactone models induce *Orobanche cumana* seed germination. Phytochemistry 58: 45-50. (Parthenolide and a related lactone stimulate germination of *O. cumana* at 1 mg/l but did not stimulate *O. crenata, O. ramosa* or *O. aegyptiaca*.)

Daz-Snchez, J., L⁄pez-Granados, F. and Garca-Torres, L. 1999. (Absorption and transloaction of propyzamide applied to the crop seed, and of imazapyr and glyphosate applied post-emergence to sunflower, as affected by parasitism of nodding broomrape (*Orobanche cumana*).) (in Spanish) In: SEMh Congreso Sociedad Espa⁄ola de Malherbologa, Actas, Logro⁄o, Spain 1999: 329-333.

Elzein, A.E.M., Kroschel, J., Assefa Admasu and Masresha Fetene. 1999. Preliminary evaluation of *Phytomyza orobanchia* (Diptera: Agromyzidae) as a controller of *Orobanche* spp. in Ethiopia. Sinet, an Ethiopian Journal of Science 22(2): 271-282. (At one location, Matima, *P. orobanchia* found to destroy 81 and 72% of capsules of *O. ramosa* and *O. cernua* respectively, on tomato. It was not found at 2 other sites.)

Erenst, M. and Scheffler, A. 1999. Photohaemolytic activity of chlorophyll degradation products in a mistletoe extract. Planta Medica 65: 627-631. (Involving *Viscum album*.)

Foley, M.J.Y. 2000 A morphological comparison between some British *Orobanche* species (Orobanchaceae) and their closely-related non-British counterparts from continental Europe: *Orobanche reticulata* Wallr. *s.l.* Watsonia

23: 257-267. (Concluding that *O. reticulata s.l.* from lowland Britain is distinct from, but close to that from continental European mountain areas, and suggesting that the British form be referred to as ssp. *procera* (Koch) Dostl.)

Garca, M.A. 1999. *Cuscuta* subgenus *Cuscuta* (Convolvulaceae) in Ethiopia, with the description of a new species. Annales Botanici Fennici 36: 165-170. (A study of the *Cuscuta* spp. in Ethiopia concluded that *C. approximata* and *C. pedicellata* do not occur, but a new endemic species *C. castroviejoi* is described.)

Gebremedhin, W., Goudriaan, J. and Naber, H. 2000. Morphological, phenological and water-use dynamics of sorghum varieties (*Sorghum bicolor*) under *Striga hermonthica* infestation. Crop Protection 19: 61-68. ((Detailed comparison of susceptible var. IS9302 and resistant var. SRN39 in pots.)

Goldwasser, Y., Plakhine, D., Kleifeld, Y., Zamski, E. and Rubin, B. 2000. The differential susceptibility of vetch (*Vicia* spp.) to *Orobanche aegyptiaca*: anatomical studies. Annals of Botany 85: 257-262. (Germination of *O. aegyptiaca* and penetration into the cortex occurs in both susceptible *V.* sativa and resistant *V. atropurpurea* but in the latter there is no penetration of the endodermis, associated with production of an unidentified secretion.)

Goldwasser, Y., Plakhine, D. and Yoder, J.I. 2000. *Arabidopsis thaliana* susceptibility to *Orobanche* spp. Weed Science 48: 342-346. (*A. thaliana* shown to stimulate germination and support development of *O. aegyptiaca, O. ramosa* and *O. minor* but not *O. crenata* and *O. cumana.*)

Gonzlez-Andjar, J.L., Martnez-Cob, A., L✍pez-Granados, F. and Garca-Torres, L. 1999. (Spatial distribution of crenate broomrape (*Orobanche crenata*) in faba bean: geostatistical analysis.) (in Spanish) SEMh Congresso 1999: Sociedad Espa⁄ola de Malherbologa, Actas, Lagro⁄o, Spain, 1999, pp. 139-143. (Results of spherical modelling revealed an aggregate distribution of *O. crenata* population with a patch size of 10 m.)

Gowda, B.S., Riopel, J.L. and Timko, M.P. 1999. *NRSA-1*: a resistance gene homolog expressed in roots of non-host plants following parasitism by *Striga asiatica* (witchweed). Plant Journal 20: 217-230. (Growth of *S. asiatica* was blocked in cortex of non-host *Tagetes minuta* with development of browning and necrosis: this was associated with expression of the nuclear gene *NRSA-1* which showed relationship to genes for disease resistance in other species.)

Gworgwor, N.A., Anaso, A.B.J., and Turaki, Z.G. 1998. Integrated cultural practices for *Striga* control in millet-based cropping systems. In: Emechebe, A.M., Ikwelle, M.C., Ajayi, O., Aminu-Kano, M. and Anaso, A.B.J. (Eds.) Pearl Millet in Nigerian Agriculture: Production, Processing and Research Priorities, pp. 87-97. (Discussing a range of cultural practices.)

Haidar, M.A. and Sidahmed, M.M. 2000. Soil solarization and chicken manure for the control of *Orobanche crenata* and other weeds in Lebanon. Crop Protection 19: 169-173. (Effect of chicken manure apparently greater than that of solarization on *O. crenata* on faba bean in pots, but methodology not clear, and fate of faba bean not reported.)

Haussmann, B.I.G., Hess, D.E., Koyama. M.L., Grivet, L., Rattunde, H.F.W. and Geiger, H.H. 2000. Breeding for *Striga* Resistance in Cereals. Proceedings of a Workshop held at IITA, Ibadan, Nigeria, from 18-20 August 1999. ICRISAT/Margraf Verlag, Germany, 376 pp. (See above for availability and a list of contents, and Haustorium 36 for a detailed report of this meeting.)

Haussmann, B.I.G., Hess, D.E., Welz, H-G. and Geiger, H.H. 2000. Improved methodologies for breeding striga-resistant sorghums. Field Crops Research 66: 195-211. (An extended review article.)

Hess, D.E. and Fernndez-Rivera, S. 2000. A note on the chemical composition, intake and digestion of *Striga hermonthica* herbage by sheep. Weed Research 40: 351-358. (*S. hermonthica* had relatively high levels of N and P but possible problems from high ash and seed transmission need to be addressed before promoting utilization of hand-pulled plants by sheep.)

Hollier, J. and Briggs, J. 1999. The specialist Hemiptera associated with mistletoe. British Journal of Entomology and Natural History 12: 237-239. (Species collected included the psyllid *Psylla visci*, the mirid *Orthops viscicola* and the tortricid *Celypha woodiana*; also the cimicid *Anthocoris visci,* a predator feeding only on *P. visci*.)

Huhta, A-P., Tuomi, J. and Rautio, P. 2000. Cost of apical dominance in two monocarpic herbs, *Erysimum strictum* and *Rhinanthus minor*. Canadian Journal of Botany 78: 591-599. (Apical damage had negligible effect on vegetative biomass or fecundity of *R. minor*.)

IDRC. 2000. Biological warfare. IDRC Annual Report 1998-1999. pp. 36-39. (Giving a very encouraging summary of progress in the use of *Fusarium oxysporum* for control of *Striga hermonthica* in Mali, including the production of the inoculum at the village level.)

Ihl, B. and Wiese, K. 2000. (Studies on *Cuscuta reflexa* Roxb.: VIII. Mechanical induction of haustoria formation in non-twining stems of the parasite.) (in German) Flora (Jena) 195(1): 1-8. (Haustoria could be induced on the sub-apical zone of the stem. The possible involvement of an interaction between IAA and cytokinin is discussed.)

IWSS. 2000. Abstracts, Third International Weed Science Congress – IWSC, Foz do Iguassu, Brazil, 2000. International Weed Science Society. 301 pp. (See above for listing of relevant abstracts.)

Janssen, T. and Wulf, A. 1999. (On the significance of mistletoes for forest protection.) (in German) Mitteilungen aus der Biologischen Bundenstalt fr Land- und Forstwirtschaft, Heft 369, 142pp. (*Loranthus europaeus* is only of importance in parts of Austria; forms of *Viscum album* are more widespread, the most important being *V. album* var. *abietis*. *Arceuthobium* spp. are of no significance in Europe at present but the extreme damage they cause in N. America fully justifies the current quarantine legislation in Europe.)

Joel, D.M., Aviv, D., Surov, T., Portnoy, T., Goldman-Guez, T. and Gressel, J. 1999. Transformation of crops to herbicide-resistance and their use against parasitic weeds. In: Altman, A. *et al*., (eds.) Plant Biotechnology and *in vitro* Biology in the 21st Century. Kluwer Academic Publishers, The Netherlands, pp. 499-502. (Reporting promising control of *Orobanche aegyptiaca* with asulam applied post-emergence to asulam-resistant potato; also with glyphosate applied as a seed dressing to glyphosate-resistant rapeseed.)

Joel, D.M., Herschenhorn, J., Goldman-Guez, T., Cohen, E., Lovan, Y. and Portnoy, V.H. 2000. Grafted host plants for broomrape (*Orobanche* spp.) control. Abstracts, Weed Science Society of America, 40: 71-72. (Susceptible sunflower and pepper, grafted onto resistant root-stocks were fully protected.)

Joel, D.M., Plakhine, D., Creanje, P., Dupuis, J.M., Kamodo, J. and Gressel, J. 2000. Broomrape (*Orobanche aegyptiaca* Pers.) control using asulam-resistant seeds coated with asulam. Abstracts, Weed Science Society of America, 40: 57. (Asulam-resistant tobacco grew normally in *Orobanche*-infested soil, while unprotected plants died.)

Juan, R., Pastor, J. and Fernndez, I. 2000. SEM and light microscope observations on fruit and seeds in Scrophulariaceae from Southwest Spain and their systematic significance. Annals of Botany 86: 323-338. (Includes key for identification to genus level via fruit/seed characteristics. Parasitic genera covered include *Bellardia* (SEM of seed of *B. trixago*), *Parentucellia, Bartsia, Odontites* and *Pedicularis*.)

Kanampiu, F.K., Friesen, D.K., Ransom, J.K. and Gressdel, J. 2000. Intercropping is not precluded when ALS herbicide-coated corn seed is used for controlling *Striga*. Abstracts, Weed Science Society of America, 40: 7-8. (No effect on crops planted 15 cm away from maize seed treated with imazapyr or pyrithiobac.)

Karim, S.M.R., Mamun, A.A. and Islam, N. 1999. Agroecology of major crops and their weeds in Bangladesh. Pakistan Journal of Scientific and Industrial Research 42: 295-300. (*Striga densiflora* and *Orobanche indica*, 'newly introduced to the country', are severely damaging sugar cane and mustard respectively.)

Karnakowski, W. 1999. (Notifiable weeds and parasitic plant material imported into Poland during 1996-99.) (in Polish)

Ochrana Rolin 44(12): 15, 33.

(Summarising interception of notifiable weeds including *Cuscuta, Orobanche* spp.)

Kasembe, E., Chivinge, O.A., Mariga, I.K. and Mabasa, S. 1999. The effect of time of ridging on witchweeed (*Striga asiatica* (L.) Kuntze) emergence, density and maize grain yield in the small-holder farming sector of Zimbabwe. Journal of Plant Protection in the Tropics 12: 15-26.

Kebreab, E. and Murdoch, A.J. 1999. Predicting *Orobanche* seed longevity for better weed management in legumes. Grain Legumes No. 23 – 1st quarter 1999: 8-9. (Longevity of seeds greatly reduced at higher temperatures and/or higher moisture.)

Kebreab, E. and Murdoch, A.J. 2000. The effect of water stress on the temperature range for germination of *Orobanche aegyptiaca* seeds. Seed Science Research 10: 127-133. (Optimum germination temperature was 17-26^{o}C at high water potential, somewhat lower, 17-20^{o}C with a decrease in water potential.)

Kelly, C.K. and Horning, K. 1999. Aquisition order and resource value in *Cuscuta attenuata*. Proc. National Academy of Sciences of the United States of America 96: 13219-13222. (*C. attenuata* shown to grow more vigorously when parasitising more than one host simultaneously.)

Kim, S.K., Akintunde, A.Y. and Walker, P. 1999. Responses of maize inbreds during development of *Striga hermonthica* infestation. Maydica 44: 333-339. (Pot experiments with massive inoculation of *S. hermonthica* seeds suggested that 'tolerance' was correlated with tendency to increased root weight in presence of *Striga*, e.g. in Corn Belt inbred B73 and in inbred Per, based on the perennial *Zea diploperennis*.)

Kranz, B. 1999. (Importance of organic manure for the germination and development of the parasitic flowering plant *Striga hermonthica* (Del.) Benth.) (in German) Agroecology No. 2: 130 pp. (A thesis exploring the importance of organic matter in the lower occurrence of *S. hermonthica* in fertile 'compound' fields compared with less fertile 'bush' fields, and concluding that N is more important than OM in reducing germination of *Striga* but OM may have other less direct beneficial effects.)

Kuehn, J.J. 1999. (Long term favourable course of a case of centroblastic-centrocytic non-Hodgkin lymphoma under administration of an extract of mistletoe (*Viscum album*).) (in German) Deutsche Medizinische Wochenschrift 124: 1414-1418. (Treatment with the *V. album* extract 'Iscador' over a 12 year period held extensive lymphomas in check. Interruption of treatment led to deterioration.)

Ladley, J. J., Kelly, D. and Robertson, A. W. 1997. Explosive flowering, nectar production, breeding systems and pollinators of New Zealand mistletoes (Loranthaceae*)*. New Zealand Journal of Botany 35: 345-360. (The pollination syndromes of 5 species of mistletoe; *Alepis flavida*, *Ileostylus micranthus, Peraxilla colensoi*, *P. tetrapetala* and *Tupeia antarctica*, are described.)

Ladley, J. J., Kelly, D. and Norton, D. A. 1997. A guide to hand-planting New Zealand mistletoes (Loranthaceae). New Zealand Botanical Society Newsletter*,* 16-19. (General guide to hand–planting mistletoe seeds.)

Lammi, A., Siikmaki, P. and Salonen, V. 1999. The role of local adaptation in the relationship between an endangered root hemiparasite *Euphrasia rostkoviana* and its host, *Agrostis capillaris*. Ecography 22: 145-152. (Little evidence for better performance of *E. rostkoviana* when parasitising local populations of the host *A. capillaris* rather than populations from elsewhere.)

Lffler, C., Czygan, F.C. and Proksch, P. 1999. Role of indole-3-acetic acid in the interaction of the phanerogamic parasite *Cuscuta* and host plants. Plant Biology 1: 613-617. (*C. reflexa* on tomato causes elongation of cells in host tissue, apparently due to IAA from the parasite, associated with elongation of epithelial cells in parasite haustorial tissue.)

Lu, Y.H., Melero-Vara, J.M., Garca-Tejada, J.A. and Blanchard, P. 2000. Development of SCAR markers linked to the gene *Or5* conferring resistance to broomrape (*Orobanche cumana* Wallr.) in sunflower. Theoretical and Applied Genetics 100:

625-632. (A contribution to more efficient use of resistance genes in sunflower.)
McKendrick, S.L., Leake, J.R., Taylor, D.L. and Read, D.J. 2000. Symbiotic germination and development of myco-heterotrophic plants in nature: ontogeny of *Corallorhiza trifida* and characterization of the mycorrhizal fungi. New Phtylogist 145: 523-537. (See following item.)

McKendrick, S.L., Leake, J.R. and Read, D.J. 2000. Symbiotic germination and development of myco-heterotrophic plants in nature: transfer of carbon from ecytomycorrhizal *Salix repens* and *Betula pendula* to the orchid *Corallorhiza trifida* through shared hyphal connections. New Phytologist 145: 539-548. (Two excellent papers challenging the use of the term 'saprophytic' for the orchid *C. trifida* and confirming the importance of transfer of carbon from the indirect hosts *S. repens* and *B. pendula* via ectomycorrhizal fungi. Should we be treating them as parasitic plants?)
Marinescu, A. and Pacureanu-Joita, M. 1998. (Sunflower wild species – sources for resistance to the parasite *Orobanche cumana* Willd.) (in Romanian) Probleme de Genetica Teoretica si Aplicata 30(1/2): 67-72.
Marler, M., Pedersen, D., Mitchell-Olds, T. and Calaway, R.M. 1999. A polymerase chain reaction method for detecting dwarf mistletoe infection in douglas fir and western larch. Canadian Journal of Forest Research 29: 1317-1321. (A PCR technique described for detecting *Arceuthobium douglasii* and *A. laricis* in the tissues of hosts *Pseudotsuga menziesii* and *Larix occidentalis*.)
Marshall, K. and Filip, G.M. 1999. The relationship of Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*) to stand conditions and plant associations in the southern Cascade Mountains, Oregon. Northwest Science 73: 301-311.
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Rao, P.N. and Basavaraju, G. 1999. Hemi- and holoparasites in species of *Cuscuta* Linn. a case of adaptive biodiversity. Paper presented at National Symposium on Microbial and Plant Diversity, Hyderabad, India, March 1999. (*C. santapui*, closely related to, or conspecific with *C. reflexa,* shows significant photosynthetic ability.)

Regalado, G.G. 1998. (The family Loranthaceae (mistletoes) of the state of Aguascalientes, Mexico.) (in Spanish) Polibotnica No 7: 1-14. (Identification, distribution and host ranges of *Phoradendron* and *Psittacanthus* spp. described, the most widespread being *Ph. forestierae*, on *Quercus* spp.)

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Robertson, A. W., Kelly, D., Ladley, J. J. and Sparrow, A. D. 1999. Effects of pollinator loss on endemic New Zealand Mistletoes (Loranthaceae). Conservation Biology 13: 499-508. (Describes how low numbers of pollinating honeyeaters leads to lower fruit set in *Peraxilla colensoi* and *P. tetrapetala*.)

Sanchez, P.A. 1999. Improved fallows come of age in the tropics. In: Buresh, R.J. and Cooper, P.J.M. (eds.) The science and practice of short-term improved fallows. Selected papers from an International Symposium, Lilongwe, 1997. Agroforestry Systems 47(1/3): 3-12. (Including comment on the value of improved fallows in control of *Striga* spp.)

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New Zealand of *Ileostylis micrantha* on nine hosts and *Tupeia antarctica* on *Carpodetus serratus* and analysis of the reason for the parasite in all cases having lower CO_2 assimilation suggested that the parasites have photosynthetic characteristics of shade plants.)

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Traor, D., Vincent, C. and Stewart, R.K. 1998. Circadian activity of *Smicronyx guineanus* Voss, a potential biocontrol agent of *Striga hermonthica* (Del.) Benth. Insect Science and its Application 18(3): 205-210. (Adult weevils mainly active during daytime and spend 85% of time on the upper parts of the plant.)

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Westbrooks, R.C. and Eplee, R.E. 2000. Discovery of small broomrape (*Orobanche minor*) in clover production areas of Oregon. Abstracts, Weed Science Society of America, 40: 130-131. (Two fields infested: implications for the high value clover seed crop discussed.)

Westwood, J.H. and McDowell, J.M. 2000. Egyptian broomrape (*Orobanche aegyptiaca* Pers.) parasitization of disease resistant mutants of *Arabidopsis thaliana*. Abstracts, Weed Science Society of America, 40: 35. (Evidence that *Orobanche* parasitism in *A. thaliana* does not trigger signal transduction pathways leading to hypersensitive response.)

Yokota, T., Sakai, H., Okuno, K., Yoneyama, K. and Takeuchi, Y. 1998. Alectrol and orobanchol, germination stimulants for *Orobanche minor*, from its host red clover. Phytochemistry 49: 1967-1973. (An important first report of the stimulant orobanchol, regrettably not noted earlier in Haustorium.)

Young, N.D., Steiner, K.E. and de Pamphilis, C.W. 1999. The evolution of parasitism in Scrophulariaceae/ Orobanchaceae: plastid gene sequences refute an evolutionary transition series. Annals of the Missouri Botanical Garden 86: 876-893. (Analysis of plastid *rps2* and *matK* suggest that *Lathraea, Harveya* and *Hyobanche* are not after all transitional between the hemi-parasitic Scrophulariaceae and the holo-parasitic Orobanchaceae but arose independently. At the broader level it is suggested that the Orobanchaceae, the parasitic Scrophulariaceae, and *Lindenbergia* be defined as Orobanchaceae.)

HAUSTORIUM 37
has been edited by Chris Parker, 5 Royal York Crescent, Bristol BS8 4JZ, UK (Email chrisparker5@compuserve.com) and Lytton J Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk Virginia 23529-0266, USA (fax 757 683 5283; Email lmusselm@odu.edu). Send material for publication to either author.

Preparation of this issue and maintenance of the website have been assisted by John Terry, Michail Semenov and others at Long Ashton Research Station, Bristol, UK.

Those interested in membership of the new International Parasitic Plant Society please send the following form to Danny Joel at:
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HAUSTORIUM BY EMAIL AND THE WEB

We are pleased to acknowledge that Old Dominion University is continuing to support the printing and mailing of Haustorium.

Many readers are already receiving Haustorium by Email. If any more of you wish to do so, please let Chris Parker know (Email address on the last page). Bear in mind that having an electronic version of the newsletter enables you to 'search'. If you cannot receive Email, or for any reason wish strongly to go on receiving hard copy, you will continue to receive by airmail.

The web-site version of this and future Haustorium issues will no longer be posted on the Long Ashton Research Station site but on Lytton Musselman's Plant site – see Websites below.

SEVENTH INTERNATIONAL PARASITIC WEED SYMPOSIUM

The 7th International Symposium will be held in Nantes, France from 5-8 June, 2001. Although the title refers to 'Weed', all aspects of parasitic plants will, as always, be covered, including academic and non-agricultural topics. The organisers report that about 100 abstracts have now been offered, including many with new and interesting information, and the editing process has begun. A provisional programme will be established in February. Those who have not already received a copy of the second circular for this major meeting should contact Patrick Thalouarn, Laboratoire de Cytopathologie Vegetale, University de Nantes, 2, Rue de la Houssinière, BP 92208, F44322 Nantes, Cedex 3, France. Email: ipws@svt.univ-nantes.fr

PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

The proposal under this title has now been approved by EU as COST Action 849, subject to acceptance and signatures from 5 participating countries. There will then be a Management Committee formed by 2 members from each country who will appoint a Chairman, and leaders for each working group. Contrary to the impression given by the note in Haustorium 37, funds will not be available for research or equipment, only for organisation and travel costs involved in co-ordination, meetings and conferences. And the total of 25 million ECU mentioned in that note is an estimate of the total budget for all activities being co-ordinated, including the (non-EU) research funds of individual projects. It is NOT the budget available from EU! The editor apologises for that misleading information.

The main objective of the Action is to increase understanding of the interaction between parasitic plants and their hosts in order to implement sustainable means of control. Activities will include annual meetings of the working groups, scientific conferences, publication of proceedings, establishment of a homepage on the internet, and short-term scientific missions, e.g. allowing exchange of staff between projects for training. Four working groups are envisaged on: Biology and ecology of parasitic plants, Parasitic plant–pathogen and -pest interactions, Genetic resistance, and Integrated control. Annual conferences will focus on Biology of parasitic plants, Management measures, Resistance to parasitic plants, Biocontrol of parasitic plants, and in year 5, a final Evaluation meeting.

Dr Diego Rubiales of CSIC, Cordoba, Spain, is to be congratulated on his success in bringing the process this far towards fruition. Those interested in receiving more information may contact him by email at ge2ruozd@uco.es

RECENT RESEARCH ON *HYDNORA*

Few plant families are as intriguing as the Hydnoraceae, a small family of two genera. *Prosopanche* is entirely New World and consists of three known species. *Hydnora*, on the other hand, is African with at least four well described species: *H. abyssinica (=H. johannis*), *H. africana, H. triceps*, and *H. esculenta.* The first species, *H. abyssinica*, is widespread across Africa and more or less restricted to *Acacia* species as hosts. Little is known of *H. esculenta*, a Madagascar endemic(?) which may be extirpated. *Hydnora africana* is frequent in the succulent karoo vegetation of southern Africa where it parasitises shrubby species of *Euphorbia* spp. Most remarkable of this fascinating lot is *H. triceps*.

It was first described by Drège in 1833 from material collected near Okiep in Namaqualand in the Northwestern Cape region of South Africa and has been seen only a few times since. Our colleague, Professor Johann Visser, who spent the last part of his life studying parasitic plants in southern Africa, rediscovered *H. triceps* in 1988—more than 150 years after Drège and more than a century since anyone at all had seen it! He found it not far from Okiep. In a survey of herbaria, Visser found that the species had been collected less than ten times. All collections are within a short radius of Okiep. Tragically, Visser died shortly after his discovery. I was fortunate to relocate Visser's site in September 1999 and 2000.

The results of my 1999 work, in collaboration with Piet Vorster of Stellenbosch University, are summarized on the *Hydnora* page of my web site: web.odu.edu/plant (scroll down to *Hydnora*). We located approximately 25 populations at one site. In 2000, I located two additional sites. It is not possible to determine if all the parasites associated with a single plant of the host *Euphorbia dregana* are a single plant or many plants. In addition to its morphological specialization and very restricted distribution, *H. triceps* has the remarkable feature of flowering underground. Hypogeous flowering is extremely rare in the angiosperms. Best known and documented is the Australian orchid genus *Rhizanthella*. *Hydnora triceps* may be the only dicot with subterranean flowering. It is well adapted for this behavior.

Like a pile-driver in reverse, the perianth lobes are united to form a piston that can crack the soil crust as the flower expands. In this way, sand does not enter the flower. Under normal conditions, the flower never emerges. Its only evidence is a crack in the soil surface and, if fresh, a disgustingly fetid odor. The only link between the nether world and pollinators is a distinctive vent-like opening, formed by the perianth lobes which are pink when fresh. Among the plants of the succulent karoo, only *Stapelia* (Asclepiadaceae) has flowers which are borne at soil level and have a pollination syndrome involving carrion favoring insects. Despite its soil borne existence, *H. triceps* probably depends on flying insects for pollination. No fruits of *H. triceps* have been described.

The region where *H. triceps* is in the succulent karoo which is characterised by the highest species richness for any semi-arid vegetation. It is also characterized by a high rate of endemism, exceeding 50%. Climatically, this biome is characterized by low (20-290 mm year) but reliable rainfall, chiefly in the winter. The dominant plants in the sandy soil of these low hills are shrubby species of *Euphorbia*.

Two factors threaten the existence of *H. triceps*. The most immediate and devastating is widespread diamond mining in the region. Large tracts of land on both sides of the Orange River are designated diamond areas. The second threat to *H. triceps* is less obvious but just as insidious. Virtually all the area outside the mining preserve is used for grazing sheep and cattle. Ranchers routinely poison raptors and jackals because they eat young sheep. Our preliminary hypothesis is that jackals harvest the fruits and distribute the seeds. This is supported by the frequency of excavated roots and old flowers at the base of the host. In addition, fruits of *H. africana* are reported to be distributed by jackals.

With Dr Erika Maass, Department of Biology, University of Namibia and Piet Vorster, we are surveying the Orange River populations of *E. dregeana* for additional stands of *H. triceps*, which is certainly among the rarest plants in the succulent karoo.

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SANTALUM ALBUM IN SRI LANKA

Research on parasitic plants in Sri Lanka is scant despite there being a total of 57 parasitic species belonging to 22 genera and 8 families in the Sri Lankan flora (see Tennakoon and Weerasuriya, 1998). A remarkable 30% of these species are endemic to Sri Lanka.

This article summarizes some research findings from 2 projects on the economically important woody root hemiparasite *Santalum album* L. (Santalaceae). *S. album*, sandalwood, is widely used in Sri Lanka as a medicinal (ayurvedic) product. It is also used for woodcarving and as a source of oil for perfumes and cosmetics. The 2 projects involved an examination of propagation techniques, and the establishment of high value sandalwood tree plantation systems with community participation in Sri Lanka. The research has been conducted by K. U. Tennakoon, E. R. L. B. Etampawala C. V. S. Gunatilleke, I. A. U. N. Gunatilleke and S. P. Ekanayake, all of the Department of Botany, University of Peradeniya, Sri Lanka.

Results of a preliminary PCR (polymerase chain reaction) study carried out to ascertain the genetic variability between the "original" Indian and Sri Lankan *S. album* varieties showed no distinct variation in the DNA banding patterns. However, results of this study are not yet conclusive and need to be repeated several times using different primers and different seed sources.

Natural stands of *S. album* in six localities in Sri Lanka were found to be associated mostly with hosts belonging to the family Fabaceae. However, shrub and host species belonging to the families Verbenaceae, Meliaceae and Lauraceae were also found to be natural hosts for *S. album*. Studies on the vegetative characters of *S. album* grown in different localities suggest that fruit and seed parameters change with the environmental conditions, while leaf parameters remain constant at all sites. Treating seeds with 0.075% gibberellic acid after two months of dormancy period was found to be the best method to enhance the germination rate of *S. album* to over 80%. Interestingly *S. album* seeds found in Sri Lanka showed a high germination rate (>70%) even without any pre-treatment in contrast to the low germination rates (about 30-40%) reported for seeds collected in India and Australia (see Surendran *et al.,* 1998). The best soil substratum for the autotrophic pre-parasitic stage of *S. album* seedlings was found to be sand, top soil and farm yard manure mixed in equal proportions. This clearly suggests that pre-parasitic *S. album* seedlings utilise nutrients from the growing medium in addition to the original seed reserves.

A detailed nine-month pot culture study showed that the best hosts for the growth of *S. album* were *Mimosa pudica* and *Tithonia diversifolia* when compared with a range of other leguminous and non-leguminous herbs and shrubs examined (see Tennakoon, Ekanayake and Etampawala 2000). The growth performance of *S. album* seedlings when grown with many annual leguminous crops such as of *Phaseolus aureus* and *P. mungo* were poor, mainly because these host plants complete their life cycles in less than one year and the resulting *S. album* haustoria have no chance to obtain nutrients continuously over a long period of time. Vesicular arbuscular mycorrhizal (VAM) infections were observed in *S. album* roots. However the intensity of VAM parasitism was very low in the parasitic *S. album* roots that had formed haustoria and attached to a host root when compared with *S. album* roots that were not attached to a host. To unravel the complexities associated with *S. album*-host associations, we intend to further study the solute transfer between hosts and *S. album* via intimate haustorial connections, carbon and nitrogen partitioning between the partners of different host-parasite associations, and the mechanisms that under-pin the regulation of host-derived xylem-borne solutes to the parasite.

Financial support from Community Environment Initiative Facility implemented by the Environment Action 1Project of the Ministry of Forestry and Environment (under a World Bank Fund) and the Sri Lanka Conservation and Sustainable Use of Medicinal Plants Project of the Ministry of Health and Indigenous Medicine are gratefully acknowledged.

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BUILDING A SPECIALISED DICTIONARY: A CALL FOR ASSISTANCE

A lexicographer and language teacher working in the teaching of scientific communication, I set out in 1996 to try and build a specialised dictionary covering the area of parasite plant research, the task is not yet finished as many theoretical issues remain to be solved, and I again need your help.

Modern lexicographic research is based on corpora, carefully selected collections of texts in electronic format that represent a given field. In 1996 I was working on a project doing just this, which is why Patrick Thalouarn intervened on my behalf in Cordoba. The texts collected are not treated individually, but are studied using computational routines so as to find regularities of usage and present them for analysis by a human lexicographer. I am now working on the dictionary itself, but need to update my collection of texts, and go further.

After the Cordoba conference I did not get copyright permission to use all the texts, which means that some areas were under-represented. So, as the 2001 meeting is in Nantes and I shall be present I would like to have your permission to include all your texts in a new database. If anyone wishes to give retroactive permission for earlier meetings I am still interested, as I would like to follow terminological usage over time. In addition if you have texts that you have published elsewhere I would be interested as scanning is very fastidious and editors not always forthcoming with permission.

One of the features of conference papers is that the published proceedings differ from what is actually said. This is because spoken and written discourse strategies differ. I, along with teacher/researcher colleagues in the UK and Hungary would like to study these differences so as to help young researchers speak at conferences. The aim would be to record the proceedings in Nantes and compare the written and spoken, again using computers. This is a long-term project as we are all heavily involved in teaching, and, like you, receive little funding for our research.

More information can be found on my personal website http://perso.wanadoo.fr/geoffrey/wiliams

I shall distribute a copyright agreement at the conference itself. Should you wish for more information before then, please do not hesitate to contact me at: geoffrey.williams@ wanadoo.fr

Geoffrey Clive Williams. Université de Bretagne Sud. France.

WEBSITES

For Lytton Musselman's Plant site (including past and current issues of Haustorium) see: http://web.odu.edu/plant

For information on the 7th International Parasitic Weed Symposium at Nantes, 2001 see: http://www.sciences.univ-nantes.fr/scnat/biologie/GPPV.web

For Dan Nickrent's 'The Parasitic Plant Collection' see: http://www.science.siu.edu/parasitic-plants/index.html

For IITA *Striga* Research Methods: a Manual, see: http://www.cgiar.org/iita

For news from Canada of progress with biocontrol techniques for *Striga* see: http://www.mcgill.ca/media/releases/1999/december/weedkiller/

For a complete copy of Hawksworth, F.G. and Wiens, D. 1996. Dwarf Mistletoes: Biology, Pathology and Systematics. USDA Agricultural Handbook 709 (now out of print) see: http://www.rmrs.nau.edu/publications/ah_709

LITERATURE

Adetimirin, V.O., Kim, S.K. and Aken'Ova, M.E. 2000. Expression of mature plant resistance to *Striga hermonthica* on maize. Euphytica 115: 149-158. (Comparison of 12 maize genotypes in plots uninfested or infested with *S. hermonthica*. Best hybrid, 9012-12, suffered 25% reduction in dry matter v. 60% in susceptible, 8338-1.)

Anil, V.S. and Sankara Rao, K. 2000. Calcium-mediated signaling during sandalwood somatic embryogenesis. Role for exogenous calcium as second messenger. Plant Physiology 123: 1301-1311. (re *Santalum album*.)

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Bayaa, B., El-Hossein, N. and Erskine, W. 2000. Attractive but deadly. ICARDA Caravan 21: 16. (Noting that *Orobanche crenata* has caused decline in lentil growing in Mediterranean region. No varietal resistance yet found. Best results from integrated packages involved delayed planting with short-season varieties and herbicides imazethapyr and imazapic.)

Bedi, J.S. and Sauerborn, J. 1999. A new technique for chlamydospore production by *Fusarium oxysporum orthoceras*, a new mycoherbicidal agent for *Orobanche cumana.* Plant Disease Research 14: 207-209. (Best results obtained with a liquid V-8 culture medium, supplemented with sodium sulphate and exposure to nutrient stress.)

Bres, J., Fischl, G. and Mikuls, J. 2000. Biological weed control with fungal pathogens in Hungary. In: Haas, H.V. and Hurle, K.J. (eds.) Proceedings 20th German Conference on Weed Biology and Weed Control, Stuttgart, 2000. pp. 667-670. (Noting limited success in studies with *Fusarium* spp. against *Orobanche* spp.)

Bewick, T.A., Porter, J.C. and Ostrowski, R.C. 2000. Field trial results with Smolder: a bioherbicide for dodder control. (abstract) Proceedings, Northeastern Weed Science Society 54: 66. (Bioherbicide based on *Alternaria destruens* at 10^{10} viable conidia/acre reduced *Cuscuta* spp. in cranberry and carrot by at least 90%. Experimental use permit being sought.)

Chanika C.S.M., Abeyasekera, S., Ritchie, J.M., Riches, C.R., Mkandawire, C.B.K., Mputeni, H., Makina, D. and Daudi, A.T. 2000. On-farm trials of technologies for the management of *Striga asiatica* in Blantyre/Shire Highlands. In: Integrated Crop Management Research in Malawi: Developing Technologies with Farmers. Proceedings of the Final Project Workshop, Mangochi, 1999. pp. 216-225. (Reporting substantial benefits to maize yields from application of 50 kg N/ha or green manuring with *Tephrosia vogelii*.)

Chanika C.S.M., Abeyasekera, S., Ritchie, J.M., Riches, C.R., Mkandawire, C.B.K., Mputeni, H., Makina, D. and Daudi, A.T. 2000. Initial results from small-scale use of *Tephrosia* and *Crotalaria* in intercropping experiments in Blantyre/Shire Highlands. In: Integrated Crop Management Research in Malawi: Developing Technologies with Farmers. Proceedings of the Final Project Workshop, Mangochi, 1999. pp. 256-262. (Including reference to experiments described in Chanika *et al*., above, but reporting a wider range of studies.)

Chikoye, D., Manyopng, V.M. and Ekeleme, F. 2000. Characteristics of speargrass (*Imperata cylindrica)* dominated fields in West Africa: crops, soil properties, farmer perceptions and management strategies. Crop Protection 19: 481-487. (*Striga* spp. important weeds for only 4% of farmers in the coastal/derived and southern Guinea savanna zones of S. Nigeria, Cote'd'Ivoire and Benin with rainfall of 900-1500 mm per annum.)

Costello, D.A., Lunt, I.D. and William, J.E. 2000. Effects of invasion by the indigenous shrub *Acacia sophorae* on plant composition of coastal grasslands in south-eastern Australia. Biological Conservation 96: 113-121. (Reduction in grazing and burning has favoured invasion by *Acacia sophorae*, threatening the 'nationally threatened herb' *Thesium australe*.)

Davies, D.M. and Graves, J.D. 2000. The impact of phosphorus on interactions of the hemiparasite angiosperm *Rhinanthus minor* on its host *Lolium perenne*. Oecologia 124: 100-106. (In pots, high P greatly favoured the host at the expense of the parasite, at least partly by reducing attachment success.)

Dobbertin, M. 1999. Relating defoliation and its causes to premature tree mortality. In: Forster, B, Kniek, M. and Grodski, W. (eds.) Methodology of forest insect and disease survey in Central Europe. Proceedings of the 2nd Workshop of the IUFRO Working Party 7.03.10, Switzerland, 1999. pp. 215-220. (Mistletoe infestation, presumably by *Viscum* *album*, included among factors contributing to mortality of *Pinus sylvestris*.)

Dozet, B., korić, D. and Marinković, R. 1999. Sunflower breeding for resistance to broomrape (*Orobanche cumana* Wallr.). Helia 22(3): 125-135. (Race E of *O. cumana* is becoming troublesome in Yugoslavia. The Or_5 gene with resistance to race E has been found in a number of lines including L-414.)

Dzerefos, C.M., Shackleton, C.M. and Witkopwski, E.T.F. 1999. Sustainable utilization of woodrose-producing mistletoes (Loranthaceae) in South Africa. (Socio-economic study suggests a viable, sustainable market for wood-roses formed by *Pedistylis galpinii* and *Erianthemum dregei*.)

Fineran, B.A. and Calvin, C.L. 2000. Transfer cells and flange cells in sinkers of the mistletoe *Phoradendron macrophyllum* (Viscaceae), and their novel combination. Protoplasma 211: 76-93. (Reporting novel anatomical features, apparently associated with loading and unloading of substances passing from host to parasite.)

Gagne, G., Roekel-Drevet, P., Grezes-Besset, B., Shindrova, P., Ivanov, P., Grand-Ravel, C., Vear, F., Charmet, G. and Nicolas, P. 2000. Amplified fragment length polymorphism (AFLP) as suitable markers to study *Orobanche cumana* genetic diversity. Journal of Phytopathology 148: 457-459. ('AFLP markers gave a higher degree of resolution for discriminating closely related germplasm than RAPD.')

Gbèhounou, G., Pieterse, A.H. and Verkleij, J.A.C. 2000. Endogenously induced secondary dormancy in seeds of *Striga hermonthica*. Weed Science 48: 561-566. (Results with seeds stored dry under laboratory conditions suggest a pronounced endogenous rhythm leading to secondary dormancy in the dry season – but variations in storage temperature and humidity not fully discounted?)

Guba, R. 2000. Sweet healing. Letter to New Scientist No. 2262. 28 October 2000. p. 54. (Noting that among essential oils with antibiotic action against *Salmonella aureus,* that from Australian sandalwood, *Santalum spicatum* is active at 0.1.mg/l.)

GuoFengGen and Li Yanghan. 2000. (Effect of spore germination and pathogenicity of parasitic fungi on dodders by solvent and temperature.) (in Chinese) Chinese Journal of Biological Control 16: 81-83. (Reporting effects of sucrose, Tween 80 and temperature on germination and pathogenicity of *Alternaria alternata, Pestalotiopsis guepinii* and *Fusarium semitectum* on *Cuscuta japonica*.)

Gwo-Ing Liao, Ming-Yih Chen and Chang-Sheng Kuoh. 2000. *Cuscuta* L. (Convolvulaceae) in Taiwan. Taiwania 45: 226-234. (4 species recorded – *C. australis, C. chinensis, C. japonica* and *C. campestris,* the latter repeatedly collected since 1964 but only now correctly identified – previously called *C. australis* or *C. chinensis*. No mention of hosts or crop damage.)

Hadfield, J.S. 1999. Douglas-fir dwarf mistletoe infection contributes to branch breakage. Western Journal of Applied Forestry 14(1) 5-6. (Survey in Washington State, USA, confirmed that branches infected by *Arceuthobium douglasii* are more likely to break – of concern in public access areas, such as campsites, etc.)

Hassan, E.A., Satour, M.M. and El-Awadi, M.E. 1999. Biological control of parasitic weeds: broomrape-pathogen interactions. Proceedings, 11th European Weed Research Society Symposium: 90. (Studies on the reaction of tubercles of *Orobanche* sp.(not specified) to *Trichodesma* and *Fusarium* spp. (also not specified).)

Haussmann, B.I.G., Hess, D.E., Reddy, B.V.S., Welz, H.G. and Geiger, H.H. 2000. Analysis of resistance to *Striga hermonthica* in diallel crosses of sorghum. Euphytica 116: 33-40. (Showing poor correlation between stimulant exudation, as determined by the agar gel assay, and *Striga* emergence in the field. Lines recommended for use in a breeding programme include low stimulant lines IS9830, M.35-1 and 555, and the high stimulant N.13.)

Hershey, D.R. 1999. Myco-heterophytes and parasitic plants in food chains. American Biology Teacher 61: 575-578. (Discussing nutrition of parasitic, saprophytic and carnivorous plants and their location in the food chain.)

Ibrahim, H.M. and Zaitoun, F.M. 1999. Effect of infection with *Orobanche crenata* and time of planting on resistant and susceptible faba bean genotypes. Proceedings, 11th European Weed Research Society Symposium: 28. (Yields of faba bean reduced 20-77% by infestation with *O. crenata*: var. X123A gave lowest yields in absence of *Orobanche* but highest when infested.)

IITA. 2000. Integrated management of *Striga* and other parasitic pests. International Institute of Tropical Agriculture Annual Report 1999. pp. 50-51. (Two *Striga*-tolerant vars of maize, EV DT-W 99 STR CO and TZEW-PopX1368STR CO 'showed superior performance' in regional trials on *S. hermonthica*.)

IDRC. 1000. Biological warfare. International Development Research Centre Annual Report 1998-1999. pp. 36-38. (Reporting the promising results with *Fusarium* for biocontrol of *Striga* as summarised in Haustorium 37 pp. 3-4.)

Jafarzadeh, N. and Pourmirza, A.A. 1999. (A study on the biology of *Phytomyza orobanchiae* Kalt. under laboratory and field conditions in Urmia (Iran.) (in Persian) Iranian Journal of Agricultural Sciences 30: 791-798. (A detailed record of the life cycle of *P. orobanchiae*, which completes 4 generations per year in Urmia, and affects 45% of *Orobanche* capsules.)

Joel, D.M. 2000. Long-term approaches to parasitic weeds control: manipulation of specific developmental mechanisms of the parasite. Crop Protection 19: 753-758. (A full version of the paper presented to the XIVth International Plant Protection Congress, noted in Haustorium 37.)

Joshi, J., Matthies, D. and Schmid, B. 2000. Root hemiparasites and plant diversity in experimental grassland communities. Journal of Ecology 88: 634-644. (*Rhinanthus alectrolophus* sown in mixture with various combinations of grass, legume and non-legumes. Parasite biomass greatest in most diverse mixtures. Grasses reduced more than other hosts. Total biomass unaffected in diverse communities but increased when only 1 or 2 hosts present.)

Kabambe, V.H. and Mloza-Banda, H. 2000. Options for management of witchweeds in cereals for smallholder farmers in Malawi. In: Integrated Crop Management Research in Malawi: Developing Technologies with Farmers. Proceedings of the Final Project Workshop, Mangochi, 1999. pp. 210-215. (Summarising farmer understanding of the biology of *Striga asiatica* in Malawi and the potential for integrated control in maize, involving fertiliser, crop rotation, inter-cropping and resistant varieties.)

Keyes, W.J., O'Malley, R.C., Kim, D. and Lynn, D.G. 2000. Signalling organogenesis in parasitic angiosperms: xenognosin generation, perception and response. Plant Growth Regulation 19: 217-231. (Detailed study of the sequence of events of haustorial initiation, involving release of H_20_2 by the parasite root tip stimulating generation of xenognostic quinones from the host root surface.)

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Kim, S.K. 2000. Tolerance: an ideal co-survival crop breeding system of pest and host in nature with reference to maize. Korean Journal of Crop Science 45:(1): 59-71. (Includes reference to *Striga*.)

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Lados, M. 1999. (Effect of temperature, pH and host plant extract on the germination of *Cuscuta trifolii* and *C. campestris* seeds.) (in Hungarian) Nvnytermeles 48: 367-376. (Following sulphuric acid treatment optimum temperatures for germination were 18-26^{0}C for *C. trifolii* and 16-32^{0}C for *C. campestris*.)

Mainjeni, C.E.D. and C.R. Riches. 2000. Resistance to the yellow witchweed, *Alectra vogelii* Benth., in common bean and cowpea in Malawi. Integrated Crop Management Research in Malawi: Developing Technologies with Farmers. Proceedings of the Final Project Workshop, Mangochi, 1999. pp. 226-233. (Pot experiments revealed apparently useful variation in susceptibility of *Phaseolus vulgaris* to *A. vogelii*, local variety Mkhalira showing high resistance, while complete resistance was shown by cowpea var. B359 ex Botswana.)

Mbwaga, A.M., Kaswende, J. and Shayo, E. 2000. A Reference Manual on *Striga* Distribution and Control in Tanzania. SIDA/FAO – FARMESA Programme, P.O. Box Ilonga, Kilosa, Tanzania. 26 pp. (**Erratum** – NB Tanzania not Zimbabwe -

apologies for incorrect title in Haustorium 37.)

Merkel, U., Peters, M., Tarawali, S.A., Schultze-Kraft, R. and Berner, D.K. 2000. Characterization of a collection of *Aeschynomene histrix* in subhumid Nigeria. Journal of Agricultural Science 134: 293-304. (Suggesting some promise for the use of *A. histrix* as a forage with potential as a trap crop for *Striga hermonthica*.)

Mutikainen, P. Salonen, V., Puustinen, S. and Koskela, T. 2000. Local adaptation, resistance , and virulence in a hemiparasite plant-host interaction. Evolution 54: 433-440. (Studies with different populations of *Rhinanthus serotinus* and *Agrostis capillaris* showed varying virulence, but failed to confirm the coevolution of local adaptation of parasites to their sympatric hosts.)

Nava-Daz, C., Osada-Kawasoe, S., Rendón-Snchez, G. and Ayola-Escobar, V. 2000. Organisms associated with cherimoya (*Annona cherimola* Mill.) in Michoacn, Mxico. Agrociencia 34: 217-226. (*Psittacanthus* sp. recorded on branches of *A. cherimola*.)

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Par, J. and Raynal-Roques, A. 1999. Embryology, taxonomy and evolution of parasitic flowering plants. Acta Biologica Cracoviensia. Series Botanica 41: 85-94.

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Pieterse, A.H. 1998. Integrated control of the parasitic weed *Striga* at small-scale farmer level in Africa. In: Risopoulos, S. (ed.) Summary of Reports of European Commission-supported STD-3 Projects (1992-1995). CTA, Wageningen. pp. 79-84. (Summarising the wide-ranging research projects conducted between 1992 and 1996 by groups in Burkino Faso, Mali, Senegal, Kenya, France, The Netherlands and UK.)

Press, M.C. and Gurney, A.L. 2000. Plant eats plant: sap-feeding witchweeds and other parasitic angiosperms. Biologist 47: 189-193. (A well-illustrated, up-to-date, general review.)

Radomiljac, A.M., McComb, J.A. and Pate, J.S. 1999. Organic solute transport and assimilation in *Santalum album* L. (Indian sandalwood): intermediate host partnerships involving beneficial and non-beneficial hosts. Annals of Botany 83: 215-224. (In pot experiment with *S. album* on nitrogen-fixing *Acacia* spp. and *Eucalyptus camaldulensis*, water relations of the parasite resembled those of a water-stress-tolerant species. Photosynthesis lower than in corresponding hosts: transpiration similar.)

Radomillac, A.M., McComb, J.A., Pate, J.S. and Tennakoon, K.U. 1998. Xylem transfer of organic solutes in *Santalum album* L. (Indian sandalwood) in association with legume and non-legume hosts. American Journal of Botany 82: 675-682. (Amino acids were similar in host and parasite when growing on legumes *Acacia trachycarpa* and *A. amphiceps* but rather different when on *Eucalyptus camaldulensis*. Sugars in the *S. album* are mainly fructose.)

Ransom, J. Long-term approaches for the control of *Striga* in cereals: field management options. Crop Protection 19: 759-763. (A full version of the paper presented to the XIVth International Plant Protection Congress, noted in Haustorium 37, emphasising the significance of 'suppressive soils' in the demise of *S. hermonthica* seed banks and the contribution of organic matter and fertilisers in inducing suppressiveness.)

Renner, S.S. and Chanderbali, A.S. 2000. What is the relationship among Hernandiaceae, Lauraceae and Monimiaceae, and why is the question so difficult to answer? International Journal of Plant Science 161 (6 Suppl.): S109-S119.

Shaw, D., Freeman, E.A. and Mathiasen, R.L. 2000. Evaluating the accuracy of ground-based hemlock dwarf mistletoe rating: a case study using the Wind River Canopy Crane. Western Journal of Applied Forestry 15: 8-

14. (Using a crane to survey *Arceuthobium tsugense* infestations of Douglas fir and western hemlock apparently gave more accurate results than those from ground-based observers.)

Smith, D. 2000. The population dynamics and community ecology of root hemiparasitic plants. American Naturalist 155: 13-23. (Modelling the ecology of parasitic plants and their relationships in different host communities.)

Verkleij, J.A.C. and Kuiper, E. 2000. Various approaches to controlling root parasitic weeds. Biotechnology and Development Monitor 41: 16-19. (Review of current methods and possibilities for use of transgenic techniques.)

Warburton, C.L., James, E.A., Fripp, Y.J., Trueman, S.J. and Wallace, H.M. 2000. Clonality and sexual reproductive failure in remnant populations of *Santalum lanceolatum* (Santalaceae). Biological Conservation 96: 45-54. (Scattered populations of *S. lanceolatum* shown to be single clones, spreading vegetatively but with very little sexual reproduction due to pollen sterility or self-incompatibility.)

Westwood, J.H., Foy, C.L. and Tolin, S.A. 1999. Movement of tobacco mosaic virus in host parasite systems involving Egyptian broomrape (*Orobanche aegyptiaca*). (abstract) Proceedings, Southern Weed Science Society 52: 221-222. (TMV not detected in parasite tissues after infection of host.)

Wilson, J.P., Hess, W.W. and Hanna, W.W. 2000. Resistance to *Striga hermonthica* in wild accessions of the primary gene pool of *Pennisetum glaucum*. Phytopathology 90: 1169-1172. (Screening of 274 lines suggested that *Striga* emergence was negatively correlated with downy mildew incidence. No significant differences in stimulant activity.)

Yoneyama, H. and Sugimoto, K. 1999. (The present situation of damage by parasitic weeds and the agriculture of the Sudan.) (in Japanese) Chemical Regulation of Plants 34: 116-118. (Noting the importance of *Striga hermonthica* and *Orobanche ramosa* and trials with triclopyr for control of the former.)

Zaitoun, F.M. and Ibrahim, H.M. 1999. Effect of planting date and faba bean genotypes on *Orobanche crenata*. Proceedings, 11th European Weed Research Society Symposium: 29. (Apparently based on the same experiments reported by Ibrahim and Zaitoun, 1999 - see above.)

Zonno, M.C., Montemurro, P. and Vurro, M. 2000. (*Orobanche ramosa*, un'infestante parassita in espansione nell'Italia meridionale.) (in Italian) Informatore Fitopatalogico 50: 13-21. (Describing the biology and spread of *O. ramosa* in numerous horticultural crops and tobacco in southern Italy, and measures for its control.)

HAUSTORIUM 38

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// HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Seed Plant Research Group

August 2001 **Number 39**

STATUS OF HAUSTORIUM

Our banner still refers to the International Parasitic Seed Plant Research Group, but since the meeting in Nantes and creation of the new International Parasitic Plant Society (IPPS) we expect this newsletter in due course to become an organ of that new society. Discussions are in progress with the officers of IPPS but for the meantime we continue to function on behalf of the old 'Research Group', while adding all members of IPPS to our mailing list.

We are pleased to acknowledge that Old Dominion University is continuing to support the printing and mailing of Haustorium.

Many readers are already receiving Haustorium by Email. If any more of you wish to do so, please let Chris Parker know (Email address on the last page). Bear in mind that having an electronic version of the newsletter enables you to 'search'. If you cannot receive Email, or for any reason wish to go on receiving hard copy, you will continue to receive by airmail.

The web-site version of this issue and past numbers of Haustorium are now available on http://web.odu.edu/haustorium, and on the IPPS site – see Websites below.

7TH INTERNATIONAL PARASITIC WEED SYMPOSIUM

The 7th International Parasitic Weed Symposium was held in Nantes, France from 5-8 June and proved a worthy successor to its distinguished forerunners. Over 130 delegates from 25 countries met in the Faculté des Sciences of Nantes University and enjoyed 4 days of presentations in excellent facilities. Over 100 papers were delivered requiring the novelty of concurrent sessions. This was a problem for some of us generalists in the subject, but was eased by most platform papers being supported by posters. The coverage of the papers was 50% on *Orobanche*, 34% on *Striga*, 6% on *Cuscuta* and 10% on others.

Several of the sessions on Biology, Ecology, Evolution, Taxonomy and Phylogeny and a later one on Methodologies were dominated by the new technologies available for studying the more basic aspects of parasitic plants and the ways they differ from non-parasites. Jim Westwood provided a valuable review of the techniques and terminology involved in molecular biology, with emphasis on applications to the study of parasitic plants. This also included a challenge to participants to think about which - if any - parasitic species would make a good model for studying genomics of parasitic plants.

The application of molecular techniques was again in evidence in several presentations on the subject of systematics and evolution. Schneeweiss described the use of nuclear ribosomal DNA sequences to clarify relationships in the *Orobanche* sect. Trionychon, while Nickrent and Malécot used both ribosomal DNA and rbcL sequences to refine the phylogeny of the Santalales. Román *et al.* reported the efficacy of RAPD markers to differentiate among *Orobanche* species from

Southern Spain, and in a separate paper suggested that variation within the species *O. foetida* was correlated with host preference as well as geographic distances. A recent DNA fingerprinting technique, the inter simple sequence repeat (ISSR), was applied for the first time to parasitic plant research, and was able to distinguish among and within *Orobanche* species (Benharrat *et al.*). This approach appears to hold promise for other studies.

Other presentations related to parasite evolution included work by Delavault *et al.*, in which evidence was presented for evolutionary movement of an *O. cumana* plastid gene into the nucleus. A consequence of this finding is the identification of a key difference between this species and the closely related *O. cernua*. Along this same line, studies of plastid function in photosynthetic and nonphotosynthetic *Cuscuta* species indicated that nonchlorophyllous species lack ribosomes, although they were found to retain at least one ribosomal gene (van der Kooij *et al.*). Evidently the transcriptional ability of some *Cuscuta* species has been lost from the plastid, which is thus dependent on nuclear-encoded polymerase (Berg *et al.*). Finally, the evolution of aerial parasitism was discussed by Fineran, and an intriguing paper by Raynal-Roques correlated advances in parasitism with a simplified life cycle and juvenile characteristics.

Mechanisms of parasitism were addressed by Yoder *et al.*, who reported the cloning of two quinone oxidoreductase-like genes from *Triphysaria versicolor* that are induced in response to DMBQ. These genes are proposed to operate in the mechanism of haustorium formation, an idea made all the more interesting by the finding that these genes have homologs in non-parasitic species and thus may have evolutionary implications. Jamison and Yoder also reported heritable variation in DMBQ responsiveness in *T. versicolor* species.

Host response to parasitism was discussed by Neumann *et al.*, who presented histological evidence of defence responses in interactions of three Scrophulariaceae species with their host. Griffitts *et al.* reported much the same for *Orobanche* parasitism of tobacco, but used evidence from host gene expression to show a shift in metabolism from normal growth to defence responses.

A special section at this symposium was devoted to methodologies for studying parasitic plants. Mohammed at al. described two laboratory assays for *Striga* research, the Extended Agar Gel and Paper Roll techniques, that could be used directly or adapted to other parasite species for facilitating characterisation of resistant host phenotypes. Aly *et al.* reported that transgenic crops expressing an anti-bacterial protein showed increase resistance to *Orobanche*, demonstrating the potential of using genetically modified host plants. An emerging trend at this Symposium was the use of mutagenesis, especially in conjunction with *Arabidopsis*, for investigating aspects of parasitism. This approach was employed in research projects directed at identifying germination or haustorium stimulant mutants in T-DNA tagged *Arabidopsis* (Atanasova *et al.*), germination stimulants in irradiated lines of *Arabidopsis* (Goldwasser and Yoder), and *Orobanche* resistance in EMS-mutagenized tobacco (Slavov *et al.*). Although some promising results were presented, all of these projects are young and will require time to confirm any putative mutants identified. It will be very interesting to see what emerges from this work by the time of the next symposium.

Papers which helped to reinforce our understanding of the germination process included new approaches to the identification of the biosynthetic pathways of germination stimulants for *Orobanche* (Denev *et al.*); the complex of interactions between GR24, ethylene, its precursors and carbon dioxide in *Striga* germination (Babiker *et al.*; Sugimoto *et al.*; Mohammed *et al.*); and corresponding interactions between gibberellins, GR24 and ethylene in *Orobanche* germination (Zehhar and Fer). Zwanenburg and Reizelman described an approach to identifying the strigolactone receptor using both fluorescent- and biotin-labelled stimulants. Although it has not yet yielded a candidate receptor, the approach is very exciting.

Physiological studies included two on the importance of mannitol (Simier *et al.*). Pageau *et al.* described how the need to cope with excess nitrate by converting it to asparagine may contribute to the reduced the vigour of *Striga* under nitrogen-rich conditions. Joel *et al.* described detailed studies on the penetration of tissues by haustoria of *Cuscuta*

There were a large number of papers on the topic of Resistance. Relatively few promised fully resistant new varieties but Rubiales *et al.* reported progress towards resistance to *Orobanche crenata* in pea; Sillero *et al.* identified sources of *Orobanche*-resistance in wild *Lathyrus* spp., of potential value for grass pea (*L. sativus*) while Rich *et al.* reported corresponding availability of *Striga*-resistance among wild *Sorghum* spp. New genes for resistance to *Striga gesnerioides* were reported by Dub *et al.* in local varieties HTR and Wango-1 in Niger. Resistance to *Striga* in *Tripsacum*, for possible transfer to maize, is being explored by Gurney *et al.* but the levels of resistance so far are low. The problem of *Orobanche cumana* continues to present a severe challenge to plant breeders but an inbred line with resistance to *O. cumana* type F in Spain was reported by Rodriguez-Ojeda *et al.*, while work in Bulgaria reported by Batchvarova *et al.* shows promise with the use of mutagenesis and interspecific hybridization in *Helianthus* spp., and Buschmann *et al.* claimed success in inducing systemic acquired resistance (SAR) with the use of a commercially available benzothiodiazole compound 'Bion'. Resistance to glyphosate was the aim of a study by Nadal *et al.* who reported striking results with a new determinate faba bean 'Retaca'.

Otherwise, understanding of resistance mechanisms, and the biochemical and genetic basis for these, was significantly advanced by a range of papers from the Nantes group, while marker-assisted selection of *Striga* resistance in sorghum and in cowpea is brought nearer by the work reported by Haussman *et al.* and Oedraogo *et al.,* respectively.

A number of papers on biological control included a progress report by Norambuena *et al.* on the project to use *Phytomyza orobanchia* against *Orobanche* in Chile; and several on various aspects of the use of *Fusarium* spp. on both *Orobanche* and *Striga*. A new approach was reported by Ahonsi *et al.* involving the selection of fluorescent pseudomonad bacteria for their suppression of *S. hermonthica* germination. These organisms are apparently responsible for suppressing *Striga* under normal field conditions. They can provide useful results when applied as seed dressings to maize, at least in sterilised soils. The hope is that highly suppressive strains will prove beneficial in normal soils.

Reports on control methods for *Striga* in the field were none too numerous but encouraging results were reported on the selection and promotion of *Striga*-resistant varieties of sorghum in Tanzania (Mbwaga *et al.*); on the use of rotations and relay cropping in sorghum in Ethiopia (Fasil Reda *et al.*; Ltourneau *et al.*); and on inter-cropping in millet in Nigeria (Gworgwor *et al.*). Of greatest interest was the report from Kenya of the striking suppressive effects on *Striga hermonthica* from intercropping maize with *Desmodium uncinatum* (Khan *et al.*). Studies so far suggest a pronounced allelopathic influence not evident with other leguminous inter-crops. Other novel observations included those from Gworgwor and Weber concerning the unexplained but almost complete suppression of *S. hermonthica* under the canopy of the leguminous tree *Faidherbia (Acacia) albida*; and from Lendzemo and Kuyper on the apparent suppression of *S. hermonthica* by arbuscular mycorrhiza. Integrated methods suitable for parts of West Africa were described by Hess *et al.*

For *Orobanche* there has been progress in the selection of herbicide treatments suitable for tomato (Eizenberg *et al.*; Plakhine *et al.*), and in the development of treatments exploiting herbicide-resistant tobacco (Valkov *et al.*) and herbicide-resistant maize (Kanampiu *et al.*).

The Proceedings include 124 papers, though just over half of these are in the form of one-page summaries only. There is an index of authors and a delegate index with email addresses. See below for full contents.

One session of the meeting was devoted to the formal establishment of the new International Parasitic Plant Society and election of officers – see below.

A range of enjoyable social events and excursions were arranged for delegates and their spouses and the city of Nantes provided a fine background to all our activities. Andr Fer and Patrick Thalouarn and all their colleagues at Nantes are to be thanked and congratulated on a highly successful meeting.

Chris Parker and Jim Westwood.

IPPS

THE INTERNATIONAL PARASITIC PLANT SOCIETY

The first General Assembly of the International Parasitic Plant Society was held in Nantes, France, during the International Parasitic Weed Symposium on June 4, 2001. At this meeting the General assembly approved the Constitution, elected the IPPS officers, and introduced the Board of Directors.

About one hundred people attended the inauguration of the IPPS, and many more expressed their wish to become members and to take part in the activities of the new Society. The founders of the Society (Danny Joel, Jim Westwood, Jos Verkleij, Patrick Thalouarn and Andr Fer) felt the need for a more formal framework for the activities of the parasitic plant working groups, that deals with all various aspects of parasitism in plants, and in particular with the biology and control of parasitic weeds. We thought that a formal society might allow a more intensive collaboration, exchange of information, and research coordination in this highly intriguing and economically important field. During the Albena *Orobanche* Workshop in 1998 a significant number of participants were supportive to this idea. The establishment of the IPPS was a very long process that started shortly after that. We discussed the objectives of the society, and in July 2000 we met in Nantes to discuss the Constitution. Then the IPPS had to be officially registered and a bank account opened. We are pleased to announce that the Society is now fully registered in Amsterdam as a non-profit scientific and educational society.

The first action that the new society chose to take was the formal acknowledgement of the immense contribution of the former International Parasitic Seed Plant Research Group that was led for many years by two distinguished members of our community, Lytton Musselman and Chris Parker. In special ceremonies during the Nantes meeting the IPPS awarded Chris and Lytton as the first Honorary Members of the Society "in commemoration of a career of extraordinary contribution to the community of parasitic plant research".

In addition, the Deputy Mayor of Nantes awarded a medal to Siny terBorg for her distinguished contribution in the field of parasitic weed research, during the formal reception in the Town Hall.

Finally, a website for the new society has been established at http://www.ppws.vt.edu/IPPS/. As the society grows, this will expand to serve as a source of information for parasitic plant researchers and the general public.
Now that all formalities have been met we are about to discuss our future activities, and need to start routine activity in order to get the IPPS into action. The only way the IPPS can really contribute to all members according to its objectives is by having direct communication between the members and the officers. We urge everybody not to hesitate to correspond directly with us concerning ideas, suggestions, queries, desires and complaints. We will do our utmost to consider seriously every communication.

IPPS Objectives:

To promote the study and understanding of parasitic plants.
To promote the exchange of information and transfer of technologies concerning parasitic plants and their control.
To promote the exchange of biological material relevant to parasitic plant research.
To form and maintain an international network for the advancement of parasitic plant research and control.
To convene international meetings on parasitic plants and their control.
To publish information of interest to persons working with parasitic plants.
To distribute scientific and technical publications related to parasitic plants.

President of the Society is Andr Fer. Full details of the Officers and Board of Directors, together with information on membership etc. may be found on the web-site, or by contacting the Treasurer, Jos Verkeij (email verkleij@bio.vu.nl) or the Secretary Danny Joel (email dmjoel@netvision.net.il)

Danny Joel, IPPS Secretary

RESEARCH ON *STRIGA ASIATICA* CONTROL STEPS UP IN MALAWI

The Rockefeller Foundation has renewed its funding to work on *Striga* control and other soil fertility issues for the season 2000/01. Activities are already on the ground and include the following:-

1. Evaluation for trap crop efficiency among different varieties or accessions of green manure crops and grain legumes. Grain legumes and green manures are now being promoted widely to diversify the food and income base and for soil fertility enhancement. The objective of this work is to allow researchers to recommend the most effective packages for integrated management of *Striga* amongst the many options. The crops being evaluated are either released or promising varieties of groundnuts or peanuts (7 varieties), soyabeans (14 entries), pigeon peas (8), *Mucuna pruriens* (4 accessions), *Canavalia ensiformis* (3) and *Crotalaria* spp.(3). The same entries are also being evaluated for their susceptibility to *Alectra vogelli.* The soyabean entries include three varieties from IITA, recommended on the basis of good adaptability and high stimulation of *S. hermonthica* germination.

2. Identifying suitable population and plant arrangement of cowpeas in a maize intercropping system. Previous work showed remarkable suppression of *Striga* emergence, but there was some suppression of maize yield.

3. Screening for *Striga* resistance among maize lines from IITA and developing hybrids and open pollinated varieties.

4. Evaluating the effectiveness of imadazolinone herbicide (imazapyr) at varying fertilizer levels.

Lead scientist in these studies is Dr Vernon Kabambe (agronomist/weed biologist). Rosan Ganunga has now taken over genotype development work. Other collaborators are Dr W. Sakala (agronomist/soil scientist), T. Kapewa (groundnut breeder), Dr H.N. Soko (soyabean breeder), C.E. Mainjeni (weed scientist) and Dr H. Mloza-Banda (agronomist - University of Malawi). Further contacts or sharing of information will be most welcome.

Vernon Kabambe, Chitedze Station, Malawi.
E-mail: maizeagronomy@malawi.net

FIRST REPORT OF *SMICRONYX CYANEUS* GYLL. ON *OROBANCHE FOETIDA* POIRET: INVESTIGATIONS IN TUNISIA

A preliminary survey on natural enemies of *Orobanche* spp. of economic importance in Tunisia was conducted from April to May 2000 in the main faba bean growing areas. Examination of *Orobanche foetida* shoots collected from infested faba bean fields in the region of Béja (western Tunisia) showed symptoms of weevil attack similar to those caused by *Smicronyx cyaneus* Gyll. (Coleoptera, Curculionidae) on *O. crenata* Forsk. described in previous reports (Zermane, 1997; Zermane *et al.,* 1999). The adult weevils were collected from the tips of the *O. foetida* shoots and were identified by Lutz Behne from the Curculio–Institut in Mönchengladbach, Germany, as being *Smicronyx cyaneus* Gyll**.** The present report of *S. cyaneus* on *O. foetida* is new. The larvae were feeding on the *Orobanche* stem tissues and were also found on *O. crenata* feeding into the stems as well as inside the capsules.

While several *Smicronyx* spp., gall forming weevils, are known to attack *Striga* spp. or *Cuscuta* spp., only *S. cyaneus* is reported to be associated with *Orobanche* spp. and seems to be relatively scarce. Thus, *S. cyaneus* has been reported to feed on *O. crenata* in Italy, Morocco and in Algeria where it occurs also on *Phelipaea lutea* Desf. and *O. rapum-genistae* Thuill. It is reported elsewhere on *O. hederae* Fauch. and *O. cruenta* Bert.

Under natural conditions *S. cyaneus* can reduce the seed production of *O. crenata* in Algeria by 14,3% and significantly reduce the stem height, the number of capsules and the dry weight of the infested broomrapes compared to healthy plants.

Further investigations will be undertaken in Tunisia to evaluate the impact of *S. cyaneus* as well as of *Phytomyza orobanchia* (Diptera, Agromyzidae), which was also found as a herbivore on the two *Orobanche* species.

References:

Zermane, N. 1997. Investigations on the behaviour of *Smicronyx cyaneus* Gyll. (Coleoptera, Curculionidae) feeding on *Orobanche crenata* Forsk. in Algeria and the preliminary evaluation of its impact on this broomrape (Abstract). In : Khouri, W. and Bayaa, B. (eds.), Proceedings of the Sixth Arab Congress of Plant Protection, Beirut, Lebanon.

Zermane N., Kroschel, J., Sall, G. and Bouznad, Z. 1999. Prospects for biological control of the parasitic weed *Orobanche* in Algeria. In: Kroschel, J. Abderabihi, M and Betz, H. (eds.), Advances in Parasitic Weed Control at On-farm Level. Vol. II. Joint Action to Control *Orobanche* in the WANA Region. Margraf Verlag, Weikersheim, Germany, pp. 173-184.

N. Zermane, J. Kroschel, University of Kassel, 37 213 Witzenhausen, Germany
T. Souissi, Institut National Agronomique de Tunis (INAT), 1082 Tunis-Mahrajene, Tunisia
and M. Kharrat, Institut National de la Recherche Agronomique de Tunis (INRAT) , 2080 Ariana. Tunisie

COST ACTION 849 – PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

The European Union-funded COST Action 849 'Parasitic Plant Management in Sustainable Agriculture' was officially launched in March 2001 with a first Management Committee Meeting in Brussels. At that meeting, administrative issues were dealt with and officers were elected as follows:

Chairman of the Action - Diego Rubiales, Spain
Vice-chairman - Daniel Joel, Israel
Coordinators of Working Groups:
- Group 1 Biology and Ecology of Parasitic Plants - Jos Verkleij, The Netherlands
- Group 2 Parasitic Plant-Pathogen and Pest Interaction - Jrgen Kroschel, Germany
- Group 3 Genetic Resistance - Danny Joel, Israel
- Group 4 Integrated Control - Charlie Riches

These 5 constitute the Executive Board that will plan the activities of the Action. They met in Nantes in June and are at present in a process of organisation and considering future activities. Any suggestions for relevant activities will be welcomed. The following countries are involved in the Action: Austria, Bulgaria, Denmark, France, Germany, Greece, Hungary, Israel, Italy, Romania, Slovakia, Spain, Holland and UK COST stands for European Cooperation in the Field of Scientific and Technical Research. For more information on this organisation see website http://www.belspo.be/cost/

Diego Rubiales, CSIC, Cordoba, Spain
Email: ge2ruozd@uco.es

A NEW TECHNICAL MANUAL

A Technical Manual for Parasitic Weed Research and Extension. Edited by Jrgen Kroschel. (2001). Kluwer Academic Publishers, Dordrecht, The Netherlands. 292 pp. (Hardbound). ISBN 0-7923-6880-0.
Price: Euro 130.00; US$ 113.00; £79.00.

This very well-produced volume, dedicated to the late Dr Werner Koch, 'provides up-to-date methodologies for various aspects of research and extension related to parasitic weed species of the genera *Striga, Alectra, Orobanche* and *Cuscuta*. It has the intention to support scientists and extension workers of international and national research and extension institutes and universities who are either new to the subject or plan to apply further techniques they are not yet familiar with.' It has seven main chapters prepared with the help of 21 co-authors. The sections within chapters often have separate authorship and their own set of references, but all citations are repeated in a final combined reference section.

After a general **Introduction**, a chapter on **Ecological studies** includes brief but practical sections on preparation of herbarium samples, morphological studies, use of DNA markers, ecological work and host-parasite relations. **Relevance to agriculture** includes sections on survey and crop-loss techniques. **Seed features** includes advice on collection and testing of seeds, separation from soil and the agar gel test. **Investigations of developmental stages** describes box, Petri-dish and polybag techniques, *in vitro* culture, pot and field experiments and collection of data. **Application of control methods** is by far the longest chapter with sections on all the main control approaches, including cultural, breeding, chemical, physical and especially detailed descriptions of biocontrol techniques. **Putting it into practice** covers many aspects of training and extension, preparation of training materials etc. There is a **Glossary, List of Crop Names, Literature,** while annexes include identification keys reproduced from Parker and Riches, 1993, life-cycle diagrams, lists of potential trap crops, various survey forms, questionnaires and a training course outline. Finally there is a section of informative colour plates. There is no index. For further detail of contents, and to order, see: http://www.uni-hohenheim.de/~www380/parasite/tema/TeMa_main_Frame.htm

Dr Kroschel is to be congratulated on this distillation from the many years of work conducted by the Hohenheim group. The price will sadly restrict its distribution somewhat but this will none-the-less be a valuable source for many institutions and individuals concerned with parasitic plants, and especially those involved in training.

Chris Parker.

STRIGA CD AND VIDEO

The Systemwide Program on Integrated Pest management (SP-IPM) have produced 'Breaking the cycle', a 20-minute video/CD on the *Striga* research of the CGIAR centres. This is available from: Braima James, SP-IPM Secretariat, IITA Plant Health Management Division, 08 BP 0932 Tri Postal, Cotonou, Republic of Benin. Email b.james@cgiar.org; fax +229-35-05-56.

From Biocontrol News and Information Vol 20.

PROCEEDINGS OF MEETING

Proceedings of the 7th International Parasitic Weed Symposium, Nantes, France, June 2001. Edited by Fer, A., Thalouarn, P., Joel, D.M., Musselman, L.J., Parker, C. and Verkleij, J.A.C. 312 pp. Available as a CDRom from Facult des Sciences, Universit de Nantes – BP 92 208, Nantes 44 322, France.
(Email Patrick.Thalouarn@svt.univ-nantes.fr)
Price: Euro 40.00 or $US 40.00.

Contents:

Akanvou, L. *et al*. Integrated control of *Striga* in farmer's maize fields. (p. 302) (S)
Ariga, E.S. *et al*. Effects of inter-cropping maize and beans on *Striga* incidence and grain yield in western Kenya. (p. 303) (S)
Reda, F. and Bayou, W. *Striga hermonthica* control through long-term crop rotation in sorghum based cropping system in Northern Ethiopia. (p. 304) (S)
Ltourneau, A. *et al*. The use of organic residues for *Striga hermonthica* control in sorghum. (p. 305) (S)
Gworgwor, N.A. *et al*. Cultural practice for controlling *Striga hermonthica* infestation in millet in northern Nigeria. (p. 306) (S)
Khan, Z.R. *et al*. Mechanisms of *Striga hermonthica* suppression by *Desmodium uncinatum* in maize-based farming systems. (p. 307) (S)
Author index
Delegate index

AVAILABILITY OF PREVIOUS SYMPOSIUM PROCEEDINGS

(1st) EWRC Symposium on Parasitic Weeds, Malta, 1973. Available from EWRS Bookstore, B.J. Post, Postbus 28, NL-6865 Doorwerth, The Netherlands. Price 10 Euro. (Email bookshop@ewrs.org)

'Advances in Parasitic Plant Research' Proceedings of the 6th International Symposium, Cordoba, Spain, 1996. Available from Mundi-Prensa Libros S.A., Castelltr, 37, 28001 Madrid, Spain. (Email export@mundiprensa.es: Internet: www.mundiprensa.com). Price 6,481 Pesetas or 38.95 Euro.

Regrettably, the Proceedings of 2nd, 3rd, 4th and 5th International Symposia, in Raleigh, USA, 1979; in Aleppo, Syria, 1984; in Marburg, Germany in 1987; and in Nairobi, Kenya in 1991 respectively, are no longer available.

WEBSITES

For past and current issues of Haustorium see: http://web.odu.edu/haustorium

For Lytton Musselman's Plant site see: http://web.odu.edu/plant

For information on the new International Parasitic Plant Society see: http://www.ppws.vt.edu/IPPS/

For Dan Nickrent's 'The Parasitic Plant Collection' see: http://www.science.siu.edu/parasitic-plants/index.html

LITERATURE

Adetimirin, V.O., Aken'ova, M.E. and Kim, S.K. 2000. Effects of *Striga hermonthica* on yield components of maize. Journal of Agricultural Science 135: 185-191. (Most yield components were affected by *S. hermonthica*, degrees of severity varying from 9022-1 (least affected) through 8644-21 and 8321-21 to 8338-1 (most susceptible).)

Adetimirin, V.O., Kim, S.K. and Aken'ova, M.E. 2000. Responses of mid-altitude maize inbred lines to *Striga hermonthica* infestations. Cereal Research Communications 28: 469-475. (Inbred lines TZMi 102, TZMi 302 and TZMi 306 showed potential as sources of resistance to *S. hermonthica*.)

Ahmed, N.E., Sugimoto, Y., Babiker, A.G.T., Ma, Y., Inanaga, S. and Nakajima, H. 2001. Effects of *Fusarium solani* isolates and metabolites on *Striga* germination. Weed Science 49: 354-358. (Extracts from an isolate of *F. solani* from Sudan prevented germination of *S. hermonthica* in the presence of GR-24. The activity is attributed to as-yet unidentified fungal toxins.)

Alonge, S.O., Lagoke, S.T.O. and Ajakaiye, C.O. 2001. Cowpea reactions to *Alectra vogelii* I: effect on growth. Crop Protection 20: 283-290. (Field trials with artificial infestation with *A. vogelii* showed stimulation of root and shoot in many varieties at early stages, but later reductions in root growth, nodulation, leaf area and shoot weight in susceptible varieties.)

Alonge, S.O., Lagoke, S.T.O. and Ajakaiye, C.O. 2001. Cowpea reactions to *Alectra vogelii* II: effect on yield and nutrient composition. Crop Protection 20: 291-296. (Field trials with 11 'resistant', 2 'tolerant' and 3 susceptible varieties showed more-or-less expected results but few differences were significant.)

Aly, R., Goldwasser, Y., Eizenberg, H., Herschenhorn, J., Golan, S. and Kleifeld, Y. 2001. Broomrape (*Orobanche cumana*) control in sunflower (*Helianthus annuus*) with imazapic. Weed Technology 15: 306-309. (Imazapic applied post-emergence to sunflower 10-15 cm high at 1.5 g/ha followed by 3 g/ha when the crop was 50-60 cm high provided excellent temporary suppression of *O. cumana* emergence and moderate yield increase. A later application at crop flower development stage was damaging.)

Alsos, I.G. and Lund, L. (Mountain eyebright *Euphrasia frigida* found in Colesdalen, Svalbard.) (in Norwegian) Blyttia 57(1): 36.

Ashworth, V.E.T.M. 2000. Phylogenetic relationships in Phorodendreae (Viscaceae) inferred from three regions of ribosomal cistron. I. Major lineages and paraphylly of *Phoradendron*. Systematic Botany 25: 349-370. ('Maximum parsimony analyses suggested that neither *Phoradendron* nor *Dendrophthora* is monophyletic. Three major clades were identified.')

Buckles, D., Etka, A., Osiname, O., Galiba, M. and Galiano, G. (eds.) 2000. Cover Crops in West Africa Contributing to Sustainable Agriculture. IDRC/IITA/Sasakewa Global 2000. 291 pp. (Collection of 29 papers with only scattered reference to *Striga* but useful coverage of recent work with *Mucuna pruriens* and other potential cover crops.)

Choi WonSil and Ahn WonYung. 2000. Electron donating ability of MeOH extracts from three Korea mistletoes. Journal of the Korean Wood Science and Technology 28(4): 1-9. (In search for antioxidants, an extract from *Loranthus yuadoriki* showed higher activity than α-tocopherol, perhaps due to the phenolic, gallic acid. *Pseudixus japonicus* and *Viscum album* var. *coloratum* were also studied.)

Clement, E.J. 2001. *Rhinanthus rumelicus* Velen. new to Britain (vc. 11). BSBI (Botanical Society of the British Isles) News 86: 51-52. (near Portsmouth, UK.)

Daugherty, C.M. and Mathiasen, R.L. 1999. Adult sex ratio of *Phoradendron juniperinum* in ten severely infected *Juniperus monosperma* in northern Arizona. Madro⁄o 46: 169-176. (Overall the sex ratio was 1:1. More parasites found on the south side of trees than on the north.)

Deliorman, D., Calis, I., and Ergun, F. 2001. A new acyclic monoterpene glucoside from *Viscum album* ssp. *album*. Fitoterapia 72(2): 101-105. (A new compound isolated from *V. album* in Turkey.)

Eizenberg, H., Tanaami, Z., Jacobsohn, R. and Rubin, B. 2001. Effect of temperature on the relationship between *Orobanche* spp. and carrot (*Daucus carota* L.). Crop Protection 20: 415-420 . (Concluding that both *O. crenata* and *O. aegyptiaca* require cool temperatures (below 20^0 C) for effective parasitism on carrot.)

Fer, A., Thalouarn, P., Joel, D.M., Musselman, L.J., Parker, C. and Verkleij, J.A.C. 2001. Proceedings of the 7th International Parasitic Weed Symposioum, Nantes France, June, 2001. Facult des Sciences, Nantes. 312 pp. (See full contents and report above.)

Fernndez-Martnez, J., Melero-Vara, J., Munz-Ruiz, J., Ruso, J. and Domnguez, J. 2000. Selection of wild and cultivated sunflower for resistance to a new broomrape race that overcomes resistance of the *Or*$_5$ gene. Crop Science 40: 550-555. (Most perennial species of wild *Helianthus* were resistant to *O. cernua/cumana* race F (population SE296), also the annual species *H. anomalus* and *H. agrestis* and 4 of 55 cultivars.)

Foley, M.J.Y. 2000. A morphological comparison between some British *Orobanche* species (Orobanchaceae) and their closely related non-British counterparts from continental Europe: *O. rapum-genistae* Thuill. s.l. Watsonia 23: 413-419. (Comparing *O. rapum-genistae* taxa from UK and Corsica and concluding that the ssp. r*igens* from Corsica should be given specific status as *O. rigens* Loisel.)

Foley, M.J.Y. 2000. The taxonomic position of *Orobanche rechingeri* Gilli (Orobanchaceae) in relation to *Orobanche nowackiana* Markgr. Candollea 55: 269-276. (Suggesting that these species, separately described from the Balkans, should be merged as *O. nowackiana*.)

Foley, M.J.Y. 2001. Orobanchaceae in the 'Flora iberica' area: new taxa, excluded taxa, and typification. Anales del Jardin Botanico de Madrid 58: 223-233. (One species of *Cistanche* and 31 species or subspecies of *Orobanche* occur in the flora area, including 2 newly described – *O. austrohispanica* M.J.Y. Foley and *O. crinita* M.J.Y. Foley.)

Friederici, P. 2001. Kissing goodbye to some old-fashioned views about mistletoe. National Wildlife December/January 2001: 18-19. (Noting the damaging effects of *Arceuthobium* spp.)

Garca, M.A. 2001. A new western Mediterranean species of *Cuscuta* (Convolvulaceae) confirms the presence of holocentric chromosomes in subgenus *Cuscuta*. Botanical Journal of the Linnean Society 135: 169-178. (The new species, *Cuscuta nivea* is separated from *C. planiflora*: it occurs on calcicole shrubs in Iberia and NW Africa.)

Gbhounou, G. 2001. Kao et les Pharaoniens (Tales on *Striga*). (in French) Institut National pour la Formation et la Recherche en Education (INFRE), Benin. (A novel manual designed for use in primary schools, providing educational material on biology and control of *Striga*. Price 'approximately' 2 $US – for more information contact the author at LDC/INRAB, B.P. 128, Porto-Novo, Rpublique de Benin – Email ldcstrig@intnet.bj)

Goldwasser, Y., Eisenberg, H., Herschenhorn, J., Plakhine, D., Blumenfeld, T., Buxbaum, H., Golan, S. and Kleifeld, K. 2001. Control of *Orobanche aegyptiaca* and *O. ramosa* in potato. Crop Protection 20: 403-410. (Rimsulfuron at 12.5 or 25 g/ha applied at 2 week intervals from 2 weeks after emergence successfully controlled both *Orobanche* spp. and has been approved for commercial use. Imazapic and triasulfuron were less selective.)

Goldwasser, Y. and Yoder, J.I. 2001. Differential induction of *Orobanche* seed germination by *Arabidopsis thaliana*. Crop Science 160: 951-959. (All 50 ecotypers of *A. thaliana* induced germination of *O. ramosa* and *O. aegyptiaca* but 94 of 13,000 fast-neutron-mutated plants were non-inducing: progeny from some of these lines showed reduced germination and are being studied further.)

Guo FengGen and Li Yanghan 2000 (Numerical taxonomy of three dodders.) (in Chinese) Acta Botanica Yunnanica 22: 263-267. (Results suggest *C. japonica* is close to *C. reflexa* while *C. chinensis* is more distinct.)

Guo QiongXia and Huang Ke-Hui 1999. (Study of *Cuscuta campestris*.) (in Chinese) Wuyi Science Journal 15: 82-84. (Study leading to quarantine regulations.)

Haupt, S., Oparka, K.J., Sauer, N. and Neumann, S. 2001. Macromolecular trafficking between *Nicotiana tabaccum* and the holoparasite *Cuscuta reflexa*. Journal of Experimental Botany 52: 173-177. (Green fluorescent protein shown to transfer from genetically modified tobacco to *C. refexa*, confirming a fully functional symplastic pathway from host to parasite.)

Heath, M.C. 2001. Non-host resistance to plant pathogens: nonspecific defense or the result of specific recognition events? Physiological and Molecular Plant Pathology 58: 53-54. (No reference to angiosperm parasites but interesting reflections on the issue of non-host reaction, concluding 'Thus, all forms of plant disease resistance may be part of a complex and seamless web of plant-pathogen interactions that defy man-made boundaries and definitions'.)

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Kim, S.K. and Adetimirin, V.O. 2001. Conditioning effects of *Striga hermonthica* seed on field performance of maize. Crop Protection 20: 159-161. (In experiments with artificial inoculation of the soil with seeds of *S. hermonthica*, no differences resulted from timing of maize planting 0, 1, 2 or 3 weeks later.)

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Westbury, D.B. and Dunnett, N.P. 2000. The effect of the presence of *Rhinanthus minor* on the composition and productivity of created swards on ex-arable land. Aspects of Applied Biology 58: 271-278. (*R. minor* sown in mixture with grasses and forbs helped to suppress grasses and favour non-grasses, especially *Leucanthemum vulgare*, at least in the first season.)

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Zuber, D. and Widmer, A. 2000. Genetic evidence for host specificity in the hemi-parasite *Viscum album* L. (Viscaceae). Molecular Ecology 9: 1069-1073. (Small differences in DNA sequences supported the distinction of three races with differing host range.)

HAUSTORIUM 39
has been edited by Chris Parker, 5 Royal York Crescent, Bristol BS8 4JZ, UK (Email chrisparker5@compuserve.com) and Lytton J Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk Virginia 23529-0266, USA (fax 757 683 5283; Email lmusselm@odu.edu). Send material for publication to either editor.

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HAUSTORUM

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STATUS OF HAUSTORIUM

Our banner still refers to the International Parasitic Seed Plant Research Group, but since the meeting in Nantes and creation of the new International Parasitic Plant Society (IPPS) we expect this newsletter in due course to become an organ of that new society.

We are pleased to acknowledge that Old Dominion University is continuing to support the printing and mailing of Haustorium.

Many readers are already receiving Haustorium by Email. If any more of you wish to do so, please let Chris Parker know (Email address on the last page). Bear in mind that having an electronic version of the newsletter enables you to 'search'. If you cannot receive Email, or for any reason wish to go on receiving hard copy, you will continue to receive by airmail.

The web-site version of this issue and past numbers of Haustorium are now available on http://web.odu.edu/haustorium, and on the IPPS site – http://www.ppws.vt.edu/IPPS/

COST ACTION 849 – PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

The European Union-funded COST Action 849 'Parasitic Plant Management in Sustainable Agriculture' held a successful meeting at Bari, Italy from 18-20 October, 2001. There were separate meetings for each of the Working Groups 1, 2, 3 and 4 and finally a Management Committee Meeting under the Chairmanship of Diego Rubiales and Danny Joel. About 50 papers were presented for discussion and a set of abstracts is to be published shortly. It is hoped to list these in the next issue, together with brief reports from the Working Groups.

Further meetings are planned for Working Groups 1 and 3 (Biology and Ecology, and Resistance) in Sofia, Bulgaria in March 2002 and for WGs 2 and 4 (Biological Control and Integrated Control) and the Management Committee in Germany in September.

GR24 AND OTHER SYNTHETIC STIMULANTS

GR24 is a synthetic germination stimulant that is widely used in research on the parasitic weeds *Striga* and *Orobanche*. Binne Zwanenburg at the University of Nijmegen in The Netherlands prepares this stimulant, but production costs are substantial. He advises us that GR24 is available for purchase - minimum quantity 100 mg, standard quantity 200 mg - for a price of Euro 75 per 100 mg or Euro 150 per 200 mg. The payments will be to a non-profit foundation and are not therefore subject to VAT. If you are interested in obtaining GR24, please contact Binne Zwanenburg by e-mail Zwanenburg@sci.kun.nl.

Binne Zwanenburg also reports that there have been encouraging field tests with the related compound Nijmegen-1 and that other Nijmegen products are also under development. We congratulate Binne on these practical products of his fundamental work on germination stimulants and look forward to further detail of these developments in future issues of Haustorium.

STRIGA IN NUSA TENGGARA PROVINCE, INDONESIA

Striga is known to occur in Indonesia and is included in the Indonesian Quarantine Service list of prohibited weeds. On the more developed islands of Java and Sumatra *Striga asiatica/lutea* is mentioned more as a curiosity than as a weed of economic importance.

When conducting an evaluation of the Nusa Tenggara Upland Farming Systems Project *Striga* was seen to be a major weed of both maize and sorghum crops in the Belun and Kefa districts of West Timor (Laycock and Bambang Murolenono, 1999). Unconfirmed reports indicate *Striga* also occurs near Kupang and Soe, also on the island of Timor (see map below). Photographs taken by agricultural staff strongly indicate *Striga* is a weed of sorghum on the island of Sumba between the towns of Waingapu and Melok. The map shows the position of Timor and Sumba islands, and the locations of *Striga* areas.

Striga plants were 25 to 50 cm when flowering. Flowers were 1 to 1.5 cm long and usually a pale purple to pink colour. However a few plants associated with sorghum had white flowers and others varied from creamy and pink off whites to pale purple in both sorghum and maize. Plants were erect and well branched. The calyx had five ribs, eliminating *S. asiatica*. Preliminary identification by Mr Chris Parker indicates the species to be *S. curviflora* (see note below) but other species may also be present.

At a government rice seed multiplication farm smaller, (15-30 cm), erect, sparsely branched *Striga* plants with deep magenta flowers were found growing on wild grasses, *Dactyloctenium* and/or *Paspalum conjugatum*

Conditions are favourable for *Striga*. Soils are generally well drained and of low fertility, with a pH near neutral. They are often shallow in valleys and become rocky as one goes up slopes to the hills: farmers often plant on slopes to reduce weed growth. Both soils and rainfall vary considerably within short distances. Rainfall is irregular within and between seasons, ranging from less than 700 mm to more than 2,000 mm per annum. The number of wet days and length of rainy season also vary considerably. One to two crops a year are “normal”, with occasionally three on the best land in good years.

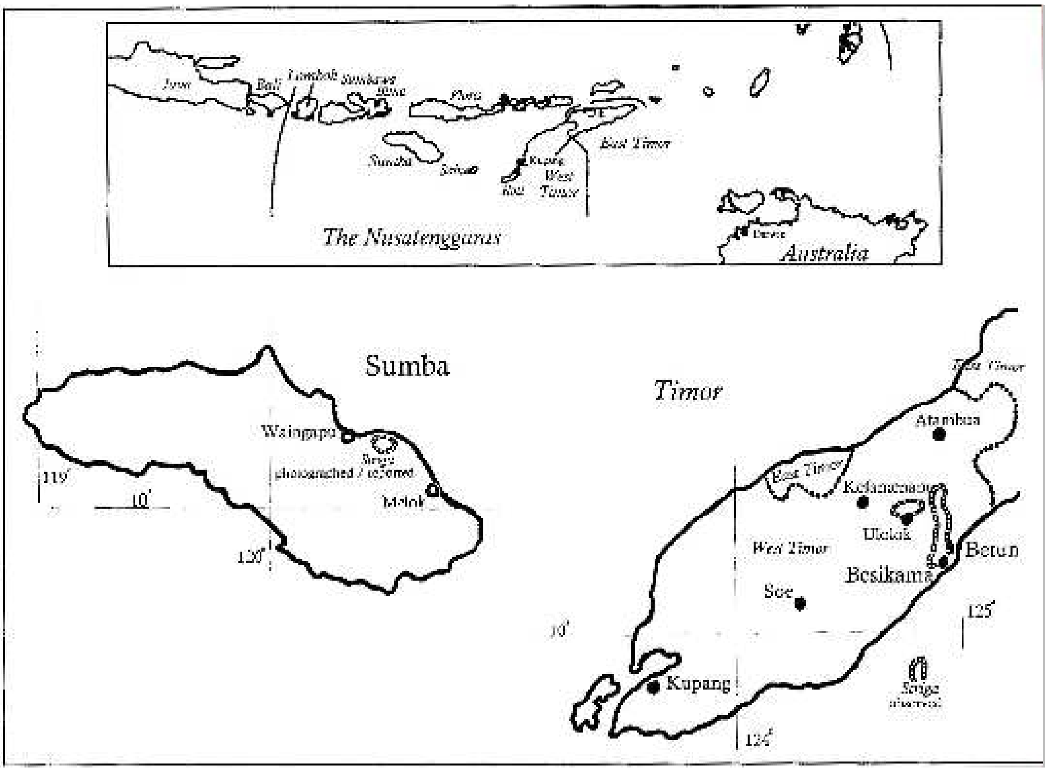
A variation in host preference was indicated. Local maize was more heavily parasitised than newly introduced maize and in general few *Striga* plants were observed in sorghum. However individual sorghum fields did have heavy *Striga* infestations. Flowering *Striga* shoots were concentrated at, or within 10 cm of the planting station. *Striga* regrowth was apparent between rows in areas weeded with a local variation of the Dutch hoe.

Striga was present in virtually all maize fields near to the road north from Besikama to Halilulik (about half way towards Atambua). Plants were weakened, sometimes dead or with almost no grain. The maize was still in the grain filling stage.

The usual cropping patterns and the incidence of *Striga* for the Betun area are summarised in Table 1. Cereal crops are infected with *Striga* in the first, and to a lesser extent in the second wet season. There were no reports of *Striga* in the third season, where the cereal grown is maize, rather than the more drought tolerant sorghum. This suggests *Striga* seeds are in a wet dormant condition or that soil temperatures are sub-optimal for the germination and or attachment development stages. The cropped area is greatest in the first, and least in the third, season.

The majority of local farmers, (25 out of 29), interviewed along the roadside were aware of *Striga* and associate it with weak plants and reduced yields. However four farmers were unaware of any relationship between *Striga* and poor crop growth. They further associated *Striga* with critical land, that is land which has been "intensively cropped for a long time" and which is low in fertility. Rested land had little on no *Striga*.

Ministry of Agriculture Staff are generally unaware of the presence of *Striga* and its associated reductions of crop yield in this district. Farmers recognise the weed and have associated it with poor crop vigour and low yields. Interestingly interviewed farmers attributed crop ill health and death to insects rather than to *Striga*. This was despite the association of flowering *Striga* with weak plants.



Maps showing the location of *Striga* in the Nusa Tenggara Region of Indonesia

Table 1. Cropping pattern and *Striga* in Betun, West Timor

Planting season	**Crops**	***Striga* situation**
Season 1 December – January	Maize, sorghum, green beans, groundnuts	Season wet. Lot of *Striga* every year
Season 2 March - April	Maize and green beans if rain. No sorghum.	Lot of *Striga* when rains good. Poor rains little or no *Striga*
Season 3 July – August Planting	Maize only	Little rain, hot and dry. No *Striga*

Striga is not a recent introduction to the area. Farmers identifying *Striga* said it had been around for as long as they could remember. Using historical events, *Striga* was present before the fall of Sukarno and the abortive communist coupe in 1965. This raises a number of questions for future strategies in cereal production and *Striga* in this area:

- why is the *Striga* problem largely unknown to, and unreported by government officials who make monthly returns of farmer problems to Jakarta?
- how widespread is *Striga*?
- is the area of *Striga* increasing?
- is the *Striga* problem increasing in severity?

- is *Striga* being spread in seed from the government seed farm?

Follow-up is required to first identify *Striga* infested areas and associated crops and second to positively identify the *Striga* species present. Establishing whether or not the area of *Striga* infestation has increased in the recent past is also necessary, particularly given the increase in land use pressure. The farming systems programme from the gricultural Institute for Adaptive Technology at Naibonat is ideally placed to look at cultural ways to minimise the impact of *Striga* given it has a sub-station in the area. There is also the question of whether or not *Striga* is present in the newly independent country of Timor. March and early April are appropriate times for field inspection of *Striga.*

Reference:

Laycock, D. and Bamban Murdolelonon. 1999. *Striga*, an underestimated parasitic weed of Nusa Tenggara. In: Proc. Workshop on Integrated Weed Management in Managed and Natural Ecoosytems. BIOTROP Special Publication No. 61: 127-135.

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IDENTIFICATION OF SOME SOUTH-EAST ASIAN *STRIGA* SPP.

In the course of helping to determine the *Striga* specimens collected in West Timor (see note above) it became apparent that the brief information on 'Additional species occurring in Australia and Southeast Asia' in Parker and Riches (1993) was misleading. Reference to the original descriptions by Bentham (1869) in Flora Australiensis Volume IV Stylideae to Pedalineae confirms that each of the three species, *S. multiflora* Benth. , *S. curviflora* Benth. and *S. parviflora* Benth. has a 5-ribbed calyx. However, in no case is the upper lip of the corolla longer than the lower. Flower colour is not clearly indicated and does not appear to be a reliable character.

Some workers believe that the distinctions made by Bentham are not sound and that further work could show that a single polymorphic species is involved, but on the basis of Bentham (1869), the following is a revised summary of these three species to replace that on p. 18 of Parker and Riches (1993):

'*Striga curviflora* Benth. Robust, often over 30 cm high. Calyx 5-ribbed, 6 mm long; corolla 8-10 mm long with lower lobes 6-8 mm, upper much shorter, 2-3 mm, slightly notched and often recurved. Flower colour variable.

***Striga multiflora* Benth.** Robust, often over 30 cm high. Calyx 5-ribbed, 4-5 mm long; corolla 6-8 mm long, upper lip more than half as long as the lower, broadly lobed. Flower colour variable.

***Striga parviflora* Benth.** Smaller than the above, up to 20 cm high. Calyx 5-ribbed, 2-3 mm long; corolla 6 mm with lobes very short. Flower colour variable.'

Other corrections we would like to point out include:

p. 4 – authority of *S. hermonthica* should be (Del.) Benth.

pp. 21, 167-8 – '*Ramphicarpa*' should be *Rhamphicarpa*.
p. 23 – in Figure 1.5. formula b) should have O added top right and in e) the ring should be a benzene ring.

We regret any confusion these errors may have caused.

We also regret that 'Parasitic Weeds of the World' is now out of print. If any readers have spare copies for disposal, they are likely to find a quick sale through the pages of Haustorium.

Chris Parker and Charlie Riches.

PROCEEDINGS OF THE 7TH INTERNATIONAL SYMPOSIUM, NANTES

Proceedings of the 7th International Symposium are no longer available as hard copy but a version on CDRom is now available at a cost of 40 Euros or 40 US$. Please Email your request to ipws@svt.univ-nantes.fr together with postal address, credit card number and expiry date. Those without CDRom facilities, or with serious difficulty over remitting payment should request further advice.

OBITUARY – EDWARD TERYOKHIN

22 May 1932 – 1 December2001

Readers of Haustorium will be saddened to learn of the death of Professor Teryokhin of the Komorov Botanical Institute in St Petersburg, Russia. Edward was a frequent participant in symposia and workshops where his enthusiasm, quick smile, and love of dancing charmed us. His contributions to parasitic plant biology are many, most notably in the field of plant morphology. One of the last classical plant morphologists, he developed a phylogenetic scheme of haustorial evolution based on extensive observations of species of *Orobanche*. He published one book in English is "Weed Broomrapes" (1997, Ausfsteif Verlag).

Professor Teryokhin is survived by his wife and one son. His warmth and friendship will be sorely missed.

Lytton John Musselman and Klaus Wegmann

NOW AVAILABLE ON CDROM

Breeding for Striga Resistance in Cereals and
Application of Molecular Markers in Plant Breeding

The proceedings of the workshop held at IITA, Ibadan, Nigeria, in August 1999, 'Breeding for Striga Resistance in Cereals', edited by B.I.G. Haussmann, D.E. Hess, M.L. Koyama, L. Grivet, H.F.W. Rattunde, and H.H. Geiger, and published by Margraf Verlag, Weikersheim, Germany, are now available on CD. The same CD also includes the ICRISAT Training Manual 'Application of Molecular Markers in Plant Breeding', edited by B.I.G. Haussmann, H.H. Geiger, D.E. Hess, C.T. Hash, and P. Bramel-Cox.

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WEBSITES

For past and current issues of Haustorium see: http://web.odu.edu/haustorium

For information on the new International Parasitic Plant Society see: http://www.ppws.vt.edu/IPPS/

For Lytton Musselman's Plant site see: http://web.odu.edu/plant

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rms.nau.edu/misteltoe/welcome.html

For on-line access to USDA Forest Service Agriculture Handbook 709 'Dwarf Mistletoes: Biology, Pathology and Systematics' (now out of print), see: http://www.rmrs.nau.edu/publications/ah_709/

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October, 2000), pp. 2043-2048. (An in-depth review of potential and actual pathways between host and parasite and proposing the use of *Arabidopsis* and fluorescent proteins expressed by particular cell types in further studies.)

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Javanbakht, M. and Ghadri, H. 2000. Competitive effect of redroot pigweed (*Amaranthus hybridus* L.) and broomrape (*Orobanche aegyptiaca* L.) on potato in greenhouse conditions. (in Iranian) Iranian Journal of Agricultural Sciences 31: 7-17. (Potato growth increasingly reduced by *O. aegyptiaca* at rates of seed from 20 to 80 mg/pot.)

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Rae, S.J. 2001. Family 178. Orobanchaceae. In: Grierson, A.J.C., Long, D.G. and Springate, L.S. (Eds.) Flora of Bhutan including a record of plants from Sikkim and Darjeeling Volume 2 Part 3. Royal Botanic Garden, Edinburgh, and Royal Government of Bhutan. pp. 1330-1334. (Including *Lathraea, Orobanche, Boschniakia, Aeginetia* and *Christisonia* species.)

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Rama Rao, P.V., Basavaraju, G., Reddy, K.B. and Rao, Piratla, N. 2001. Chloroplast ultrastructure in *Cuscuta chinensis* Lamarck. In: Abstracts of National Symposium on 21st Century Perspectives in Plant Sciences, July, 2001, Andhre University, Visakhapatnam 530003, India. (May possibly refer to *C. campestris*?)

Rao, P.N., Rama Rao, P.V. and Reddy, K.B. 2001. A biopesticide as a cuscuticide. In: Abstracts of Biopesticide Conference 'Biopesticides: Emerging Trends' bet 2001, February, 2001, Chandigarh, India.. p. 130. (Reporting the activity of several commercialised neem extracts in preventing germination of *Cuscuta* seeds at about 300-1000 ppm azadirachtin active ingredient.)

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SAA. 2001. Ethiopia. Feeding the Future. Newsletter of the Sasakawa Africa Association, Issue 16, p. 11. ('SG 2000 has been promoting the use of improved sorghum varieties with genetic resistance to the parasitic weed *Striga* in lower elevation areas with less moisture. Results from the work have been promising.')

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Subramanyam, P. 2001. New hosts of the parasitic flowering plant, *Alectra vogelii*, in Malawi. Plant Disease 85: 442. (*A. vogelii* parasitised and weakened several wild *Arachis* spp. in a germ plasm experiment.)

Sukno, S., Fernández-Martnez, J.M. and Melero-Vara, J. 2001. Temperature effects on the disease reactions of sunflower to infection by *Orobanche cumana*. Plant Disease 85: 553-556. (Studies with three populations of *O. cumana* and 4 sunflower lines suggested that interactions with temperature were complex.)

USDA Forest Service. 2000. Forest insect and disease conditions in the United States 1999. USDA Forest Service, Washington, USA. 94 pp. (Including information on distribution and severity of *Arceuthobium* infestations.)

van Rijn, P.J. 2000. Weed Management in the Humid and Sub-humid Tropics. Royal Tropical Institute, Amsterdam. 234 pp. (Including some very brief mention of parasitic weeds and their control.)

Wang Zhan and Fang JiNian 2001. (Studies on the polysaccharide H3 of *Cuscuta chinensis*.) (in Chinese) Acta Pharmaceutica Sinica 36: 192-195.

(Results suggest H3 is a highly branched heteropolysaccharide.)

White, D.G. 1999. Disease caused by a parasitic seed plant. In: White, D.G. (ed.) Compendium of Corn Diseases. 3rd edition. APS Press. p. 63. (A single page on *Striga*, mainly on *S. asiatica,* plus two colour plates, but symptoms not well illustrated or described.)

Wrobel, R.L. and Yoder, J.I. 2001. Differential RNA expression of α-expansin gene family members in the parasitic angiosperm *Tryphysaria versicolor* (Scrophulariaceae). Gene 266: 85-93. (Results suggest that the expansins examined fulfil functions distinct from haustorial development.)

Wynne-Jones, J. 2001. *Cuscuta campestris* in Herefordshire. Botanical Society of the British Isles BSBI News 87: 50. (Recording *C. campestris* on garden *Petunia* and *Callistephyus chinensis.*)

Yoon TaekJoon, Yoo YungChoon, Kang TaeBong, Her Ere, Kim SungHoon, Kim KarSu, Azuma I. and Kim JongBae. 2001 Cellular and humoral adjuvant activity of lectins isolated from Korean mistletoe (*Viscum album coloratum*. International Immunopharmacology 1: 881-889. (Results suggest that the Korean mistletoe lectin KML-C is a potent immunoadjuvant to enhance cellular and humoral immune responses.)

HAUSTORIUM 40
has been edited by Chris Parker, 5 Royal York Crescent, Bristol BS8 4JZ, UK (Email chrisparker5@compuserve.com) and Lytton John Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk Virginia 23529-0266, USA (fax 757 683 5283; Email lmusselm@odu.edu). Send material for publication to either editor.

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HAUSTORIUM

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STATUS OF HAUSTORIUM

The banner above shows that Haustorium is now the official organ of the International Parasitic Plant Society (IPPS) which has effectively replaced the shadowy (but effective!) Parasitic Seed Plant Research Group. The format remains the same for the time being but we welcome Jim Westwood, Editor of IPPS, as an additional editor and he will in due course be introducing new features, as indicated by his personal message below.

We are pleased to acknowledge that Old Dominion University is once again supporting the printing and mailing of this issue of Haustorium.

The future circulation of the newsletter has yet to be decided and there are some doubts whether non-members of IPPS will continue to receive Haustorium, especially if they wish to receive hard copy, rather than the electronic version. Many readers are already receiving Haustorium by Email. If any more of you wish to do so, please let Chris Parker know (Email address on the last page). Bear in mind that having an electronic version of the newsletter also enables you to 'search'.

The web-site version of this issue and past issues of Haustorium are now available on http://web.odu.edu/haustorium, and on the IPPS site – http://www.ppws.vt.edu/IPPS/

A MESSAGE FROM THE NEW EDITOR

Dear readers,

You may notice some changes in this 41st issue of Haustorium as compared to previous ones. This issue marks the official union of Haustorium with the IPPS, and reflects increased IPPS involvement in producing what is now our Society's newsletter. You will notice a new item, the President's Message, written by IPPS President Andr Fer. We plan to continue this as regular component of Haustorium and to look for other features that will be of interest and continue to provide value for all parasitic plant researchers.

To help guide this "evolution of the Haustorium" we are establishing an Editorial Board, composed of scientists representing a variety of disciplines and geographical distribution. The Editorial Board will consider issues related to Haustorium content, offer suggestions on new features, and generate and/or review articles in their area of expertise.

Of course, one should not tamper recklessly with something that has worked so well for many years. Rather, we hope to build on the strengths of Haustorium by involving more IPPS members as contributors. This is one of our best ways to communicate as a society and we welcome ideas and feedback from all of you.

Jim Westwood

IPPS NEWS

Message from thePresident

The International Parasitic Plant society (IPPS) was inaugurated last year during the Seventh International Parasitic Weed Symposium in Nantes and was registered in Amsterdam during the summer. The founders of IPPS were primarily interested in stimulating the development of research in the extraordinary field of parasitic flowering plants. We hope that formalizing a society that has existed informally for many years will provide both stability and renewed energy to carry us through the coming years.

One of the aims of the new society was to continue the invaluable work that Lytton Musselman and Chris Parker have put into editing the Haustorium newsletter for many years. But, of course, the activity of the society should not be limited to publishing Haustorium. It is also necessary to promote interdisciplinary research to significantly improve our understanding of parasitic plants. Several parasitic plant genera have a severe impact on the production of major crops. Surely existing approaches (mainly chemical) for controlling such pests can be further improved, but new control strategies that would be acceptable for the development of sustainable agriculture are also needed. For this to be realized, it is clear that we have to greatly increase our understanding of host-parasite relationships.

For example, it is necessary to make progress in identifying the signals responsible for triggering germination, and also those involved in inducing and controlling haustorium formation. The signaling pathways acting in these processes are still almost unknown, and we need to put more effort into detailed studies of the molecular dialogue that results in the building of the host-parasite association. Molecular approaches (i.e. gene expression) and the use of genetically engineered host plants and mutants are some of the tools that will be necessary. Such research programs benefit from collaboration between laboratories and should be encouraged. Resulting data could be invaluable for the development of selective control methods and new resistant host varieties.

Another challenge for the parasitic plant research community is to understand why, within the same host crop species, some genotypes are resistant while other are susceptible. Competition between host and parasitic sinks may be a decisive factor in determining susceptibility or resistance of the host to root-holoparasites that obtain their nutrients mainly from the phloem of the parasitized plants. Composition of host xylem sap (mainly the C:N ratio of transported substances) depends on the sink strength of the host root and can affect the nutritional balance of xylem-taping root-hemiparasites. Histological and cellular responses related to resistance are regularly observed. But are these responses the cause or the consequence of resistance? Finally, are phytoalexins involved in resistance to parasitic plants? When the main factors responsible for resistance to a parasite are clearly identified and understood, then we will be able to design crop genotypes exhibiting stable polygenic resistance. Here again, studies of the mechanisms of resistance require a highly interdisciplinary program.

If the molecular dialogue resulting in host parasite association (including understanding of mechaisms of resistance to root-parasites) is a very important topic, it is also clear that studies need to be conducted on other parasite species. This is most important for species that have dramatic effects on forest trees and timber production (mistletoes) and for parasites of economic importance (sandalwood).

As I have tried to point out in this short article, our ignorance in the area of parasitic flowering plants is still enormous. This presents an exciting challenge for our young society, and it is an urgent task of IPPS to develop and maintain an international network for the advancement of parasitic plant research and control. Working together, we can hope to make progress.

André Fer, President, IPPS

COST ACTION 849 – PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

The first meeting of the Working Groups was held in Bari, Italy in October, 2001, and a listing of the papers presented is now provided below, under Proceedings of Meetings.

Further meetings of Working Group 1 (Biology and Epidemiology) and WG 3 (Resistance) were held in Sofia, in February. Meetings of WG 2 (Biological Control) and WG 4 (Integrated Control) and of the Management Committee are now scheduled for July 24-28 in Obermarchtal, Germany. Abstracts will be published on a COST website – details in the next issue.

PARASITIC PLANTS IN SRI LANKA

In the course of a holiday trip to Sri Lanka, I enjoyed a very interesting day out with Dr Kushan Tennakoon of University of Peradeniya. Dr Tennakoon has contributed to this newsletter on the topic of sandalwood. We drove from Kandy at about 300 m elevation up to the Knuckles Mountains at 1200 m, passing through tea plantations and then natural forest which between the elevations of 800 and 1100 m is wonderfully rich in mistletoes. Most were out of reach but we were able to collect one sample of the abundant and very variable *Dendropthoe falcata.* The host in this case was *Eucalytpus grandis* but the literature shows that *D. falcata* has an extremely wide host range including many garden fruit and native forest tree species.

According to the well-illustrated article by Tennakoon and Weerasooriya (1998), belatedly noted in this issue, there are 22 species of Loranthaceae and 9 Viscaceae in Sri Lanka. Altogether 57 parasitic plant species belonging to 22 genera in 8 families are currently recognised in the Sri Lankan flora, many of them endemic. The biology and host range of many of these species is not well known. Dr Tennakoon is keen to develop a study project on this topic and would be delighted to hear from anyone interested in collaborating or contributing to such a project on biology and physiology of parasitic plants in Sri Lanka.

Cradled by the Knuckles Mountains is a botanically fascinating area of short wet grassland wonderfully rich in insectivorous *Drosera* and *Utricularia* species. Among these was what reminded me very much of *Cycnium tubulosum* in Africa. This turned out to be the related hemi-parasite *Centranthera indica*. Other Scrophulariaceae in Sri Lanka include *Pedicularis* and *Striga* spp.

Among other parasites seen that day were several populations of *Cuscuta campestris* which, as in parts of India, is being locally mistaken for *C. chinensis*

Several representatives of Olacaceae, Santalaceae and Opiliaceae also occur. I strongly recommend Sri Lanka as a rich hunting ground for the parasitic plant specialist.

Ref: Tennakoon, K. and Weerasooriya, A. 1998. Nature's scroungers – The fascinating world of plant parasites. Sri Lanka Nature March 1998: 45-58.

Chris Parker

SCREENING LEGUMES FOR RESISTANCE TO *ALECTRA* IN MALAWI

The incidence of yellow witchweed (*Alectra vogelii*) is on the increase in Malawi due to greater efforts to promote legume crops. A study was initiated at Chitedze Research Station in Malawi in November 2000 with the objective of screening amongst existing and promising varieties of soybean, groundnuts and pigeon peas (medium maturity), and several green manure crop species for susceptibility to *Alectra vogelii.*.

Four trials were conducted including, respectively, 11 soybean lines; 7 groundnut lines; 8 pigeon pea lines; and 10 green manure entries (4 entries of *Mucuna pruriens*, 3 of *Canavalia ensiformis* and one each of *Crotalaria ochroleuca, C. juncea* and *C. grahamiana*). The design was randomised complete block with 3-4 replications. Plots were artificially inoculated with approximately 1000 seeds *of A. vogelli* seeds (over 90% germination) per m row length banded at 10 cm depth on the ridge.

Data were recorded on canopy width, yield and *Alectra* count at several times after planting. Results for soybean are given in Table 1. Some soybean varieties were quite susceptible to *A. vogelii* (eg 427/5/7, Kudu, TGx1448-2E and Duocrop) while some were apparently resistant (eg TGx1661-3F, Bossier and Ocepara-4).

Infestation of groundnut was lower than that in soybean but all varieties were moderately susceptible. Yields varied from 789 to 1097 kg/ha and *A. vogelii* counts at 109 DAP from 0.17 to 0.46 m^{-2} but differences were not significant. All entries of pigeon pea and green manures had no *Alectra*, suggesting immunity.

It had been expected that there might be some correlation between canopy width and *Alectra* count, due to the possible effects of shading on the parasite, but this was not apparent in either soybean or in groundnut.

Table 1. Soybean canopy width (CW), grain yield (kg/ha), and *Alectra* counts (AC, m^{-2}) at 109 days after planting.

Entry	CW 11 weeks	Grain yield kg/ha	AC m^{-2}
Bossier	86	2355	0.07
427/5/7	74	2319	5.20
Santarosa	70	2541	1.20
Kudu	77	1117	2.73
501/6/12	87	2506	0.83
Ocepara-4	73	2639	0.20
491/5/6	69	2141	1.40
Duocrop	86	1026	3.03
Impala	75	2509	0.26
TGx1649-11F	80	1840	0.03
TGx1681-3F	78	1292	0.56
TGx1448-2E	91	1454	2.20
Mean	79	1944	1.33
P	0.12	0.004	0.0001
SED	7	392	0.75
CV	11	24	69

It is concluded that the immune species may be recommended in areas of *Alectra* infestation, where farmers must grow a legume to control *Striga*, improve fertility or any other purpose. Yields of pigeon pea were notably low, while those of green manures were highest, but at present these have no economic value in Malawi.

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IDENTIFICATION OF *OROBANCHE* SPECIES OCCURRING IN NEPAL

Determination of *Orobanche* species is difficult because the plants have few characters for diagnosis. Characters are often lost upon drying. In the Flora of British India, Hooker (1885) described eleven *Orobanche* species occurring in the Himalayan region, eight in Osproleon including *O. kashmirica* Clarke, *O. cernua* Loeffl., *O. hansii* Kerner, *O. borealis* Turez., *O. solmsi* Clarke. *O epithymum* DC., *O. nicotianae* Wright and *O. clarkei* Hook.., and three in Trionychon including *O. indica Ham.* (= *O. aegyptiaca* Pers.), *O. ramosa L., and O. psila* Clarke. An Enumeration of Flowering Plants of Nepal by Hara *et al.* (1982) lists five *Orobanche* species occurring exclusively in Nepal with *O. coerulescens* Steph. and *O. alba* Steph. ex Willd. as new additions. Sahu and Sinha (1983) reported three species, *O. aegyptiaca, O. ramosa* and *O. cernua* in crop fields of Nepal. Rao *et al.* (1988) reported occurrence of two *Orobanche* species, *O. aegyptiaca* and *O. solmsii* in agronomic fields of the country.

There has been controversy and misinterpretation of *Orobanche* species occurring in Nepal (Rao *et al.* 1988). Hence, an effort has been made to ascertain and update the taxonomy of *Orobanche* species in Nepal. Available literature, herbarium specimens located in the Department of Forest and Plant Research (DFPR), Godawary, Lalitpur, Nepal, and personal collections of plant materials from different ecological zones of Nepal have been studied.

The oldest specimen of *Orobanche* present in the herbarium of DFPR, Godawary, was collected in 1952 by O.Polunin, V.R.Shakey and L.J.H.William (No.1997), as *O. coerulescens*. Close examination of the specimens revealed that the 4 specimens named as *O. coerulescens* showed variations. Specimens 1997 and 87/32 are confirmed as *O. coerulescens* but specimens 8285 and 74/2355 have short spikes (ave. 4.1 cm), short bristle-like glandular hairs and low insertion of stamen on the corolla tube (less than

3 mm) and are re-identified as *O. alba*. These two species are recorded from wild hosts, not crops.

My personal collection of *Orobanche* specimens belonging to the section Osproleon from tobacco, tomato and brinjal fields differed from the description of *O. solmsii* in purplish brown flowers and in the insertion of stamens well above the base of corolla tube. They also differed from *O. nicotianae* in their bifid calyx. However, they closely matched *O. cernua* except for their bracts which are nearly as long as the corolla tube.

O. aegyptiaca is the most widespread and troublesome *Orobanche* species damaging tori (*Brassica campestris* var *toria* Duthie) and tobacco crops in Nepal. Compared to tobacco, tori plants are smaller (40-70 cm) and have a shorter growing period (80-90 days). Probably for this reason, the shoots parasitising tori may remain unbranched. Such unbranched specimens may have been mistaken for *O. cernua* (Rao *et al.*, 1988).

O. ramosa, reported to occur in Nepal by Hara (1982) and Sahu & Sinha (1983) was not found. *O. ramosa* and *O. aegyptiaca* are closely related: both possess the same number of chromosomes (2n=24) and are interfertile (Musselman, 1986). It is probable that the *O. ramosa* reported was in fact *O. aegyptiaca.*

O. aegyptiaca heavily parasitises tobacco in Terai districts, particularly Sarlahi, Mahotari and Dhanusa. But *O. aegyptiaca* in other parts of Nepal was never observed parasitising tobacco. Tobacco seedlings brought from Sarlahi were planted in an *Orobanche* infested tori field at in Chitawan where there is an extensive cultivation of tori. Surprisingly, not a single tobacco plant was found to be infected by this population of *O. aegyptiaca*.

After a careful study of available *Orobanche* specimens, an attempt has been made to produce a key for their field identification

1. Bracteoles present, stem usually branched, calyx entire…………..…..….*O. aegyptiaca*
1. Bracteoles absent, stem unbranched, calyx divided in 2 segments.………………..…...2
2. Calyx segments equal, each bifid…*O. cernua*
2. Calyx segments unequal, one 3-lobed, the other 2-lobed…..………….……..……...3
3. Spike as long as the stem (ave. 9 cm), woolly hairs, stamen inserted above 3 mm from the base of corolla; corolla deep purple…………………..*O. coerulescens*
3. Spike short, bristle-like glandular hairs, stamens inserted less than 3 mm from the base of corolla; colour reddish violet to brown……………………………*O. alba*

Morphological investigation of specimens collected from Nepal exhibited variation in the size of spike, in the form of the calyx, in the insertion of stamens on the corolla tube, in the nature of surface hairs, and in the colour of flowers. The study seems to have revealed that there are four well defined species of *Orobanche* in Nepal: three species, namely *O. coerulescens, O. alba* and *O. cernua* in section Osproleon*,* and one species, *O. aegyptiaca* in section Trionychon. The study also suggests that *O. cernua, O. solmsii* and *O. nicotianae* mentioned by Sahu & Sinha (1983), Rao *et al* (1988) and Hooker respectively were different names given to the same species, *O. cernua.*

O. aegyptiaca, which is virulent on tomato in Israel and other Middle-East countries, was found to be less virulent on tomato in Nepal (Khattri et al, 1991). The inconsistent behaviour exhibited by *O. aegyptiaca* might explain why the species adapted to tori crop in Chitawan could not infect tobacco plants. These facts support the possibility of the existence of populations of *O. aegyptiaca* having different host specificity.

Orobanche aegyptiaca is an out-crosser (Musselman, 1986). Verkleij *et al* (1986) detected a high degree of genetic variation within and between populations of *O. aegyptiaca* by way of isozyme variation. Moreover, host plants may influence vigour of the parasitic plant (Musselman, 1986). Therefore, it could be assumed that the variations and heterogeneity met within as well as between population(s) of the *Orobanche* species might be partly due to the host species and partly to inherent genetic variability. Pronounced variation in the local climate due to the sharp altitudinal changes in Nepal could be the source of the genetic variability between the populations of *Orobanche* species occurring in different ecological zones of the country. Therefore, further studies on *Orobanche* populations occurring in contrasting climatic conditions of Nepal might reveal the extent of variations and adaptive mechanisms of the parasite not known to us. Finally, the present work might provide some basis for the identification of *Orobanche* species occurring in Nepal.

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BOOK REVIEW

Molecular Biology of Weed Control. 2002 Jonathan Gressel. Taylor & Francis, London. Hardcover, 520 pages. £75.00 ($120.00).

In "Molecular Biology of Weed Control", Jonny Gressel has written an ambitious book that tackles a broad range of weed control issues from a molecular biologist's point of view. Everything from herbicide mechanisms of action, to weed ecology, to biological control is considered and analysed in light of the fundamental biochemical and genetic principles that control them. The result is a book that maintains an integrated view of biology. For example, basic principles of plant genetics are not confined to a single chapter, but emerge throughout to explain aspects of herbicide resistance or gene flow. Jonny does this almost constantly, connecting together concepts from multiple disciplines to support his arguments, and filling the book with new ideas as well as outright speculation. Such conjecture and probing of the edge of our knowledge sets this book clearly apart from other weed science texts, even as it covers much of the standard territory. Although Jonny is generally clear in explaining mechanisms that may be unfamiliar to the average weed scientist (e.g., ABC transporters as a potential herbicide resistance mechanism), it assumes that the reader has a basic knowledge of genetics and molecular biology. Even with these assumptions, he finds plenty to write about, and this is a substantial book, including 390 pages of text, and another 100 pages containing 1591 references.

As a parasitic plant researcher, among his other interests, Jonny knows parasitic plants and frequently uses them (primarily *Striga* and *Orobanche*) to illustrate his points. He devotes several pages to the science, politics, and economics of why parasitic weeds are an example of "millennial weeds", which he defines as "weeds with global, widespread distributions that are uncontrollable with affordable agronomic techniques." He contends that these weeds present the most urgent need for biotechnologically-derived herbicide resistant crops (BD-HRCs), and that corporations controlling the BD-HRC traits have been too slow to respond. Although the economics of using herbicides at low rates (in sprays or the promising seed-dressing approach) seems unprofitable, he argues that widespread adoption of such techniques across the vast affected areas could justify the investment needed. In addition to the BD-HRCs, he envisions that molecular biology will contribute to the control of parasitic weeds through engineering of host plants for increased resistance, or engineering biocontrol pathogens for enhanced virulence on the weeds.

Anyone who knows him will recognize this book as quintessential Jonny Gressel, full of provocative ideas and opinions. The style of writing is conversational, with editorial comments inserted parenthetically, and it appears that little editing was done by the publisher. It is packed with ideas, many of them juxtaposed in intriguing combinations, and many admittedly straying into the realm of science fiction. Jonny obviously had fun writing this book, and anyone with an interest in agriculture and molecular biology will enjoy reading it.

Jim Westwood

THE SANDALWOOD RESEARCH NEWSLETTER

The Sandal Wood Research Newsletter is published three times per year by the Department of Conservation and Land Management, Western Australia, and is distributed free of charge. It is intended as a forum for information and exchange on *Santalum* species worldwide. Articles on *Santalum* species research and management issues are welcomed by the newsletter. To contribute or to be added to the mailing list send details of name, title, position, organisation, postal address etc to the Editor, Ms Tanya Vernes, Dept. of Conservation and Land Management, P.O. Box 942, Kununurra 6743, Western Australia, tel: (61)-8-91684200, fax: (61)-8-91682179.

The contents of the newsletter relate to the commercial exploitation of sandalwoods, and the policy issues involved. Each issue comprises an editorial and 2-3 articles. These include references but there is no separate Literature section. Articles over the past 2 years have included the following (issue:page numbers in brackets):

Jiko, L.R. 2000. Status and current interest in sandalwood in Fiji. (10:1-3)

Rohad, D. *et al.* 2000. Can sandalwood in East Nusa Tenggara survive? Lessons from the policy impact on resource sustainability. (10:3-6)

Taylor, D. *et al.* 2000. Testing growth and survival of four sandalwood species in Queensland. (10:6-8)

Tennakoon, K.U. *et al.* An overview of *Santalum album* research in Sri Lanka. (11:1-4)

Bristow, M. *et al.* 2000. Queensland sandalwood (*Santalum lanceolatum*): regeneration following harvesting. (11:4-8)

Lethbridge, B. 2001. Grafting compatibility of quandong, *Santalum acuminatum*. (12: 2)

Jones, P. 2001. Sandalwood re-visited in Western Australia. (12: 3-4.)

Wright, A. 2001. East Timor (Timor Timur) sandalwood plantation development: a feasibility study. (12:5-6)

Dey, S. 2001. Mass cloning of *Santalum album* L. through somatic emryogenesis: scale up in bioreactor. (13:1-3)

Setiadi, D. *et al./* 2001. Current sandalwood seed source in Timor Island. (13: 3-5)

Vernes, T. Preliminary results from *Santalum macgregorii ex situ* conservation planting. (13:6-7.)

Trueman, S. *et al.* 2001. Clonality in remnant populations of *Santalum lanceolatum*. (14:1-4)

Moretta, P. *et al.* 2001. Longitudinal variation in the yield and composition of sandalwood oil from *Santalum spicatum*. (14:5-7)

Ilah, A. *et al.* 2002. Somatic embryo irregularities in *in vitro* cloning of sandal (*Santalum album* L.). (15:2-3)

Ryan, P.C. and Brand, J.E. 2002. Techniques to improve sandalwood (*Santalum spicatum*) regeneration at Shark Bay, Western Australia: stem coppice and direct seeding. (15:4-7)

PP LISTSERVE

We noted the existence of this parasitic plants mailing list in Haustorium 34. This allows for the immediate exchange of news and queries between those interested in parasitic plants. Over recent months the flow of messages has been disappointingly slow but we believe this is at least partly due to the fact that their email address was changed without subscribers being informed. The new address to register as a subscriber is: listserv@opus.labs.agilent.com (note the lack of 'e' on 'listserv'). To subscribe, send the command: SUBSCRIBE PP <your name> in the message space (not the subject line). It should not be followed by any further text or signature.

To contribute your own messages, the new address is: pp@opus.labs.agilent.com

The website (see WEBSITE section below) indicates that the service is primarily for discussion of holoparasites, but the range of messages suggests that all parasitic plants are likely to be of interest. We encourage all Haustorium readers to subscribe to the PP List, which is free. Recent exchanges have included requests for seeds of *Cuscuta* spp, for information on pollination of *Viscum minimum*, on *Balanophora*, on tissue culture of *Orobanche*, and for data on effects of parasites on their hosts. Do you have a query or observation that cannot wait for the next issue of Haustorium? Join now. It would be good to see it more actively used.

Chris Parker

NEW THESES

K. Pageau (PhD, Universit de Nantes, June 4, 2001) Nitrogen nutrition and metabolism in the root hemi-parasite *Striga hermonthica* (Del.) Benth.: relation with carbon metabolism.

The present study was carried out with the relationship *Striga hermonthica*/*Sorghum bicolor* and focuses on elucidating aspects of the nitrogen nutrition of the parasite.

By feeding $K^{15}NO_3$ to the roots of the host sorghum plants, evidence was obtained for the transfer of ^{15}N from the host to the parasite. In the xylem exudate obtained from decapitated *Striga* plants, nitrogen was primarily present as nitrate (70% of the total transported nitrogen), glutamine (20%) and asparagine (10%). The total concentration of amino acids in the aerial parts of *Striga* was 4 times higher than in the leaves of the host. This difference could largely be attributed to the accumulation of asparagine, which accounted for 80% of the pool of free amino acids in the aerial parts of the parasite. Furthermore, 95% of the total ^{15}N recovered in the free amino acid pool was associated with asparagine. Thus, it appears that nitrogen is largely procured from the host in the form of nitrate and is accumulated as asparagine by the parasite. This indicates that the parasite has a high capacity to assimilate nitrate and to synthesise asparagine. This capacity was demonstrated with excised shoots of *Striga*, which massively incorporated supplied $K^{15}NO_3$ into asparagine. It appears, therefore, that *Striga* shows an unusual metabolism, excess nitrogen being stored as asparagine. This reflects the high transpiration rate of the plant, which results in high level of nitrate being transferred from the xylem sap of the roots of the host plant. In effect, the parasite is confronted with an excess of available nitrogen, which is stocked in a non-toxic form, asparagine.

The accumulation of asparagine thus provides a readily available reserve that can be mobilised at the end of the development cycle. In addition, this amino acid can contribute, with mannitol, to establishing and maintaining the gradient of hydrostatic potential between host and parasite. The assimilation of nitrate requires a range of enzymes – glutamine synthetase, glutamate synthase, glutamate oxoglutarate aminotransferase (glutamate deshydrogenase) - all of which were determined. The key enzyme of the biosynthesis of asparagine - asparagine synthetase - could also be detected. On the basis of the presence of these activities and the measured concentrations of metabolites, a global scheme for the synthesis of asparagine and its relationship to general carbon metabolism in *Striga* is proposed.

M.C. Arnaud (PhD, Universit de Nantes, December 12, 2001) Study of *Striga hermonthica* (Del.) Benth. resistance in *Sorghum bicolor* (L.) Moench. var Framida.

In Africa, *Striga hermonthica* is the main pest for subsistence cultures. There, the most efficient strategy of control is obtaining resistant crops. Up to now, selection was based on the evaluation of the resistance in infested fields. However, the understanding of resistance mechanisms would be useful for breeding resistant crops. We have characterised the resistance mechanisms of the sorghum Framida variety to *S. hermonthica*. Comparison between the host root exudates from sorghum Framida and a sensitive one (CK-60B) supported that stimulation of the parasite germination was not a determining point in the resistance mechanism of Framida variety. An *in vitro* system of *Striga*-sorghum co-culture was developed to follow the parasite development after attachment on the host roots. Some of the *Striga* attached to the resistant sorghum roots were stopped at the first stage of their development and did not connect the host plant xylem vessels. For the other attached *Striga*, stem growth was reduced in comparison with *Striga* growing on the sensitive variety. A lower transfer of organic substances from the resistant sorghum Framida to the young *S. hermonthica* plant was measured. This result might be related to a better competitiveness of the resistant line roots, and to structural modifications of the host root (cell wall thickening, obstruction of some vessels and phenolic compounds deposits at the host-parasite interface). Finally, the impact of *S. hermonthica* on the growth of Framida variety was reduced as compared to the total destruction of the sensitive sorghum line.

P. Labrousse (PhD, Universit de Nantes,

April 26, 2002) Study of *Orobanche cumana* Wallr. (Orobanchaceae) resistance in several *Helianthus* (Asteraceae) genotypes.

In order to find broomrape-resistant *Helianthus* genotypes, a screening of numerous wild hybrid lines and varieties was carried out under glasshouse conditions. A more accurate study of the most interesting genotypes shows that *H. debilis debilis*-215 x *H. annuus* derived genotype (LR1) induces parasite necrosis leading to a decrease in broomrape emergence and flowering. 92B6, an inbred line derived from interspecific genepool (*H. argophyllus*-92 X *H. annuus*) exhibits broomrape necrosis at a later stage and only seldom were flowers of the parasite observed. Development of a sunflower/broomrape hydroponic co-culture system allowed a study of defence reactions in LR1. The response of this genotype involved cell wall thickening, xylem vessel occlusion and cell division in cortical parenchyma and phloem. All these defence reactions decrease water and nutrient transfer to parasite. Radiolabelled (^{14}C) photoassimilate transfer from the host to *O. cumana* was lower when the parasite was growing on the LR1 genotype than when it was growing on the susceptible sunflower. Study of resistance in recombined inbred lines (RIL), derived from a cross of sunflower with LR1, first showed the existence of lines more resistant than LR1. Secondly, resistance mechanisms (low stimulation of broomrape germination and parasite necrosis) were not linked since low stimulating lines could also induce parasite necrosis. This work will lead to both the localisation of gene groups involved in the different resistance mechanisms to *O. cumana* and a more precise understanding of resistance inheritance. A further objective would be to obtain sunflowers with polygenic resistance to broomrape.

Fasil Reda (PhD, Vrije Universiteit, Amsterdam, 21 June 2002) *Striga hermonthica* in Tigray (Northern Ethiopia). Prospects for control and improvement of crop productivity through mixed cropping.

Tigray is the most northern state of Ethiopia. Cereals account for 87% of cultivated land and *Striga hermonthica* is among the top three problems perceived by farmers, together with drought and low soil fertility. Studies were conducted on possible solutions to the *Striga* problem, including relay cropping with *Sesbania sesban* and *Cajanus cajan*, and inter-cropping with alternate rows of various legume and oilseed crops.

Relay cropping, with or without additional fertilizer over a 3-year period showed promise at Sheraro, the wetter of two sites, but not at Adibakel, a drier site. Inter-cropping with two different cowpea varieties, planted as alternate rows 3 weeks after crop sowing gave superior results to those from haricot bean, soyabean, groundnut or noug (*Guizotia abyssinica)* giving increased total crop yields, though *Striga* numbers were not significantly reduced.

Tests with 19 populations of *S. hermonthica* from a range of host crops showed significant variation in virulence on two improved sorghum varieties, SRN-39 and P-9401, with populations from SE Tigray tending to be more virulent than those from W Tigray.

Assays with root exudates from a range of crop and potential trap-crop species showed significant variations in germination of 3 populations of *S. hermonthica*, the most interesting being two finger millet landraces showing very much lower germination stimulation than other varieties, while cowpea demonstrated the best trap-crop potential.

The thesis discusses the need for integration of different approaches, and the need for care in the introduction of new varieties without attention to the virulence of the local *Striga* populations, especially in the S and SE of Tigray.

PROCEEDINGS OF MEETINGS

The State of the Art in *Orobanche* control. Abstracts of a Workshop Meeting of the Working Groups 1, 2, 3 and 4 of COST Action 849, 'Parasitic Plant Management in Sustainable Agriculture. 2001. Edited by Daniel M. Joel. 48 pp. (Due to be published on a COST 849 website, to be detailed in the next issue.)

Contents:

***Striga* Research in Southern Africa and Strategies for Regionalized Control Options. Proceedings of the SADC *Striga* Working Group Workshop, Dar-es-Salaam, May 2000. 2001.** Edited by: Mgonja, M.A., Chivinge, O.A. and Monyo, E.S. ICRISAT, Bulawayo, Zimbabwe. 112 pp.

Contents:

Botany 2001 Meeting, Albuquerque, New Mexico, August, 2001. See the Parasitic Plants Connection web-site (URL below) for abstracts of presentations and posters on parasitic plants which included:

Nickrent, D.L. *et al.,* Paleoherb status of Hydnoraceae supported by multigene analyses.
Garcia, M.A. *et al.*, Intra-individual variation in plastid rDNA sequences from the holoparasite.
Wolfe, A.D. *et al*., Phylogeny and biogeography of Orobanchaceae reconstructed from nuclear rDNA and ITS sequence data.
Randle, C.P. and Wolfe, A.D. Molecular evolution of photosynthetic genes in holoparasites.
Olmstead, R. and Ferguson, D. A molecular phylogeny of the

Boraginaceae/Hydrophylllaceae. (Including the small parasitic family Lennoaceae.)
Stefanovic, S. and Olmstead, R.G. Molecular systematics of Convolvulaceae inferred from multiple chloroplast loci.

3rd International Canopy Conference, Cairns, Australia, June 2002. Symposium: Parasities in the Canopy: Mistletoe Evolution and Ecology. See the Parasitic Plants Connection web-site (URL below) for abstracts of papers and posters which included:

Nickrent, D.L. Origin and phylogeny of the mistletoes.
Glatzel, G. Physiological ecology of mistletoes.
Reid, N. Birds and mistletoes.
Mathiasen, R. Ecology of dwarf mistletoes in western North America.
Wiens, D. and Barlow, B. Epiparasitism in mistletoes, a neglected phomenon in forest canopy biology.
Bannister, P. *et al*. Is differential accumulation of elements in leaves of mistletoes and their hosts related to greater water loss in mistletoes?
Kallarackal, J. *et al.* Ecophysiology of teak (*Tectona grandis*) and its canopy parasite *Dendrophthoe falcata*.
Shaw, D.C. Ecology of *Arceuthobium tsugense* (Viscaceae), Cascade Mts. USA.
Devkota, M.P. and Glatzel, G. Effects of infection of *Scurrula elata* (Edgew.) Danser (Loranthaceae) on the wood properties of its host.
Watson, D.M. Mistelotes as a keystone resource – a progress report.
Cabrera, J.F. and Nickrent, D.L. Historical biogeography of Loranthaceae inferred from chloroplast matK sequences.
Devkota, M.P. and Glatzel, G. Mistletoes of the Annapurna Conservation Area, Central Nepal.

WEBSITES

For past and current issues of Haustorium see: http://web.odu.edu/haustorium

For information on the new International Parasitic Plant Society see: http://www.ppws.vt.edu/IPPS/

For Lytton Musselman's Plant site see: http://web.odu.edu/plant

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html
For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rms.nau.edu/misteltoe/welcome.html

For on-line access to USDA Forest Service Agriculture Handbook 709 'Dwarf Mistletoes: Biology, Pathology and Systematics' see: http://www.rmrs.nau.edu/publications/ah_709/ (Brian Geils asks us to point out that, contrary to the note in the last issue, some hard copies are still available – via bgeils@fs.fed.us)

For information on the Parasitic Plants mailing list 'PP listserve' see: http://www2.labs.agilent.com/botany/pp/html/pp_listserv.html

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' see: http://www2.labs.agilent.com/bot/pp_home

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Joel, D.M. 2002. Broomrape (*Orobanche* spp.) as an angiospermous pathogen: biological aspects and their impact on potential control. (abstract) Phytoparasitica 30: 295-296. (Opening lecture at 23rd Congress of Israeli Phytopathological Society, Feb, 2002. reviewing *Orobanche* as a pathogen, and the possible new approaches to control that might be applied.)

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valuable review of the potential and techniques for exploiting *P. orobanchia.*)

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Souza, V.C., Elias, S.I. and Giulietti, A.M. 2001. Notes on *Agalinis* (Scrophulariaceae) from Brazil. Novon 11: 484-488. (Two new species *A. itambensis* and *A. nana* are described, also the new combination *A. schwackeana*.)

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Tadey, M. and Aizen, M.A. 2001. Why do flowers of a hummingbird-pollinated mistletoe face down? Functional Ecology 15: 782-790. (Studies with *Tristerix corymbosus* provided no clear answer.)

Tennakoon, K. and Weerasooriya, A. 1998. Nature's scroungers – The fascinating world of plant parasites. Sri Lanka Nature March 1998: 45-58. (A regrettably belated listing of a highly informative, very well illustrated, article on the hemi-parasitic species of Sri Lanka, with indications of the distribution and importance of 22 species of Loranthaceae, 9 spp. of Viscaceae, 4 spp. of Olacaceae, 3 spp. of Scrophulariaceae (*Pedicularis zeylanica* and 3 spp. of *Striga*), 3 spp. of Santalaceae, and one sp. of Opiliaceae.)

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Zheng XingFeng and Ding YuLong 2001. Morphological features of *Phacellaria rigidula* Benth. Journal of Nanjing Forestry University 25(5): 33-36. (Discussing morphology of *P. rigidula* (Santalaceae) on *Taxillus calareas* var. *fargesii* .)

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has been edited by Chris Parker, 5 Royal York Crescent, Bristol BS8 4JZ, UK (Email chrisparker5@compuserve.com), Lytton John Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old

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Send material for publication to any of the editors.

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STATUS OF HAUSTORIUM

Haustorium is the official organ of the International Parasitic Plant Society (IPPS) and is published twice yearly.

We are pleased to acknowledge that Old Dominion University continues to support the printing and mailing of Haustorium.

Many readers are already receiving Haustorium by Email. If any more of you wish to do so, please let Chris Parker know (Email address on the last page). Bear in mind that having an electronic version of the newsletter enables you to 'search' for selected key words.

The web-site version of this issue and past issues of Haustorium are available on http://web.odu.edu/haustorium, and on the IPPS site – http://www.ppws.vt.edu/IPPS/

IPPS EDITORIAL BOARD ESTABLISHED

I am pleased to announce the formation of an Editorial Board for IPPS. This represents a new mechanism for IPPS to generate and review information of interest to parasitic plant researchers. The objective of having an Editorial Board is to assist in producing the publications of our Society. Specifically, the job of the Editorial Board members is to 1) participate in discussions on the form and function of Haustorium, and 2) contribute occasional content or editing to the newsletter. At some point in the future, IPPS may also produce other publications and the Editorial Board will assist in shaping the form and content of these as well.

The Editorial Board was selected to represent a diversity of expertise and perspectives, and each member represents a specific discipline. In addition, the Board reflects much of the geographical diversity of our society. Editorial Board members are:

Agronomy	Charlie Riches
Anatomy	Brian Fineran
Biochemistry	Philippe Simier
Biotech	Jonny Gressel
Breeding	Rositza Batchvarova
Chemistry	Koichi Yoneyama
Ecophysiology	Kushan Tennakoon
Taxonomy	Dan Nickrent

An important feature of the Editorial Board is this wide range of perspectives it will bring to Haustorium. We hope that this will encourage an increase in the number and diversity of articles in Haustorium and also ease the work load needed to publish each issue. One of the keys to the success of any society is involvement of its membership, and this Board represents a positive step in that direction. We are grateful to these individuals for sharing their time and talents with IPPS.

Jim Westwood

CIMMYT UNVEILS HERBICIDE-COATED MAIZE SEED TECHNOLOGY FOR *STRIGA* CONTROL

New, locally adapted, herbicide-resistant, open pollinated and hybrid maize varieties along with the seed-coating technology for *Striga* control were described to seed and chemical companies as well as pesticide and seed variety regulators in Eastern and Southern Africa in a two and a half day meeting in early July, 2002, at Kisumu, Kenya. *Striga* infests an estimated 20 to 40 million hectares of farmland cultivated by poor farmers throughout sub-Saharan Africa. In Kenya, an estimated 150,000 ha of land are infested (76 % of farmland in Western Kenya) causing an estimated crop loss valued at about US$38 million. In sub-Saharan Africa, the value of yield lost annually to *Striga* is estimated at US$1 billion, affecting the welfare and livelihood of over 100 million people. Heretofore alternative *Striga* control methods have not gained wide acceptance by farmers because they were not cost effective or did not fit well into the existing cropping systems, including intercropping with sensitive legumes as often practiced by small-scale African farmers.

On the first day of the meeting, scientists described years of research by CIMMYT in collaboration with the Weizmann Institute of Science (Israel) (with funding from the Rockefeller Foundation) to develop the varieties and the control package for *Striga* control in maize. It combines low doses (as little as 30 grams per hectare) of a systemic acetolactate synthase-inhibiting herbicide such as imazapyr or pyrithiobac as a seed coating with imidazolinone-resistant (IR) maize seed. Field researchers from four east African countries described how the treatment leaves a field virtually clear of emerging *Striga* stalks up to harvest, and allows intercropping with legumes as long as the legume is interplanted between the maize rows at least 12 cm from the treated maize seed. Since the maize seed is treated, there is no need or added cost for spraying equipment and no possibility of off-target application. The herbicide is compatible with commonly-used fungicide/insecticide seed dressings, and is applied with them. With effective *Striga* control, the potential for returns on inputs such as fertilizers and other pest control products is greatly improved. The CIMMYT breeders described the laborious process of transferring the mutant IR gene from a Pioneer hybrid into a locally adapted background that has superior streak virus and fungal disease resistance. The regulators described the hurdles that must be overcome to register the herbicide and its new form of application, and the new varieties. Representatives of the chemical companies described perceived problems in marketing – initially the material should be available only to seed companies to prevent farmers from losing their crops by treating non-IR maize. An economist and representatives of the seed companies described their perceptions of the market. However, no one was overly excited at the end of the first day.

The second day was devoted to visiting two experiment stations, and a large number of farmers' fields in heavily infested areas of western Kenya, up to the Uganda border. Huge differences between the treated and non-treated plots were seen at the Kibos experiment station, the first stop of the tour; *Striga* had clearly bewitched the untreated maize but the infested maize was still standing. This was not the case in farmers' fields where almost totally devastated plots of farmers' maize in full *Striga* bloom stood in stark contrast beside clean normal stands of herbicide-treated IR-maize. The herbicide treatments more than tripled yields (on average) when there were more than ten *Striga* plants emerging per square meter in the farmers fields (Fig. 1). Even with low infestations, most farmers reported significantly improved yields.

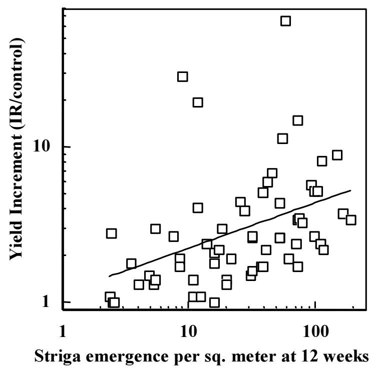

Figure 1. Increased yields of herbicide treated IR-maize as a function of *Striga* infestation. Yields of two imazapyr-treated locally-adapted CIMMYT IR-maize (averaged) were compared with (divided by) those of the untreated local landrace (Nyamulla) and commercial hybrid H513 (averaged).

Interviews with the farmers clearly affected the participants, especially when the farmers volunteered that they would pay much more for the technology than the seed producers estimated to charge. Seed companies have already developed a market for quality hybrid maize among subsistence farmers in nearby non-infested areas, and there is a realization for the large market potential where *Striga* is prevalent. The excitement from seeing the field trials was apparent on the third day when seed companies expressed strong interest in acquiring the technology. The plight of the farmers was not ignored by the regulators who discussed methods of fast-tracking chemical and varietal registrations for the *Striga* hot spots. It is anticipated that IR-maize lines adapted to the *Striga* infested agro-ecology of western Kenya will be released by CIMMYT to seed companies before the coming season, who will begin the process of certification and bulking up. Meanwhile CIMMYT breeders are developing additional varieties appropriate for other areas in sub-Saharan Africa where *Striga* is endemic.

Fred Kanampiu and Dennis Friesen, CIMMYT, Kenya
Jonathan Gressel, Weizmann Institute of Science, Israel

SORGHUM CULTIVARS RELEASED IN TANZANIA

Following extensive laboratory testing and participatory evaluation by farmers on *Striga* infested land in the Lake and Central zones of Tanzania, two white grained, early maturing sorghum cultivars have been approved for release by the national seed registration authority. Both lines were developed at Purdue University, USA. Line P9405 has been registered with the Swahili name HAKIKA (meaning 'be sure' i.e. that the farmer is sure to harvest something even from *Striga* infested fields) while P9406 has been named WAHI (meaning 'early' to indicate the early maturity of this material). Both lines have been evaluated on-farm over the past six years and have been found by farmer groups to support lower numbers of *S. hermonthica* or *S. asiatica* and to produce higher yields on infested fields compared to previously available local land races and cultivars. The early maturity, drought tolerance, grain quality and taste of these lines have also impressed farmers. Laboratory studies undertaken at the University of Sheffield, UK, partners in this project funded by the Crop Protection Programme of the UK Department for International Development, have confirmed the *Striga* tolerance of both lines in terms of maintenance of stem biomass. HAKIKA shows a high degree of tolerance to *S. hermonthica* even at low nitrogen availability, equivalent to conditions in many continuously cultivated fields that farmers identify to have low and declining soil fertility.

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MISTLETOE SYMPOSIUM IN CAIRNS, AUSTRALIA

The Third International Canopy Conference was held in Cairns, Queensland, Australia from June 23-28, 2002. One of the symposia presented during that week was entitled 'Conservation, biodiversity, and management of mistletoes' and was co-organized by Dave Shaw (Wind River Canopy Crane Research Facility, Carson, Washington, USA) and Daniel Nickrent (Southern Illinois University, Carbondale, Illinois, USA). The symposium had a plenary session entitled 'Parasites in the Canopy: Mistletoe Evolution and Ecology' that included the following talks: Dan Nickrent 'Origin and phylogeny of the mistletoes,' Gerhard Glatzel 'Physiological ecology of mistletoes,' Nick Reid, Mark Stafford Smith, and Jake Overton 'Birds and mistletoes,' Robert Mathiasen 'Ecology of dwarf mistletoes,' and Bryan Barlow and Del Wiens 'Epiparasitism in mistletoes, a neglected phenomenon in forest canopy biology.' In addition, there were the following contributed papers: Peter Bannister, Graham L. Strong and Inge Andrew 'Is differential accumulation of elements in leaves of mistletoes and their hosts related to greater water loss in mistletoes?' David C. Shaw 'Ecology of *Arceuthobium tsugense* (Viscaceae), Cascade Mts. USA,' and David M. Watson 'Mistletoe as a keystone resource: a progress report.' Because of cancellations (Jose Kallarackal et al. and Mohan P. Devkota), we had time slots open that were filled by David Norton (University of Canterbury, New Zealand) who spoke on his research on the ecology and conservation of New Zealand mistletoes, such as *Peraxilla tetrapetala*.

In addition to presented papers, there were four posters dealing with mistletoes: Jon Cabrera and Dan Nickrent 'Historical biogeography of Loranthaceae inferred from chloroplast matK sequences,' Mohan Devkota and Gerhard Glatzel 'Mistletoes of the Annapurna Conservation Area, Central Nepal,' Ainsley Calladine 'Evolution of the mistletoe family Loranthaceae in Australia,' and Wilfried Morawetz 'Investigations on the ecology of the Loranthaceae and Viscaceae in the upper Orinoco (Venezuela).' To view the abstracts from the plenary and contributed papers, see: http://www.science.siu.edu/parasitic-plants/MistletoeAbstracts.html

On June 26, a group of enthusiastic 'mistletoers' were treated to a marvellous field trip lead by Bryan Barlow. We began by visiting the mangrove swamp near the Cairns airport where we saw *Lysiana maritima* and *Amyema mackayense*. The next stops were Trinity beach and Pebble beach where we saw *Amyema queenslandica*, *Dendrophthoe vitellina, Lysiana subfalcata*, and *Cansjera leptostachya* (Opiliaceae). Although not a mistletoe, our stop at Kingfisher Park to see *Balanophora fungosa* was a treat for some of us! A parasite of *Melaleuca viridiflora*, *Diplatia tomentosa*, was next seen at Abattoir Swamp. In Atherton we got to see the flowers and fruits of *Amylotheca dictyophleba* thanks to the tree climbing ability of Nick Reid! North of Tolga, where we had a wonderful lunch by the way, we saw the beautiful *Decaisnina brittenii* parasitic on *Lophostemon suaveolens*. Finally, the 'pièce de résistance' or possibly the 'coup de grâce' for those who had had quite enough, was the tree on Hastie road near Atherton that contained, all in one clump (and including some epiparasites): *Dendrophthoe curvata, D. vitellina, Amyema queenslandica, A. glabra, Notothixos subaureus*, and *Viscum articulatum*! So, an even dozen mistletoe species in seven genera in one day; where else besides Australia can one do that?

Dan Nickrent, Southern Illinois University, Carbondale, USA

SANDALWOOD RESEARCH NEWSLETTER

Further to the item in Haustorium 41, please note that the editor is now Jon Brand, Dept. of Conservation and Land Management, Bag 104, Bentley, WA 6983, Australia; email **jonb@calm.wa.gov.au**; fax 61-8-93340327. Issue 16 was published in July 2002 and includes 3 articles noted in the Literature section below under Vernes and Robson, 2002, TueMan Luong, 2002, and Angadi *et al*., 2002.

CALLING ALL PARASITICULTURALISTS

Greetings fellow Haustorium readers. I am a recent initiate to your group but am very keen to expand our knowledge regarding the horticulture of the more spectacular plant parasites. I have been growing a wide range of unusual plants for most of my life and would like to add parasites to the list, provided material can be made more widely available. I am interested in hearing expressions of interest in setting up a seed-bank for members to access, featuring seed of plant parasites which might be of horticultural interest (but probably excluding those known to parasitise any crops of economic importance). Plants such as *Hydnora, Cynomoria, Cytinus, Tristerix aphyllus* and *Viscum minimum* spring to mind. I should be able to personally contribute seeds of a few Australian mistletoes. If you might be able to supply material or are keen to obtain particular species, please contact me.

Shane Simonsen, 6 Edgar Street, West End 4101, Queensland, Australia.
Email: void_genesis@hotmail.com

MISTLETOES OF NORTH AMERICAN CONIFERS

At the request of the North American Forestry Commission, the Rocky Mountain Research Station in partnership with the Canadian Forest Service and Mexican Sanidad Forestal has published a general guide and literature review, *Mistletoes of North American Conifers*. The guide provides resource managers, foresters, arborists, and land owners with a recent, practical, and user-appropriate summary of literature and current research on the leafy and dwarf mistletoes in North America (includes over 600 references, most published since 1990). Information is presented for the three major genera of mistletoes on their hosts, distribution, life cycle, damage, ecological effects, and economic importance. Current and emerging methods for the survey and management of infested trees and stands with biological, chemical, genetic, and cultural approaches are described. These approaches especially consider situations where resources are managed for timber or non-timber objectives such as wildlife or wildfire hazard reduction. A Spanish translation is being prepared.

Copies of Geils, Cibrián, and Moody (2002) [*Mistletoes of North American Conifers*. Gen. Tech. Rep. RMRS-GTR-98. Ogden UT:U.S. Dept. Agric. Forest Service, Rocky Mountain Research Station. 123 p.] are freely available through several means. The publication is on-line at http://www.fs.fed.us/rm/pubs/rmrs_gtr098.pdf. Individual or several printed copies can be requested from the Rocky Mountain Research Station by phone (970-498-1392), mail (Richard Schneider, USDA Forest Service, Rocky Mountain Research Station, 240 W Prospect Road, Fort Collins, CO 80526), or Internet (http://www.fs.fed.us/rm/main/pubs/order.html). The publication is intended for a general audience; therefore, instructors, arboreta, and others who would like to have multiple copies for their distribution are encouraged to request copies in box lots (50 per box) by contacting Brian Geils at the Rocky Mountain Research Station (bgeils@fs.fed.us or 928-556-2076).

The *Mistletoes of North American Conifers* updates, expands upon, and complements the previous technical monograph by Hawksworth and Wiens (1996) [*Dwarf Mistletoes: Biology, Pathology, and Systematics*. Agric. Handb. 709. Washington, DC: U.S. Dept. Agric. Forest Service. 410 p.]. This publication intended for botanists and pathologists can be viewed at http://www.rmrs.nau.edu/publications/ah_709/index.html. A limited supply of printed copies is also still available (contact Richard Schneider by phone, mail or Internet as listed above).

Internet links to both of these publications (and other information) are also located at the Mistletoe Center (http://www.rmrs.nau.edu/mistletoe). The server on which the Mistletoe Center resides is presently without a webmaster and may occasionally be unavailable. We are, however, working to obtain needed technical support for the site and intend to continue providing access to the Mistletoe Literature Database.

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WEBSITES

For past and current issues of Haustorium see: http://web.odu.edu/haustorium

For information on the International Parasitic Plant Society see: http://www.ppws.vt.edu/IPPS/

For Lytton Musselman's Plant site see: http://web.odu.edu/plant

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rms.nau.edu/misteltoe/welcome.html

For on-line access to USDA Forest Service Agriculture Handbook 709 'Dwarf Mistletoes: Biology, Pathology and Systematics' see: http://www.rmrs.nau.edu/publications/ah_709/ (Brian Geils asks us to point out that, contrary to the note in Haustorium 40, some hard copies are still available – via bgeils@fs.fed.us)

For information on the Parasitic Plants mailing list 'PP listserve' see: http://www2.labs.agilent.com/botany/pp/html/pp_listserv.html

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' see: http://www2.labs.agilent.com/bot/pp_home

For 'Hosts and geographic distribution of *Arceuthobium oxycedri*.' (version 1.0) by Ciesla, W.M., Geils, B.W. and Adams, R.P. 2001. USDA Forest Service, Fort Collins, RMRS-RN-11WWW see: http://www.fs.fed.us/rm/pubs/rmrs_rn11/

LITERATURE

Acharya, B.D., Khattri, G.B., Chettri, M.K. and Srivastava, S.C. Effect of *Brassica campestris* var. *toria* as a catch crop on *Orobanche aegyptiaca* seed bank. Crop Protection 21: 533-537. (A normal crop of tori was followed after harvest by a second catch crop grown for 1 month, as a vegetable. This reduced the *O. aegyptiaca* seed bank by about 30%.)

Adagba, M.A., Lagoke, S.T.O. and Imolehin, E.D. 2002. Nitrogen effect on the incidence of *Striga hermonthica* (Del.) Benth in upland rice. Acta Agronomica Hungarica 50(2): 145-150. (Susceptible cultivars required higher rates of nitrogen to ameliorate the effect of *S. hermonthica* than the resistant cultivars.)

Adagba, M.A., Lagoke, S.T.O. Singh, B.N. and Ndahi, W.B. 2002. Potential of cinosulfuron and CGA152005 seed treatment for control of *Striga hermonthica* in upland rice. Acta Agronomica Hungarica 50(1): 7-18. (In field trials, rice varieties FARO 40 and WAB 56-50 showed complete resistance to *S. hermonthica,* without herbicide, while Faro 11 showed tolerance. *Striga* emergence was delayed, and crop growth improved by herbicide treatments in susceptible varieties.)

Adeosun, J. O., Gbadegesin, R.A., Shebeyan, J.Y., Aba, D.A., Idisi, P.O. and Yusuf, J.O. 2001. Evaluation of sorghum cultivars for their resistance to *Striga hermonthica.* Moor Journal of Agricultural Research 2(1): 25-30. (ICSV 400 supported *Striga* emergence but yielded well, while ICSV 1007 BF showed resistance but yielded poorly.)

Aflakpui, G.K.S., Gregory, P.J. and Froud-Williams, R.J. 2002. Growth and biomass partitioning of maize during vegetative growth in response to *Striga hermonthica* infection and nitrogen supply. Experimental Agriculture 38: 265-276. (In a pot experiment, reductions in photosynthesis and growth of maize shoots were not influenced by rates of N equivalent to 20-60 kg N/ha.)

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Aukema, J.E. and Martinez del Rio, C. 2002. Mistletoes as parasites and seed-dispersing birds as disease vectors: current understanding, challenges and opportunities. In: Levey, D.J., Silva, W.R., Galetti, M. Proceedings, Third International Symposium-Workshop on Frugivores and Seed Dispersal, Sao Pedro, Brazil, August, 2000. pp.99-110. (Discussing the interactions between birds, host plants and the desert mistletoes *Tristerix aphyllus* and *Phoradendron californicum*.)

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Cohen, B.A., Amsellem, Z., Maor, R., Sharon, A. and Gressel, J. 2002. Transgenically enhanced expression of indole-3-acetic acid confers hypervirulence to plant pathogens. Phytopathology 92: 590-596. (Introduction of one or two genes for IAA expression into *Fusarium oxysporum* or *F. arthrosporioides* enhanced their virulence against *O. aegyptiaca*.)

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Sofletea, N. and Stanescu, V. 2000. (Directions and implications of ecological genetics in silviculture.) (in Romanian) Revista Padurilor 115(3): 1-3. (Discusses interaction between *Abies alba* and 'mistletoe', *Viscum album*?)

Solymosi, P. and Horvath, Z. 2001. (Infraspecific taxa of the *Orobanche ramosa* L. in Hungary.) (in Hungarian) Novenyvedelem 37(4): 183-186. (Forma. *polyclonos* and f. *cyanea* were frequent while f. *monoclonos* and f. *albiflora* were rare.)

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Zheng XingFeng and Ding YuLong 2001. Morphological features of *Phacellaria rigidula* Benth. Journal of Nanjing Forestry University 25(5): 33-36. (*P. rigoidula* thrives mainly on *Taxillus calareas* var *fargesii.*)

Zonno, M.C. and Vurro, M. 2002. Inhibition of germination of *Orobanche ramosa* seeds by *Fusarium* toxins. Phytoparasitica 30: 519-524. (Of 18 toxins tested, 7 caused 100% inhibition of germination at 10 µM. Diacetoxyscirpenol caused 95% inhibition at 0.1 µM.)

HAUSTORIUM 42
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IPPS UPDATE

The Next Meetings of the International Parasitic Plant Society (IPPS)

The Society, which started activity at the International Parasitic Weed Symposium in Nantes, is now preparing two scientific meetings: (1) a Parasitic Weeds Workshop in Durban (South Africa) which is due for late June 2004, and an International Congress on Parasitic Plants in 2006. In addition, we are negotiating the possibility of organizing a workshop on mechanisms of parasitism in *Orobanche*, in conjunction with a COST meeting.

(1) IPPS Workshop on Parasitic Weeds (IPPSW)

The Workshop will take place in Durban (South Africa) in collaboration with the International Weed Science Congress (IWSC) that is due on June 19-25, 2004. The exact dates of the Workshop are still under negotiations and will be published soon, together with a call for papers. The preliminary plan for the IPPS Workshop is:

Thursday 24 June 2004.

Plenary lecture on **The parasitic weeds problem and its fate in the 21st century**.

Workshop on ***Striga* management in various cropping systems**. This workshop is open for contributions.

Poster session on **Parasitic weeds,** including discussion of selected contributions.

A special session on **Progress in parasitic weed research**, with review lectures on:

i. Understanding key developmental processes in parasitic weeds.

ii. New methodologies for the management of parasitic weeds.

iii. Mechanisms of resistance and their application in susceptible crops.

iv. Demography of parasitic weeds and its impact on management.

Friday 25 June 2004.

Workshop on **Genetic variation in parasitic weeds.** This workshop is open for contributions.

Workshop on **Molecular and physiological aspects of parasitic plants development.** This workshop is open for contributions.

The program of the IPPSW and the IWSC are complementary, so that participants in both meetings will have the opportunity to discuss parasitic weeds within the wider scope of weed biology and control, and benefit from both.

(2) The International Parasitic Plants Congress (IPPSC)

The IPPS Congress will take place in 2006, and will cover all aspects of the biology and control of parasitic plants. Special sessions will be dedicated to the mistletoe problem, to root parasites, to mechanisms of parasitism, to novel aspects of the management parasitic weeds, and to many other aspects of parasitic plant biology and management. The exact dates and venue for the Congress and a call for papers will be published in due course.

Danny Joel, IPPS Secretary
dmjoel@volcani.agri.gov.il

SYMPOSIUM IN USA, 2004

Preliminary plans are under way for a one day symposium on parasitic plants to be held in August 2004 at Snow Bird, Utah as part of the annual Botanical Society of America meeting. The theme is 'After the book--Parasitic Plant Biology After Three Decades'. Our understanding of parasitic plants has advanced remarkably since the appearance of Job Kuijt's 'Biology of Parasitic Flowering Plants' in 1969, the starting date of modern research on the topic. The object of this symposium is to review progress, highlight major contributions, and discuss avenues for further investigations. Further information available from:

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COVER CROPS AND ORGANIC RESIDUES FROM TREES FOR REDUCING *STRIGA HERMONTHICA* IN SORGHUM

An integrated approach including the use of tolerant cultivars and adequate cultural practices can help limit the damage caused by *Striga hermonthica* on cereal crops. Could cover crops be a component of such an approach?

The use of organic residues, as well as land management based on rotation and association with nitrogen-fixing legumes, are among the cultural practices that have been proposed to help control *S. hermonthica* infestation. This led us to undertake a study on the effect of organic residues from leguminous and non-leguminous trees and crops on *S. hermonthica* infestation in sorghum.

In a field experiment conducted in collaboration with the Institute of Rural Economy, in Mali, a one-year rotation with *Canavalia ensiformis*, *Cajanus cajan* or a natural fallow did not reduce *S. hermonthica* infestation, as compared to monocropping of sorghum (control). However, the rotation with *C. ensiformis* doubled sorghum yield as compared to control.

The effect of organic residues from various tree species on the sorghum-witchweed interaction has also been tested in pot experiments. Adding 2 g of ground leaves from either *Gliricidia sepium* or *Vitellaria paradoxa* (shea nut) in the top soil of 10-cm pots resulted in a significant decrease in the number of emerged *S. hermonthica* as compared to control. A better growth of infested sorghum was also observed when adding ground leaves from either *Azadirachta indica* (neem), *G. sepium* or *Cassia siamea*, although it remained significantly lower than the growth of non-infested sorghum.

These results indicate that the use of organic residues from species such as *C. ensiformis* and *G. sepium* could eventually help control the damage caused by *S. hermonthica* in sorghum. As pointed out by Rao and Gacheru (1998), increased microbial activity following the incorporation of organic residues could affect witchweed emergence. While reducing *S. hermonthica* infestation, organic residues would also help restore soil fertility, thus promoting sorghum growth.

Reference: Rao, M.R. and E. Gacheru. 1998. Agroforestry Forum 9: 22-27.

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UPDATE ON THE *DESMODIUM* INTERCROP TECHNIQUE FOR *STRIGA* CONTROL

During a visit to Kenya in February, I was fortunate to have the opportunity to visit the ICIPE (International Centre of Insect Physiology and Ecology) headquarters in Nairobi and their substation at Mbita Point on the shores of Lake Victoria, where the 'push-pull' techniques for control of stalk borers and *Striga* have been developed over the past 5-6 years in collaboration with Rothamsted Research, UK, with funding from the Gatsby Charitable Foundation. In the case of stalk borers both push and pull are involved, the push from the repelling affect of an intercrop such as *Desmodium uncinatum* (silver-leaf desmodium) or *Melinis minutiflora* (molasses-grass) and the pull by attraction of adult moths to *Pennisetum pupureum* (napier-grass) grown around the field borders (see the web-site listed below for further background). Control of *Striga* involves just the *Desmodium*. Dr Zeyaur Khan kindly arranged my visit to Mbita Point where irrigation is used during the dry season to maintain plots for demonstration purposes. Here I was duly impressed by the performance of *Desmodium* not only in almost totally suppressing emergence of *S. hermonthica* but also in increasing soil fertility and the vigour of the maize crop through nitrogen fixation. Equally impressive were pot experiments in screen houses which vividly demonstrate how the suppressive effect on *Striga* is quite independent of the increase in nitrogen status. The direct effect on *Striga* is being described as allelopathic, as the *Striga* seedlings cease growth soon after germination, but we await more detail of the laboratory studies, such as those reported in Dr Tsanuo's thesis (see abstract below), which show that premature haustorial initiation is involved, thus involving a stimulatory as well as an inhibitory process.

I was particularly interested to learn some aspects of the technique which had not been clear to me from the available literature. Although it has been explained that *D. uncinatum* is a perennial, I had not appreciated that the technique ideally involves the maintenance of the *Desmodium* rows over many years, with maize being repeatedly planted into the inter-rows. And while a benefit in both *Striga* suppression and maize growth may be recorded in the first season after establishment, there is a cumulative effect on soil fertility which is very striking indeed after 3-5 years. This fulfils the widely endorsed thesis that for sustainable control of *Striga* there must be improvement in soil fertility as well as suppression of the *Striga* itself. It also means that the cost of seed and planting the legume is only incurred in the first year. Conversely there are the disadvantages that climatic conditions have to be such that the legume survives any dry seasons, and furthermore, the legume plantings have to be protected against grazing, especially during the dry season, by fencing if necessary. Many local farmers are none-the-less adopting the technique and a number are finding that the availability of the legume helps them to maintain a dairy cow which in turn helps cover any additional costs of fencing. Promotion of the technique in Kenya and Uganda is continuing to be supported by Gatsby Charitable Foundation and is currently receiving additional support in the form of a UK DFID (Department for International Development)-funded project involving ICIPE, Rothamsted Research and a number of other Kenya-based institutions, including a local company who will be producing *D. uncinatum* seed. Farm Africa are also hoping to initiate work in Tanzania. We congratulate ICIPE and their collaborators on this promising development and look forward to hearing news of further progress.

Chris Parker.

SIPWEMA
AFRICA-WIDE PARTNERSHIP TO COMBAT *STRIGA* AND *OROBANCHE*

An Africa-wide partnership project called "Sustainable integrated parasitic weed management in cereal-legume production systems in Africa", with the sweet African sounding acronym "SIPWEMA" is in the wings. SIPWEMA is a time-bound initiative of 12 pioneering countries in North, West, Central, East and Southern Africa, the CGIAR System-wide Program on Integrated Pest Management (SP-IPM), FAO Agriculture Departmental Group of the Regional Office for Africa (FAORAFA), Pan-African *Striga* Control Network (PASCON), Semi-Arid Food Grain Research and Development (AU/SAFGRAD) program of the African Union, and the Global IPM Facility. After planning workshops in Benin in October, 2002 and Morocco in March 2003, these key partners are dedicated to develop a 6-year programme which will break isolation barriers amongst themselves to bring benefits of prior research and outreach activities to reduce staggering cereal and legume food deficits caused by parasitic weed infestations in the production systems.

The parasitic weed problem is intimately associated with changes in intensity of land use. As population pressure has increased, subsequent demand for food production has increased, and land use has intensified. This intensification is reflected in greater use of cereal mono-cropping with little fallow to non-host crops. As a result, the extent and intensity of parasitic weed infestations have rapidly increased and become threats to food production. Over the years, research has provided sound knowledge-base on cropping systems and crop and land management practices that increase food production while repressing parasitic weeds, but has so far had limited impact at the farm level. In North Africa, for example, *Orobanche* attacks a wide range of key food legumes crops causing estimated

average annual losses of up to US $15 million in individual countries. In West and Central Africa, *Striga* attacks a wide range of stable cereals and legumes causing estimated annual cereal losses of US $5 to 7 billion, affecting over 100 million people. *Striga* epidemic is a primary biotic constraint to maize production in Southern Africa countries. Drastic changes in the production practices are therefore required to reduce losses by means friendly to human health and the environment.
To be sustainable, parasitic weed management practices must improve crop yield, improve soil fertility and be acceptable to farmers even in the absence of parasitic weed infestation. Towards this end, the SIPWEMA focus is on local capacity building to ensure rapid spread and farmer adoption of parasitic weed management practices Africa-wide. The short term aim of SIPWEMA is to reduce parasitic weed incidence and damage by at least 60% in a large number of farmers' fields; in the medium term the project aims to increase cereal and food legume crop yields by 20-40% over current farmers' practices; and in the long-term SIPWEMA aims to significantly reduce parasitic weed seed bank and remove land and soil degradation factors which aggravate the parasitic weed damage to crops. Drastic changes in the production practices are therefore required to reduce losses by means friendly to human health and the environment.

SIPWEMA is building on several prior and on-going initiatives by national governments, sub-regional networks and research organizations to address a common challenge: develop a field program that breaks isolation barriers, promotes inclusive partnerships, and focuses on action by the participating countries to increase stakeholder ownership of processes and results and produce impact at the community level. Building on prior inter-African initiatives, SIPWEMA provides a coordinated platform for the key players to harmonize approaches, exchange of information, expertise, technical resources, and extrapolate proven results and experiences to new locations. Working through regional, national and local focal points, SIPWEMA will harness complementary strengths of stakeholder groups to bring results of prior research to enhance farmers' capacity to manage the parasitic weed problems against which traditional coping strategies continue to be ineffective. SIPWEMA will search for proven parasitic weed management options, adapt, harmonize, and promote the options. The activities will be driven by technical innovation, cohesive partnerships, and change in attitude across a broad spectrum of stakeholders. SIPWEMA implementation is through a set of horizontal rows of sub-regional activities to underpin vertical columns of a complementary set of location-specific activities in participating countries. Location-specific activities will be contingent upon and incremental to underpinning regional activities; subject to modular funding, the activities will be extended to countries requesting assistance.

Over six years SIPWEMA will empower farmers in 28 countries to obtain highest return on production inputs and thereby contribute significantly to household and national food security and economies which are increasingly undermined by damaging infestations of the parasitic weeds. The primary beneficiaries are African men and women farmers with their immediate technical support groups. These partners will benefit from reduced pest load, increased capacity to manage cereal-legume production systems for higher and stable productivity and profitability, and foster healthy production environments. Community-based feedback mechanisms will allow research organizations to re-define research agenda in a bottom-up manner to respond to emerging issues from the farmers' field experiences, and strengthen international collaboration. The project's exit strategy centres on capacity-building to increase scientific literacy in farming communities, and promote participatory extension to scale out/up gains and benefits.

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On behalf of the nucleus of SIPWEMA partners: PASCON (pascon1@yahoo.com), AU/SAFGRAD (ouattaram.safgrad@cenatrin.bf), FAORAFA (Sulayman.MBoob@fao.org), and Global IPM Facility (Peter.Kenmore@fao.org).

COST 849

Dr Diego Rubiales reports that COST 849 activities have been severely limited over the past year owing to changes in EU administration and associated budgetary restrictions. There have been no further meetings since that in

Obermarchtal in July 2002 but one is now planned for Greece in September, 2003. Abstracts of the papers presented at the meetings in Bari, Sofia and Obermarchtal may be seen on the COST web-site (see below). The titles of those presented at Sofia and Obermarchtal appear below under Proceedings of Meetings. Hard-copy proceedings will **not** be available.

OROBANCHE IPM IN NEAR EAST AND NORTH AFRICA

An expert consultation meeting was jointly organized by ICARDA, FAO and INRA, Morocco on IPM for *Orobanche* in food legume systems in Near East and North Africa in Rabat, Morocco , 7-9 April, 2003. The main objective was to develop a project proposal on *Orobanch*e control for possible funding. Participants from 10 countries (Egypt, Ethiopia, Sudan, Iran, Syria, Turkey, Algeria, Morocco, Jordan and Tunisia), and representatives from ICARDA, FAO and Germany attended the meeting. It was indicated that FAO encourages regional activities to control this parasite through participatory approaches in the form of Farmer Field Schools. The topics presented in the meeting included: Country reports on *Orobanche* control, development of technologies for *Orobanche* management, biological control, and the status of the overall scenario on *Orobanche* control. Towards the conclusion of the meeting, the participants formulated a log frame for the proposed project on *Orobanche* IPM in the food legumes systems of the Near East and North African region. Proceedings of the meeting will be published in the near future.

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RETIREMENT

Chester L. Foy retired on July 1, 2002 after more than 50 years of distinguished academic service in research, teaching, extension and administration at three major Land Grant institutions. He served the last 36 years as Professor of Plant Physiology/Weed Science at Virginia Tech, including six years as Department Head.

Dr. Foy has been extremely active in international scholarship, including parasitic plant research. He participated in five International Symposia on Parasitic Plants, and in two Workshops on *Orobanche* Research. In addition to other work on parasitic plants, Foy served as Scientific Coordinator for a 4-year, tri-national, $3 million US AID MERC Project for collaborative research on *Orobanche* research with colleagues in Israel and Egypt. He is a charter member of the International Weed Science Society (IWSS) and later served as President of IWSS. He presided over the First International Weed Congress in Australia and participated in the Second and Third Congresses.

Consistent with his international research interests, Foy has directed M. S. and Ph. D. students from 14 different countries. He has hosted a number of international postdoctoral researchers, Fulbright Scholars, and other Visiting Scientists, e.g. from Israel, India, Lebanon, Jordan, Iraq, Spain, The Philippines, Germany, and others for shorter visits. Moreover, he has traveled extensively, often by invitation, and has presented lectures in countries throughout the world.

Foy has also been very active in the Weed Science Society of America (WSSA) and other professional and honorary organizations during his career. He served as President of the WSSA and was named a WSSA Fellow in 1980. He was Editor of "Reviews of Weed Science" for 5 years, is a charter member of the Editorial Board of "Pesticide Biochemistry and Physiology", and in 2002 completed 12 years as Editor of "Weed Technology".

In addition to honors from WSSA, Foy has received numerous honors and awards in recognition of contributions to his scientific disciplines and professional leadership. For his work in international agriculture, Foy received the IWSS Outstanding Achievement Award – Developed Countries, and the 'International Award for Distinguished Achievement in Agriculture', presented by Gamma Sigma Delta, the Honor Society of Agriculture (He is the first weed scientist to receive this honor).

Dr. Foy retires leaving behind not only a legacy of outstanding and unselfish service to the university and his profession, both nationally and internationally, but a named scholarship fund as well (Please contact the Development Office, College of Agriculture and Life Sciences, Virginia Tech, 104 Hutcheson Hall, Blacksburg, VA 24061, or phone 540-231-5546 to inquire about the fund). He will remain affiliated with Virginia Tech as a Professor Emeritus. In retirement, he and his wife Betty will devote their new life to family, travelling, church and community service, and other interests. They will continue to reside at 607 Landsdowne Drive, Blacksburg, VA 24060 and may be reached by e-mail at cfoy@vt.edu.

PP LISTSERVE (OUT) – Pp DIGEST (IN)

Further to the note in Haustorium 41, there is another change to report. The PP Listserve has moved again and re-named itself the Pp Digest. It is apparently intended to function exactly as before. Do please consider using it for exchanging/requesting information on any aspect of parasitic plants. If you subscribed to the Listserve you will have already heard that you were automatically transferred to the new mailing list. For general information and instructions for new subscribers, please go to: http://omnisterra.com/mailman/listinfo/pp_omnisterra.com

SANDALWOOD RESEARCH NEWSLETTER

Newsletter No 17 includes three papers on *Santalum* species, listed below under Lethbridge, 2003, Angadi *et al.*, 2003, and Jain *et al*., 2003.

N.B. Yet another change of contact address. Jon Brand is still Editor but has moved to Forest Products Commission, MidWest Sharefarms, Lot1 / 260 Kalamunda Rd., South Guildford WA 6055, Australia; email jonb@fpc.wa.gov.au

THESES

Muniru Khamis Tsanuo (PhD, Jomo Kenyatta University of Agriculture and Technology, Nairobi, 2001) Studies on *Striga*-affecting semiochemicals associated with root exudates of *Desmodium uncinatum*.

This study was carried out to establish the role of semiochemicals in striga (*Striga hermonthica* (Del.) Benth.) (Scrophulariaceae) suppression by desmodium (*Desmodium uncinatum* (JacQ.) DC.) (Fabaceae) in maize (*Zea mays* L.) (Poaceae)/desmodium intercrop and to isolate and identify some of the semiochemicals involved.

Three hypotheses with respect to the role of semiochemicals were initially investigated: (i) that desmodium produces germination inhibitors; (ii) that, like other legumes, desmodium produces germination stimulants, but attempts to attach on desmodium by striga induces production of antagonists (inhibitors); and (iii) that, in addition to germination stimulants, inhibitors are also produced by desmodium and that may inhibit haustorial growth and/or its attachment to the host (maize).

To test hypotheses (i) and (ii), the germination level of *S. hermonthica* exposed to desmodium root exudates and/or maize root exudates was compared. No significant difference in striga germination was observed. The germination activity of *D. uncinatum* exudates on *S. hermonthica* was independent of striga density in the soil and comparable to that of maize exudates. Thus hypotheses (i) and (ii) were rejected.

Further observations revealed that the aqueous exudate of desmodium inhibits haustorium growth and initiates (premature) upper haustorium formation of the germinated striga seeds. These effects account for striga suppression by desmodium. Thus unlike other legumes, which act simply as false hosts of striga, desmodium interferes with the attachment of germinated striga seeds on the hosts present in the vicinity.

Germination stimulants and haustorium growth allomones of striga seeds were recovered continuously from the aqueous root exudates of a large number of *D. uncinatum* seedlings in a hydroponic device. Water was continuously pumped through an absorbent from which the compounds were later desorbed with methanol. Of the three absorbents tested (activated charcoal and bonded reverse phase C-18 and C-8 silica) C-18 silica was found the best and was used for large scale trapping of the compounds.

The extract desorbed with methanol was analysed by High Performance Liquid Chromatography (HPLC). Fractions from the eluent were collected and bioassayed on striga seeds. The allomones eluted earlier on reverse phase C-18 silica (more polar) than the germination stimulants (less polar). A bioassay-guided fractionation of germination stimulating fractions indicated the presence of not less than five active components, of which the following two novel compounds were isolated and characterized.: (a) 4",5"-dihydro-5,2',4'-trihydroxy-5"-isoprenylfurano-(2",3";7,6)-isoflavone; and (b) 5,7,2',4'-tetrahydroxy-6-(3-methylbut-2-enyl)-isoflavone. The first stimulated the germination of *S. hermonthica* while the second was inactive on its own. The former isoflavone represents the first compound of its class to show striga germination property.

Qualitative HPLC analysis, aided by on-line ultraviolet scan, showed that the above two compounds are absent in maize exudates.

In parallel, large-scale extraction of macerated desmodium roots was also undertaken using acetone and dichloromethane. Both extracts were found to induce germination of *S. hermonthica*. The acetone extract gave higher haustorium inhibition activity than the dichloromethane extract while the latter had higher germination activity, confirming bioassay results from hydroponic fractions that growth allomones were relatively more polar than the germination stimulants. The acetone extract was subjected to chromatographic fractionation on Florisil (magnesium silicate). Activities of the fractions were monitored using striga germination and haustorium growth assays. Again, germination activity was highest on the mid-polar fractions while haustorium growth activity was mainly found in polar fractions. The active fractions were further fractionated by semi-preparative HPLC and two very active sub-fractions that induced germination of *S. hermonthica* were obtained. No structural analyses were possible on the amounts isolated. Chromatographic fractionation of dichloromethane extract led to the isolation of a weak germination stimulant, 5,7,2',4'-tetrahydroxy-6-(3-methylbut-2-enyl)-isoflavone and 5.7.4'-trihydroxyisoflavone (genistein). Partial structure of the germination stimulant is presented.

HPLC analysis of the allomone containing fractions, from both aqueous exudates and organic extracts showed these to be intricate mixtures of compounds. To date no pure component has been isolated in sufficient amount for structural analysis. The isolation of sufficient amount of individual components with a variety of chromatographic techniques should be a priority in follow-up activities.

The results provide evidence that semiochemicals play a role in the suppression of striga in maize/desmodium inter-crop. Desmodium root exudate contains both germination stimulants and haustorium allomones. This blend of compounds initiates the germination of striga and at the same time disrupts the normal growth of germinated seeds thus preventing (or interfering with) successful attachment on host roots.

E M Kunjo (PhD, The University of Reading, 2002) Integration of socio-economically appropriate management strategies for *Striga hermonthica* in the Gambia.

Striga hermonthica severely constrains coarse grain production in the Gambia. Integrated *Striga* control trials involving crop rotation, fertility enhancement and catch cropping were carried out in 1997 and 1998 at Mankamang Kunda and Kaiaf. These sites represent Eastern and Western Gambia, respectively. Effectiveness was assessed by reduced infestations, improved crop yields, financial returns, and in the longer term by depletion of the *Striga* soil seed bank.

Using Participatory Rural Appraisal tools, surveys of farmers at both sites revealed that infestations were partly due to cereal monocropping and lack of fertilisers and herbicides. Farmers also knew the benefits of hand pulling *Striga*. To improve fertility, farmers, especially in eastern Gambia, could tether livestock in the fields.

When root exudates of potential trap crops were screened in vitro for their ability to stimulate germination of one Gambian biotype of S. *hermonthica* , cotton stimulated most (51 to 57%), while cowpea caused only 38% germination. Trap cropping combined with tethering of livestock at night during the dry season in cereal fields and hand-pulling *Striga* before seed shedding, depleted the *Striga* soil seed bank by 92% and 86 % compared to 53% to 72% depletion with unfertilized continuous cropping over two wet seasons at Mankamang Kunda and Kaiaf, respectively. By contrast, the common practice of monocropping unfertilised maize (Kaiaf) or sorghum (Mankamang kunda) without *Striga* control by hand pulling increased the soil seed bank by 200%. Even with *Striga* control by hand-pulling at Mankamang Kunda, unfertilised sorghum monocropping only gave 53% depletion of the seed bank and financial returns were less than 25% of those with a cotton trap crop/sorghum rotation with livestock tethering. Hand pulling of *Striga* was also done and this clearly has a major impact on the depletion effects.

When financial returns, crop yields and infestations and soil seed bank depletion of *Striga hermonthica* were all taken into account, integration of organic fertility improvement, rotation with a trap crop and hand-pulling residual *Striga* may be socio-economically appropriate in the Gambia. Participatory farmer research and extension is needed to validate this proposal.

A.S. Mwakaboko (PhD, Catholic University, Nijmegen, 25 March 2003) Synthesis and biological evaluation of new strigolactone analogues as germination stimulants for the seeds of the parasitic weeds *Striga* and *Orobanche* spp.

This thesis deals with the synthesis and biological evaluation of new germinating agents for the seeds of the parasitic angiosperms *Striga* and *Orobanche* spp. So far only four naturally occurring germination stimulants, named strigolactones, have been isolated (strigol, sorgolactone, alectrol and orobanchol). These compounds have three structural rings in common, namely the C-ring, the connecting enol ether moiety, and the D-ring. This so-called bioactiphore has been shown to be responsible for the biological activity, and a molecular mechanism has been proposed that explains the triggering of germination at the receptor site. The structural features of the bio-actiphore have been used as a lead to the design of structurally simpler strigolactone analogues for possible application in the control of *Striga* and *Orobanche* in the field by suicidal germination. The bulk of the thesis involves the methodology of synthesis of numerous strigolactone analogues from a wide range of chemical starting points, and confirmation of their biological activity. In Chapter 9, a range of the more promising analogues are tested in pot experiments with *Striga* spp., confirming their high activity and stability in soil. The final chapter deals with the first successful field test using the formulated dimethyl analogue of Nijmegen-1 in controlling infestations of *Orobanche* spp. in tobacco. These studies allow the conclusion that the suicidal germination approach can be successfully applied as a control method for the reduction of seed banks of parasitic weeds in the soil. However, success is likely to be depenent on appropriate timing of application and on soil conditions. Further research on the use of synthetic germination stimulants is strongly recommended.

Mohan Devkota (PhD, Universität für Bodenkultur, Vienna, May, 2003.) Mistletoes of the Annapurna Conservation Area of the Central Nepal Himalayas diversity, distribution and biology.

In this work, the diversity, distribution and biology of the mistletoes of the Ananapurna Conservation Area, Nepal's largest conservation area, with diverse geo-topographical features and rich floral diversity, were studied. A total of 12 mistletoe species, 8 from 5 genera in Loranthaceae and 4 from Viscaceae were documented from 95 host species in 45 angiospermic host families. Four species of mistletoe were recorded for the first time in Nepal. Mistletoes of the family Loranthaceae usually have a wide host range and are mostly generalists, whereas the Viscaceous mistletoes have a narrow host range and can be highly specific. Degraded marginal forests and sunny warm slopes below 3000m are suitable habitats for mistletoes. The irregular and patchy distribution of mistletoes is governed by three factors, forest structure, site mesoclimate and zoochore dispersal, which is in most cases the most important factor. Two bird species, *Aethopyga ignicauda* (fire-tailed sunbird) and *Dicaeum ignipectus* (fire-breasted flower-pecker) are important pollinators and dispersers, respectively. The haustorial systems within the genus *Scurrula* Linn. (Loranthaceae) were documented and classified. In the genus *Scurrula* there is only one basic type of haustorium: wood rose with epicortical roots, which remains basically unchanged regardless of host and elevation, with some deviations in the endophytic system in some of the species. Vegetative reproduction by the robust epicortical roots in the genus *Scurrula* is of common occurrence. Host branch size and the age of *S. elata* are important factors in determining the length of the epicortical roots. *S. elata* produces many secondary haustoria to overcome the haustorial resistance and produce more secondary shoots to replace its aging primary shoots. Infestation of *S. elata* does not bring any changes in the wood properties of its host *Rhododendron arboretum* Sm. despite competition for water in the host branch. The total leaf area and the total foliar dry mass in the infested branch of *R. arboretum* were reduced by the infection of *S. elata* but in similar sized uninfested and infested host branches the total foliage area and dry mass is in a similar range, following the pipe theory concept. Damage to the infested host branch occurs as a result of insufficient conductive area to supply both host and mistletoe. The theories of passive vs. active uptake of mineral nutrients were tested for the nutritional relationship between *S. elata* and its hosts. The foliage of *S. elata* consistently had higher contents of phosphorus and potassium compared to the host foliage. By comparing nutrient levels in host leaves on infested and uninfested branches no evidence of selective discrimination by the haustorial system could be detected. This supports the hypothesis of passive enrichment of phosphorus and potassium by entrapment. These elements are cycled between xylem and phloem in the host plant, but cannot escape the mistletoe back to the hosts's phloem. By source sink manipulation, i.e. the selective removal of competition within a mistletoe by pruning, the possible role of haustorial resistance was studied in *S. elata.* The data on growth and mineral nutrient content imply the haustorial resistance is not limiting in this species, which is fast growing and capable of producing abundant secondary haustoria.

PROCEEDINGS OF MEETINGS

Broomrape: biology and resistance. 2002. Edited by Rubiales, D., Verkleij, J. Batchvarova, R. and Joel, D. Joint meeting of EU COST 849 Working Groups 1 and 3, Sofia, March 14-18, 2002. One-page abstracts of the following papers are available on the COST website (see below).

Benvenuti, S. Knowledge of seedbank size, germination ecology and emergence dynamics as tools to improve *Orobanche* control strategy.
Fernández-Martínez, J.M. Inheritance of resistance to *Orobanche cumana* in sunflower.
Murdoch, A.J. and Kebreab, E. Seed ecology and crop resistance to *Orobanche*.
Aly, R. Crop protection against parasites/pathogens through expression of sarcotoxin-like peptide.
Bouwmeester, H. *et al.* Secondary metabolites in the signalling between parasitic weeds and host plants.
Jorrín *et al.* On the search of *Orobanche cernua* (sunflower broomrape) germination stimulants.
Wegmann, K. Phytoalexin biosynthesis.
Pérez de Luque, A. *et al.* Hypersensitive reaction and necrosis of *Orobanche crenata* tubercles in legumes: histological studies.
Plakhine, D. *et al.* The influence of temperature on *Orobanche* resistance.
Slavov, S.B. and Batchvarova, R.B. Chemical mutagenesis of tobacco for broomrape resistance.
Thaloarn, P. *et al.* Resistance mechanisms in sunflower.
Rubiales, D. *et al.* Resistance to *Orobanche crenata* in grain legumes.
Haussmann, B.I.G. Strategies for the application of marker-assisted selection.
Bervillé, A. *et al.* Analysis for susceptibility/resistance to *Orobanche* using a set of sunflower recombinant inbred lines.
Koutoula-Sika, E. *Orobanche ramosa* control in tomato with herbicides or using transgenic glyphosate-resistant crop.

Integrated Control of Broomrape. 2002. Edited by Rubiales, D., Wegmann, K., Riches, C.R. and Vurro, M. Joint meeting of EU COST 849 Working Groups 2 and 4, Obermarchtal, Germany, 25-27 July, 2002. One-page abstracts of the following papers are available on the COST website (see below).

Boari, A. and Abouzeid, M. Progress in biological control of *Orobanche* in Italy.
Chrysayi-Tokousbalides, M. Fungal pathogens from naturally infected *Orobanche* found in Greece.
Klein, O. and Kroschel, J. Status quo of *Phytomyza orobanchia* research.
Tóth, P. and Cagáň, L. *Phytomyza orobanchia* Kalt. on different species of *Orobanche* in Slovakia.
Dor, E. and Herschenhorn, J. *Fusarium solani* as a possible agent for broomrape control.
Joel, D.M. The *Phytomyza* status in Israel.
Gressel, J. *et al.* Enhancement of mycoherbicide effectiveness by genetics.

Cristofaro, M. Combining insects and fungi: a strategy to enhance parasitic plant biocontrol?
Vurro, M. Integration of fungal toxins with pathogens.
Amsellem, Z. *et al*. *Nep1* literally transforms a sleeping mycoherbicide into Rambos.
Müller-Stöver, D. and Sauerborn, J. Formulation and application of a potential mycoherbicide against *Orobanche cumana*.
Zermane, N. *et al.* Potential of rhizobacteria to control parasitic weeds of the genus *Orobanche*.
Murdoch, A.J. Impact of seasonal effects on parasitic weed model predictions.
Press, M.C. Implications of nitrogen relations for parasite growth models.
Boulet, C. *et al.* *Orobanche*- weeds relationships; an important aspect of broomrape control.
Manschadi, A.M. *et al.* Development of a parasite modue in APSIM – case study: the parasitic weed *Orobanche crenata* infesting fababean.
Kanampiu, F.K. *et al*. *Striga* control in maize using herbicide seed coating.
Del Grasso, C. *et al.* Potential use of systemic acquired resistance for broomrape control.
Simier, P. *et al.* Search for specific targets in *Orobanche* for chemical control.
Streibig, J.C. Assessing relative efficacy of Nijmegen 1 for *Stiga* control.
Wegmann, K. Control of broomrape by germination stimulants.
Vouzounis, N. and Ioannou, N. Management of *Orobanche* spp. in vegetable crops in Cyprus.
Pacureanu-Joita, M. Control of broomrape in Romania.
Nadler-Hassar, T. and Rubin, B. *Cuscuta* tolerates high rates of herbicides inhibiting amino acid biosynthesis.
Slalov, S.B. and Prinsen, E. The role of plant hormones in the seed germination of plant parasite *Orobanche* spp.
Nadal, S. *et al.* Control of *Orobance crenata* in horticultural faba beans of determinate habit.
Rubiales, D. *et al.* Need to integrate several control methods to solve the broomrape (*Orobanche crenata*) problem in pea in southern Spain.
Herschenhorn, J. *et al.* Broomrape control in tomato and sunflower.
Arapis, G. Environmental impact of chemicals used for the broomrape control.
Macías, F.A. *et al.* Synthesis of sesquiterpene lactone modes as *Orobanche* cumana seed germination elicitors.
Kiesecker, H. Genetic engineering in grain legumes as a platform technology for parasitic weed control.

BOOK

The *Arabidopsis* Book. The use of *Arabidopsis* to study interactions between parasitic angiosperms and their plant hosts is described by Yaakov Goldwasser, Jim Westwood and John Yoder in a new WWW book published by the American Society of Plant Biologists (ASPB) at: http://www.aspb.org/publications/arabidopsis/toc.cfm Chapters in this virtual book will be added and updated as research progresses.

BOOK NEWS – NEW EDITION

A Technical Manual for Parasitic Weed Research and Extension. Edited by Jrgen Kroschel. (2001). Kluwer Academic Publishers, Dordrecht, The Netherlands. 292 pp. Now available in paper-back edition for Euro 70.00 (orders to orderdept@wkap.nl).

WEB SITES

For information on the International Parasitic Plant Society see: http://www.ppws.vt.edu/IPPS/

For past and current issues of Haustorium see: http://web.odu.edu/haustorium

For Lytton Musselman's Plant site see: http://web.odu.edu/plant

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rmrs.nau.edu/misteltoe/welcome.html

For information on activities and publications of the parasitic weed group at the University of

Hohenheim see: http://www.uni-hohenheim.de/~www380/parasite/start.htm

For on-line access to USDA Forest Service Agriculture Handbook 709 'Dwarf Mistletoes: Biology, Pathology and Systematics' see: http://www.rmrs.nau.edu/publications/ah_709/

For information on, and to subscribe to, PpDigest see: http://omnisterra.com/mailman/listinfo/pp_omnisterra.com

For information on the EU COST 849 Project and reports of its meetings see: http://cost849.ba.cnr.it/

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' the NEW address is: http://www.omnisterra.com/bot/pp_home.cgi

For a description and other information about the 'Push-Pull' technique for *Striga* suppression, see: http://www.push-pull.net

LITERATURE

Adler, L.S. 2002. Host effects on herbivory and pollination in a hemi-parasitic plant. Ecology 83: 2700-2710. (*Castilleja miniata* parasitising *Lupinus argenteus* produced twice as many seeds as when parasitizing other host species. It was also less affected by moth, fly and mammal herbivores. Benefits could not be directly attributed to alkaloid content, but were influenced by greater nitrogen resources.)

Ahonsi, M.O., Berner, D.K., Emechebe, A.M. and Lagoke, S.T. 2002. Effects of soil pasteurisation and soil N status on severity of *Striga hermonthica* (Del.) Benth. in maize. Soil Biology & Biochemistry 34: 1675-1681. (Interesting but somewhat confusing results are reported for the effects of N and/or pasteurisation on *Striga* emergence and maize yield.)

Al-Hussien, N., Bayaa, B. and Erskine, W. 2002. Integrated management of lentil broomrape. 1. Sowing date and chemical treatments. Arab Journal of Plant Protection 20(2): 84-92. (At two field sites in Syria, delaying the sowing date and applying imazapic and imazethapyr resulted in 97-98% weed control and 221 and 40% more seed yield.)

Angadi, V.G., Jain, S.H. and Shankaranarayana, K.H. 2003. Genetic diversity between sandal populations of different provenances in India. Sandalwood Research Newsletter 17: 4-5. (Isoenzyme studies suggest distinct genetic differences between 8 populations of *Santalum album*.)

Angel Garcia, M. and Castroviejo, S. 2002. (Cytotaxonomic studies in the Iberian species of the genus *Cuscuta* (Convolvulaceae).) (in Spanish) Anales del Jardin Botanico de Madrid 60(1): 33-44. (New chromosome numbers are reported for some *Cuscuta* species. The chromosome numbers found in some species, such as *C. epithymum*, indicate the possibility of agmatoploidy and symploidy in the genus.)

Aviv, D., Amsellem, Z. and Gressel, J. 2002. Transformation of carrot with mutant acetolactate synthase for *Orobanche* (broomrape) control. Pest Management Science 58: 1187-1193. (Using an ALS resistance gene from herbicide-selected mutant *Arabidopsis thaliana*.)

Bannister, P. Strong, G.L. and Andrew, I. 2002. Differential accumulation of nutrient elements in some New Zealand mistletoes and their hosts. Functional Plant Biology 29: 1309-1318. (Studies with *Ileostylus micranthus* and *Tupeia antarctica* on a range of hosts showed levels of Ca and Mg in the parasite similar to those in the host, levels of N lower, and of K, Na and P higher. It is suggested these differences can be attributed to the lack of a phloem connection combined with circulation of elements in the host phloem and their transfer in the host xylem.)

Bar-Nun, N. and Mayer, A.M. 2002. Composition of and changes in storage compounds in *Orobanche aegyptiaca* seeds during preconditioning. Israel Journal of Plant Sciences 50: 277- 279. (Reducing sugars are rapidly utilized during the first three days of preconditioning, followed by a small increase in sucrose. Lipids involving oleic and linoleic acids remain relatively unchanged.)

Benharrat, H., Veronesi, C., Theodet, C. and Thalouarn, P. 2002. *Orobanche* species and population discrimination using intersimple sequence repeat (ISSR). Weed Research 42: 470-475. (ISSR markers were useful in distinguishing among the species *O. hederae* and *O. amthystea,* and among *O. cernua* and *O. cumana.* Analysis also showed polymorphism among geographically separate populations of *O. hederae.*)

Bidartondo, M.I., Redecker, D., Hijri, I., Wiemken, A., Bruns, T.D., Dominguez, L., Sersic, A., Leake, J.R. and Read, D.J. 2002. Epiparasitic plants specialized on arbuscular mycorrhizal fungi. Nature (London) 419: 389-392. (Showing that non-photosynthetic plants associated with arbuscular mycorrhizal fungi (AMF) can display the characteristic specificity of epi-parasites and that AMF can mediate significant interplant carbon transfer in nature. See also Callaway *et al.*)

Borkowski, J. and Robak, J. 2002. (Presence and control of parasitic *Orobanche ramosa* on the potato.) (in Polish) Ochrona Roslin 46(7): 20-22. (Chlorsulfuron was found to have some useful effect, also saltpetre and urea.)

Botanga, C.J., Kling, J.G., Berner, D.K. and Timko, M.P. 2002. Genetic variability of *Striga asiatica* (L.) Kuntze based on AFLP analysis and host-parasite interaction. Euphytica 128: 375-388. (A range of 14 mainly yellow-flowered populations of *S. asiatica* collected from maize, *Rottboellia* and *Panicum* hosts in Benin showed wide variation in virulence and host-preference, as well as genetic difference as revealed by AFLP. None attacked a usually susceptible sorghum variety. A single red form was very close genetically to the associated yellow form in the same field.)

Brand, J.E. 2002. Review of the influence of *Acacia* species on establishment of sandalwood (*Santalum spicatum*) in Western Australia. Conservation Science Western Australia 4(3): 125-129. (A successful establishment technique involves planting *S. spicatum* seeds near 1-2 year old *Acacia acuminata* seedlings.)

Buschmann, H. and Sauerborn, J. 2002. Induced resistance in sunflower against *Orobanche cumana*. In: Schmitt, A. and Mauch-Mani, B. (eds) Proceedings of the IOBC/WPRS study group on Induced Resistance in Plants against Insects and Diseases, Wageningen, April, 2001. Bulletin OILB/SROP 25(6): 145-148. (Treatment of sunflower seeds with 60 ppm of benzo(1,2,3)thiadiazole-7-carbothioic acid S-methyl ester (BTH) prevented infection in root chambers and reduced *O. cumana* by 95% in pot studies.)

Cabin, R.J., Weller, S.G., Lorence, D.H., Cordell, S. and Hadway, L.J. 2002. Effects of microsite, water, weeding, and direct seeding on the regeneration of native and alien species within a Hawaiian dry forest preserve. Biological Conservation 104: 181-190. (Reporting complex interactions between the native *Santalum paniculatum* and and native weedy species.)

Callaway, R.M., Mahall, B.E., Wicks, C., Pankey, J. and Zabinski, C. 2003. Soil fungi and the effect of an invasive forb on grasses: neighbour identity matters. Ecology 84: 129-135. (More vigorous growth of *Centaurea melitensis* in the presence of *Nassella pulchra* and arbuscular mycorrhizal fungi could possibly have been due to 'a form of fungi-mediated parasitism'? See also Bidartondo *et al.*)

Campagna, G. and Rapparini, G. 2002. (Development of biological means of weed control.) (in Italian) Informatore Agrario 58(45): 53-58. (Including discussion of the use of *Phytomyza orobanchia* for *Orobanche* control and *Smicronyux* spp. for control of *Cuscuta*.)

Chán, V., Lepsi, M., Lepsi, P., Stech, M. and Vydrová, A. 2001. (The finds of interesting and new plants in the South Bohemian flora VII.) (in Czech) Sbornik Jihoceskeho Muzea v Ceskych Budejovicich, Prirodni Vedy 41: 87-89. (*Orobanche lutea* and *Phelipanche purpurea* subsp. *purpurea* are reported for the first time.)

Chiu, S.B., Chan Sai Mun and Aloysius Siow. 2002. Biological control of *Mikania micrantha* – a preliminary finding. The Planter 78(921): 715-718. (Reporting very effective use of 'tali puteri' (probably a *Cuscuta* sp. but possibly *Cassytha*) for suppression of *M. micrantha* in West Kalimantan.)

Covarelli, L. 2002. Studies on the control of broomrape (*Orobanche ramosa* L.) in Virginia tobacco (*Nicotiana tabacum* L.). Beitrage zur Tabakforschung International 20(2): 77-81. (Tobacco variety BC 60 FB was found to be highly resistant to the weed with 85% less infestation than other varieties. Satisfactory chemical control was achieved with maleic hydrazide applied at the early crop flowering stage, and moderate control by rimsulfuron applied 55 days after transplanting.)

Deal, R. L., Tappeiner, J.C. and Hennon, P. E. 2002. Developing silvicultural systems based on partial cutting in western hemlock-Sitka spruce stands of southeast Alaska. In: Rotach, P., Schuz, J.P. and Kenk G. (eds) Uneven-aged silviculture. Selected papers from a joint meeting of IUFRO working groups 1.14 and 4.01.03, Zurich, Switzerland, September 2001. Forestry (Oxford) 75: 425-431. (A wide range of partial cutting intensities did not result in significant changes in infection by *Arceuthobium tsugense*.)

Deeks, S.J., Shamoun, S.F. and Punja, Z.K. 2002. Histopathology of callus and germinating seeds of *Arceuthobium tsugense* subsp. *tsugense* infected by *Cylindrocarpon cylindroides* and *Colletotrichum gloeosporioides*. International Journal of Plant Sciences 163: 765-773. (The methods developed in this study helped to elucidate host-pathogen interactions and showed that *C. cylindroides* was more virulent in colonizing dwarf mistletoe tissues than *C. gloeosporioides*.)

DeNitto, G. 2002. Montana: forest insect and disease conditions and program highlights: 2001. Forest Health Protection Report - Northern Region, USDA Forest Service, 2002, No.02-1, 41 pp. (Including survey data on losses to *Arceuthobium species*.)

Dos Santos, CV., Letousey, P., Delavault, P. and Thalouarn, P. 2003. Defence gene expression analysis of *Arabidopsis thaliana* parasitized by *Orobanche ramosa.* Phytopathology 93: 451-457. (Semi-quantitative PCR indicates that *O. ramosa* parasitism induced defence gene expression in host roots prior to attachment. Defence signaling pathways induced included jasmonate and ethylene, but not salicylic acid-mediated responses.)

Díaz-Sanchez, J., Jurado-Expósito, M., López-Granados, F., Castejón-Muñoz, M. and García-Torres, L. 2003. Pronamide applied to sunflower seeds for *Orobanche cumana* control. Weed Technology 17: 314-319. (Soaking or coating sunflower seeds with pronamide reduced *O. cumana* by 50-77% without affecting crop growth, unless the treated seeds were kept for 60 days after treatment.)

Dubrovsky, J.G. 2002. Tumorous malformations in natural populations of *Pachycereus* and its association with mistletoe. Cactaceas y Suculentas Mexicanas 47(3): 48-56. (*Phoradendron diguetianum* was associated with swellings on *Pachycereus pringlei* and *P. pecten-aboriginum* but was not apparently the cause.)

Eizenberg, H., Herschenhorn, J., Plakhine, D., Kleifeld, Y., Shtienberg, D. and Rubin, B. 2003. Effect of temperature on susceptibility of sunflower varieties to sunflower broomrape (*Orobanche cumana*) and Egyptian broomrape (*Orobanche aegyptiaca*). Weed Science 51: 279-286. (The 'resistant' sunflower variety Ambar is shown to be susceptible to both *Orobanche* spp. at temperatures below 20^0C but increasingly resistant at higher temperatures, while the susceptible variety Adi shows increasing susceptibility at higher temperatures.)

Eizenberg, H., Plakhine, D., Hershenhorn, J., Kleifeld, Y. and Rubin, B. 2003. Resistance to broomrape (*Orobanche* spp.) in sunflower (*Helianthus annuus* L.) is temperature dependent. Journal of Experimental Botany 54: 1305-1311. (The resistance demonstrated in variety Ambar (see previous entry) is shown to be due to degeneration of the parasite after attachment.)

Elias, P. 2002. Host woody species of mistletoes (Loranthaceae) in Slovakia. Bulletin Slovenskej Botanickej Spolocnosti pri Slovenskej akademiii vied, Bratislava 24: 175-180. (Lists hosts of *Viscum album* and *Loranthus europaeus* in Slovakia, with comments. Hosts of *L. europaeus* include at least 7 species of *Quercus* and occasionally *Betula pendula*.)

Emechebe, A.M. and Ahonsi, M.O. 2003. Ability of excised root and stem pieces of maize, cowpea and soybean to cause germination of *Striga hermonthica* seeds. Crop Protection 22: 347-353. (Reporting the effects of varying details of the technique.)

Escher, P., Eiblmeier, M., Hetzger, I. and Rennenberg, H. 2003. Seasonal and spatial variation of reduced sulphur compounds in mistletoes (*Viscum album*) and the xylem sap of its hosts (*Populus x euramericana* and *Abies alba*). Physiologia Plantarum 117: 72-78. (The seasonal pattern in the thiol composition and contents of *Viscum* leaves showed high levels in spring and autumn and low levels in summer. The significance of these seasonal changes is discussed.)

Fayed, M.T.B., Hamdi, A., Samia, A.M. and Shaaban, M. 2002. Performance of *Orobanche* control treatments in faba bean crop. Egyptian Journal of Agricultural Research 80: 753-769. (Beneficial effects are described for a range of treatments including late sowing, glyphosate application and the tolerant variety cv. Giza 429.)

Gbehounou, G. and Adango, E. 2003. Trap crops of *Striga hermonthica*: *in vitro* identification and effectiveness *in situ*. Crop Protection 22: 395-404. (Cowpea varieties IT 90k-56 and TVX 1850-01F significantly reduced infestation by *S. hermonthica* in the following maize crop, compared with a weed-free fallow, and maize yields were increased.)

Geils, B.W., Tovar, J.C. and Moody, B. (eds) 2002. Mistletoes of North American Conifers. USDA Forest Service General Technical Report RMRS-GTR-98. 123 pp. (The 8 chapters cover specific descriptions, host range, economic importance and management strategies for *Psittacanthus* (in Mexico), *Phoradendron* (in USA and Mexico), *Arceuthobium* (in N. America), and more general consideration of damaging effects, survey techniques and various approaches to management. A mine of information.)

Godfree, R.C., Tinnin, R.O. and Forbes, R.B. 2002. The effects of dwarf mistletoe, witches' brooms, stand structure, and site characteristics on the crown architecture of lodgepole pine in Oregon. Canadian Journal of Forest Research 32: 1360-1371. (The results suggest that *Arceuthobium americanum* can be an important factor in determining the crown dimensions of *Pinus contorta* but that these effects may be interpreted only in the context of site characteristics and stand structure.)

Godfree, R.C., Tinnin, R.O. and Forbes, R.B. 2003. Relationships between *Arceuthobium americanum* and the structure of *Pinus contorta* var. *murrayana* stands in central Oregon. Plant Ecology 165: 69-84. (Concluding that the effects of *A. americanum* on different *P. contorta* size classes depends on spatial scale.)

Goldwasser, Y., Eizenberg, H., Golan, S. and Kleifeld, Y. 2003. Control of *Orobanche crenata* and *Orobanche aegyptiaca* in parsley. Crop Protection.22: 295-305. (*O. crenata* and *O. aegyptiaca* were completely controlled by split foliar application of imazapic at 2.5-5.0g/ha or glyphosate 36-72 g/ha, applied on 5-7 leaf parsley before the first cutting and on the young new growth after each cutting. Mixtures or alternating herbicides is suggested to reduce risk of herbicide resistance.)

Goldwasser, Y and Kleifeld, Y. 2002. Tolerance of parsley varieties to *Orobanche*. Crop Protection 21: 1101-107. (Exposed to *O. crenata* ex carrot and *O. aegyptiaca* ex tomato, parsley varieties Garland and Garbo were less damaged than several others. There were no differences in parasite germination, but less attachment and/or premature death of parasite seedlings.)

Groves, R. H. and Panetta, F.D. 2002. Some general principles for weed eradication programs. In: Jacob, H.S., Dodd, J. and Moore, J.H. (eds) 13th Australian Weeds Conference: weeds "threats now and forever?" Perth, Australia, 2002. pp. 307-310. (Reviewing the progress of nine weed eradication programmes including one on *Orobanche ramosa*.)

Gutschick, V.R. and Bloom, A.J. 2003. Crossroads of animal, plant, and microbial physiological ecology. BioScience 53(3): 256-259. (This report of a symposium on physiological ecology considered chemical signalling among animals, plants, and microbes. Parasitic plants were included with an emphasis on short range and high accuracy of signalling between host and parasite.)

Gworgwor, N.A., Hudu, A.I. and Joshua, S.D. 2002. Seed treatment of sorghum varieties with brine (NaCl) solution for control of *Striga hermonthica* in sorghum. Crop Protection 21: 1015-1021. (Treatment of sorghum seeds with sodium chloride at 1.5M reduced *Striga* infestation and increased crop yields in spite of some reduction in crop stand; 2.0M damaged the crop more severely.)

Haidar, M.A., Bibi, W. and Sidahmed, M.M. 2003. Response of branched broomrape (*Orobanche ramosa*) growth and development to various soil amendments in potato. Crop Protection 22: 291-294. (Goat manure was the most effective of a range of amendments in reducing *O. ramosa* emergence, but failed to significantly increase crop yield.)

Han RongLan, Zhang DianXiang, Hao Gang and Qiu HuaXing. 2002. (Geographical distribution of Chinese species of *Viscum* (Viscaceae) and its hosts.) (in Chinese) Journal of Tropical and Subtropical Botany 10: 222-228.

Holzapfel, S., Faville, M.Z. and Gemmill, C.E.C. 2002. Genetic variation of the endangered holoparasite *Dactylanthus taylorii*

(Balanophoraceae) in New Zealand. Journal of Biogeography 29: 663-676. (Genetic variation was predominantly (63%) among, as opposed to within, populations and not correlated with geographical distance below the regional scale.)

Huguet, B., Faure, A., Durand, T. and Decoin, M. 2003. (Less water, some diseases, good yields. Rape - 2001/2002 plant health review.) (in French) Phytoma 556: 18-20. (Noting the continuing spread of '*Orobanche cernua*', but presumably referring to *O. ramosa*.)

Hunter, J.T. 2003. Factors affecting range size differences for plant species on rock outcrops in eastern Australia. Diversity and Distributions 9: 211-220. (Keywords include parasitic plants.)

Jain, S.H., Angadi, V.G., Shankaranarayana, K.H. 2003. Edaphic, environmental and genetic factors associated with growth and adaptability of sandal (*Santalum album* L.) in provenances. Sandalwood Research Newsletter 17: 6-7.

Jan, C.C., Fernandez-Martinez, J.M., Ruso, J., Munoz-Ruz, J. 2002. Registration of four sunflower germplasms with resistance to *Orobanche cumana* Race F. Crop Science 42: 2217-2218. (Four sunflower populations, BR1, BR2, BR3 and BR4, had been released on the basis of their resistance to *O. cumana* race F.)

Jurado-Expósito, M., López-Granados, F., García-Torres, L., García-Ferrer, A., Sánchez de la Orden, M. and Atenciano, S. 2003. Multi-species weed spatial variability, and site-specific management maps in cultivated sunflower. Weed Science 51: 319-328. (Including data on spatial distribution characteristics for *Orobanche cernua*.)

Kalita, R.K and Anup Chandra. 2002. Natural infestation of mistletoe in various trees in Jorhat District of Assam. Indian Forester 128(7): 815-816. (Recording 11 host tree species, but not the identity of the mistletoes involved.)

Kanampiu, F., Friesen, D. and Gressel, J. 2003. A new approach to *Striga* control. Pesticide Outlook 14(2): 51-53. (Reporting on seed-coating technology using imazapyr or pyrithiobac with new, locally adapted, herbicide-resistant, open-pollinated maize cultivars.)

Khaled Makkouk, Saadia Lhaloui and Mamdouh Omar 2001. Seeking sustainable solutions: integrated pest management pilot sites in Egypt and Morocco. ICARDA Caravan 15: 37-38. (Including reference to *Orobanche* in faba bean.)

Kim, S.K. and Adetimrin, V.O. (compilers) 2002. Maize Breeding and Related Research for the Control of *Striga* in Sub-Saharan Africa. Kyunghpook National University Press, Taegu, Korea. 191 pp. (A compilation of 21 journal papers published by Dr Kim and associates over the years 1987 to 2002.)

Kintzios, S., Barberaki, M., Drossopoulos, J., Turgelis, P. and Konstas, J. 2003. Effect of medium composition and explant source on the distribution profiles of selected micronutrients in mistletoe tissue cultures. Journal of Plant Nutrition 26: 369-397. (Micronutrient accumulation, especially Fe, Mn, Zn, and Cu, in tissue cultures of *Viscum album* substantially exceeds that of either whole plants or their hosts. Relative accumulation rates fluctuate over the course of 10 wks of culture, and addition of ascorbic acid to the medium increases micronutrient accumulation)

Krause, K., Berg, S. and Krupinska, K. 2003. Plastid transcription in the holoparasitic plant genus *Cuscuta*: parallel loss of the rrn16 PEP-promoter and of the rpoA and rpoB genes coding for the plastid-encoded RNA polymerase. Planta 216: 815-823. (A PEP promoter, present in *C. reflexa* is missing in three other species, *C. gronovii, C. odorata* and *C. subinclusa.*)

Kuchinda, N.C., Kureh, I., Tarfa, B.D., Shinggu, C. and Omolehin, R. 2003. On-farm evaluation of improved maize varieties intercropped with some legumes in the control of *Striga* in the Northern Guinea savanna of Nigeria. Crop Protection 22: 533-538. (Intercropping the improved maize varieties Acr.97 TZL Comp. 1 and Oba Super 1 with either soyabean or groundnut was more profitable than the local cultivar grown alone.)

Kureh, I. and Alabi, S.O. 2003. The parasitic angiosperm *Alectra vogelii* Benth. can influence the growth and nodulation of host soybean (*Glycine max* (L.) Merrill). Crop Protection 22: 361-367. (Reporting varied reaction among 22 soybean varieties in numbers of *A. vogelii* emerged, *Rhizobium* nodulation, and crop yield.)

Lehel, J. and Vetter, J. 2002. (Frequent phytotoxicoses in small animal practice. Review article.) (in Hungarian) Magyar Allatorvosok Lapja 124: 597-606. (*Viscum* *album* among the species causing phytotoxicosis.)

Lethbridge, M. 2003. Progress report: integrated wattle and quandong orchard. Sandalwood Research Newsletter 17: 1-4. (*Acacia victoriae* proved the best of eight wattle seed (human food) producers as host of *Santalum acuminatum*, also grown for its edible fruits.)

Liu Hui and Yuan ShiBin. 2002. A preliminary study of the toxins of *Colletotrichum gloeosporioides* (Penz) Sacc. f.sp. *cuscutae* Chang. Journal of Sichuan Agricultural University 20: 246-248. (Toxins shown to be large molecules, possibly polysaccharides, water-soluble, stable to heat but not to HCl.)

Logan, B.A., Huhn, E.R. and Tissue, D.T. 2002. Photosynthetic characteristics of eastern dwarf mistletoe (*Arceuthobium pusillum* Peck) and its effects on the needles of host white spruce (*Picea glauca* [Moench] Voss). Plant Biology 4: 740-745. (Photosynthetic oxygen evolution in *A. pusillum* was exceeded by respiratory oxygen consumption at all light intensities through full sunlight. Other results suggest that carbon exchange dynamics between the host and parasite do not fully explain the detrimental effects of infection on the host.)

Lohézic-Le-Dévéhat, F., Tomasi, S., Fontanel, D. and Boustie, J. 2002. Flavonols from *Scurrula ferruginea* Danser (Loranthaceae). Zeitschrift für Naturforschung. Section C, Biosciences 57: 1092-1095. (Three flavonols were isolated from *S. ferruginea*: quercetin, quercitrin, and a flavonol glycoside 4"-O-acetylquercitrin. Quercetin was the most active on human cancer cell lines.)

Lyu SuYun, Choi SangHo and Park WonBong. 2002. Korean mistletoe lectin-induced apoptosis in hepatocarcinoma cells is associated with inhibition of telomerase via mitochondrial controlled pathway independent of p53. Archives of Pharmacal Research 25(1): 93-101.

Lyu SuYun, Rhim JeeYoung, Moon YouSun, Jung SeungHee, Lee KyueYim and Park WonBong. 2002. Antitumor activities of extract of *Viscum album* var. *coloratum* modified with *Viscum album* var. *coloratum* agglutinin. Natural Product Sciences 8(4): 155-161.

Macklin, J. and Parnell, J. 2002. An account of the Santalaceae of Thailand. Thai Forest Bulletin (Botany) 30:75-108. (13 species in seven genera are fully described. Many belong to the tribe Amphorogyneae, aerial parasites with similarities toViscaceae. Hosts include *Quercus, Lithocarpus* and *Vaccinium* spp.)

Makarov, V.S. 2002. (Dodder in Yakutiya.) (in Russian) Zashchita i Karantin Rastenii, 2002, No.3: 39. (Three species of *Cuscuta* are spreading in Siberia, including *C. europaea* and ?*C. japonica*. Hosts affected include *Ribes* and *Rosa* spp. Some *Cuscuta* had been introduced on grapes from Central Asia.)

Marshall, K., Mamone, M. and Barclay, R. 2003. A survey of Douglas-fir dwarf mistletoe brooms used for nests by northern spotted owls on the Applegate Ranger District and Ashland Resource Area in Southwest Oregon. Western Journal of Applied Forestry 18(2): 115-117. (*Arceuthobium douglasii.*)

Mathiasen, R. 2002. First report of white fir dwarf mistletoe on mountain hemlock. Plant Disease 86: 1274. (*Arceuthobium abietinum* ssp. *concoloris* on *Tsuga mertensiana* among severely infested *Abies grandis*.)

Mathiasen, R.L. and Daugherty, C.M. 2002. Adult sex ratio of *Arceuthobium gillii* (Viscaceae). Madroño 49: 12-15. (Results show a ratio effectively 50:50.)

Matsubara, S., Gilmore, A.M., Ball, M.C., Anderson, J.M. and Osmond, C.B. 2002. Sustained downregulation of photosystem II in mistletoes during winter depression of photosynthesis. In: Gilmore, A.M., Farley, S.J. and McCutchan, J.S. (eds) Papers originating from the Light Stress satellite meeting of the 12th International Photosynthetic Congress, Heron Island, Queensland, Australia, 2001. Functional Plant Biology 29: 1157-1169. (Studies involved *Amyema miquelii* on hosts *Eucalyptus blakelyi* and *E. melliodora.*)

Matthies, D. 2003. Positive and negative interactions among individuals of a root hemiparasite. Plant Biology 5: 79-84. (Seedling survival of *Rhinanthus alectorolophus* was increased at high sowing densities and the proportion of seeds producing a young plant increased linearly with sowing density, indicating positive interactions among seedlings, perhaps resulting from haustorial connections.)

Maurer, W.D., Eder, W. and Tabel, U. 2003. (A genetic study on Scots pine (*Pinus sylvestris* L.) populations of differing health status growing in the Lennebergwald and the adjacent strict nature reserve Mainzer Sand by using isozyme gene markers.) (in German) Mitteilungen aus der Forschungsanstalt fur

Waldökologie und Forstwirtschaft Rheinland-Pfalz. 49(2): 75-88. (Decline of *P. sylvestris* partly attributed to *Viscum album*.)

Medel, R., Botto-Mahan, C., Smith-Ramirez, C., Mendez, M.A., Ossa, C.G., Caputo, L. and Gonzales, W. L. 2002. Quantitative natural history of a host-parasite relationship: the *Tristerix*-cactus system in semiarid Chile. (in Spanish) Revista Chilena de Historia Natural.75(1): 127-140. (Quantifying the autoecology of the floral biology, pollination, seed dispersal, and parasitism of *Tristerix aphyllus* on its cactus host species.)

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Parnell, J. 2001. A revision of Orobanchaceae in Thailand. Thai Forest Bulletin (Botany) 29: 72-80. (Three species occur – *Aeginetia* *indica, A. pedunculata* and *Christisonia siamensis*. Including SEMs of pollen.)

Pierce, S., Mbwaga, A.M., Ley, G., Lamboll, R.I., Riches, C.R., Press, M.C., Scholes, J.D. and Watling, J. 2003. Chemical characteristics of soil and sorghum from *Striga*-infested regions of Tanzania, and the influence of fertilizer application. Working Paper, University of Sheffield, Sheffield, UK. 32 pp. (Concluding that farmyard manure is a more reliable source of N than urea, and if the latter is used it should be in split doses over the season; also that varieties Hakika, Wahi and Macia are more tolerant of *Striga* attack than Pato. In the presence of *Striga*, Hakika is recommended for less fertile soils and Wahi and Macia on the more fertile.)

Pierce, S., Mbwaga, A.M., Press, M.C. and Scholes, J.D. 2003. Xenognosin production and tolerance to *Striga asiatica* infection of high-yielding maize cultivars. Weed Research 43: 139-145. (Laboratory studies confirmed that maize var. IWD STR Co and *Zea diploperennis* line BC4C2 avoided serious attack from *S. asiatica* by exuding less germination stimulant, but were not resistant to penetration.)

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(*Trichosurus vulpecula)* reduced mistletoe foliage cover from 50% to 16% and mean plant size by about 55% over a 4-year period.)

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Zheng XingFeng and Ding YuLong. 2001. (Life habit of *Phacellaria rigidula* Benth.) (in Chinese) Journal of Nanjing Forestry University 25(4): 7-11. (*P. rigidula* is a hyper-parasite, mainly on *Taxillus caloreas* var. *fargesii* but also on *Scurrula parasitica* var. *graciliflora,* both growing on *Keteleeria evelyniana* (Pinaceae) in sparse forest in Yunnan, China. Many aspects of the biology and ecology of *P. rigidula* are usefully described.)
Zych, A. and Zandarski, J. 2002. Organisms harmful to plants as a biological weapon. (in Polish) Ochrona Roslin 46(9): 12-14. (Discussing the potential of parasitic plants as biological weapons!)

HAUSTORIUM 43
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IPPS SYMPOSIUM ON PARASITIC WEEDS

We are pleased to announce that the next IPPS Symposium will take place in Durban (South Africa) on June 24-25, 2004, in collaboration with the International Weed Science Congress (IWSC).

The Symposium will include three workshops:
1. *Striga* management in various cropping systems.
2. Genetic variation in parasitic weeds.
3. Physiological and molecular aspects of parasitic plant development.

IPPS members are also invited to attend the Parasitic Weeds Sessions of the 4th International Weed Science Congress, scheduled on Thursday 24 June. The IPPS Symposia and the IWSC parasitic weeds sessions are complementary, so that all participants will have the opportunity to discuss parasitic weeds within the wider scope of weed biology and control.

Programme:
Thursday 24 June 2004
IWSC Plenary lecture - The parasitic weed problem and its fate in the 21st century.
IWSC session - Progress in parasitic weed research, with invited lectures on:
1. Understanding key developmental processes in parasitic weeds (Gebisa Ejeta).
2. New methodologies for the management of parasitic weeds (Joel Ransom).
3. Mechanisms of resistance and their application in susceptible crops (Andre Fer).
4. Demography of parasitic weeds and its impact on management (Paula Westerman).
IPPS Workshop - *Striga* management in various cropping systems.
Poster session on parasitic weeds, including discussion of selected contributions.

Friday 25 June 2004
IPPS Workshop - Genetic variation in parasitic weeds.
IPPS Workshop - Physiological and molecular aspects of parasitic plant development.

Registration:
Registration is organized by the IWSC. Please fill in the form that is found at:
https://secure.turners.co.za/iwsc2004/form.asp#Payment

Registration rates:
Thursday-Friday IWSC sessions and parasitic weed symposium (for those not attending the IWSC):

IPPS members	US$ 120
IPPS students	US$ 50
Non-members	US$ 180
Non-member students	US$ 50

Friday IPPS symposium for those registered for the IWSC

IPPS members	Free
Non-members	US$ 50

Call for papers:
Papers are invited for the three Workshops of the IPPS Symposium. Authors are requested to submit a short summary of their intended contribution in the form of an abstract as described for the IWSC conference at: (http://www.iwsc2004.org.za/Abstracts.htm). The only modification necessary is to include the words, “IPPS Symposium:” in front of the abstract title. The summary should be of not more than 250 words. It should include a clear definition of the objective and approach, present sufficient details regarding results, pointing out

material that is new. The authors are asked to indicate whether they wish to contribute a poster or an oral presentation. The Scientific Committee reserves the right to request authors to present a poster after submission of summary for oral presentation. Contributions will be refereed. All accepted contributions will be published on the IPPS website.

The deadline for abstract submission is February 20, 2004.

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THE 4TH INTERNATIONAL WEED SCIENCE CONGRESS

We also encourage IPPS members who are interested in parasitic weed control to attend the 4th International Weed Science Congress, on 20-24 June in the same place, where many aspects of weed science will be discussed in detail. More information on the Congress can be found at: http://www.iwsc2004.org.za/

We are looking forward to meeting all parasitic plant researchers and sharing results and views and for fruitful discussions and for the promotion of parasitic plant research.

Useful internet addresses:
Congress venue (ICC) in Durban: www.icc.co.za
Accommodations in South Africa: www.portfoliocollection.co.za
Kingdom of the Zulu: www.zulu.org.za
Kwazulu-Natal Parks: www.kznwildlife.com
City of Durban: www.kwazulu-natal.co.za/DBN
South African National Parks Board: www.parks-sa.co.za

FIRST REPORT OF *AEGINETIA PEDUNCULATA* CAUSING SUGARCANE WILT IN INDIA

Barring one short mention that *Aeginetia pedunculata* (Roxb.) Wall. (as *Orobanche acaulis* Roxb.) grows on China sugarcane (*Saccharum sinense* Roxb.) in the Botanic Garden at Kolkata (erstwhile, Calcutta) (Roxburgh, 1832), this *Aeginetia* species has not been reported as a parasite on sugarcane (*Saccharum officinarum* L.) in India, although *A. indica* has been (Parker and Riches, 1993). Now, during a survey in 2000 and around Plassey Sugar Mill area in Nadia district of West Bengal, India, the first author observed that nearly 100 ha of sugarcane crop was infected with *A. pedunculata* as identified by Botanical Survey of India, Kolkata. The parasite, 10 to 15 cm tall, appears at the base of sugarcane clumps during July, one month after the onset of the southwest monsoon. Emergence of new inflorescence and flowering continues till harvest of the crop in December-January. The first flowers produce seeds in capsules in September. The seeds are minute (0.3mm x 0.2 mm) and numerous (8-18,000 per capsule). They float on water and can readily spread to other places. Flowers are very attractive bearing ca > 50 mm purple limbs with a yellow lip. Morphological variations in respect of plant height, shape and colour are also common. *A. pedunculata* plants which grow on wild grass hosts are smaller than on sugarcane, dark red in colour, appear during August to October and bear only a few flowers and capsules, whereas plants growing on sugarcane produce luxuriant growth, abundant large flowers with varied shades of colour and many capsules. The parasite can survive during mild winter months only under the dense canopy of sugarcane plants. The loss caused due to the parasite is only visible when the infected canes began to wilt and dry at the time of harvest in December-January. Periodic sampling of infected and healthy canes from different varieties and from plant and ratoon crops showed that on an average the infected cane juice contains Brix 7.8 % and sucrose 2 % in compared to healthy plant which contains Brix 19.6 % and sucrose 16.3 %. The loss is 100 % in completely dried up patches in infected fields. For management of the parasite, weeding with manual labour and spraying herbicides like 2,4-D and glyphosate are practiced but resurgence of the parasitic plant is very quick, needing repeated applications albeit without satisfactory management. Development of resistant varieties may be the sustainable solution of the problem. Work has been initiated in this direction at Sugarcane Research Station, Bethuadahari, Nadia, West Bengal, India since 2000-01. We are also attempting to develop an appropriate IPM. *A. pedunculata* is a rare and threatened plant species which is also a medicinal plant, implying the need for adequate steps in conservation under protection and isolation away from its economic hosts.

A photograph of *A. pedunculata* can be seen at http://www.odu.edu/webroot/instr/sci/plant.nsf

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PARASITIC SCROPHS – NO SUCH THING?

It seems that the problem from serious parasitic weeds of the Scrophulariaceae has at last been eliminated – on paper at least. The editors of Haustorium regret that an important reference – a landmark even – was overlooked two years ago. Olmstead *et al*.'s paper 'Disintegration of the Scrophulariaceae' (American Journal of Botany 2001, 88: 348-361) proposes that all the parasitic genera previously included in the Scrophulariaceae should be transferred to Orobanchaceae. It had previously been pointed out (e.g. by U. Molau in 'Parasitic Plants' by Press and Graves, 1995) that the Orobanchaceae were closely allied with the Rhinanthoideae and should be lumped, or integrated with Scrophulariaceae. We now have a re-splitting, or dis-integration, on new lines which appears to be soundly based on the latest molecular phylogenetic techniques. Dan Nickrent has been adopting the new alignment on his 'Parasitic Plant Connection' web-site and it is apparently accepted by many others of our parasitic plant colleagues. A survey of web-site data-bases, however, suggests that it has not yet gained full recognition. On the USDA GRIN site, the family for *Striga* is given as 'Scrophulariaceae. Also placed in Orobanchaceae', but other sites such as USDA PLANTS, Missouri Botanic Garden, Flora Europaea/Royal Botanic Garden Edinburgh, IPNI and ITIS all continue to place *Striga* etc in Scrophulariaceae. It seems there will be an inevitable long lag before this change is fully adopted. Haustorium will be happy to hear from any who have views or comments.

Chris Parker.

COST 849

Under this European Union programme, a meeting was recently held in Athens, Greece. See under Proceedings of Meetings below for a list of the papers presented. Further meetings are planned for 2004 including two in February, the first on Genetic Diversity of Parasitic Plants, in Cordoba, Spain, the second on Biological Control, in Rome, Italy.

SYMPOSIUM ON NON-WEEDY HEMIPARASITIC SCROPHULARIACEAE

A two-day symposium on the biology of the non-weedy hemiparasitic Scrophulariaceae (Orobanchaceae) will be held in Wageningen (Netherlands) on 15 and 16 April 2004. A broad range of subjects concerning the biology of this group will be covered by a number of specialists, including Matthies (Ecology), Press (Ecophysiology), Kwak & Bekker (Endangered species), DePamphilis (Evolution), and others. Further information is available on the internet (www.hemiparasites.nl), or can be requested by sending an email to Siny ter Borg (info@hemiparasites.nl).

THESES

Denneal Sarah Jamison-McClung (PhD, Department of Vegetable Crops and Weed Science, University of California, Davis, September 2003) Haustorium Development in the Parasitic Plant, *Triphysaria* (Orobanchaceae): A Genetic and Molecular Analysis.

In the Orobanchaceae, a single origin of root parasitism followed by multiple losses of photosynthetic capacity characterize the evolution of parasitic plants. Increasing heterotrophy or reliance on host nutrients is accompanied by loss of genetic material from the chloroplast, gain of parasite-specific traits, and increasing host specificity via recognition of common plant secondary metabolites.

Triphysaria, a hemiparasitic plant belonging to the Orobanchaceae, was used as a model to investigate the genetic and molecular mechanisms governing haustorium development. Haustoria are the "organs of parasitism" and form at the root tips of parasitic Orobanchaceae in response to host-derived haustorium inducing factors (HIF's). Variation in natural populations of *Triphysaria* was observed for haustorium development in response to the HIF, 2, 6-dimethoxy-p-benzoquinone (DMBQ). DMBQ responsiveness was shown to be heritable and influenced by maternal effects.

Development of autohaustoria, haustoria that form in the absence of host-derived factors, was monitored in *Triphysaria pusilla. Triphysaria* rarely form haustoria when grown alone or with conspecific plants, suggestive of a mechanism for self-recognition and avoidance of self-parasitism. Propensity to form autohaustoria showed a strong positive correlation with degree of anthocyanin pigmentation. GA_3 pre-treatment of seeds obtained from high and low anthocyanin parents leads to a significant and unexpected increase in autohaustoria formation for both groups. Results suggest that high anthocyanin plants may be self-inducing via exuded flavonoids and that plant hormones, particularly auxin and gibberellin, may be involved in regulating self-recognition and autohaustorium development in root parasitic plants.

Transcript accumulation of three genes was assayed in variant *Triphysaria* populations. Two genes, TvQR1 and TvQR2, encode putative quinone oxidoreductases and one, TvPirin, encodes a nuclear transcription factor involved in cell cycle regulation. TvQR1 performs a one-electron reduction of quinone to semiquinone, and was positively correlated to haustorium development. TvQR2 performs a two-electron reduction of quinone to phenolic acid and was correlated to DMBQ induction, though not haustorium development. TvPirin was also correlated to DMBQ induction, but not haustorium development. Results support the proposed redox cycling model of semiquinone-induced haustorium development in the Orobanchaceae.

Cinzia Costantino (PhD Università degli Studi, Genova, July 2003) Experiments with *in vitro* growth of *Scurrula pulverulenta* G. Don (plant parasite of woody-plant species widely distributed in sub-tropical areas). (in Italian)

The study involved *in vitro* culture of the hemi-parasitic plant *Scurrula pulverulenta* G.Don (Loranthaceae), grown from *in vitro* germinated seeds, without any growth regulators (exogenous hormones), and followed the development of shoots, leaves and haustorial strands. In the optimum medium numerous new shoots grew close to the chlorophyllous hypocotylar region. These were excised in the second year taking particular care to preserve some of the undifferentiated callus. Cultures involving different hosts revealed that the haustorium penetrated the host by cellular lysis, allowing the haustorium to penetrate further by mechanical means into the inner tissues. The host *Genista monosperma* Lam. responded to the penetration by producing a pink callus but still allowed penetration to the central stele and suffered damage. In the case of the host *Citrus auriantum* L. there was also progressive sub-cortical growth of the haustorium in the stem.

S. pulverulenta grown on a nutrient medium with cellulose, without a host, but with the addition of a *Viscum album* extract, showed abundant development of self-regenerating chlorophyllous callus originating from the site of cotylar fusion in the embryo. Furthermore, this callus and the hypoctyl callus also showed consolidated callus leading to the development of pseudo-xylem tissue, lignin-like material, lining the culture tubes. Addition of the *Viscum* extract was conducive to more vigorous growth, including development of the epidermis and most noticeably, of the powdery surface responsible for the specific name *'pulverulenta'.* After 3 years in *in vitro* culture, *S. pulverulenta* is observed to produce a thin web of viscin and to show full vegetative vigour. Electron microscope study of the epidermis in field-grown plants revealed the presence of *Lactobacillus* sp. inside pedunculate hairs in the form of a three-pointed star.

S. pulverulenta spreads freely in its native habitats in sub-tropical regions, while in the Mediterranean area it only spreads as a result of the sporadic activity of birds or deliberate transfer by researchers. It is suggested that *S. pulverulenta* may be a useful indicator of climate change since the amount of fruiting is noted to be closely correlated to temperature and rainfall.

It is also suggested that improved techniques for *in vitro* culture could be welcome as the cyto-toxic effects from extracts of this species on tumour cells (Ascites-test Yoshida) compare favourably with the standard extract (Hiscia Iscador ®) prepared from *Viscum album* L.. Other comparisons by Drs Urech and Schaller of leaf and pseudo-berry extracts of *S. pulverulenta* with the standard extract (Hiscia Iscador ®) obtained from *V. album* also suggest similar anti-tumour activity.

Finally, chromatographic studies of extracts from *S. pulverulenta* show differences depending on the host plant, confirming interaction between host and hemi-parasite resulting in differences of biochemical compounds in the extracts.

Anat Reizelman-Lucassen (PhD, University of Nijmegen, 4 November, 2003) Synthesis and function of germination stimulants for seeds of the parasitic weeds *Striga* and *Orobanche* spp. (Supervision: Professor Binne Zwanenburg)

This thesis reviews the synthetic methods used in the synthesis of strigol and other strigolactones. All 8 stereoisomers of strigol were prepared and their activity compared. 'Natural' strigol was by far the most active, by a factor of at least 100 compared with most others.

An efficient synthesis of (+/-) orobanchol is reported; also new improved methods for GR7, GR24 and Nijmegen-1, based on a palladium-catalyzed asymmetric coupling

The remainder of the thesis is devoted to studies aimed at the isolation and identification of the strigolactone receptor with the help of a biotin-labelled strigolactone analogue (amino-GR-24), affinity chromatography, immobilized avidin or streptavidin, and fluorescence correlation spectroscopy. The presence of a strigolactone specific binding protein (SPLB) in the insoluble membrane fractions of *Striga* seeds was shown by a dot-blot analysis. Preliminary results with SDS-PAGE showed an enrichment of a 60kDa protein, isolated from these fractions by purification.

Christina Vieira Dos Santos (PhD, University of Nantes, France). Molecular aspects of the *Arabidopsis thaliana* response infected by the obligate root parasite *Orobanche ramosa*. (Supervision: Philippe Delavault and Patrick Thalouarn, Groupe de Physiologie et Pathologie Végétales) (in French)

The infection of *Arabidopsis thaliana* roots with the holoparasite *Orobanche ramosa* represents a useful model for a molecular study of the host plant response to a parasitic plant attack. Thus, we developed an in vitro co-culture system, allowing us an investigation by PCR amplification methods of the expression of some host genes already known to be involved in plant/pathogen interactions: ethylene, isoprenoid, phenylpropanoid, and jasmonate pathways, oxidative stress responses and PR proteins. A non-targeted study based on a suppression subtractive hybridization strategy was also used to identify genes that were induced two hours after placing *O. ramosa* seeds near *A. thaliana* roots. Infestation will not start before the seventh day. The kinetic gene expression was assayed from 1h to 7 days after *O. ramosa* germinations were placed. Proteins encoded by these genes are also involved in *A. thaliana* defence pathways: signal transduction, pectin methylesterase inhibition, detoxification of reactive oxygen species, jasmonate-dependent pathway and cell wall reinforcement. From these studies, no salicylic acid-dependent defence has been detected whereas jasmonate- and ethylene-dependent pathways were induced.

Related papers :

Vieira Dos Santos C., Letousey P., Delavault P. and Thalouarn P., 2003. Defence gene expression analysis of *Arabidopsis thaliana* parasitized by *Orobanche ramosa*. Phytopathology, 93:451-457

And Santos *et al.* 2003 – in Literature section below.

Aurélie Rousset (PhD, University of Nantes, France) Contribution to the chemical control of the parasitic and mannitol-producing plants. Identification and characterization of in vitro inhibitors of mannose 6-phosphate reductase and study of their activity on simplified biological models (protoplasts and

calli). (Supervision: Philippe Delavault and Patrick Thalouarn, Groupe de Physiologie et Pathologie Végétales) (in French)

The strategy based on the inhibition of mannose 6-phosphate reductase (M6PR), the key enzyme of mannitol production, could be efficient against *Striga* and *Orobanche*. Some aromatic and phosphorylated compounds inhibit competitively M6PR in vitro and protoplasts and callus culture were obtained from *Striga* leaves to estimate their activity on simple models. Protoplasts and calli kept mannitol synthesis as a major pathway, as shown by the analysis of their carbon fluxes, carbohydrate patterns and M6PR activities. In a similar proportion as in leaves, a significant part of the photosynthetically fixed 14C is incorporated into mannitol in protoplasts. Calli were much less active in photosynthesis but synthesized mannitol from exogenous sucrose or mannose. In presence of M6PR inhibitor, carbon fluxes towards soluble carbohydrates, notably mannitol, were reduced in treated protoplasts and calli.

Related paper :
Rousset *et al.* 2002. in Literature section below.

PROCEEDINGS OF MEETINGS

7th EWRS (European Weed Research Society) Mediterranean Symposium, Adana, Turkey, 2003. The Proceedings of this meeting are not yet published but should be available from the EWRS web site (www.ewrs.org) bookshop before long. The following are selected titles relating to parasitic plants, which will be published in the form of 2-page abstracts.

Manschadi A.M.*et al.* - Development of a systems approach for ecological management of parasitic weeds in legume-based Mediterranean cropping systems.
Grenz J. *et al*. - Identification of optimum sowing strategies for faba bean infested with the parasitic weed *Orobanche crenata* in the Cukurova region, Turkey. Predictions from simulation studies.
Nemli Y. *et al.* - Problems caused by broomrape (*Orobanche* spp.) and some control methods. Review and results.
Goran, M. *et al.* - Weed and broomrape (*Orobanche cernua*) control in Clearfield sunflower.
Orel-Aksoy E. and Uygur F.N. - Distribution of *Orobanche* spp. in the East Mediterranean region of Turkey.
Demirci M. *et al.* - Effect of soil temperature on *Orobanche cernua* Loeffl. growing stages and control strategies.

COST Action 849 Meeting: Biology and control of broomrape. October 30-November 2, Athens, Greece. Abstracts of this meeting are available on the COST web-site (see below). Titles were as follows:

Sauerborn, J. - Parasitic flowering plants – from botanical curiosity to antibiosis.
Cubero, J.I. - Phylogeny of the genus *Orobanche* inferred from cpDNA sequence variation.
Fer, A. - Experimental data strongly suggest the existence of several pathovars in *Orobanche ramosa* L.
Verkleij, J.A.C. *et al.* - Assessing genetic variability in *Striga hermonthica* and *S. aspera* by RAPD and SCAR analysis.
Delavault, P. *et al.* - Defense gene expression in host roots infected by *Orobanche* species.
Press, M.C. - Biology and control of parasitic weeds: *Striga* and *Orobanche.*
Bouwmeester, H. *et al.* - Germination of broomrape seeds.
Wegmann, K. - Recent experience in *Orobanche* control by suicide germination.
Matusova, R. *et al.* Changes in the sensitivity of parasitic weed seeds to germination stimulants.
Joel, D.M. - Sanitation and quarantine policies need to be adopted in Europe.
Murdoch, A.J. - Evaluating integrated management strategies for *Orobanche* and *Striga.*
Slavov, S. *et al.* - Chlorsulfuron resistant transgenic tobacco as a tool for broomrape control.
Kotoula-Syka, E. - *Orobanche ramosa* control in tomato.
Montemurro, P. and Lasorella, C. - Control of *Orobanche ramosa* by glyphosate in tomato.
Cagán, L. and Tóth, P. - Impact of *Orobanche ramo*sa to the yield of tomato fruits in the southwest of Slovakia.
Vouzounis, N. - Control of *Orobanche* sp. in melon and watermelon crops in Cyprus.
Nadal, S. *et al.* Control of broomrape (*Orobanche crenata* Forsk.) in narbon bean (*Vicia narbonensis* L) by glyphosate.
Pacureanu-Joiþa, M. and Procopovici, E. - Broomrape control in Romania.

Rubiales, D. *et al.* - Integrated control of crenate broomrape in pea.
Vurro, M. - Toxins from pathogens of parasitic plants.
Gressel, J. - So what if transgenic hypervirulence changes host range of a biocontrol agent? We need not jump to conclusions.
Dor, E. - The efficacy of a mixture of fungi to control Egyptian and sunflower broomrape.
Zermane1, N. *et al.* - Natural antagonists of *Orobanche* spp. in Tunisia with potential as biocontrol agents
Tóth, P. and Cagán, L. - Natural enemies of dodders (*Cuscuta* spp.) in Slovakia.

WEB SITES

For information on the International Parasitic Plant Society see: http://www.ppws.vt.edu/IPPS/

For past and current issues of Haustorium see: http://web.odu.edu/haustorium

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rmrs.nau.edu/misteltoe/welcome.html

For on-line access to USDA Forest Service Agriculture Handbook 709 'Dwarf Mistletoes: Biology, Pathology and Systematics' see: http://www.rmrs.nau.edu/publications/ah_709/

For information on activities and publications of the parasitic weed group at the University of Hohenheim see: http://www.uni-hohenheim.de/~www380/parasite/start.htm

For information on, and to subscribe to, PpDigest see: http://omnisterra.com/mailman/listinfo/pp_omnisterra.com

For information on the EU COST 849 Project and reports of its meetings see: http://cost849.ba.cnr.it/

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' the address is: http://www.omnisterra.com/bot/pp_home.cgi

For a description and other information about the *Desmodium* technique for *Striga* suppression, see: http://www.push-pull.net

For information on EC-funded project 'Improved *Striga* control in maize and sorghum (ISCIMAS) see: http://www.plant.dlo.nl/projects/Striga/

For brief articles on *Striga* in New Agriculturist on-line see: http://www.new-agri.co.uk/04-1/focuson/focuson5.html

LITERATURE

Abunyewa, A.A. and Padi, F. K. 2003. Changes in soil fertility and *Striga hermonthica* prevalence associated with legume and cereal cultivation in the Sudan savannah zone of Ghana. Land Degradation & Development 14: 335-343. (Growing soyabean or bambara nuts in place of bush fallow provided benefits in terms of soil fertility and *Striga* infestation.)

Adler, L.S. 2002. Host effects on herbivory and pollination in a hemiparasitic plant. Ecology 83: 2700-2710. (Further exploration of the complex interactions between *Castilleja indivisa* and *Lupinus albus* referred to in the next item.)

Adler, L.S., Karban, R. and Strauss, S.Y. 2001. Direct and indirect effects of alkaloids on plant fitness via herbivory and pollination. Ecology 82: 2032-2044. (Studies with *Castilleja indivisa* on *Lupinus albus* with varying alkaloid content +/- insecticide application confirmed that alkaloid reduced predation of *C. indivisa* without interfering with pollination.)

Ahonsi, M.O., Berner, D.K., Emechebe, A.M., Sanginga, N. and Lagoke, S.T.O. 2002. Selection of non-pathogenic ethylene-producing rhizobacteria for accelerated depletion of *Striga hermonthica* seed bank. African Crop Science Journal 10(2): 145-156. (Three strains of *Pseudomonas syringae* pv. *glycinea* shown to have caused high germination of *S. hermonthica*; but gene modification may be needed to reduce risk of pathogenicity to crops.)

Ahonsi, M.O., Berner, D.K., Emechebe, A.M., Lagoke, S.T. and Sanginga, N. 2003. Potential of ethylene-producing

pseudomonads in combination with effective N_2-fixing bradyrhizobial strains as supplements to legume rotation for *Striga hermonthica* control. Biological Control 28: 1-10. (Inoculation of cowpea or soyabean with the ethylene-producing *Pseudomonas syringae* pv. *glycinea* and N-fixing *Bradyrhizobia japonicum* enhanced their trap-crop effect.)

Al-Hussein, N., Bayaa, B. and Erskine, W. 2002. Integrated management of lentil broomrape, 1. Sowing date and chemical treatments. Arab Journal of Plant Protection 20(2): 84-92. (Delaying the sowing date and applying imazapic and imazethapyr resulted in 97-98% control of '*Orobanche* spp.' in lentil.)

Anderson, R.L. 2003. Changing forests and forest management policy in relation to dealing with forest diseases. Phytopathology 93: 1041-1043. (Including reference to mistletoes.)

Aukema, J.E. and Rio, C.M. dell 2002. Where does a fruit-eating bird deposit mistletoe seeds? Seed deposition patterns and an experiment. Ecology 83: 3489-3496. (Finding that the bird *Phainopepla nitens* deposited most seeds of *Phoradendron californicum* into *Prosopis velutina* which was already mistletoe-infested.)

Bako, M.L., Gulyas, A., Hegedus, Z., Szekrenyes, G. and Tuske-Bano, E. 2003. (Population studies in race-differentiating sunflower varieties with sunflower broomrape (*Orobanche cernua* Loefl./*Orobanche cumana* Wallr.) collected from the region of Bacsalmas.) (in Hungarian) Novenyvedelem 39: 429-436.

Babalola, O.O., Osir, E.O and; Sanni, A.I. 2002. Characterization of potential ethylene-producing rhizosphere bacteria of *Striga*-infested maize and sorghum. African Journal of Biotechnology 1(2): 67-69. (Three rhizosphere bacteria, *Pseudomonas* sp., *Enterobacter sakazakii* and *Klebsiella oxytoca*, were analysed for genetic variation. DNA fingerprint patterns of the three bacteria were markedly different.)

Babalola, O.O., Osir, E.O., Sanni, A.I., Odhiambo, G.D. and Bulimo, W.D. 2003. Amplification of 1-amino-cyclopropane-1-carboxylic (ACC) deaminase from plant growth promoting rhizobacteria in *Striga*-infested soil. African Journal of Biotechnology 2,(6): 157-160. (Providing the first report of ACC deaminase in *Klebsiella oxytoca*)

Bar Nun, N. *et al.* – see Nun, N.B. *et al.*

Benharrat, H., Boulet, C., Veronesi, C. and Thalouarn, P. 2003. (An overview of ongoing laboratory and field studies carried out on *Orobanche ramosa*: a pest for rape seed, hemp and tobacco.) (in French) Phytoma.564: 24-26. (A review of current research activity.)

Berner, D.K., Sauerborn, J., Hess, D.E. and Emechebe, A.M. 2002. The role of biological control in integrated management of *Striga* species in Africa. Neuenschwander, P., Borgemeister, C. and Langewald, J. (eds) Biological control in IPM systems in Africa, pp. 259-276. (Discussing the role of biological control agents, especially plant pathogenic fungi and bacteria.)

Beuth, J. 2003. (Evidence-based complementary therapy measures in carcinoma of the breast.) (in German) Medizin 32(1): 21-24. (Concluding that 'although complementary treatments cannot replace the standard oncological therapies for breast cancer…. treatments with mistletoe extracts are also of value.)

Bouwmeester, H.J., Matusova, R., Sun Zhongkui and Beale, M.H. 2003. Secondary metabolite signalling in host-parasitic plant interactions. Current Opinions in Plant Biology 6: 358-364. (Reviewing recent literature on germination stimulants and the analytic techniques involved; also the potential for the use of 'model' plants such as *Arabidopsis* in the study of stimulant biosynthesis and the possibilities for manipulation of germination stimulant production in crops.)

Brand, J.E. 2002. Review of the influence of *Acacia* species on establishment of sandalwood (*Santalum spicatum*) in Western Australia. In: Maslin, B.R. and George, A.S. (eds) Conservation Science Western Australia 4(3): 125-129. (A successful establishment technique involves planting *S. spicatum* seeds near 1-2 year old *Acacia acuminata* seedlings. Other *Acacia* spp. vary in suitability. *Allocasuarina huegeliana* is less suitable than *A. acuminata*, while planting close to *Eucalyptus loxophleba* results in seedling death.)

Braun, J.M., Ko, H.L., Schierholz, J.M. and Beuth, J. 2002. Standardized mistletoe extract augments immune response and down-regulates local and metastatic tumor growth in murine models. Anticancer Research 22(6C): 4187-4190.

Briemle, G. and Ruck, K. 2003. (Poisonous plants in pastures for horses....keep a lookout for them.) (in German) Fachpraxis 43: 14-18. (*Rhinanthus* spp. listed among toxic species.)

Campbell, S., Azuma, D. and Weyermann, D. 2003. Forests of Eastern Oregon: an overview. General Technical Report - Pacific Northwest Research Station, USDA Forest Service No.PNW-GTR-578, 31 pp. (Including reference to *Arceuthobium* spp.)

Carsky, R.J., Akakpo, C., Singh, B.B. and Detongnon, J. 2003. Cowpea yield gain from resistance to *Striga gesnerioides* parasitism in Southern Benin. Experimental Agriculture 39: 327-333. (IITA breeding line IT93KZ-4-5-6-1-5 has shown complete resistance to *S. gesnerioides* at more than 20 field sites in S. Benin and given mean yields over 150% greater than susceptible varieties.)

Christensen, N.M., Dörr, I., Hansen, M., Kooij, T.A.W. van der and Schulz, A. 2003. Development of *Cuscuta* species on a partially incompatible host: induction of xylem transfer cells. Protoplasma 220(3/4): 131-142. (*C. reflexa* and *C. japonica* growing on the incompatible host *Euphorbia pulcherrima* develop xylem transfer cells, not seen on a compatible host; suggesting that *Cuscuta* spp. have this genetic ability, elicited in response to developmental stress.)

Cooke, D. 2002. Control of Branched Broomrape. A literature review. Adelaide, Australia: Department of Water, Land and Biodiversity Conservation. 39 pp. (Including Appendix: A comparison of techniques to reduce the soil seedbank of branched boomrape, by J. Virtue and P. Jupp.)

Daugherty, C.M. and Mathiasen, R.L. 2003. Estimates of the incidence of mistletoes in pinyon-juniper woodlands of the Coconino National Forest, Arizona. Western North American Naturalist 63: 382-390. (About 50% of the woodlands surveyed were infested with *Phoradendron juniperinum* or *P. capitellatum* but only 12% with *Arceuthobium divaricatum* occurring on pinyon *Pinus* spp.)

Deng Xiong, Feng HuiLing, Ye WanHui, Yang QiHe, Xu KaiYang, CaoHongLin and Fu Qiang 2003. (A study on the control of exotic weed *Mikania micrantha* by using parasitic *Cuscuta campestris*.) (in Chinese) Journal of Tropical and Subtropical Botany 11: 117-122. (*C. campestris* could spread up to 5 m within 2 months and inhibited the growth and development of *M. micrantha*.)

DeNitto, G. 2002. Montana: forest insect and disease conditions and program: 2001. Forest Health Protection Report - Northern Region, USDA Forest Service, No.02-1, 41 pp. (Including estimated losses from *Arceuthobium* spp.)

Dubrovsky, J.G. 2002. Tumorous malformations in natural populations of *Pachycereus* and its association with mistletoe. Cactaceas y Suculentas Mexicanas 47(3): 48-56. (A study suggesting that *Phoradendron diguetianum*, although often associated with galls on *Pachycereus, Stenocereus* and *Opuntia* spp., is not their cause.)

Dugenci, S.K., Arda, N. and Candan, A. 2003. Some medicinal plants as immunostimulant for fish. Journal of Ethnopharmacology 88: 99-106. (Extracts of *Viscum album* included in studies on *Oncorhynchus mykiss* but were not active.)

Dzerefos, C.M., Witkowski, E.T.F. and Shackleton, C.M. 2003. Host-preference and density of woodrose-forming mistletoes (Loranthaceae) on savanna vegetation, South Africa. Plant Ecology 167: 163-177. (*Erianthemum dregei* and *Pedistylis galpinii* each had many hosts but *Sclerocarya birrea* was the most favoured and there was negative correlation between host preference and host wood density. *P. galpinii* has the higher market value.)

Eizenberg, H., Colquohoun, J.B. and Mallory-Smith, C.A. 2003. Weed Science 51: 759-763. (14 varieties of *Trifolium pratense* were highly susceptible to *O. minor*; 7 varieties of *T. repens* allowed many attachments but few developed normally and there was little host damage; 2 varieties of *T. incarnatum* were apparently immune in this study.).

El-Sayed, N.E., Abd-Elkrim, M.A., El-Aref, H.M., Taghian, A.S. and El-Lithy, R.E. 2003. Selection and molecular characterization of faba bean lines resistant to broomrape (*Orobanche crenata* Forsk). Assiut Journal of Agricultural Sciences 34(1): 165-180. (Crosses among Giza Blanca, Giza 402, and Giza 674 produced plants with enhanced parasite resistance and host seed yield. PCR-RAPD markers were identified that correlated with the resistance trait.)

Ensbey, R. and Blackmore, P. 2003. Serious weed threats to NSW - your legal obligations for W1 weeds. Agnote - NSW Agriculture No.DPI-451(1st Edition), 6 pp. (Including *Orobanche* spp. among 14 species classified as W1 Noxious.)

Ernst, E., Schmidt, K. and Steuer-Vogt, M.K. 2003. Mistletoe for cancer? A systematic review of randomised clinical trials. International Journal of Cancer.107: 262-267. (Conclusions from a critical analysis of 10 published studies concluded that none of the methodologically stronger trials exhibited efficacy in terms of quality of life, survival or other outcome measures. Sadly 'rigorous trials of mistletoe extracts fail to demonstrate efficacy of this therapy'.)

Fan Jiang, Jeschke, W.D. and Hartung, W. 2003. Water flows in the parasitic association *Rhinanthus minor/Hordeum vulgare*. Journal of Experimental Botany 54: 1985-1993. (Confirming that stomata of *R. minor* remain open day and night despite high levels of ABA, while those of *Melampyrum arvense* do not. Studies showed that *R. minor* extracted 20% of the water taken up by the host. Response of the host involved decreased shoot growth but somewhat increased root development.)

Fayed, M.T.B., Hamdi, A., Samia, A.M. and Shaaban, M. 2002. Performance of *Orobanche* control treatments in faba bean crop. Egyptian Journal of Agricultural Research 80: 753-769. (Comparing a range of treatments involving late sowing, glyphosate application, integrated control, non-chemical integrated control, and the tolerant cv. Giza 429.)

Foley, M.J.Y. 2003. *Orobanche hirtiflora* subsp. *zosimii* M.J.Y. Foley (Orobanchaceae), a new subspecies from Cyprus. Candollea 58(1): 83-95.

Frost, A., López-Gutiérrez, J.C. and Purrington, C.B. 2003. Fitness of *Cuscuta salina* (Convolvulaceae) grown under different salinity regimes. American Journal of Botany 90: 1032-1037. (It is postulated that distribution of *C. salina* may be dictated more by the salt status of the host than by the soil type, but experiments involving the host *Beta vulgaris* grown on varying levels of salt failed to give clear confirmation of this.).

Ganeshaiah, K.N., Shaanker, R.U. and Bawa, K.S. 2001. Theme I: Global change and tropical forest ecosystems. Economic valuation of natural resources: local and global perspectives. In Ganeshaiah, K.N., Shaanker, R.U. and Bawa, K.S. (eds) Proceedings of the International Conference on Tropical Ecosystems: Structure, Diversity and Human Welfare, Banglore, India, July 2001, pp. 29-52. (Including a section on silviculture of *Santalum album*.)

Garkoti, S.C., Akoijam, S.B. and Singh, S.P. 2002. Ecology of water relations between mistletoe (*Taxillus vestitus*) and its host oak *(Quercus floribunda*). Tropical Ecology 43: 243-249. (Measurements of water potential in host and parasite demonstrate a constant differential between the two, with the parasite always lower than its host.)

Gbèhounou, G., Pieterse, A.H. and Verkleij, J.A.C. 2003. Longevity of *Striga* seeds reconsidered: results of a study on purple witchweed (*Striga hermonthica*) in Bénin. Weed Science 51: 940-946. (Studies with seeds buried in nylon gauze bags suggest rapid loss of viability during the rainy season in northern Bénin and no wet dormancy. But note Mourik *et al.*, below, suggesting an effect of seed density which could affect this type of study.)

Gibot-Leclerc, S., Brault, M., Pinochet, X. and Sallé, G. 2003. (Potential role of winter rape weeds in the extension of broomrape in Poitou-Charentes.) (in French). Comptes Rendus Biologies.326: 645-658. (50% of the weeds of winter rape could be parasitized by *Orobanche ramosa*.)

Gibot-Leclerc, S., Brault, M. and Salle, G. 2003. (*Orobanche ramosa*: a true pest for various crops in France.) (in French) Phytoma 561: 9-12. (*O. ramosa* is continuing to spread in France and is now present in 20 of the 96 departments, affecting tobacco and hemp as well as rape.)

Gilmore, A.M., Matsubara, S., Ball, M.C., Barker, D.H. and Itoh, S. 2003. Excitation energy flow at 77 K in the photosynthetic apparatus of overwintering evergreens. Plant, Cell and Environment 26: 1021-1034. (Results with *Amyema miquelii* on *Eucalyptus pauciflora* are consistent with a functional association between the cold-hard-band of chlorophyll a spectra, PSII energy dissipation, and protective storage of chlorophyll in overwintering evergreens.)

Godfree, R.C., Tinnin, R.O. and Forbes, R.B. 2003. Relationships between dwarf mistletoe and the canopy structure of an old-growth lodgepole pine forest in central Oregon. Canadian Journal of Forest Research 33: 997-1009. (Stands of *Pinus contorta* heavily infested by *Arceuthobium americanum* contained fewer large but many more small trees than lightly infested stands.)

Gotts, R.I.C. and Ginn, S.G. 2003. The previously undescribed female of *Delias shunichii* Morita (Lepidoptera: Pieridae) from New Britain, Papua New Guinea. Australian Entomologist 30(1): 1-4. (The larvae are believed to feed on Loranthaceae.)

Gworgwor, N.A. 2002. The use of legume trap crops for control *of Striga hermonthica* (Del.) Benth. in sorghum (*Sorghum bicolor* L. Moench) in Northern Nigeria. Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen, Universiteit Gent 67(3): 421-430. (Confirming the potential of groundnut and bambara to reduce numbers of *S. hermonthica*, especially when planted as alternate hills rather than in alternate rows.)

Gworgwor, N.A. 2003. Resistance of sorghum varieties to *Striga hermonthica*. Tropical Science 43(1): 48-52. (Local varieties Ex-Dapchi and Idon Makaho in Nigeria showed evidence of tolerance to *S. hermonthica*.)

Haas, K., Bauer, M. and Wollenweber, E. 2003. Cuticular waxes and flavonol aglycones of mistletoes. Zeitschrift fur Naturforschung. Section C, Biosciences 58: 464-470. (Neither the crystalloid structures nor the chemical composition of the wax allowed discrimination between *Viscum album* and *V. cruciatum*.)

Haidar, M.A. 2003. Characterisation of the interaction between cryptochromes and phytochromes in blue light-induced coiling and prehaustoria development of dodder (*Cuscuta campestris*) seedlings. Annals of Applied Biology 143: 57-62.

Hirsch, A.M., Bauer, W.D., Bird, D.M., Cullimore, J., Tyler, B. and Yoder, J.I. 2003. Molecular signals and receptors: controlling rhizosphere interactions between plants and other organisms. Ecology 84: 858-868. (Including a section on germination and haustorial stimulants in parasitic plants.)

Hunter, J.T. 2003. Factors affecting range size differences for plant species on rock outcrops in eastern Australia. Diversity and Distributions 9(3): 211-220. (Hemi-parasites apparently contribute to greater species range sizes.)

Hyun JinO, Lim Yongseok and Shin Hyunchur 2003. Validation of *Orobanche filicicola* (Orobanchaceae) from Korea. Novon, 2003 13(1): 64-67.

Idris, A.E., Abouzeid, M.A., Boari, A., Vurro, M. and Evidente, A. 2003. Identification of phytotoxic metabolites of a new *Fusarium* sp. inhibiting germination of *Striga hermonthica* seeds. Phytopathologia Mediterranea 42(1): 65-70.

Idu, M., Begho, E.R. and Akpaja, E.O. 2002. Anatomy of attachment of the root parasite *Thonningia sanguinea* Vahl. on *Hevea brasiliensis*. Indian Journal of Natural Rubber Research 15(1) 33-35. (Detailed observations on *T. sanguinea,* damaging to rubber in Nigeria.)

INTSORMIL 2002. Bibliography - INTSORMIL, 1984-2002: fighting hunger and poverty with research, a team effort. International Sorghum and Millet Collaborative Research Program. 237 pp. (Including INTSORMIL articles on *Striga*.)

Joita, M.P., Procopovici, E. and Raranciuc, S. 2002. Sunflower breeding for resistance to the new races of broomrape (*Orobanche cumana* Wallr.) in Romania. In: Taborsky, V., Polak, J., Lebeda, A. and Kudela, V. (eds) Plant Protection Science 38(Special 2): 604-607. (Demonstrating the existence of a new race F, and corresponding dominant resistance gene Or6.)

Joshi, S.K. and Sanjay Gairola 2003. *Cuscuta europaea* Linn. (dodder plant): an emerging threat to plant diversity of Valley of Flowers. Current Science 84: 1285-1286. (Hosts in Uttah Pradesh include medicinal plants *Dactylorhiza hatagirea, Gentianella moorcroftiana, Swertia paniculata, Selinum tenuifolium* and *Potentilla* spp.)

Kanampiu, F., Friesen, D. and Gressel, J. 2003. A new approach to *Striga* control. Pesticide Outlook 14(2): 51-53. (A general review of recent developments including seed-coating with imazapyr or pyrithiobac and new locally adapted, herbicide-resistant, open-pollinated maize cultivars.)

Kanampiu, F.K., Kabambe, V., Massawe, C., Jasi, L., Friesen, D., Ransom, J.K. and Gressel, J. 2003. Multi-site, multi-season field tests demonstrate that herbicide-coating herbicide-resistance maize controls *Striga* spp and increases yields in several African countries. Crop Protection 22: 697-706. (Tests with imazapyr and pyrithiobac on over 90 sites in Kenya, Malawi, Tanzania, and Zimbabwe gave excellent control of *S. hermonthica* and *S. asiatica* and showed increased yields up to 4-fold on heavily infested sites.)

Krause, K., Berg, S. and Krupinska, K. 2003. Plastid transcription in the holoparasitic plant genus *Cuscuta*: parallel loss of the rrn16

PEP-promoter and of the rpoA and rpoB genes coding for the plastid-encoded RNA polymerase. Planta 216: 815-823. (Three achlorophyllous species*, C. odorata, C. subinclusa*, and *C. gronovii*, lack promoters for the plastid-encoded RNA polymerase but contain motifs similar to a nuclear-encoded RNA polymerase promoter. This contrasts with the chlorophyll-containing *C. reflexa*, which retains the plastid-encoded polymerase promoter. Parasitic plants continue to be useful in studying the evolution of plastid genes and their regulation.)

Kuchinda, N.C., Kureh, I., Tarfa, B.D., Shinggu, C. and Omolehin, R. 2003. On-farm evaluation of improved maize varieties intercropped with some legumes in the control of *Striga* in the Northern Guinea savanna of Nigeria. Crop Protection 22: 533-538. (Intercropping the improved varieties with either soyabean or groundnut was more profitable than the local cultivar grown alone.)

Kuijt, J. 2003. Miscellaneous mistletoe notes, 37-47. Novon 13(1): 72-88. (Proposing 9 new species of Loranthaceae, 2 of *Cladocolea*, 4 of *Struthanthus* and 3 of *Dendrophthora*.)

Li XueMei, Pfiz, M., Kuppers, M., Einig, W., Rennenberg, H. and Hampp, R. 2003. Sucrose phosphate synthase in leaves of mistletoe: its regulation in relation to host (*Abies alba*) and season. Trees: Structure and Function 17(3): 221-227. (Seasonal changes in carbohydrate metabolism in the parasite may be tied to availability of sugar in the host xylem.)

Mack, R.N. and Lonsdale, W.M. 2003. Eradicating invasive plants: hard-won lessons for islands. In: Veitch, C.R. and Clout, M.N. (eds) Turning the tide: the eradication of invasive species: Proceedings of the International Conference on eradication of island invasives, pp.164-172. (Using the *Striga* control programme in USA as an example of what is possible.)

Macklin, J. and Parnell, J. 2002. An account of the Santalaceae of Thailand. Thai Forest Bulletin (Botany) 30: 75-108. (Keys and full descriptions for 13 species in 7 genera, including some aerial parasities, mostly occurring in montane regions on e.g. *Quercus*, *Lithocarpus* and *Vaccinium*.)

Manschadi, A.M., Wang, E., Robertson, M.J., Meinke, H. and Sauerborn, J. 2003. Development of a parasite module in APSIM - case study: the parasitic weed *Orobanche crenata* infesting faba bean. In: Unkovich, M. and O'Leary, G. (eds) Solutions for a better environment: Proceedings of the 11th Australian Agronomy Conference, Geelong, Victoria, February 2003, pp.0-4. (The parasite module, together with APSIM-Faba bean, was capable of predicting the biomass accumulation of *O. crenata* and the yield loss of infected faba bean for various infestation levels and sowing dates, also under different water supply conditions.)

Marambe, B., Wijesundara, D.S.A., Tennakoon, K.U., Peneniya, D. and Jayasinghe, C. 2002. Growth and development of *Cuscuta chinensis* Lam. and its impact on selected crops. Weed Biology and Management 2: 79-83. (In pot experiments '*C. chinensis*' (just possibly *C. campestris*?) showed greatest vigour on tomato causing about 80% reduction in dry weight; it was less vigorous and caused only 30-40% reduction of chilli; and it failed to parasitize rice. Germination was increased by scarification.)

Maurer, W.D. 2003. (Dendroecological research on silver fir (*Abies alba* Mill.) stands damaged by mistletoe (*Viscum album*).) (in German) Mitteilüngen aus der Forschungsanstalt für Waldokologie und Forstwirtschaft Rheinland-Pfalz 50(3) 161-170. (Analysing attack by mistletoe under varying climate, soil, stand structure, and atmospheric deposition.)

Millot, M. 2002. (Forest renewal one century after reforestation with black pines of badlands in the Haute-Provence.) (in French) Comptes rendus de l'Academie d'Agriculture de France 88(6): 59-68. (With reference to *Viscum album* as a factor in growing *Pinus nigra*.)

Mohamed, A., Ellicott, A., Housley, T.L. and Ejeta, G. 2003. Hypersensitive response to *Striga* infection in Sorghum. Crop Science 43: 1320-1324. (Characterising the hyper-sensitive response (HR) in varieties Framida and Dobbs and in the wild accession P47121. HR in P47121 proved heritable. Genotypes SRN-39, IS9830, and 555 had low stimulant activity but no HR. Framida had both characters.)

Mooney, K.A. 2003. *Promylea lunigerella glendella* Dyar (Pyralidae) feeds on both conifers and parasitic dwarf mistletoe (*Arceuthobium* spp.): one example of food plant shifting between parasitic plants and their hosts. Journal of the Lepidopterists' Society 57: 47-53. (Feeding noted on both

Arceuthobium vaginatum and on *Pinus ponderosa.* Comparisons made with *Dasypyga alternosquamella*, a closely related phycitine, also feeding on *Arceuthobium* at this site.)

Morlon-Guyot, J., Helmy, M., Lombard-Frasca, S., Pignol, D., Pieroni, G. and Beaumelle, B. 2003. Identification of the ricin lipase site and implication in cytotoxicity. Journal of Biological Chemistry 278: 17006-17011.

Mourik, T.A. van, Stomph, T.J and Westerman, P.R. 2003. Estimating *Striga hermonthica* seed mortality under field conditions. In: Bekker, R.M., Forcella, F., Grundy, A.C., ,Jones, N.E., Marshall, E.J.P. and Murdoch, A.J. (eds) Aspects of Applied Biology 69: 187-194. (Loss of viability under field conditions in Mali was less in sterilised soil, and when seed density was lower.)

Murdoch, A.J. and Kunjo, E.M. 2003. Depletion of natural soil seedbanks of *Striga hermonthica* in West Africa under different integrated management regimes. In: Bekker, R.M., Forcella, F. and Grundy, A.C., Jones, N.E., Marshall, E.J.P. and Murdoch, A.J. (eds) Aspects of Applied Biology 69: 261-268. (Depletion of *S. hermonthica* seeds over 2 seasons in Gambia was 90% when fertilised cotton was grown but only 46% under unfertilised sorghum.)

Mullen, J.D., Taylor, D.B., Fofana, M. and Kebe, D. 2003. A bio-economic model of long-run *Striga* control with an application to subsistence farming in Mali. International Journal of Pest Management 49: 251-264.

Murwani, R. 2003. Indonesian tea mistletoe (*Scurrula oortiana*) stem extract increases tumour cell sensitivity to tumour necrosis factor alpha (TNFalpha). Phytotherapy Research 17: 407-409. (Confirming that extracts of *S. oortiana* are cytotoxic to the WEHI-164 tumour cell line and increase tumour cell sensitivity to TNFalpha mediated lysis.)

Musambasi, D., Chivinge, O.A. and Mariga, I.K. 2002. Intercropping maize with grain legumes for *Striga* control in Zimbabwe. African Crop Science Journal 10: 163-171. (Intercropping maize with cowpea, groundnut, field bean and bambara nut caused only partial and unreliable reductions in emergence of *S. asiatica* but there may have been small advantages in total crop yields.)

Mutikainen, P. and Koskela, T. 2002. Population structure of a parasitic plant and its perennial host. Heredity 89: 318-324. (Allozyme studies suggested little evidence for co-evolution of *Cuscuta europaea* with its host *Urtica dioica*.)

Nadler-Hassar, T. and Rubin, B. 2003. Natural tolerance of *Cuscuta campestris* to herbicides inhibiting amino acid biosynthesis. Weed Research 43: 341-347. (*C. campestris* from several different hosts and sources, including Israel and USA, also one sample of *C. monogyna*, proved highly tolerant of glyphosate and related herbicides. Treatment of glyphosate-resistant sugar beet and tomato in the field resulted in initial suppression of *C. campestris* but there was later recovery and only limited benefit in host vigour. Over-expression and/or high specific activity of the target enzyme is suspected of being responsible. The usefulness of these herbicides for *Cuscuta* control in herbicide-resistant crops is questioned.)

Ndakidemi, P.A. and Dakora, F.D. 2003. Legume seed flavonoids and nitrogenous metabolites as signals and protectants in early seedling development. Functional Plant Biology 30: 729-745. (Summarizing the roles of seed coat metabolites in symbiotic legumes, with the aim of evaluating the potential for manipulating these molecules to increase plant yields. *Striga* also considered.)

Nun, N.B., Plakhine, D., Joel, D.M. and Mayer, A.M. 2003. Changes in the activity of the alternative oxidase in *Orobanche* seeds during conditioning and their possible physiological function. Phytochemistry 64(1): 235-241. (AOX respiratory pathway plays an important role during seed preconditioning and may function in reducing levels of reactive oxygen species.)

Ohashi, K., Winarno, H., Mukai, M., Inoue, M., Prana, M. S., Simanjuntak, P. and Shibuya, H. 2003. Indonesian medicinal plants. XXV. Cancer cell invasion inhibitory effects of chemical constituents in the plant *Scurrula atropurpurea* (Loranthaceae). Chemical & Pharmaceutical Bulletin 51(3): 343-345. (Among the constituents studied, the alkynic fatty acid octadeca-8,10,12-triynoic acid exhibited inhibitory effects on cancer cell invasion *in vitro*. *S. atropururea* is referred to as a parasite of tea.)

Olmstead, R.G., Depamphilis, C.W., Wolfe, A.D., Young, N.D., Elisens, W.J. and Reeves, P.J. 2001. Disintegration of the Scrophulariaceae. American Journal of Botany 88: 348-361. (On the basis of molecular studies involving three plastid genes, proposing the transfer of all parasitic genera of Scrophulariaceae into Orobanchaceae. Apologies for late posting – see item above 'Parasitic Scrophs – no such thing?'.)

Olupot, J.R., Osiru, D.S.O., Oryokot, J. and Gebrekidan, B. 2003. The effectiveness of *Celosia argentea* (*Striga* "chaser") to control *Striga* on sorghum in Uganda. Crop Protection 22: 463-468. (Inter-planting *C. argentea* reduced *Striga* about 50% and increased sorghum yields. *C. argentea* is shown to stimulate *Striga* germination.)

Ouyang Jie, Wang XiaoDong, Zhao Bing and Wang YuChun 2003. Light intensity and spectral quality influencing the callus growth of *Cistanche deserticola* and biosynthesis of phenylethanoid glycosides. Plant Science 165: 657-661. (Blue light caused increased callus biomass and phenylethanoid glycoside (PeG) production as compared to cultures growing under white light. Greater PeG levels are attributed to higher phenylalanine ammonia lyase activity in blue light.)

Parnell, J. 2001. A revision of Orobanchaceae in Thailand. Thai Forest Bulletin (Botany) 29: 72-80. (Describing the widespread *Aeginetia indica*, the rarer *A. pedunculata* and the endemic *Christisonia siamensis*.)

Pierce, S., Ley, G., Mbwaga, A.M., Lamboll, R.I., Riches, C.R., Press, M.C. and Scholes, J.D. 2003. Farmers, farms and physiology: an integrated approach to *Striga* research. In: Proceedings, Crop Science and Technology 2003, BCPC International Congress, Glasgow, 2003, pp. (Reviewing a range of inter-related studies leading to practical choices of new sorghum varieties for farmers, based on soil type and fertilizer use.)

Plitmann, U. 2002. Agamospermy is much more common than conceived: a hypothesis. Israel Journal of Plant Sciences 50(Supplement): S111-S117. (Discussing the evolutionary implications of casual or facultative agamospermy in opportunistic plants and higher parasitic plants.)

Procopovici, E. 2001. (Behaviour of some sunflower hybrids to *Orobanche cumana* attack under conditions of Dobrogea.) (in Romanian) Probleme de Protectia Plantelor 29(2): 209-214. (Varieties Favorit, Turbo, Melody, Arena, and Pixel are recommended for growth in *O. cumana*-infested areas of Dobrogea.)

Puustinen, S. and Mutikainen, P. 2001. Host-parasite-herbivore interactions: implications of host cyanogenesis. Ecology 82: 2059-2071. (Studies on *Trifolium repens* with varying levels of cyanogenic glucosides, in the presence of parasitic *Rhinanthus serotinus* and/or the predatory snail *Arianta arbustorum* show that cyanogenesis deters the snail but not the parasite, while the snail was deterred by parasitism only in the absence of cyanogenesis.)

Quested, H.M., Press, M.C. and Callaghan, T.V. 2003. Litter of the hemiparasite *Bartsia alpina* enhances plant growth: evidence for a functional role in nutrient cycling. Oecologia 135: 606-614. (Showing that litter from the nutrient-rich foliage of *B. alpina* enhances growth of *Betula nana* and *Poa alpina*.)

Rathore, B.S. 2003. Blond psyllium - a new host for *Orobanche.* Indian Phytopathology 56(1): 121. (*'Orobanche* sp.' recorded on *Plantago ovata*.)

Rehms, L. and Osterbauer, N.K. 2003. Detecting *Orobanche minor* seeds in soil using PCR. Plant Health Progress. July, 2003: 1-3.

Robinson, D.C.E., Geils, B.W. and Muir, J.A. 2002. Spatial statistical model for the spread of dwarf mistletoe within and between stands. In: Crookston, N.L., Havis, R.N. (eds) Proceedings - Rocky Mountain Research Station, USDA Forest Service, 2002, No.RMRS-P-25, pp.178-185.

Rodriguez-Cruz, M.E., Perez-Ordaz, L., Serrato-Barajas, B.E., Juarez-Oropeza, M.A., Mascher, D. and Paredes-Carbajal, M.C. 2003. Endothelium-dependent effects of the ethanolic extract of the mistletoe *Psittacanthus calyculatus* on the vasomotor responses of rat aortic rings. Journal of Ethnopharmacology 86(2/3): 213-218. (Suggesting a mechanism for the supposed actiity of extracts of *P. calyculatus* against hypertension in traditional Mexican medicine.)

Rousset, A., Simier, P. and Fer, A. 2003. Characterisation of simple *in vitro* cultures of *Striga hermonthica* suitable for metabolic studies. Plant Biology 5: 265-273. (Attempts to standardise the use of protoplasts were not successful, but the use of globular calluses looks promising.)

Rubiales, D., Alcantara, C., Perez-de-Luque, A., Gil, J. and Sillero, J.C. 2003. Infection of chickpea (*Cicer arietinum*) by crenate broomrape (*Orobanche crenata*) as influenced by sowing date and weather conditions. Agronomie 23: 359-362. (Although there is somewhat more attack by *O. crenata* on chickpea with early, winter, sowing, the crop is still relatively resistant and little damaged.)

Rubiales, D., Perez-de-Luque, A., Cubero, J.I. and Sillero, J.C. 2003. Crenate broomrape (*Orobanche crenata*) infection in field pea cultivars. Crop Protection 22: 865-872. (Reporting little resistance in 20 pea varieties but some useful results from delayed sowing and imazethapyr pre- and post-emergence.)

Rubiales, D., Pérez-de-Luque, A., Joel, D.M., Alcántara, C. and Sillero, J.c. 2003. Characterization of resistance in chickpea to crenate broomrape (*Orobanche crenata*). Weed Science 51: 702-707. (Resistant chickpea varieties CA2065 and P2245 were shown to cause very little germination of *O. crenata* but also resisted penetration of haustoria by a form of resistance which did not involve host cell death but discolouration, inhibition and death of the invading haustorium.)

Rugutt, K.J., Rugutt, J.K. and Berner, D.K. 2003. In vitro germination of *Striga hermonthica* and *Striga aspera* seeds by 1-aminocyclopropane-1-carboxylic acid. Natural Product Research 17(1): .47-62. (Results suggest a hormonal mode of action for ACC, involving indirect stimulation of biosynthesis of ethylene that then triggers seed germination.)

Sanjai, V.N. and Balakrishnan, N.P. 2001. A note on the cryptic mimicry exhibited by Indian Viscaceae. Indian Journal of Forestry 24: 233-234.

Sanjai, V.N. and Balakrishnan, N.P. 2001. A note on hyper-parasitism in Indian Viscaceae. Indian Journal of Forestry 24: 235-236.

Santos, C.V. dos – see Vieira Dos Santos, C.

Sarikaya, O. and Avci, M. 2002. (Pest and diseases of the West Mediterranean forest tree, Cilician fir (*Abies cilicica* Carr.).) (in Turkish) Orman Muhendisligi 39(9/10): 20-23. (Including reference to damage by *Viscum album*.)

Sauerborn, J., Kranz, B. and Mercer-Quarshie, H. 2003. Organic amendments mitigate heterotrophic weed infestation in savannah agriculture. Applied Soil Ecology 23: 181-186. (Observations in N. Ghana on 'near' and 'far' fields with contrasting manuring and soil fertility help to confirm a negative correlation between soil fertility and *Striga* infestation.)

Schawaller, W. 2002. (The plant parasite *Cynomorium* as a feeding plant of cetonid beetles (Coleoptera: Scarabeidae) in southeastern Kazakhstan.) (in German) Entomologische Zeitschrift mit Insekten-Borse.112: 363-364. (*Cetonia aurata* and *Potosia karelini* observed feeding and causing damage.)

Schneeweiss, G.M. and Weiss, H. 2003. Polyploidy in *Aeginetia indica* L. (Orobanchaceae). Cytologia 68(1): 15-17. (2n found to be 120 – apparently octoploid.)

Showemimo, F.A. 2002. Evaluation of sorghum lines for *Striga* resistance. Tropical Agriculture 79: 237-240. (Field trails in Nigeria suggest lines SS-3, KSV-4 and KSV-8 are potential sources of *S. hermonthica* resistance.)

Showemimo, F.A. 2003. Selection criteria for combining high yield and *Striga* resistance in sorghum. Tropicultura.21(3): 157-159. (Plant vigour, stem girth, root weight, shoot weight and plant height all shown to be positively correlated with crop yield in the presence of *Striga.*)

Singh, H.P., Batish, D.R. and Kohli, R.K. 2003. Allelopathic interactions and allelochemicals: new possibilities for sustainable weed management. Critical Reviews in Plant Sciences 22: 239-311. (Including a section on the stimulatory allelochemicals involved in parasitic plant germination and haustorial initiation, also the use of microorganisms for parasitic weed control.)

Stein, G.M., Bussing, A. and Schietzel, M. 2002. Stimulation of the maturation of dendritic cells *in vitro* by a fermented mistletoe extract. Anticancer Research.22(6C): 4215-4220.

Sugimoto, Y., Ali, A.M., Yabuta, S., Kinoshita, H., Inananga, S. and Itai, A. 2003. Germination strategy of *Striga hermonthica* involves regulation of ethylene biosynthesis. Physiologia Plantarum 119: 137-145. (Detailed studies tend to confirm that conditioning of *S. hermonthica* seeds involves expression of ACC oxidase genes peaking after 15 days, while exposure to GR24 resulted in expression of ACC synthase genes, peaking after 10 hours, leading to endogenous ethylene generation and hence germination.)

Swift, K., Turner, J. and Rankin, L. 2002. Cariboo Forest Region: Part 1 of 3. Forest health Stand Establishment Decision Aids. BC Journal of Ecosystems and Management 2(1): 13-18. (An extension note including discussion of the problem of *Arceuthobium americanum* in *Pinus contorta*.)

Tang, S.X., Heesacker, A., Kishore, V.K., Fernandez, A., El-Sayed, S., Cole, G. and Knapp, S.J. 2003. Genetic mapping of the Or5 gene for resistance to *Orobanche* Race E in sunflower. Crop Science 43: 1021-1028. (Simple sequence repeat (SSR) markers were used to map Or5 to sunflower linkage group 3. This adds detail to previous maps, but Or5 is located in a telomeric region and is proving difficult to map precisely.)

Tikader, A. and Thangavelu, K. 2002. Incidence of *Elyctranthe parasitica* (L.) Dans., an epiphyte on mulberry. Indian Journal of Sericulture 41(2): 162-163.

Tsanuo, M.K., Hassanali,A., Hooper, A.M., Khan, Z., Kaberia, F., Pickett, J.A,. and Wadhams, L.J. 2003. Isoflavones from the allelopathic aqueous root exudates of *Desmodium uncinatum*. Phytochemistry 64: 265-273. (Paper based on the thesis reported in the previous issue – reporting the separation of several active fractions from the root exudates of *D. uncinatum,* and the chemical structure of some of the major iso-flavanoid components, one, uncinanone B, stimulating germination at 10-50 ppm, while uncinanone C inhibited radicle elongation at 5-10 ppm.)

Vaughn, K.C. 2003. Dodder hyphae invade the host: a structural and immunocytochemical characterization. Protoplasma 220(3/4) 189-200. (Close examination of *C. pentagona* reveals that hyphae do not grow through the host cell walls but rather induce the host to form a new cell wall which coats the growing hypha. It is also shown that the chimeric walls so formed are unique in composition and structure.)

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HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Plant Society

August 2005 **Number 45**

IPPS –A MESSAGE FROM THE SECRETARY

Dear IPPS Members,

Our most recent Symposium on Parasitic Weeds, which took place in Durban (South Africa) last June, was a wonderful occasion to learn about progress in many areas of parasitic plant research, to discuss new ideas, to meet old friends and colleagues, and to make new acquaintances. Let me take this opportunity to once again thank everyone who contributed to the meeting; it was in many ways a resounding success!

The International Parasitic Plants Society was inaugurated during the International Parasitic Weeds Conference in Nantes. Due to some legal difficulties it was possible to officially register the IPPS as an international society only in 2002. The Board of Directors provided the Executive Committee with recommendations that are now gradually implemented. Due to the delay in the formal registration of the Society we postponed our plans for a while and organized an international Symposium only recently. The Executive committee started organizing the Symposium as early as January 2003, but all technical issues could be finalized only shortly before the Symposium. We owe special thanks to the Committee Members Jim Westwood and Jos Verkleij for their continuous involvement in the decisions behind the meeting.

The 8th International Symposium on parasitic weeds has certainly been the highlight of our activities so far. Delegates from 23 countries presented their research results in posters and in lectures, covering many aspects of parasitic plant biology and management. A diversity of parasitic plant problems was discussed in seven sessions.

Thanks to the fruitful collaboration with the International Weed Science Society (IWSS) we were able to link the Symposium to the Weed Science Congress (IWSC), by which the parasitic weed researchers were exposed to the broader scope of weed science and the IWSC participants could take part in presentations and discussions during our Symposium. We are grateful to the organizers of the IWSC, and in particular to Baruch Rubin, Vice-President of the IWSS and member of our Board, for help and encouragement regarding the coordination of these two scientific meetings.

The International Scientific Committee, with representative of the major areas of parasitic plant research and control, evaluated all submitted abstracts, and the final program was constructed according to their recommendations. We happily thank all members of the committee for their contribution to the success of the Symposium. The Proceedings of the 8th International Symposium on Parasitic Weeds can be downloaded from the IPPS website at http://www.ppws.vt.edu/IPPS/ .

The publication of *Haustorium* is a big job. Thanks to the Editors, Chris Parker Jim Westwood and Lytton Musselman, this newsletter is prepared and distributed periodically to the benefit of all of us. The efforts, thinking, and hard work that they contribute are highly appreciated. Obviously the quality of the newsletter depends on contributions from all of us. The newsletter will certainly improve once additional material is submitted to the editors. Please make sure that you update us through *Haustorium* with dissertation summaries, research reports, interesting observations, and new ideas for discussion.

We will soon start preparations for the next IPPS Congress, which is due for 2006. Any suggestions for a venue will be most welcome. Please contact me with your suggestions at dmjoel@volcani.agri.gov.il. The Executive Committee will select the suggestions, and the final decision will be taken by the General Assembly. In addition, we will be happy to receive suggestions for a workshop on a more focused subject, which should be organized in 2005.

Danny Joel, IPPS Secretary

8TH INTERNATIONAL PARASITIC WEED SYMPOSIUM and 4TH INTERNATIONAL WEED SCIENCE CONGRESS – AN OVERVIEW OF CONTRIBUTIONS

These two meetings were held in tandem in Durban, South Africa, June 21-25, 2004. All the posters and many papers on parasitics were presented at parasitic plant sessions on the final day of the Weed Science Congress while further papers were presented at the specialised 8th International Symposium on the final day, and a few at earlier sessions of the main congress. A total of 69 papers and posters of relevance to parasitic plants were submitted to these two meetings, though not quite all these were personally presented. A full list is included under Meetings below.

The highlight was the keynote presentation by Danny Joel, which reviewed the current status of research, the problems remaining and in some cases still worsening, followed by discussion of the potential for new approaches based on advanced technologies. These might include manipulation of metabolic pathways, development of artificial resistance, parasite-specific herbicides, etc with the aims of developing new resistances, improving biological control agents and developing diagnostic tools to assist in precision parasitic weed management.

The persistent problems from *Striga* and its management were the subject of a major session, starting with a useful review by Joel Ransom, incidentally noting the potential for transplanting, followed by in-depth consideration of many aspects of genetic diversity, breeding, selection, etc. (Ejeta; Menkir; Ouédraogo; Haussmann; Rodenburg). Two papers related specifically to races of *S. gesnerioides* and efforts to map resistance genes (Botanga; Gowda). Among papers on management, several emphasised the value of integrating techniques involving inter-cropping, rotation with trap crops selected for high stimulant production, fertilization, etc (Gworgwor; Kamara, Emechebe; Franke) and the potential for modelling to assist decision-making (Westerman). In East Africa, the use of herbicide-treated seed of herbicide-tolerant maize continues to show promise (Kanampiu), while the use of green-manure crops is highly encouraging in Tanzania (Akulumuka). Two papers dealt with the possibilities of manipulating mycorrhiza (Gworgwor; Lenndzemo).

Papers on *Orobanche* included several on new and increasing problems in Australia (McLaren), and USA (Mallory-Smith; Westwood); some up-to-date consideration of virulence and resistance in the *O. cumana*/sunflowers relationship (Plakhine; Gidoni); imidazolinone use in herbicide-tolerant sunflower (Malidza); modelling to help decision making in control of *Orobanche* spp. (Grenz; Eizenberg); progress in the use of herbicides in tomato (Goldwasser; Lande); and the potential for enhancing resistance with the use of BTH (Müller-Stöver), salicylic acid (Buschmann) or perhaps with transgenically-induced sarcotoxin (Aly) or other novel approaches (Winston).

Biological control of parasitic weeds was reviewed by Joachim Sauerborn and a number of papers described the latest attempts to bring *Fusarium* species into practical use (Yonli), the most promising of these relating to treatment of crop seed with chlamydospores of *F. oxysporum* 'Foxy 2' (Abuelgasim) and combination with BTH treatment (Müller-Stöver). One paper suggested more consideration of *Smicronyx cyaneus* for control of *Orobanche* spp. (Zermane).

More basic work on *Striga* and *Orobanche* spp. included studies of the analysis and production of strigolactones (Yoneyama; Watanabe); influence of fluridone and plant growth regulators on the conditioning process (Chae); effect of nutrients on stimulant production (Song); distinction of *S. hermonthica* from *S. aspera* by SCAR markers (Verkleij); use of tissue culture in studies of *Orobanche* host specificity (Zhou).

Among the few papers on *Cuscuta* spp. was one describing the useful integration of herbicide use with varietal resistance to *C. campestris* in tomato (Lanini).

Papers on mistletoes included new observations on the endophyte of *V. album* (de Mol); on mineral uptake in *Scurrula elata* (Glatzel); on the involvement of jasmonic acid in nutation in *V. album* (Dorka); tissue culture of *Arceuthobium tsugense* (Shamoun); and on possibilities for biocontrol of *Arceuthobium* spp. (Shamoun).

A paper on *Osyris alba* in Jordan included new information on host range (Qasem), while there was useful new information on the germination biology of *Rhamphicarpa fistulosa* (Gbèhounou); on the floral biology of *Hydnora* spp. (Maass); and on host range in *Rhinanthus minor* (Cameron).

Chris Parker.

NEWS ABOUT CHRISTMAS MISTLETOE, *VISCUM ALBUM*, IN BRITAIN

Following the hugely popular national mistletoe survey in the 1990s (Briggs, 1999) *Viscum album* is enjoying a bit more attention in the UK - and not just at Christmas. Much of this is based on the belief that mistletoe is becoming scarce because of the decline of traditional apple orchards – the best-known host and habitat for *V. album* in Britain. The survey, conducted by the Botanical Society of the British Isles (BSBI) and Plantlife International, asked people to send in sightings of mistletoe, with details of host and habitat. The official period ran from 1994 to 1996 but records were still being submitted in 1998. Results were compared to a similar BSBI survey from 1970.

The survey results could not show a link with apple orchard decline because of the nature of the data – of variable quality and largely un-quantitative. Though general observations suggest that 'cultivated' mistletoe – i.e. mistletoe deliberately tolerated as a side crop on farmed fruit trees, might be in decline, the overall distribution data suggest that mistletoe in general is doing just fine. In fact a comparison of the 1970 and 1990s distribution maps suggest an increase in range – though this may be an artefact of increased recording effort in the 1990s.

Host patterns were consistent from 1970s to 1990s with apple heading the list followed by limes (*Tilia* spp.), hawthorn, poplars, maples, willows etc. Habitats, where recorded, confirmed an expected pattern headed by gardens and followed by orchards, parkland, roadside and hedgerow. An important observation here is that most *V. album* records in Britain are clearly from man-made habitats. This is especially true for records outside the species' main range in the SW Midlands – it is possible that all records east and north of this area have artificial origins.

The implications of any decline, real or imaginary, in 'cultivated' mistletoe are difficult to assess but Britain has always largely depended on imports from northern France for Christmas stocks. Perhaps we should be worrying more about harvestable supplies there – which, like Britain, are largely from the declining traditional apple orchards.

Despite the overall survey results much of the British public, informed by alarmist media coverage, now believe *V. album* to be endangered. This belief, reinforced by the species' natural scarcity in many parts of the country, is not a problem, as it helps deliver a general conservation and sustainability message through one of our best-loved (and, in Britain, harmless) native plants. The most common manifestation of this is the inclusion of mistletoe in local Biodiversity Action Plans (BAPs), especially in areas where mistletoe is genuinely scarce, though not necessarily endangered. Biodiversity Action Plans are not, of course, just for endangered species, and UK guidance at least suggests inclusion on the grounds of local character and cultural importance.

For example the Greater London BAP (London Biodiversity Partnership, 2001) includes *V. album* on the grounds of local rarity, cultural significance and ease of monitoring. The mistletoe plan in the London BAP (accessible via www.lbp.org.uk/03action_pages/ac22_mistletoe.html) includes provision to collate data on existing sites, seeks site protection, establishment of new sites and a review of *V. album* in other similar cities. This has provided an interesting opportunity to supplement the national survey with a detailed local study of populations and their origins. London has scattered records of mistletoe in gardens but also has larger historic colonies, centred on Bushy and Home Parks (near Hampton Court), and Myddelton House and Forty Hall (Enfield). The Hampton Court populations have a long history – known from at least the 1720s – but they are of obscure origin. The Enfield populations were established by, or at least encouraged by, E A Bowles (1864–1954), the plant breeder and garden writer, who lived at Myddelton House all his life.

This pattern and history have similarities with other European cities on the edge of the *V. album* range. A recent study in Brussels (Olivier, 1998) details long-established but isolated mistletoe populations in the city's cemeteries. A comparable study in Hamburg (Poppendieck and Petersen, 1999) describes several populations established in about 1903 which, though thriving, have only spread within a few hundred metres of their origin. Further north in Britain there are scattered garden records in Glasgow and Edinburgh – but long-established small colonies (known from the 19th century) in some districts. These include the Botanic Garden and the Dean Cemetery in Edinburgh (said to have been introduced by Victorian local botanist William Paxton) and the University Grounds in Glasgow. By encouraging the establishment of new colonies the London project follows in the tradition of these historic introductions. Similar initiatives are described for Hamburg by Poppendieck and Petersen. (This may seem odd behaviour to those more accustomed to dealing with the more pestilential mistletoe species!)

Other recent news on mistletoe in Britain relates to the animal associates of *V. album*. The blackcap (*Sylvia atricapilla*), mistletoe's main continental bird vector, does not usually overwinter in Britain, leaving berry distribution to the less efficient mistle thrush (*Turdus viscivorus*). But recent changes in blackcap behaviour have resulted in increasing numbers in the UK each winter – with possible significance for Britain's mistletoe. The British mistletoe insect fauna is also changing – or perhaps more correctly, being properly documented. Until the 1990s only four obligate associates of *V. album* were known in Britain – the lepidopteran *Celypha woodiana*, the homopteran, *Psylla visci* and the heteropterans *Anthocoris visci* and *Orthops viscicola*. Since then the National Trust's ecological survey team have recorded the mistletoe weevil *Ixapion variegatum* (Foster *et al,*. 2001) and most recently (2003) the team have recorded another bug *Hypseloecus visci* (newspaper reports Dec 2003). Both species are new to Britain but known on continental mistletoe – perhaps there are more to be found…

There is a review of many of these issues, and other aspects of *Viscum album*, in Briggs (2003). I would welcome any comments on the notes above – particularly on *V. album* distribution, possible future supply problems, isolated colonies in cities, reintroductions, and insect/bird associations.

Jonathan Briggs
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MEETINGS

8TH INTERNATIONAL PARASITIC WEED SYMPOSIUM and 4TH INTERNATIONAL WEED SCIENCE CONGRESS

The following list includes all the relevant papers presented at both meetings, and all the posters for which abstracts were provided. No Proceedings are to be published, but the abstracts of the 56 papers and posters that were personally presented on the final two days (marked * below) will be available on the IPPS web-site (http://www.ppws.vt.edu/IPPS/). Abstracts for the 4th IWSC, including most of the items without asterisks below will be available on http://www.olemiss.edu/orgs/iws/DEFAULT.HTM.

Abu-Irmaileh, B.E. and Abu-Rayyan, A.M. - Animal manure fermentation reduces *Orobanche* infestation on tomatoes.*

Akulumuka, V. *et al.* - Improving food security through *Striga* and soil fertility management in lowland maize: a participatory development process.

Al-Khateeb, W.M. *et al.* - Influence of salinity on the interaction between tomato and *Orobanche cernua.**

Aly, R *et al.* - A new approach to parasitic weed control based on inducible expression of sarcotoxin in transgenic plants

Benventi S. *et al.* - Germination ecology, emergence and early host parasitization of *Cuscuta campestris* Yuncker.*

Botanga, C.J. and Timko, M.P. - Genetic variability and host specialization in *Striga gesnerioides*.*

Buschmann, H. and Sauerborn, J. - Induced resistance: an effective method for the control of parasitic weeds?*

Cameron, D.D. *et al.* - Using the broad-spectrum hemi-parasitic angiosperm, *Rhinanthus minor*, as a tool to investigate compatible and incompatible host-parasite interactions.*

Chae, S.H. *et al.* - Fluridone promotes conditioning and germination of root parasitic weed seeds.*

Dayan, F.E. *et al.* - Biosynthesis of sorgoleone: retrobiosynthetic NMR, root hair specific EST, and biochemical analyses.

De Mol, M. and Heller, A. - Water relations and development of the European mistletoe *Viscum album* L.*

Dorka, R. *et al.* - Endogenous rhythms of nutational movement in *Viscum album* L. correlates with high level of jasmonic acid.*

Eizenberg, H. *et al.* - Growing degree days - a predicitve tool for *Orobanche* spp. parasitism in certain crops.*

Ejeta. G. and Rich, P.J. -Understanding key developmental processes in parasitic weeds.*

Elzein, A. - Pesta formulation and seed treatment technology: attractive delivery systems for *Striga* mycoherbicides - step towards practical field application.

Elzein, A. *et al.* - Seed treatment technology: an appropriate delivery system for controlling *Striga* spp. with *Fusarium oxysporum* Foxy 2.*

Emechebe, A.M. - Ways to manage *Striga* infestations without herbicides in West and Central Africa.*

Franke, A.C. *et al.*- On-farm testing of *Striga hermonthica* control technologies in the northern Guinea savanna.*

Gbehounou, G. and Assigbe, P. - A study of germination of seeds of *Rhamphicarpa fistulosa* (Hochst.) Benth. , a new pest of rice.*

Gidoni, D. *et al.* - Is host range potential related to genetic diversity in *Orobanche*?*

Glatzel, G. and Devkota, M. - Active vs passive mineral nutrient uptake in mistletoes – a still unresolved question.*

Goldwasser, Y. and Rubin, B. - Utilizing herbicide-resistant tomato to manage *Orobanche aegyptiaca.**

Gowda, B.S. *et al.* - Mapping and cloning of race-specific resistance genes to *Striga gesnerioides* and *Alectra vogelii* in cowpea.*

Grenz, J. *et al.* - Evaluating strategies to control the parasitic weed *Orobanche crenata* in faba bean – a simulation study using APSIM.*

Gworgwor, N.A. - Development of systems approach for ecological management of *Striga* in cereal-based cropping systems in northern Nigeria.*

Gworgwor, N.A. and Ndahi, W.B. - Parasitic weeds and their control/management in north-eastern Nigeria.

Gworgwor, N.A. and Weber, H.C. - The effect of arbuscular mycorrhiza (AM) fungi on the control/management of *Striga hermonthica* in sorghum.*

Haidar, M.A. *et al.* - Blue light induced changes in inositol 1,4,5-trisphosphate in dodder (*Cuscuta campestris*) seedlings.*

Haussmann, B.I.G. - Genetic variability of *Striga hermonthica* (review).*

Haussmann, B.I.G. *et al.* - Arresting the scourge of *Striga* sorghum in Africa by combining the strengths of marker-assisted backcrossing and farmer-participatory selection.*

Joel, D.M. - The parasitic weed problem and its fate in the 21st century.*

Kamara, A.Y. *et al.* - Cereal-legume rotation to control *Striga* and improve on-farm yield of maize in northern Guinea savanna of Nigeria: I. Effects of one-year rotation.*

Kanampiu, F.K. *et al.* - *Striga* weed control in maize using herbicide seed coating technology.*

Lande, T. *et al.* - *Orobanche aegyptiaca* control in processing tomato.*

Lanini,W.T. *et al.* - Management of *Cuscuta* in tomato with resistant varieties and herbicides.*

Lendzemo, V.W. *et al.* - Field inoculation with arbuscular mycorrhizal fungi reduces *Striga* performance on cereal crops and has the potential to increase cereal production.*

Maass, E. - Floral biology of *Hydnora.*

Malidza, G. - Control of *Orobanche cernua* in imidazolinone-tolerant sunflower hybrids.*

Mallory-Smith, C.A. *et al.* - Integrated management of *Orobanche minor* in *Trifolium pratense*.*

McLaren, D.A. *et al.* - Operation rapid response – dealing with the potential incursion of branched broomrape (*Orobanche ramosa* L.) into Victoria, Australia.

Menkir, A. *et al.* - Use of inbreeding as a tool to improve resistance to *Striga.**

Müller-Stöver, D. *et al.* - Enhancing the efficacy of a fungal biocontrol agent against *Orobanche cumana* through combination with a resistance-inducing chemical.*

Murdoch, A. and Dzomeku, I.K. - Linking laboratory and field studies of dormancy in *Striga hermonthica*: is delayed planting an option for integrated control?*

Nadler-Hassar, T. *et al.* - Natural tolerance of *Cuscuta* spp. to herbicides inhibiting amino acid biosynthesis*

Okazawa, A. *et al.* - Characterization of photoreceptors from *Orobanche minor* Sm.
Ouédraogo, O. *et al.* - Identification of resistance mechanisms of some sorghum varieties towards *Striga hermonthica*.*
Plakhine, D. *et al.* - Variation in the response of resistant sunflower to *Orobanche cumana* populations in Israel.*
Qasem, J.R. and Foy, C.L. - Host range of branched broomrape (*Orobanche ramosa* L.) among some cultivated and wild grown plant species.*
Qasem, J.R. - *Osyris alba* occurrence in Jordan: new hosts and importance.*
Ransom, J.K. *et al.* - New methodologies for the management of parasitic weeds.*
Rodenburg, J. *et al.* - Yielding ability, resistance and tolerance as independent selection criteria for breeding against *Striga*.*
Roman, B. *et al.* - Biodiversity in *Orobanche crenata* in the Mediterranean region - a review.*
Sauerborn, J. *et al.* - The role of biological control in managing parasitic weeds.
Shamoun, S. - Recent developments in biological control research for vegetation management in Canadian forests.
Shamoun, S. *et al.* - Advances in tissue culture of western hemlock dwarf mistletoe (*Arceuthobium tsugense* subsp. *tsugense*).*
Song, W.J. *et al.* - Changes in germination of *Orobanche* seeds in response to conditioning temperature and PGR treatments.*
Tesfamichael, N. *et al.* - Prospects and limitations for *Striga asiatica* control in sorghum/*Desmodium* intercrop.*
Tesfamichael, N. *et al.* - Sensitivity of sorghum varieties towards *Striga asiatica* as influenced by nitrogen, potassium and moisture regimes.
Verkleij, J. *et al.* - Analysis of genetic variability in the closely related species *Striga hermonthica* and *S. aspera* by RAPD and SCAR markers.*
Westerman, P.R. *et al.* - Density dependence in the *Striga*-host interaction and its consequences for *Striga* management.*
Westwood, J.H. and Fagg, C.M. - ISSR characterization of *Orobanche minor* populations in the U.S.*
Winston, E.M. *et al.* - Manipulating host defenses to enhance tobacco resistance to *Orobanche aegyptiaca*.*
Yoneyama, K. *et al.* - Effects of nutrients on the production of germination stimulants.*
Yoneyama, K. *et al.* - Determination and quantification of strigolactones.*
Yonli, D. *et al.* - Pathogenicity of *Fusarium* spp isolates and metabolites to *Striga hermonthica* in Burkina Faso.
Yonli, D. *et al.* - Effect of growth medium and method of application of *Fusarium oxysporum* on infestation of sorghum by *Striga hermonthica* in Burkina Faso.
Zermane, N. - *Smicronyx cyaneus* Gyll. (Coleoptera: Curculionidae): a neglected natural enemy of the parasitic weed *Orobanche*.
Zhou Wei-jun. *et al.* - Callus production of parasitic weed *Orobanche* and its novel aseptic infection on host roots.*
Zygier, L. and Rubin, B. - EPSP-synthase presence and activity in Egyptian broomrape (*Orobanche aegyptiaca* Pers.).*

NON-WEEDY HEMIPARASITIC SCROPHULARIACEAE (OROBANCHACEAE)

A two-day symposium on the non-weedy hemiparasitic (ex-)Scrophulariaceae (Orobanchaceae) was held in Wageningen, 15-16 April 2004. It was attended by about 40 participants from Europe and USA. Andrea Wolfe's stimulating talk on the evolution and taxonomy of the Orobanchaceae was followed by about 30 oral and poster presentations on a wide range of aspects of the biology of this group of hemiparasites, as listed below.

Full proceedings will not be published. However, several papers will be submitted for a special volume of Folia Geobotanica that is planned to be published early 2005. A limited number of copies of the booklet with abstracts of oral and poster presentations are still available. The texts can also be forwarded by email. Those interested in receiving either the booklet or the electronic text may send an email to siny.terborg@wur.nl.

1. Oral presentations
1.1. Taxonomy & Evolution:
Andrea Wolfe (Ohio, USA) - Phylogeny and biogeography of Orobanchaceae.
Robert Mill (Edinburgh, UK) - A new arboreal epiphytic *Pedicularis* from Nepal: an introduction to its taxonomy and morphology.
Mikael Lönn (Huddinge, SE) - Local and regional differentiation in *Euphrasia*.
Veronique Ducarme (Louvain, B) - Origin and evolution of natural hybridization in the genus *Rhinanthus.*
Per Larsson (Arvika, SE) - Morphologic and genetic variation of *Rhinanthus serotinus* or *angustifolius*, in western Sweden.
1.2. Ecophysiology and Mechanisms:

Malcolm Press (Sheffield, UK) - Ecophysiological characteristics of root hemiparasitic angiosperms: consequences for ecosystems structure-function relations.

John Yoder (Davis, USA) - Genetic mechanisms of host plant recognition.

Wendy Seel (Aberdeen, UK) - Mechanisms underpinning the effects of *Rhinanthus minor* on its host.

Wolfram Hartung, W.D. Jeschke & Fan Yiang (Wuerzburg, D) – Long distance transport within the hemiparasitic association *Rhinanthus minor/Hordeum vulgare.*

Duncan Cameron (Aberdeen, UK) - How does an understanding of parasite nutrition help us to understand the variable effect of *Rhinanthus minor* at the community level?

1.3. Population Ecology:

Diethart Matthies (Marburg, D) - The ecology of hemiparasite-host interactions.

Päivi Lehtonen (Turku, FIN) - Trophic interactions among host plant, endophytic fungus, hemiparasitic plant and its herbivore.

Leonid Rasran (Kiel, D) - Effects of seed limitation and disturbance on the hemiparasitic fen grassland species *Rhinanthus angustifolius* and *Pedicularis palustris*.

Sarah Dalrymple (Aberdeen, UK) - Population ecology of British Small Cow-wheat (*Melampyrum sylvaticum*).

Dorothy Allard (Bakersfield, USA) - An ecological study of *Pedicularis dendrothauma* R. R. Mill and D. J. Allard, sp. nov.

Brita Svensson (Uppsala, SE) - The hemiparasitic plant: friend or foe?

Siny ter Borg (Wageningen, NL) - Dormancy and germination of *Rhinanthus* spp in relation to the local climate; a comparative study.

1.4. Community & Restoration Ecology:

Manja Kwak (Groningen, NL) - Hemiparasitic Scrophulariaceae: plants with special reproductive traits in common.

James Bullock (Dorchester, UK) - *Rhinanthus minor:* a tool for restoration of species rich grasslands.

Duncan Westbury (Reading, UK) - The use of *Rhinanthus minor* to increase forb abundance in newly established meadows on ex-arable land.

2. Posters

Riitta Ahonen (Oulu, FIN) - Are there genetic constraints in utilization of host species and autotrophic performance of *Rhinanthus serotinus*?

Els Ameloot (Leuven, B) - Community structure in a chronosequence of restored semi-natural grasslands and the facilitating role of *Rhinanthus* species.

Duncan Cameron (Aberdeen, UK) - Host resistance to the grassland hemi-parasite, *Rhinanthus minor* and its role in determining community composition.

Susan Dalrymple (Aberdeen, UK) - Identifying factors affecting the survival of *Melampyrum sylvaticum.*

Fan Jiang (Wuerzburg, D) – The haustoria of the host/*Rhinanthus serotinus* association.

Christine Krebs (Marburg, D) - The influence of different hosts on the hemiparasites *Rhinanthus minor* and *R. alecorolophus.*

Tom van Mourik (Wageningen, NL) - Ecological approach to an agronomical pest (*Striga hermonthica*), limitations to a parasites' reproductive output.

Milan Štech (Ceske Budejovice, Tsj) - Morphometric and RAPD study of *Melampyrum sylvaticum* group in the Sudeten, Alpen and Carpathian mountains.

Milan Štech (Ceske Budejovice, Tsj) - Seasonal variation in *Melampyrum pratense* – a morphological point of view.

Zhongkui Sun (Wageningen, NL) - Isolation and characterisation of key-genes in the formation of germination stimulants of the parasitic weeds *Striga* and *Orobanche.*

Jerôme Vrancken (Louvain, B) - Phylogeography of the genus *Rhinanthus* in Europe.

COST 849 - PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

This programme, funded by European Union via European Science Foundation, has been able to arrange an increased number of meetings in 2004. Those already completed are noted below. Several more are scheduled. Abstracts and/or reports of most of these meetings are available on the COST849 web-site (http://cost849.ba.cnr.it/) or will be added in due course.

Genetic diversity of parasitic plants held in Cordoba, Spain, 19-21 February. The following is a list of the papers presented and discussed:

Jury, S.L. and Rumsey, F.J. - A new system for *Orobanche* taxonomy in Europe.

Schneeweiss, G.M. - Taxonomy and phylogeny in *Orobanche.*

García, M.A. - Taxonomy and systematics of *Cuscuta* L. (Convolvulaceae).

Domina, G. - *Orobanche canescens* C. Presl in Sicily. Distribution and taxonomic notes.
Carlón, L. *et al.* - Taxonomic, chorological and iconographical contributions to the knowledge of genus *Orobanche* (Orobanchaceae) in the north of the Iberian Peninsula.
Cagáň, Ľ. and Tóth, P. - Distribution of broomrapes (*Orobanche* sp.) in Slovakia.
Wegmann, K. - Ecology and epidemiology of *Orobanche ramosa* in Europe.
Plakhine, D. *et al.* - A new race of *Orobanche cumana* in Israel.
Joita-Pacureanu1. *et al.* - Races of broomrape in Romania.
Molinero, L. and Melero-Vara, J.M. - Highly virulent populations of sunflower broomrape (*Orobanche cumana*).
Batchvarova, R.B. *et al.* - Morphological and genetic diversity of broomrapes in Bulgaria.
Streibig, J.C. - Response of *Striga hermonthica* biotypes to sorghum exudates.
Lyra D. *et al.* - Seed germination study in *Orobanche* populations infesting tobacco plants in Greece.
Lyra D. *et al.* - Abiotic factors affecting the infestation in tobacco crops from *Orobanche* in Greece.
Simier, Ph. *et al.* - Aggressiveness and pectinolytic activities within populations of *Orobanche cumana* Wallr. a root parasite of sunflower.
Nickrent, D.L. - Molecular evolution and phylogeny of parasitic plants.
Letousey, P. *et al.* - Parasitism and evolution of the plastid genome.
Joel, D.M. *et al.* - Genetic diversity of *Orobanche* species and host range potential.
Haussmann, B.I.G. - Genetic variability of *Striga* (review)
Román, B. *et al.* - Molecular markers for diagnosis and genetic diversity studies in *Orobanche.*
Satovic1, Z. *et al.*- Overcoming limitations of dominant marker data: population structure of the parasitic plant *Cistanche phelypaea* inferred from RAPD markers
Curto, M. *et al.* - Two-dimensional gel electrophoresis as a tool to identify and characterize the protein profile of *Orobanche* spp. seeds.

Biological control held in Rome, 27-28 February, 2004. Papers presented and discussed included the following:

Vibeke Leth - Enhancement of pathogens using proper formulations.
Joachin Sauerborn - Integrating biocontrol and induced resistance for parasitic weed management.
Jonathan Gressel - Transgenic synergies for biocontrol.
Joseph Hershenhorn - The efficacy of a mixture of fungi to control Egyptian and sunflower broomrape.
Maurizio Vurro - Synergistic use of phytopathogenic fungi and fungal metabolites.
Angela Boari - Natural compounds for alternative strategies of parasitic plant management.
Ludovit Cagan - Differences in synergistic use of biocontrol agents on *Orobanche* and *Cuscuta*.
Peter Toth - Potential of wild parasitic weed species as a source of biocontrol agents.
Paul C. Quimby Jr. - Sucrose: an osmotic agent for harvesting/stabilizing microbial biocontrol agents.
David C. Sands - Recent progress in development of synergistic components for biocontrol of weeds.
Elzein Abuelgasin - Enhancing *Striga*-mycoherbicide's efficacy though seed treatment delivery system: step towards practical field application.
Nadjie Zermane - Attempts to combine the non pathogenic *Fusarium oxysporum* Tn01 with Rhizobacteria to control the root parasitic weed *O. crenata*.

Herbicide testing for control of broomrape held in Nicosia, Cypress, 13-15 May, 2004. Papers presented and discussed included the following:

Vibeke Leth - Enhancement of pathogens using proper formulations.
Joachin Sauerborn - Integrating biocontrol and induced resistance for parasitic weed management.
Jonathan Gressel - Transgenic synergies for biocontrol.
Joseph Hershenhorn - The efficacy of a mixture of fungi to control Egyptian and sunflower broomrape.
Maurizio Vurro - Synergistic use of phytopathogenic fungi and fungal metabolites.
Angela Boari - Natural compounds for alternative strategies of parasitic plant management.
Ludovit Cagan - Differences in synergistic use of biocontrol agents on *Orobanche* and *Cuscuta*.
Peter Toth - Potential of wild parasitic weed species as a source of biocontrol agents.
Paul C. Quimby Jr. - Sucrose: an osmotic agent for harvesting/stabilizing microbial biocontrol agents.

David C. Sands - Recent progress in development of synergistic components for biocontrol of weeds.
Elzein Abuelgasin - Enhancing *Striga*-mycoherbicide's efficacy though seed treatment delivery system: step towards practical field application.
Nadjie Zermane - Attempts to combine the non pathogenic *Fusarium oxysporum* Tn01 with Rhizobacteria to control the root parasitic weed *O. crenata*.

Genetic diversity of broomrape held in Palermo, Sicily, 27-29 May, 2004. Papers presented and discussed included the following:

Schneeweiss, G.M. Taxonomy and phylogeny in *Orobanche*.
Lira, S. *Orobanche* populations infesting tobacco plants in Greece.
Economou, G. Ecology of broomrape.
Joel, D.M. Molecular markers in *Orobanche* research.
Angel, M. Genetic diversity in *Orobanche crenata.*

Fernández-Aparicio, M. Taxonomy in *Orobanche.*
Cagan, L. Distribution of *Orobanche* in Slovakia.

Broomrape management - a joint Working Groups and Management Committee meeting held in Nitra, Slovakia, 15-17 July 2004. Papers presented and discussed were:

1. WG1 Knowledge in broomrape biology relevant to its control:
D. Cameron, D. - Compatible and incompatible interactions in root parasites.
Maldonado, A. - A proteomic approach to study plant – parasitic plant interaction.
González, C - Cloning and analysis of a peroxidase gene expressed during early infection stages *Orobanche ramosa.*
Bowmeester, H. - Biosynthesis of broomrape germination stimulants.
Cagáň, L. and Tóth, P. - Time of emergence and flowering of *Orobanche* species in Slovakia. 2. WG2 Biological control:
Dor, E. - Perspectives for biological control with fungi.
Strange, R. - New biological agents for *O. crenata* control.
Vurro, M. - Perspectives for biological control with aminoacids.
Watson, A. - New perspectives for parasitic plant management.
3. WG3. Resistance breeding:
Pérez-de-Luque, A. - Mechanisms of resistance in legumes.
Satovic, Z. - Mapping QTL for broomrape resistance in grain legumes.
Thalouarn, P. - Arabidopsis as a model for early host-*Orobanche* interaction.
Denev, I. - Use of activation tag mutants of *Arabidopsis* to identify key genes regulating early steps of plant interactions with broomrapes (*Orobanche* spp.).
4. WG4 Integrated control
Rubin, R. - Response of *Cuscuta* and *Orobanche* to herbicides inhibiting amino acid biosynthesis.
Eizenberg, H. - New approaches in chemical control of *Orobanche*.
Goldwasser, Y. - *O. aegyptiaca* control in glyphosate resistant tomato.
Jacobson, R. - Broomrape control in carrot.
van Ast, A. - Delaying the moment of infection by *Striga hermonthica*: an option to improve sorghum yield under *Striga*-infested conditions?
Riches, C.R. - Using legumes to improve the productivity of *Striga* infested land.

THESES

Venasius W. Lendzemo (PhD, Wageningen University, The Netherlands, June 2004)
The tripartite interaction between sorghum, *Striga hermonthica*, and arbuscular mycorrhizal fungi.

The witchweed *Striga hermonthica* is a major biological constraint to cereal production in Africa. The intricate association between this phytoparasite and the cereal host makes management difficult. Damage to the host begins before *Striga* comes out of the soil. Also, infestation correlates negatively with soil fertility. Arbuscular mycorrrhizal (AM) fungi have a variety of ecological functions ranging from improved uptake of immobile nutrients, protection of host from pathogens, to soil aggregation. The question whether these beneficial micro-organisms could play a role within the *Striga*-cereal (patho)system was addressed. Inoculating *Striga*-infested sorghum with AM fungi in pots or in the field resulted in a significant reduction in the performance of *Striga* in terms of numbers attached to the roots, relative time of emergence, numbers emerged and dry weight of *Striga* shoots at sorghum harvest. AM effects on *Striga* were more pronounced with the *Striga*-tolerant S-35 sorghum cultivar compared to effects with the *Striga*-sensitive CK60B. Inoculation with AM fungi compensated for damage by *Striga* in the S-35 cultivar. This compensation was independent of AM inoculum density and was not affected by P application. Germination of preconditioned *Striga* seeds after exposure to root exudates from sorghum colonized by AM fungi was significantly reduced, with effects more prominent with exudates from S-35 plants. AM fungi have the potential to affect *Striga* during germination, attachment, emergence, and possibly subsequent growth and development. It is important to understand the kind of management practices that farmers can apply to enhance mycorrhizal performance in an integrated management system.

Abuelgasim Elzein (PhD, University of Hohenheim)
Development of a granular mycoherbicidal formulation of *Fusarium oxysporum* Foxy 2 for the biological control of *Striga hermonthica* (Del.) Benth. (Supervision: Prof. Dr. Jürgen Kroschel, Institute of Plant Production and Agroecology in the Tropics and Subtropics)

Developing a formulation of microbial weed control agents is essential for their storage, ease of application and protection against environmental constraints. *Fusarium oxysporum* Foxy 2 is a fungal antagonist of *Striga hermonthica*, a root parasite of cereal crops that constitutes a major biotic constraint to food production in the Sahelian and the Savannah zones of Africa. The principal objective of this study was to develop a granular formulation of Foxy 2, in order to ease its application and to reduce the amount of inoculum required for adequate infection in the field to a practicable level. Foxy 2 was able to control both *S. hermonthica and S. asiatica*. All tested non-target plant species were immune, none developed any symptoms of infection when inoculated with Foxy 2. The ability of Foxy 2 to control more than one *Striga* species provides an opportunity to control both parasites simultaneously in those regions where they are co-existing (e.g. Tanzania and Kenya). This advantage together with the non-susceptibility of a wide range of non-target test plant species (other closely related species to the target weed *S. hermonthica*, some selected Poaceous crops, crop species reported to be highly susceptible to *Fusarium* diseases in tropical and subtropical regions, as well as economically important cultivated crops) to the fungus, should encourage the regulatory authorities to accept and introduce the antagonist for field testing.

A range of agricultural by-products were tested as substrates for the production of spores, especially chlamydospores, of Foxy 2 in liquid culture. These included maize straw, cotton seed cake, wheat and triticale stillage (the spent fermentation broth of ethanol production). Abundant chlamydospores and microconidia (and very few macroconidia) were produced in all types of substrates tested. The use of agricultural by-products, which are inexpensive and readily available in the areas where *Striga* is a major problem, is attractive for the economic feasibility of the Pesta formulation.

The efficacy of different granular formulations of Foxy 2 including sodium alginate pellets; vermiculite; and Pesta granules were compared with the fungal inoculum propagated on wheat grains. Application of 2 g of formulated Pesta granules per pot (4 kg of soil) provided the same promising level of efficacy of *Striga* control as was achieved when 40 g of inoculum propagated on wheat grains were used. Such enormous reduction (95%) in the amount of fungal inoculum as a result of adopting Pesta formulation technology could offer a significant economical practical possibility for large-scale application.

The 85-100% shelf-life of Pesta granules made with chlamydospore-rich biomass for at least one year at 4ºC is adequate for commercialization. Moreover, the stability of dried chlamydospores inoculum entrapped into Pesta granules during the first six months (100-51%) of storage at room temperature is sufficient for storage, handling and delivery under realistic conditions. Such kind of knowledge has significant applications to better understanding of the conditions for optimizing and prolonging shelf-life of biocontrol products, specially of Pesta formulations.

In conclusion, the results of the present study demonstrate the safety of non-target test plant species and suitability and economic feasibility of Pesta technology for formulating Foxy 2. The promising levels of *Striga* control and of the substantial increase in sorghum yield obtained with Pesta granules containing fresh chlamydospores inoclum of Foxy 2 under glasshouse conditions justify a further development of Pesta granules for field testing. The preparation of Pesta as free-flowing granules enable them to be applied using existing agricultural equipment, and to be easily integrated with existing *Striga* control methods e.g. cultural, mechanical and use of resistant varieties. Additional advantages of Pesta formulation are: non-toxic; relatively cost effective; can be produced on a large scale; convenient to store; and simple to use. These promising results of Pesta granular formulation and seed treatment might contribute significantly to the development of an effective integrated *Striga*-control approach adoptable and acceptable to subsistence farmers.

The thesis is published within the Book Series Tropical Agriculture (12), - Advance in Crop Research (2). The book can be ordered directly from Margraf Publisher: www.margraf-verlag.de, under ISBN 3-8236-1405-3, ISSN 0932-3074.

BOOKS

Broomrape in Israel (in Hebrew) by Goldwasser, Y., Kleifeld, Y. and Golan, S. 2003. Published by The Extension Service, Israel Ministry of Agriculture, P.O. Box 28, Bet Dagan, Israel. This 37 page booklet includes 17 colour photos and summarizes 30 years of *Orobanche* control research. The booklet is intended for students, extension, researchers, farmers, nature lovers and anyone interested in these fascinating plants and those who have to combat them in the field. The chapters are: 1.Historical background. 2. Biology. 3. *Orobanche* species, description and host range. 4. Infestation and damage according to regions. 5. Control. 6. Why is *Orobanche* difficult to control ? 7. Bibliography (117 references). The authors would welcome any suggestions for sources of funding for the publication of an English version.

Weed Biology and Management edited by Inderjit, 2004. Published by Kluwer Academic Publishers, Dordrecht, Germany. 553 pp.

Living up to its all-encompassing title, 'Weed Biology and Management' offers a compilation of 25 chapters that touch on nearly every aspect of weed science. Chapter topics range from weed evolution, to herbicide fate, to control strategies for specific crops. Of course, Inderjit's affection for allelopathy and weed ecology is well represented, and the emphasis of the book is toward the biology of weeds and agricultural systems. With such a diversity of topics presented, anyone with an interest in weeds is sure to find at least a few chapters of interest. This is equally true for those interested in parasitic plants, because three chapters address the parasitic weeds *Orobanche* and *Striga*. A brief summary of these chapters follows:

'Molecular aspects of host-parasite interactions: opportunities for engineering resistance to parasitic weeds.' James Westwood (pp. 177-198) examines the life cycles of *Orobanche* and *Striga* (and to some extent *Triphysaria*) from the molecular point of view. Starting with germination signaling and continuing through parasite growth and nutrient acquisition, the contribution of molecular approaches to understanding parasitism is integrated into a brief description of our knowledge of the host-parasite interactions. For each stage, there is discussion (or speculation!) of the potential for genetic engineering to enhance host resistance to parasitism.

'Biological control of root parasitic weeds with plant pathogens.' Jürgen Kroschel, and Dorette Müller-Stöver (pp. 423-438) cover the rapidly expanding body of literature on biological control of *Striga* and *Orobanche* species. After a brief consideration of insects, the review concentrates on fungi (primarily of the genus *Fusarium*) that have shown promise in lab and greenhouse studies. Aspects of biological control ranging from target specificity and efficacy to application strategies are covered.

'Recent approaches to *Orobanche* management: a review.' Yaakov Goldwasser and Yeshaiahu Kleifeld (pp. 439-466) concisely review all the methods used to control *Orobanche*, including prevention, cultural practices, chemicals, biological agents, resistant cultivars, and many more. Specific emphasis is given to chemical control, but biological control and resistant cultivars also receive significant attention. This topic covers a vast amount of literature, and is difficult to address in-depth in a single chapter, but the advantages and limitations of each approach are clearly presented. This chapter is likely to be cited frequently as it provides a recent summary of the challenges, practices, and limitations in controlling *Orobanche*.

One minor complaint about the book is that some topics may already be somewhat out of date. Despite the 2004 publication, the chapters were written in 2001 or early 2002, so reviews of rapidly advancing fields do not include the most recent literature. However, this does not substantially diminish the value of the volume.

James Westwood.

South African Parasitic Plants by Johann Visser. 1981. Published by Juta, South Africa. Readers may be interested to know that this beautifully illustrated and informative book is still available from: The Bookshop, National Botanical Institute, Private Bag X101 Pretoria 0001, South Africa (email: bookshop@nbi.ac.za). The price is US$15 plus

$14.50 for packing and postage by surface mail. There is an order form on the web-site (www.nbi.ac.za).

GENERAL WEB SITES

For individual web-site papers and reports see LITERATURE

For information on the International Parasitic Plant Society, past and current issues of Hustorium, etc. see: http://www.ppws.vt.edu/IPPS/

For past and current issues of Haustorium see also: http://web.odu.edu/haustorium

For the ODU parasite site see: http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rmrs.nau.edu/misteltoe/welcome.html

For on-line access to USDA Forest Service Agriculture Handbook 709 'Dwarf Mistletoes: Biology, Pathology and Systematics' see: http://www.rmrs.nau.edu/publications/ah_709/

For information on activities and publications of the parasitic weed group at the University of Hohenheim see: http://www.uni-hohenheim.de/~www380/parasite/start.htm

For information on, and to subscribe to, PpDigest see: http://omnisterra.com/mailman/listinfo/pp_omnisterra.com

For information on the EU COST 849 Project and reports of its meetings see: http://cost849.ba.cnr.it/

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' the address is: http://www.omnisterra.com/bot/pp_home.cgi

For a description and other information about the *Desmodium* technique for *Striga* suppression, see: http://www.push-pull.net

For information on EC-funded project 'Improved *Striga* control in maize and sorghum (ISCIMAS) see: http://www.plant.dlo.nl/projects/Striga/

For brief articles on *Striga* in New Agriculturist on-line see: http://www.new-agri.co.uk/04-1/focuson/focuson5.html

LITERATURE

* indicates web-site reference only

Abouzeid, M.A., Boari, A., Zonno, M.C., Vurro, M. and Evidente, A. 2004. Toxicity profiles of potential biocontrol agents of *Orobanche ramosa*. Weed Science 52: 326-332. (Tests with 53 strains of 15 mainly *Fusarium* spp. showed 9 to be highly virulent against *O. ramosa*. Virulence was not necessarily correlated with production of fusaric or dehydrofusaric acids, or with toxicity to brine shrimps.)

Adhikari, D., Arunachalam, A., Majumder, M., Sarmah, R. and Khan, M.L. 2003. A rare root parasitic plant (*Sapria himalayana* Griffith.) in Namdapha National Park, northeastern India. Current Science 85: 1668-1669. (Describing *Tetrastigma bracteolatum* and *T. serrulatum* the hosts plants of the holoparasitic *S. himalayana* (Rafflesiaceae).)

Aizen, M.A. 2003. Influences of animal pollination and seed dispersal on winter flowering in a temperate mistletoe. Ecology 84: 2613-2627. (It appears that winter flowering in *Tristerix corymbosus* is associated with optimal fruit dispersal by the marsupial *Dromiciops australis* in summer.)

Aliyu, L., Lagoke, S.T.O., Carsky, R.J., Kling, J., Omotayo, O. and Shebayan, J.Y. 2004. Technical and economic evaluation of some *Striga* control packages in maize in the Nigerian Guinea Savanna. Crop Protection 23: 65-69. (Describing a range of integrated control options involving tolerant maize varieties, N fertilizer, and pre- and post-emergence herbicide.)

Amuchástegui, A., Petryna, L., Cantero, J.J. and Núñez, C. 2003. (Parasitic flowering plants of central Argentina.) (in Spanish) Acta Botanica Malacitana 28: 37-46. (Eight taxa belonging to 5 families and 8 genera are reported, but not listed in the abstract.)

Anon 2003. New resistant cultivars. Zashchita i Karantin Rasteniĭ11: 42-44. (Including information on a range of sunflower varieties released in 2002, and their resistance to *Orobanche.*)

Arda, N., Önay, E , Koz, Ö. and Kirmizigül, S. 2003. Monosaccharides and polyols from mistletoes (*Viscum album* L.) growing on two different host species. Biologia (Bratislava) 58: 1037-1041. (Sugar contents varied according to the subspecies of *V. album*, glucose and galactose being much higher in ssp. *abietis* on *Pinus nigra*, while mannose, arabinose, xylitol and inositol tended to be higher in ssp. *album* on *Tilia tomentosa*.)

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Avdeyev, Y.I., Scherbinin, B.M., Ivanova, L.M. and Avdeyev, A.Y. 2003. Studying of tomato resistance to broomrape and breeding varieties for processing. In: Bieche, B. and Branthome, X. (eds.) Acta Horticulturae 613: 283-290. (Including results of screening tomato for resistance to *Orobanche aegyptiaca* and *O. cernua*.)

Aymerich, P. 2003. (Floristic data of the upper Segre and Llobregat basins.) (in Catalan) Acta Botanica Barcinonensia 48: 15-28. (Noting new sites for *Arceuthobium oxycedri* in the Spanish Pyrenees.)

Barkman, T.J., Emoi, B.E. and Repin, R. 2003. The genus *Balanophora* (Balanophoraceae) in Sabah, Malaysia. Blumea 48: 465-474. (Providing descriptions, illustrations and a key to 5 species of *Balanophora* occurring on Borneo.)

Barkman, T.J., Lim, S.H , Kamarudin Mat Salleh and Jamili Nais. 2004. Mitochondrial DNA sequences reveal the photosynthetic relatives of *Rafflesia*, the world's largest flower. Proceedings of the National Academy of Sciences of the United States of America 101: 787-792. (Proposing relationship of *Rafflesia* with Malpighiales, and of *Mitrastemma* (Mitrastemmaceae) with Ericales.)

Berg, S., Krupinska, K. and Krause, K. 2003. Plastids of three *Cuscuta* species differing in plastid coding capacity have a common parasite-specific RNA composition. Planta 218: 135-142. (Although *C. odorata*, *C. gronovii*, and *C. reflexa* reflect a spectrum of reduction in chloroplast genes, all three accumulate approximately equivalent RNA levels.)

Bérubé, C. 2004. FarmServe Africa. Farmer to Farmer Volunteer report. http://www3.telus.net/conrad/index (Report, including photographs, of a 6-week visit to Ghana, promoting benefits of IPM, including legume intercropping, for control of *Striga hermonthica*.)

Botanga, C.J., Alabi, S.O., Echekwu, C.A. and Lagoke, S.T.O. 2003. Genetics of suicidal germination of *Striga hermonthica* (Del.) Benth by cotton. Crop Science 43: 483-488. (A range of cotton genotypes showed a range of germination stimulant activity, which proved to be controlled by a single dominant gene for high stimulant production.)

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Brand, J.E., Robinson, N. and Archibald, R.D. 2003. Establishment and growth of sandalwood (*Santalum spicatum*) in south-western Australia: *Acacia* host trials. Australian Forestry 66: 294-299. (*S. spicatum* sown next to 1-year old hosts grew better on *A. saligna* (53 mm stem diameter after 3 years) than on *A. acuminata* (33 mm), *A. microbotrya* (20 mm) or *A. hemiteles* (11 mm).)

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Braun, J.M., Blackwell, C.C., Weir, D.M. and Beuth, J. 2003. Cytokine release of whole blood from adult female donors challenged with mistletoe lectin-1 standardised mistletoe extract and *E. coli* endotoxin or phytohaemagglutinin (PHA). Anticancer Research 23: 1349-1352.

Bungard, R.A. 2004. Photosynthetic evolution in parasitic plants: insight from the chloroplast genome. BioEssays 26: 235-247. (A review of the evolution of the chloroplast genomes of parasitic plants, with consideration of genes that seem to be lost rapidly (chlororespiratory ndh genes) or retained beyond obvious usefulness (rubisco rbcL).)

Buschmann, H. 2004. (Hemp death, tobacco strangler - and soon a threat for rape? The parasitic weed *Orobanche ramosa* is gaining ground.) (in German) Gesunde Pflanzen 56: 39-47. (Referring to the serious infestation of rape-seed by *O. ramosa* in western France, while hemp, tomato and tobacco are the main hosts in central Europe.)

Carranza González, E. 2002. (Flora of Bajio and adjacent regions. Family Rafflesiaceae.) (in Spanish) Flora del Bajío y de Regiones Adyacentes 107: 13 pp. (Four genera of Rafflesiaceae occur in Mexico. The genera *Bdallophytum* and the species *B. americanum* and *Pilostyles thurberi* are described.)

Chae SangHeon , Yoneyama, K., Takeuchi, Y. and Joel, D.M. 2004. Fluridone and norflurazon, carotenoid-biosynthesis inhibitors, promote seed conditioning and germination of the holoparasite *Orobanche minor*. Physiologia Plantarum 120: 328-337. (Fluridone and norflurazon mimicked GA in enhancing conditioning of *O. minor* seed but apparently by some mechanism other than inhibiting ABA biosynthesis.)

Chiu, S.B. and Shen Hao. 2004. Growth studies of *Cuscuta* spp. (dodder parasitic plant) on *Mikania micrantha* and *Asystasia intrusa*. The Planter (Kuala Lumpur) 88(934): 31-36. (In experiments in Malaysia and in W. Kalimantan, Indonesia, artificial establishment of *C. campestris* from seed or stems showed a low rate of establishment but successful control of both target species when establishment succeeded. Establishment of a second, non-flowering species, perhaps *C. reflexa,* was more reliable and also led to good control of *M. micrantha*.)

Corazzi, G. 2003. Taxonomic notes and distribution of *Orobanche* L. (Orobanchaceae) in Latium (Central Italy). Webbia 58: 411-439. (Providing a revised dichotomous key for the 19 taxa now found in this district.)

Coulon, A., Mosbah, A., Lopez, A., Sautereau, A.M., Schaller, G., Urech, K., Rougé, P. and Darbon, H. 2003. Comparative membrane interaction study of viscotoxins A3, A2 and B from mistletoe (*Viscum album*) and connections with their structures. Biochemical Journal 374: 71-78. (NMR determination of the 3D structures of viscotoxins A2 and B help to explain their lesser activity compared with A3.)

Csiky, J., Baráth, K. and Lájer, K. 2004. *Cuscuta* species in Hungary. Zeitschrift für Pflanzenkrankheit und Pflanzenschutz 19: 201-208. (Eight *Cuscuta* spp. have been recorded, though *C. epilinum* is now thought to be extinct. *C. campestris, C. epithymum* and *C. europaea* affected crops in the past and are still the commonest, but are no longer damaging. Other spp. include *C. kotschyi* in dry grassland, *C. lupuliformis* (becoming rare) in flood plains, *C. australis* in sedge vegetation, and *C. approximata* only recently found in oak woodland. A total of 2500 host species are recorded.)

Denirchi, F., Baser, K.H.C. 2004. The volatiles of fresh-cut *Osyris alba* L. flowers. Flavour and Fragrance Journal 19(1): 72-73. (Identifying 13 hexyl and hexenyl compounds contributing to flower fragrance in *O. alba.*)

Denwar, N.N. and Ofori, K. 2003. Variation in trap-crop capacity of soybean genotypes for the control of *Striga hermonthica*. International Journal of Agriculture and Biology 5: 504-506. (Production of germination stimulant varied widely among 60 varieties of soybean tested, but was not apparently correlated with any of the agronomic traits studied.)

Eizenberg, H., Hershenhorn, J., Graph, S. and Manor, H. 2003. *Orobanche aegyptiaca* control in tomato with sulfonylurea herbicides. In: Bieche, B. and Branthome, X. (eds.) Acta Horticulturae 613: 205-208. (Successful control achieved with post-emergence rimsulfuron or sulfosulfuron followed by sprinkler irrigation, and then by repeated chlorsulfuron via drip irrigation.)

Eizenberg, H., Plakhine, D., Hershenhorn, J., Kleifeld, Y. and Rubin, B. 2004. Variation in responses of sunflower cultivars to the parasitic weed broomrape. Plant Disease 88: 479-484. (*O. cernua* germinated but failed to develop on sunflower. Resistance of var. Ambar to *O. cumana, O. ramosa* and *O. aegyptiaca* is also manifested during tubercle development.)

Ekbote, S.D., Kachapur, M.R. and Chattannavar, S.N. 2003. Niger - new host of dodder. Journal of Mycology and Plant Pathology 33(1): 149. (Reporting *Cuscuta* sp. on *Guizotia abyssinica* in Karnataka, India.)

Elzein, A. and Kroschel, J. 2003. Progress on management of parasitic weeds. FAO Plant Production and Protection Paper No.120(Add.1): 109-143. (A general review of control measures for *Striga* and *Orobanche* spp.)

Elzein, A., Kroschel, J. and Müller-Stöver, D. 2004. Effects of inoculum type and propagule concentration on shelf life of Pesta formulations containing *Fusarium oxysporum* Foxy 2, a potential mycoherbicide agent for *Striga* spp. Biological Control 30: 203-211. (Among a range of formulations, Pesta formulation with chlamydospores proved most promising.)

Emechebe, A.M., Ellis-Jones, J., Schulz, S., Chikoye, D., Douthwaite, B., Kureh, I., Tarawali, G., Hussaini, M.A., Kormawa, P. and Sanni, A. 2004. Farmers' perception of the *Striga* problem and its control in Northern Nigeria. Experimental Agriculture 40: 215-232. (A wide survey of farmers revealed attitudes to the *Striga* problem and its control and concluded that a legume-cereal rotation was the most highly-rated control option.)

Encheva, J., Christov, M., Nenov, N., Tsvetkova, F., Ivanov, P., Shindrova, P. and Encheva, V. 2003. Developing genetic variability in sunflower (*Helianthus annuus* L.) by combined use of hybridization with gamma radiation or ultrasound. Helia 26:99-108. (Use of embryo culture, gamma radiation and ultrasound helped to accelerate the development of useful genetic traits, including 100% resistance to *Orobanche cumana* in lines R114 and R116.)

Escher, P., Eiblmeier, M., Hetzger, I. and Rennenberg, H. 2004. Seasonal and spatial variation of carbohydrates in mistletoes (*Viscum album*) and the xylem sap of its hosts (*Populus x euamericana* and *Abies alba*). Physiologia Plantarum 120: 212-219. (Levels of soluble carbohydrate in *V. album* largely reflected those of its host, more-or-less uniform year-round on *A. alba* while showing a peak in spring, on *P. x euamericana.*)

Fernández-Martínez, J., Pérez-Vich, B., Akhtouch, B., Velasco, L., Muñoz-Ruz, J., Melero-Vara, J.M. and Domínguez, J. 2004. Registration of four sunflower germplasm resistant to race F of broomrape. Crop Science 44: 1033-1034. (Vars K-96, R-96, P-96 and L-86 released in Spain in 2001.)

Fracchiolla, M. and Boari, A. 2003. (Effect of the infestation of *Orobanche ramosa* on tomato and cauliflower yield.) (in Italian) Informatore Fitopatologico 53(2): 52-53. (Recording yield losses of 6-20 t/ha in the two crops in Italy.)

Galal, A.A. 2003. Bacterial wilt disease of broomrape, *Orobanche* spp., in Egypt. Assiut Journal of Agricultural Sciences 34: 163-176. (Studies on *Pseudomonas syringae* pv. *orobanchia* suggest it has some potential as a biocontrol agent.)

Gbèhounou, G., Adango, E., Hinvi, J.C. and Nonfon, R. 2004. Sowing date or transplanting as components for integrated *Striga hermonthica* control in grain-cereal crops? Crop Protection 23: 379-386. (The causes of reduced *Striga* infestation with delayed sowing are discussed without conclusive explanation. Yields of maize and sorghum were not improved by delayed sowing, but transplanting from a *Striga*-free nursery may prove beneficial.)

Giudici, A.M., Regente, M.C., Villalain, J., Pfüller, K., Pfüller, U. and de la Canal, L. 2004. Mistletoe viscotoxins induce membrane permeabilization and spore death in phytopathogenic fungi. Physiologia Plantarum 121: 27. (Viscotoxins VtA_3 and VtB completely inhibited germination of spores of *Fusarium solani* and *Sclerotinia sclerotiorum* at 10μM and 50% inhibition of growth occurred at 1.5 to 3.75 μM.)

Goldwasser, Y. and Kleifeld, Y. 2004. Recent approaches to *Orobanche* management: a review. In: Inderjit (ed.) Weed Biology and Management. Dortmund, Germany: Kluwer, pp. 439-466. (see Book review above.)

Gressel, J. and Amsellem, Z. 2003. Transgenic mycoherbicides for effective and economic weed control. In: Proceedings, Crop Science and Technology 2003, BCPC International Congress, Glasgow, 2003, pp. 61-68. (Suggests that biological control organisms will need to have their virulence increased to be effective. Engineering fungi to overproduce auxin or toxins enhances pathogenicity.)

Gressel, J., Hanafi, A., Head, G., Marasas, W., Obilana, A.B., Ochanda, J., Souissi, T. and Tzotzos, G. 2004. Major heretofore intractable biotic constraints to African food security that may be amenable to novel biotechnological solutions. Crop Protection 23: 661-698. (A useful review of biotic constraints affecting African farmers, including new estimates of the extent and seriousness of problems from both *Striga* and *Orobanche* spp. and discussion of available control methods)

Gurney, A.L., Grimanelli, D., Kanampiu, F., Hoisington, D., Scholes, J. D. and Press, M.C. 2003.Novel sources of resistance to *Striga hermonthica* in *Tripsacum dactyloides*, a wild relative of maize. New Phytologist 160: 557-568. (Results suggest that *T. dactyloides* produces a signal that inhibits haustorial development and is mobile in the parasite, so preventing further attachments to a susceptible maize root.)

Gworgwor, N.A. and Weber, H.C. 2003. Arbuscular mycorrhizal fungi-parasite-host interaction for the control of *Striga hermonthica* (Del.) Benth. in sorghum (*Sorghum bicolor* (L.) Moench.). Mycorrhiza 13: 277-281. (Among 5 *Glomus* spp. tested in pots, *G. mosseae* reduced emergence of *S. hermonthica* by 60% and increased sorghum weight by 30%.)

Hellström, K.. Rautio, P., Huhta, A.P. and Tuomi, J. 2004. Tolerance of an annual hemiparasite, *Euphrasia stricta* agg., to simulated grazing in relation to the host environment. Flora (Jena) 199: 247-255. (Removing the top 10% of *E. stricta* had no detrimental effect and could even be beneficial in some mowing/grazing situations, but removing 50% was fatal.)

Hess, D.E. and Dodo, H. 2004. Potential for sesame to contribute to integrated control of *Striga hermonthica* in the West African Sahel. Crop Protection 23: 515-522. (Rotation with sesamum reduces the *Striga* problem in pearl millet, but soil fertility and water conservation also need to be addressed.)

Ho JiauChing, Chen ChiuMing and Row LieChing. 2004. Neolignans from the parasitic plants. Part 2. *Cassytha filiformis*. Journal of the Chinese Chemical Society 51(1): 221-223. (*C.filiformis*, parasitic on *Ipomoea imperati* or *Imperata cylindrica* is known as a folk medicine in Taiwan and used for the treatment of kidney diseases.)

Huber, R., Klein, R., Berg, P.A., Lüdtke, R. and Werner, M. 2002. Effects of a lectin- and a viscotoxin-rich mistletoe preparation on clinical and hematologic parameters: a placebo-controlled evaluation in healthy subjects. Journal of Alternative and Complementary Medicine 8: 857-866. (Comparing the effects of the lectin-rich Iscador Qu and the lectin-poor but viscotoxin-rich Iscador Pini mistletoe preparations on clinical and haematologic parameters in healthy subjects.)

Huguet, B., Guéry, B., Moinard, J. and Pillon, O. 2004. (Protein crops - 2000/2003 plant health review: cold snap for some, heat wave for others.) (in French) Phytoma 567: 26-29. (*Orobanche ramosa* mentioned as a weed of rapeseed.)

Hwang SukYeon, Yang EunYoung, Yeo JeongHoon, Jin JiYoung, Kim HyunSung, Park WonBong and Suh JungJin. 2003. Anti-tumor effect of Korean mistletoe extract intensified with mistletoe lectin against melanoma cells in vitro and in vivo. Korean Journal of Pharmacognosy 34: 218-222.

Idžojtic, M., Pernar, R., Kauzlaric, Ž., Abramovic, M., Jankovic, D. and Pleše, M. 2003. (Intensity of infestation of silver fir (*Abies alba* Mill.) with mistletoe (*Viscum album* L. ssp. *abietis* (Wiesb.) Abrom.) on the area of the Forest Administration Delnice.) (in Croatian) Šumarski List 127: 545-559. (Results of a survey.)

Inderjit (ed.) 2004. Weed Biology and Management. Dordrecht, Germany: Kluwer Academic Publishers,. 553 pp. (Containing several chapters relating to parasitic plants – see Book review above.)

IWSC. 2004. Weed Science Serving Humanity. Abstracts of the 4th International Weed Science Congress, June 20-24, 2004, Durban, Southe Africa. IWSC/South African Weed Science Society, 128 pp. (Including abstracts of many papers and posters -on parasitic plants. See under Meetings above.)

Jain, S.H., Angadi, V.G., Shankaranarayana, K.H. and Ravikumar, G. 2003. Relationship between girth and percentage of oil in trees of sandal (*Santalum album* L.) provenances. Sandalwood Research Newsletter 18: 4-5. (In a survey of *S. album* trees in S. India, oil content was found to increase from about 1.5-2.5% at 40 cm girth to about 4% at 80cm girth with little increase beyond this stage.)

Kanampiu, F.K., Friesen, D. and Gressel, J. 2002. CIMMYT collaborative efforts unveils herbicide-coated maize seed technology to curb problematic *Striga.* Integrated Pest Management Reviews 7,(1): 63-64. (A further review of this successful technology.)

Kaplan, A. 2003. Leaf anatomy and morphology of 14 species belonging to the Turkish Rhinantheae (Scrophulariaceae) tribe. Israel Journal of Plant Sciences 51: 297-304. (Studies of leaf anatomy in 14 species of 11 genera showed striking variation.)

Kataria, O.P. , Chauhan, D.R. and Balyan, R.S. 2003. Effect of herbicides on weeds and seed yield of tobacco (*Nicotiana tobacum* L.). Indian Journal of Weed Science 35(1/2): 151-152. (Weeds included *Orobanche aegyptiaca*.)

Kim MyungSunny, Lee Jienny, Lee KangMin, Yang SeiHoon, Choi Sujinna, Chung

SangYoung, Kim TaeYoung, Jeong WonHun and Park Raeki. 2003. Involvement of hydrogen peroxide in mistletoe lectin-II-induced apoptosis of myeloleukemic U937 cells. Life Sciences 73: 1231-1243. (Korean mistletoe lectin II promotes strong induction of H_2O_2 in tumor cells, leading to cell death.)

Koch, A.M., Binder, C., Sanders, I.R. 2004. Does the generalist parasitic plant *Cuscuta campestris* selectively forage in heterogeneous plant communities? New Phytologist 162: 147-155. (There was no evidence for direct benefits of a mixed host diet. *Cuscuta campestris* foraged by parasitising the most rewarding hosts the fastest and then investing the most on them.)

Korol'kova, E.O. 2002. Comparative stem anatomy of *Cistanche* (Orobanchaceae) representatives: systematics problems. Moscow University Biological Sciences Bulletin 57(3): 31-39. (Noting the absence of glandualr hairs on the stems of *Cistanche* compared with *Orobanche*. And suggesting arrangement of local species into a different grouping than that proposed by Beck.)

Kroschel, J. and Elzein, A. 2004. Bioherbicidal effect of fumonisin B1, a phytotoxic metabolite naturally produced by *Fusarium nygamai*, on parasitic weeds of the genus *Striga*. Biocontrol Science and Technology 14: 117-128. (Fuminosin B1 at 1 mg/l caused some reduction in germination. Much higher concentrations were toxic when applied to foliage.)

Kroschel, J. and Muller-Stover, D. 2004. Biological control of parasitic weeds. In: Inderjit (ed.) Weed Biology and Management. Dortmund, Germany: Kluwer, pp. 423-438. (See Book review above.)

Kureh, I., Hussaini, M.A., Chikoye, D., Emechebe, A.M., Kormawa, P., Schulz, S., Tarawali, G., Franke, A.C. and Ellis-Jones, J. 2003. Promoting integrated *Striga* management practices in maize in northern Nigeria. In: Proceedings, Crop Science and Technology 2003, BCPC International Congress, Glasgow, 2003, pp. 1023-1028. (Describing the development of an integrated programme for control of *Striga hermonthica*, based on a tolerant maize variety, N fertilizer, and intercropping with soybean.)

Kutafin, A.I. 2003. Control of foci of quarantine weeds. Zashchita i Karantin Rasteniĭ12: 10-11. (Including reference to *Cuscuta* spp.)

Kuyper, T.W. 2002. (Deceit in mycorrhiza world, or how the mycorrhizal fungus proved to be a cheat. (in Dutch) Coolia 45(4): 205-207. (Reviewing literature on the triangular relationship between the parasitic plant *Monotropa hypopitys*, the ectomycorrhizal genus *Tricholoma* and the tree host, whereby *M. hypopitys* obtains its nutrients from the fungus and its sugars from the tree via the fungus.)

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Labrousse, P., Arnaud, M.C., Griveau, Y., Fer, A. and Thalouarn, P. 2004. Analysis of resistance criteria of sunflower recombined inbred lines against *Orobanche cumana* Wallr. Crop Protection 23: 407-413. (Suggesting several different resistance mechanisms available from crosses of *Helianthus annuus* with the resistant wild species *H. debilis*.)

Liu Hui and Yuan ShiBin 2003. Biological characteristics of *Glomerella cingulata* (Penz.) Sacc. f.sp. *cuscutae* Chang. Journal of Sichuan Agricultural University 21(1): 23-26. (*G. cingulata*, the active ingredient of Lubao No. 1, used for biocontrol of *Cuscuta chinensis*, is shown to be stimulated by extracts of the *Cuscuta*.)

Lundquist, J.E., Goheen, E.M. and Goheen, D. J. 2002. Measuring positive, negative, and null impacts of forest disturbances: a case study using dwarf mistletoe on Douglas fir. Environmental Management 30: 793-800. (Describing a model which indicates positive, negative, and neutral impacts from *Arceuthobium douglasii* on douglas fir.)

Lynch, A.M. 2004. Fate and characteristics of *Picea* damaged by *Elatobium abietinum* (Walker) (Homoptera: Aphididae) in the White Mountains of Arizona. Western North American Naturalist 64(1): 7-17. (Mortality of *Picea pungens* and *P. microcarpum* from *E. abietinum* was enhanced by infestation with *Arceuthobium microcarpum.*)

Ma YongQing 2003. Allelopathy research in mainland China. Allelopathy Journal 12(2): 163-178. (Including a report of allelopathic effects of *Pedicularis longiflora*.)

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Maloy, O.C. and Lang, K.J. 2003. Carl Freiherr von Tubeuf: pioneer in biological control of plant diseases. Annual Review of Phytopathology 41: 41-52. (Noting von Tubeuf's interest in the mistletoes.)

Marley, P.S., Aba, D.A., Shebayan, J.A.Y., Musa, R. and Sanni, A. 2004. Integrated management of *Striga hermonthica* in sorghum using a mycoherbicide and host plant resistance in the Nigerian Sudano-Sahelian savanna. Weed Research 44: 157-162. (Emergence of *S. hermonthica* was reduced by 95% and sorghum yields increased 50% by a combination of a mycoherbicide based on *Fusarium oxysporum* isolate PSM 197, applied in the planting hole, and use of sorghum variety Samsorg 40 (ICSV 111).)

Marley, P.S., Toure, A., Shebayan, J.A.Y., Aba, D.A., Toure, A.O., Diallo, A.G. and Katilé, S.O. 2004. Variability in host plant resistance of sorghum to *Striga hermonthica* infestation in West Africa. Archives of Phytopathology and Plant Protection 37: 29-34. (As a result of field trials in Nigeria and Mali, the varieties MALISOR 84-1, SAMSORG 41, 97-SB-F5DT-64, 97-SB-F5DT-65, CMDT 39 and SAMSORT 14 are proposed for wider evaluation.)

Mathiasen, R., Haefeli, M. and Leatherman, D. 2003. First report of *Arceuthobium vaginatum* subsp. *cryptopodum* on *Pinus mugo*. Plant Disease 87: 1395. (In Colorado, USA.).

Mathiasen, R.L., Melgar, J., Beatty, J.S., Parks, C.G., Nickrent, D.L., Sesnie, S., Daugherty, C.M., Howell, B.E. and Garnett, G.N. New distributions and hosts for mistletoes parasitizing pines in Southern Mexico and Central America. Madroño 50(2): 115-121. (Miscellaneous observations on distribution and hosts ranges of *Psittacanthus, Struthanthus* and *Arceuthobium* spp.)

Matsubara, S., Morosinotto, T., Bassi, R. , Christian, A.L., Fischer-Schliebs, E., Lüttge, U., Orthen, B., Franco, A.C., Scarano, F.R., Förster, B., Pogson, B.J. and Osmond, C.B. 2003. Occurrence of the lutein-epoxide cycle in mistletoes of the Loranthaceae and Viscaceae. Planta 217: 868-879.

Matthes, M., Napier, J.A., Pickett, J.A. and Woodcock, C.M. 2003. New chemical signals in plant protection against herbivores and weeds. In: Proceedings, Crop Science and Technology 2003, BCPC International Congress, Glasgow, 2003, pp. 1227-1236. (Referring to the use of *Desmodium uncinatum* in control of *Striga hermonthica*.)

Mbwaga, A. 2004. Rice is greener on the other side. Annual Report for 2003-2004. Crop protection Programme. Department for International Development. Aylesford, UK: Natural Resources International Ltd. p. 1.25. (Describing successful use of rotation with '*Crotalaria* sp.' (*C. ochroleuca*) or pigeon pea as a green manure, for improving soil fertility and controlling *Striga asiatica* in rice. Rice yields have been increased four-fold.)

Mercadé, A. 2003. (Notes on the flora of Moianès (Catalonia, Spain).) (in Catalan) 2003. Acta Botanica Barcinonensia 48: 29-44. (Including notes on *Odontites lanceolata* spp. *olotensis.*)

Meyer, L. 2004. Montana - forest insect and disease conditions and program highlights - 2003. Forest Health Protection Report - Northern Region, USDA Forest Service, 2004, No. 04-1, 53 pp. (Including reports on *Arceuthobium* infestation.)

Miller, A.C., Watling, J.R., Overton, I.C. and Sinclair, R. 2003. Does water status of *Eucalyptus largiflorens* (Myrtaceae) affect infection by the mistletoe *Amyema miquelii* (Loranthaceae)? Functional Plant Biology 30: 1239-1247. (Concluding that increasing water and/or salinity stress make *E. largiflorens* a less suitable host for *A. miqelii.*)

Mishra, J.S., Manish Bhan, Moorthy, B.T.S. and Yaduraju, N.T. 2003. Influence of seeding depth on emergence of *Cuscuta* with linseed and summer blackgram. Indian Journal of Weed Science 35: 281-282. (Most emergence of *C. ?campestris* was from the surface and 2 and 4 cm depths. None occurred from below 8 cm depth.)

Mishra, V., Sharma, R.S., Yadav, S., Babu, C.R. and Singh, T.P. 2004. Purification and characterization of four isoforms of Himalayan mistletoe ribosome-inactivating protein from *Viscum album* having unique sugar affinity. Archives of Biochemistry and Biophysics 423: 288-301.

Moorthy, B.T.S., Mishra, J.S. and Dubey, R.P. 2003. Certain investigations on the parasitic weed *Cuscuta* in field crops. Indian Journal of Weed Science 35: 214-216. (Mung bean, niger seed, lentil and chickpea were highly susceptible to *C. ?campestris*; linseed and pea were less susceptible; and wheat, Indian mustard and *Phaseolus* beans were unaffected.)

Muir, J.A., Robinson, D.C.E. and Geils, B.W. 2003. Characterizing the effects of dwarf mistletoe and other diseases for sustainable forest management. BC Journal of Ecosystems and Management 3(2): 88-94. (The effects of *Arceuthobium tsugense* on western hemlock are being manipulated and modelled to clarify the potential for reducing damage via a range of management options.)

Murphy, M. and Garkalis, M. 2003. Hopping into a bright future – the woylie sandalwood story. Western Wildlife 7(3), July 2003 and reproduced in Sandalwood Research Newsletter 18: 6-7. (Confirming the role of the marsupial rat-kangaroo *Bettongia pencillata* in dispersing the seeds of *Santalum spicatum* in Western Australia.)

Nagaveni, H.C. and Vijayalakshmi, G. 2003. Growth performance of sandal (*Santalum album* L.) with different host species. Sandalwood Research Newsletter 18: 1-4. (In pot and field comparisons of 9 potential hosts, *Pongamia pinnata* and *Caasuarina equisetifolia* supported most robust growth of *S. album* while *Aacacia auriculiformis* and *Sweitenia mahogani* hindered growth.)

Nickrent, D.L., Garcia, M.A., Martin, M.P. and Mathiasen, R.L. 2004. A phylogeny of all species of *Arceuthobium* (Viscaceae) using nuclear and chloroplast DNA sequences. American Journal of Botany 91: 125-138. (A revised classification of the genus based on molecular data.)

Noetzli, K.P., Müller, B. and Sieber, T.N. 2003. Impact of population dynamics of white mistletoe (*Viscum album* ssp. *abietis*) on European silver fir (*Abies alba*). Annals of Forest Science 60: 773-779. (Growth of 70-year old *A. alba* had apparently been seriously reduced by infestation of *V. album* since 1983.)

Odebiyi, J.A., Bada, S.O., Omoloye, A.A., Awodoyin, R.O. and Oni, P. 2004. I. Vertebrate and insect pests and hemi-parasitic plants of *Parkia biglobosa* and *Vitellaria paradoxa* in Nigeria. In: Teklehaimanot, Z. (ed.) Agroforestry parkland systems in sub-Saharan Africa. Selected papers from an international workshop held in Ouagadougou, Burkina Faso, 13-16 January 2003. Agroforestry Systems 60(1): 51-59. (*Tapinanthus globiferus* and *T. dodoneifolius* are both of concern. Pruning affected branches had not proved an effective control method.)

*O'Driscoll, C.W. 2003. Preliminary review of the genus *Cuscuta* in North America prepared for the NAPPO PRA panel – July/August 2003. North American Plant Protection Organization. http://www.nappo.org/PRA-sheets/CuscutaTable2003.pdf (Listing about 80 species occurring in N. America, with brief notes on their characteristics and host range and their distribution within USA, Canada and Mexico.)

Okonta, J.M. , Ezugwu, C.O. and Nwodo, J. N. 2003. Blood sugar lowering effect of *Viscum album* seed extract in rabbits. Journal of Tropical Medicinal Plants 4(1): 39-41.

Oswald, A. and Ransom, J.K. 2004. Response of maize varieties to *Striga* infestation. Crop Protection 23: 89-94. (Field screening suggests some useful degrees of tolerance or resistance, among medium-term maize varieties in western Kenya.)

Pérez-de-Luque, A., Jorrín, J.V. and Rubiales, D. 2004. Crenate broomrape control in pea by foliar application of benzothiadiazole (BTH). Phytoparasitica 32: 21-29. (Foliar application of BTH reduced infection of pea by *O. crenata*, reducing attachment and slowing development.)

Piotrowski, A., Ochocka, J.R., Stefanowicz, J. and Luczkiewicz, M. 2003. Molecular genetic survey of European mistletoe (*Viscum album*) subspecies with allele-specific and dCAPS type markers specific for chloroplast and nuclear DNA sequences. Planta Medica 69: 939-944. (Of 118 plants surveyed, 103 displayed characteristics consistent with strict host specificity of the subspecies. No evidence was found for hybridization among subspecies.).

Pryme, I.F., Bardocz, S., Pusztai, A., Ewen, S.W. and Pfüller, U. 2004. A mistletoe lectin (ML-1)-containing diet reduces the viability of a murine non-Hodgkin lymphoma tumor. Cancer Detection and Prevention 28: 52-56.

Punz, W. 2001. (Heavy metal accumulating and hyperaccumulating plants on mining areas in the Eastern Alps.) (in German) Verhandlungen der Zoologisch-Botanischen Gesellschaft in Österreich 138: 129-136. (*Euphrasia* is among a number of genera found to accumulate more than 1000 ppm zinc.)

Puustinen, S., Koskela, T. and Mutikainen, P. 2004. Direct and ecological costs of resistance and tolerance in the stinging nettle. Oecologia 139: 76-82. (An expansion of previous work (see Mutikainen, P. and Koskela, T. 2002 in Haustorium 44) and concluding that there were no significant correlations among resistance and tolerance of *Urtica dioica* to different natural enemies (i.e. *Cuscuta europaea*, snails, and mammals).

Quested, H.M., Cornelissen, J.H.C., Press, M.C., Callaghan, T.V., Aerts, R., Trosien, F., Riemann, P., Gwynn-Jones, D., Kondratchuk, A. and Jonasson, S.E. 2003. Decomposition of sub-arctic plants with differing nitrogen economies: a functional role for hemiparasites. Ecology: 84: 3209-3221. (Concluding that production of nutrient rich, rapidly decomposing litter by *Bartsia apina*, *Pedicularis lapponica, P. hirsuta*, *P. sceptrum-carolinum*, *Rhinanthus minor,* *Euphrasia frigida* and *Melampyrum silvaticum* has the potential to greatly enhance the availability of nutrients within patches where they are abundant, with possible consequent effects on small-scale biodiversity (cf. Quested *et al.*, 2003 in Haustorium 44)).

Rassoulzadeh , S., Saneii, S.M. and Asgarii, M.A. 2003. Selective control of dodder (*Cuscuta monogina* L.) parasitizing pomegranate trees (*Punica granatum* L.). In: Lee JungMyung and Zhang DongLin (eds.) Asian plants with unique horticultural potential: genetic resources, cultural practices and utilization. Proceedings of the XXVI International Horticultural Congress, Toronto, Canada, 11-17 August 2002. Acta Horticulturae 620: 215-219. (Reporting successful trials with diluted glyphosate for control of *C. monogyna* on pomegranate.)

Rodríguez-Conde, M.F., Moreno, M.T., Cubero, J.I. and Rubiales, D. 2004. Characterization of the *Orobanche-Medicago truncatula* association for studying early stages of the parasite-host interaction. Weed Research (Oxford) 44: 218-223. (*M. trunculata* shows variation in its stimulation of, and susceptibility to, *Orobanche* spp., making it a potentially useful model plant for studies on host/parasite interactions.)

Ross, K.C., Colquhoun, J.B. and Mallory-Smith, C.A. 2004. Small broomrape (*Orobanche minor*) germination and early development in response to plant species. Weed Science 52: 260-266. (*O. minor* from a red clover host was tested on a wide range of crop and weed species in polyethylene bags and in the field. Several other *Trifolium* spp., and lucerne/alfalfa were susceptible hosts in both situations; many other species stimulated germination only in the bags. Among these *Vicia sativa* did not support development in polyethythene bags but was attacked in the field.)

Rubiales, D. 2003. Parasitic plants, wild relatives and the nature of resistance. New Phytologist 160: 459-461. (A review, highlighting the resistance of *Tripsacum dactyloides* to *Striga hermonthuca*.)

Rubiales, D., Alcántara, C. and Sillero, J.C. 2004. Variation in resistance to *Orobanche crenata* in species of *Cicer*. Weed Research 44: 27-32. (A high degree of resistance to *O. crenata* was shown in many of the 99 accessions tested, belonging to 11 species of *Cicer* (curiously excluding *C. arietinum*). Resistance was based largely on low stimulant exudation, but also included some apparent hyper-sensitive response.)

Sallé, G. and Frochot, H. 2002. (The forestry problems caused by muérdago (*Viscum album*) and potential methods of control.) (in Spanish) Chapter 7 in: Lopez Saez, J.A. and Catalan, P. (eds) Plantas parasitas de la peninsula iberica y Baleares, Spain: Mundi-Prensa. pp. 477-499.

Sallé, G. and Neumann, U. 2003. (Angiosperm parasites: biology and control methods) (in French) In: Lepoivre, P. (ed.) Phytopathologie. Bases moléculaire et biologiques des pathosystèmes et fondeme de lutte. Traité de phytopathologie végétale. Gembloux, Belgium : de Boeck and Les Presses Agronomiques de Gembloux, pp. 145-159.

Samaké, O. 2003. Integrated crop management strategies in Sahelian land use systems to improve agricultural productivity and sustainability: a case study in Mali. Tropical Resource Management Papers 47, 132 pp. (Reporting trials with cowpea intercropping or rotation, and phosphate fertilizer among strategies to improve millet yields in the presence of severe *Striga hermonthica* infestations.)

Sánchez Gómez, P., Carrión Vilches, M.Á., Hernández González, A., Vera Pérez, J.B. and López Espinosa, J.A. 2003. (Chorological and nomenclatural notes about vascular flora of SE Spain.) (in Spanish) Anales de Biología 25: 109-112. (Including a first record of *Odontites luteus* in Albacete province.)

Sandler, H.A., Shumaker, D.E. and Mason, J. 2003. Compost recipe development and weed seed viability evaluation with cranberry leaves. Compost Science & Utilization 11: 351-360. (Composted cranberry leaves reached temperatures sufficient to kill weed seeds including those of *Cuscuta*.)

Sanginga, N., Dashiell, K.E., Diels, J., Vanlauwe, B., Lyasse, O., Carsky, R.J., Tarawali, S., Asafo-Adjei, B., Menkir, A., Schulz, S., Singh, B.B., Chikoye, D., Keatinge, D. and Ortiz, R. 2003. Sustainable resource management coupled to resilient germplasm to provide new intensive cereal-grain-legume-livestock systems in the dry savanna. In: Lyasse, O., Sanginga, N., Vanlauwe, B., Diels, J. and Merckx, R. (eds.) Agriculture, Ecosystems & Environment 100(2/3): 305-314. (Claiming promising potential for an integrated livestock/cropping system in *Striga hermonthica*-infested land, involving rotations of maize and ‘promiscuous’ (high-nodulating) soybean, with finger millet and dual-purpose cowpeas.)

Satô, M. 2004. (The first record of *Orobanche coerulescens* from Rishiri Island, northern Hokkaido.) (in Japanese) Rishiri Studies 23: 3,5.

Schneeweiss, G.M., Colwell, A., Park JeongMi, Jang ChangGee and Stuessy, T.F. 2004. Phylogeny of holoparasitic *Orobanche* (Orobanchaceae) inferred from nuclear ITS sequences. Molecular Phylogenetics and Evolution 30: 465-478. (Concluding that *Orobanche* is not monophyletic, but falls into two lineages: (1) the *Orobanche* group comprises *Orobanche* sect. *Orobanche* and the genus *Diphelypaea*; (2) the *Phelipanche* group contains *Orobanche* sects. *Gymnocaulis, Myzorrhiza,* and *Trionychon*.)

Schneeweiss, G.M., Palomeque, T., Colwell, A.E. and Weiss-Schneeweiss, H. 2004. Chromosome numbers and karyotype evolution in holoparasitic *Orobanche* (Orobanchaceae) and related genera. American Journal of Botany 91: 439-448. (Concluding that chromosome number has evolved by polyploidisation from two ancestral base numbers, 5 and 6 to x = 20 in *Cistanche*, to x = 12 or 24 in *Orobanche* (sections *Gymnocaulis, Myorrhiza* and *Trionychon*) and, after dysploidisation, to x = 19 in *Orobanche* (section *Orobanche*) and *Diphelypaea*.)

Showemimo, F.A. and Alabi, S.O. 2004. Influence of cotton plant population in the control of *Striga hermonthica* in maize under greenhouse condition. Journal of Food, Agriculture & Environment 2: 281-284. (In a pot experiment, cotton variety TAMCOT-CAMD-E proved superior to 3 other varieties in suppressing *S. hermonthica*. and improving maize growth)

Snyder, A.M., Clark, B.M., Robert, B., Ruban, A.V. and Bungard, R.A. 2004. Carotenoid specificity of light-harvesting complex II binding sites: occurrence of 9-cis-violaxanthin in the neoxanthin-binding site in the parasitic angiosperm *Cuscuta reflexa.* Journal of Biological Chemistry 279: 5162-5168. (*C. reflexa* has a unique carotenoid composition, in which the novel compound 9-cis-violaxanthin replaces neoxanthin, which is found in all other higher plant species studied to date.)

Ssango, F. and Balitenda, M. 2003. Effect of application of witch weed control options on performance of two maize varieties in Uganda. Muarik Bulletin 6: 83-88. (Recording profitable effects of integrating urea fertilizer, dicamba, and mechanical weeding for control of *Striga (?hermonthica)*. Sunflower as a trap crop did not appear to be effective.)

Stein, G.M., Bussing, A. and Schietzel, M. 2002. Activation of dendritic cells by an aqueous mistletoe extract and mistletoe lectin-3 in vitro. Anticancer Research.22 (1A): 267-274.

Strange, R. 2003. Introduction to Plant Pathology. London, UK: John Wiley & Sons, Ltd. 464 pp. (A text book with comprehensive coverage of plant disease, including a section on parasitic plants.)

Sweetapple, P.J. 2003. Possum (*Trichosurus vulpecula*) diet in a mast and non-mast seed year in a New Zealand *Nothofagus* forest. New Zealand Journal of Ecology 27: 157-167. (Noting that mistletoes *Peroxilla tetrapetala* and *Alepis flavida* are preferred foods of the possum but are only ever available in small quantities.)

Tănase, M., Bobes, I. and Moldovan, I. 1998. Contributions to the study of *Cuscuta* varieties from Sibiu county. Notulae Botanicae, Horti Agrobotanici, Cluj-Napoca 28: 7-10. (Describing *Cuscuta* spp. and their hosts in Romania.)

Tănase, M., Neata, L. and Barbu, H. 2000. (Some aspects concerning the germination of *Cuscuta* seed.) (in Romanian) Lucrai Stiintifice - Agricultura, Universitatea de Stiinte Agricole si Medicina Veterinara a Banatului Timisoara 32(1): 403-406.

Tei, F., Montemurro, P., Baumann, D.T., Dobrzanski, A., Giovinazzo, R., Kleifeld, Y., Rocha, F., Rzozi, S.B., Sanseovic, T., Simončič, A. and Zaragoza, C. 2003. Weeds and weed management in processing tomato. In: Bieche, B., Branthome, X. (eds.) Acta Horticulturae 613: 111-121. (Increasing problems in tomato include *Orobanche* spp. in Spain, Portugal, Morocco, Israel and Italy, while *Cuscuta campestris* is a problem in Spain and Israel.)

Thomas, P.A. and Polwart, A. 2003. *Taxus baccata* L. Journal of Ecology (Oxford) Vol.91: .489-524. (Including reference to occurrence of plant parasites in U.K. – presumably *Viscum album*.)

Tomilov, A., Tomilova, N. and Yoder, J.I. 2004. *In vitro* haustorium development in roots and root cultures of the hemiparasitic plant *Triphysaria versicolor*. Plant Cell, Tissue and Organ Culture 77: 257-265. (Concluding that root cultures should provide useful material for molecular studies of haustorium development.)

Tsopelas, P. and Angelopoulos, A. 2003. Incidence of root diseases in the fir forest of Mount Parnis National Park, Greece. In: Laflamme, G., Bérubé, J.A. and Bussières, G. (eds.) Information Report - Laurentian Forestry Centre, Quebec Region, Canadian Forest Service, 2003, No. LAU-X-126, pp. 408-412.

(*Viscum album* described as an 'important factor' in tree mortality of *Abies cephalonica*.)

Tugnoli, V. 2003. (Costs and benefits of weed control in sugarbeet.) (in Italian) Informatore Agrario 59(49) 57-60. (Referring to '*Cuscuta*' as a major weed of sugar beet.)

Udod, A.N. 2003. Systematic work is needed. Zashchita i Karantin Rasteniĭ11: 36. (Noting the infestation of over 40,000 ha with the quarantine weeds *Cuscuta* spp. in Rostov region.)

Vitek, E. 2002. (Comments to the revised edition of "Exkursionsflora von Deutschland, Band 4 (Kritischer Band)". 4. A new subspecies of *Euphrasia officinalis*.) (in German) Schlechtendalia 8: 15-16. (Describing a new combination *E. officinalis* ssp. *versicolor*.)

Vurro, M. and Boari, A. 2004. Evaluation of *Fusarium* spp. and other fungi as biological control agents of broomrape (*Orobanche ramosa*). Biological Control 30: 212-219. (Among 50 isolates of 15 species tested on *O. ramosa* on tomato in southern Italy, *Fusarium oxysporum, F. solani, F. chlamydosporum* and *F. camptoceras* were among those showing some potential as biocontrol, agents.)

Wass, E.F. and Mathiasen, R.L. 2003. A new subspecies of *Arceuthobium tsugense* (Viscaceae) from British Columbia and Washington. Novon 13: 268-276. (*A. tsugense* ssp. *contortae* described from shore pine, *Pinus contorta* var. *contorta*.)

Westwood, J.H. 2004. Molecular aspects of host-parasite interactions: opportunities for engineering resistance to parasitic weeds. In: Inderjit (Ed.) Weed Biology and Management. Dortmund, Germany: Kluwer, pp. 177-198. (See Book review above.)

Wiens, D. and Hawksworth, F. 2004. New species of *Phoradendron* (Viscaceae) from Mexico and Guatemala and a synopsis of species in section Pauciflorae. Aliso (dated 2002) 21(1): 33-43. (Describing 7 new species of *Phoradendron* including 3 species epi-(hyper-)parasitic on other *Phoradendron* or *Cladocolea* spp.)

Wood, B.W. and Reilly, C.C. 2004. Control of mistletoe in pecan trees. HortScience 39: 110-114. (Spot treatment of *Phoradendron flavescens*, with 2,4-D at 1.2 to 2.4 g/litre (plus 2% crop oil), 2 to 3 weeks before bud-break, gave effective long-term control of *P. flavescens* without adverse effect on pecan.)

Yakutkin, V.I. It is possible to prevent sunflower diseases. 2003. Zashchita i Karantin Rastenii, 2003, No. 6, 40 pp. (Referring to the use of varieties resistant to *Orobanche cumana*.)

*Young, E. and Mottram, A. 2004. Transplanting sorghum and millet – a key to risk management. http://www.bangor.ac.uk/transplanting/Transplanting.pdf. (Referring to successful trials in Zimbabwe and Ghana and relevance to *Striga* control.)

Zhang, L.Y., Ye, W.H., Cao, H.L. and Feng, H.L. 2004. *Mikania micrantha* H.B.K. in China – an overview. Weed Research 4: 42-49. (Referring to a number of studies in China suggesting useful control of *M. micrantha* by *Cuscuta campestris, C. australis* and *C. chinensis*.)

Zhou, W.J., Yoneyama, Y., Iso, S., Rungmekarat, S., Chae, S.H., Sato, D. and Joel, D.M. 2004. *In vitro* infection of host roots by differentiated calli of the parasitic plant *Orobanche*. Journal of Experimental Botany 55: 899-907. (Calli from *O. ramosa, O. aegyptiaca* and *O. minor* were induced to produce roots which infected roots of red clover and carrot.)

Zuber, D. 2004. Biological flora of Central Europe: *Viscum album* L. Flora (Jena) 199: 181-203. (A general review on taxonomy, biology, physiology, etc.)

HAUSTORIUM 45
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HAUSTORIUM

Parasitic Plants Newsletter

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IPPS TO ELECT NEW OFFICERS

The time has come to elect a new set of officers for the International Parasitic Plants Society. The term of service for officers is four years, and we are soon approaching the fourth anniversary of the inauguration of IPPS, which took place during the 7th International Parasitic Plant Symposium in Nantes, France. The new group of leaders will continue the work of advancing the Society, decide on all activities of the Society, and coordinate the next symposium and workshops. Elected positions are President, Vice President, Secretary, Treasurer, and two Members at Large.

Three members of the current Executive Committee volunteered as members of the Election Committee: Patrick Thalouarn, Gbèhounou Gualbert, and Jos Verkleij. Patrick Thalouarn, who is currently the Vice President of the IPPS agreed to serve as Chair of the Election Committee.

All members of the IPPS will receive a nomination form by email in early 2005. Then an electronic ballot will be sent to the members. Please begin thinking about who you would like to nominate and whether you would consider serving if nominated.

The IPPS extends its best wishes to all researchers of parasitic plants: let us hope that 2005 will be a fruitful year with breakthroughs in the understanding of key issues concerning the parasitic syndrome in plants, and with the introduction of new methods for an effective management of parasitic weeds.

Danny Joel
IPPS Secretary

ERRATA

We regret to note two errors in Haustorium 45 (partially corrected on the web-site version).

1. the date should of course have read August 2004 not 2005

2. the list of papers noted under the COST meeting in Nicosia, Cyprus (not Cypress!) was a repetition of those presented to the Rome meeting. The correct list of papers is included below.

Our apologies to those confused.

AFTER THE BOOK – PROGRESS IN PARASITIC PLANT RESEARCH SINCE KUIJT'S 'BIOLOGY OF PARASITIC FLOWERING PLANTS' - OVERVIEW OF A SYMPOSIUM JULY/AUGUST 2004

This symposium was held at Botany 2004 - the joint annual meeting of the American Bryological and Lichenological Society (ABLS), the American Fern Society (AFS), the American Society of Plant Taxonomists (ASPT), and the Botanical Society of America (BSA) held from July 31 to August 5 in Snowbird, Utah.

The symposium was presided over by Lytton Musselman and Daniel Nickrent and sponsored by the Tropical Botany and Systematics sections of BSA and Old Dominion University. It was dedicated to Job Kuijt's seminal publication, The Biology of Parasitic Flowering Plants (1969), a volume that has indisputably influenced a generation (or two) of botanists. Current research was presented in twelve papers encompassing the ecology, systematics, and anatomy of parasitic plants. In addition to the symposium, five presentations on parasitic plants were given in other paper sessions at the meeting. The following is a brief overview of all pertinent papers presented at Snowbird, with the senior author in each case indicated in brackets.

The opening presentation by Lytton Musselman discussed the impact of Kuijt's book on plant sciences and reviewed progress of research since its publication. Musselman emphasized the disparity between research progress and the lack of positive change for the poorest world citizens suffering from parasitic plants.

Job Kuijt spoke kindly about the recognition of his efforts, the motivation for his book, and without approbation, the current emphasis on molecular systematics at the expense of descriptive work. David Lye introduced their joint paper giving information about the complex organization of *Arceuthobium* tissues in undifferentiated *Psuedotsuga* apical buds (Kuijt).

Symposium papers on Orobanchaceae included phylogenetic analyses that compared the generic relationships within the family using ITS sequence data (Wolfe); the Orobanchaceae as a model for the molecular evolution of a gene (PHYA) encoding for phytochrome (Bennett); the use of transgenic host plants engineered for hypersensitive response to parasitism by *Orobanche* (Westwood); and a helpful review of parasite-host interactions for root hemiparasites in a community assembly and ecophysiological framework by Malcolm Press. In the regular paper sessions, species relationships in *Hyobanche* complexes were resolved using ISSR markers and correlated with biogeograpic patterns of morphology (Wolfe).

A convincing argument was made for the photosynthetic potential of *Cuscuta* using natural history observations and molecular data that included the sequences of entire chloroplast genomes of two *Cuscuta* species (McNeal). *Dactylanthus taylorii* (Balanophoraceae), a New Zealand endemic, faces a variety of conservation issues, primarily introduced rodents, while its intriguing basic biology is just beginning to be understood (Holzapfel). New information regarding the pollination biology of *Hydnora* was presented and a potential cryptic species was identified using ISSR markers (Maass).

Phylogenetic and biogeographic relationships within the Santalaceae were elucidated with sequence data from multiple gene regions (rDNA, rbcL, and matK), and strong support for several monophyletic clades were discussed (Nickrent). In the paper sessions evidence for the Australian origin of *Santalum* and the affiliations of Hawaiian and other Pacific island taxa are discussed using ITS sequence data (Harbaugh). An 80 million year biogeographic history of the Olacaceae was described using molecular, morphological, and fossil data (Malécot). Relationships within the Rafflesiales were discussed in light of horizontal gene transfer events, questioning the utility of mitochondrial sequences as phylogenetic markers (Blarer).

In the regular paper sessions of the symposium, the queen of the plant parasite world, *Rafflesia,* was placed in the Malpighiales using phylogenetic analyses of the mitochondrial gene matR (Barkman); a novel vector of horizontal gene transfer in angiosperms was presented with evidence for multiple origins of parasitism using three mitochondrial genes (Barkman); and the patterns of character divergence and convergence were shown in canopy dwelling Loranthaceae (Wilson).

The proceedings of this meeting will not be published but a list of relevant titles is included below and abstracts may be found on: http://www.2004.botanyconference.org/. or on http://www.science.siu.edu/parasitic-plants/Meetings/BotSoc2004.html

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Barkman, T.J. *et al.* - Mitochondrial DNA suggests 12 origins of parasitism in angiosperms and implicates parasitic plants as vectors of horizontal gene transfer.
Barkman, T.J. *et al.* Phylogenetic analysis reveals the photosynthetic relatives of *Rafflesia*, the world's largest flower.
Bennett, J. and Mathews, S. - Phytochrome evolution in Orobanchaceae.
Blarer, A. *et al.* - Rafflesiales – problems and advances in research.
Holzapfel, A.S. - Biology and Conservation of the New Zealand endemic parasitic plant *Dactylanthus taylorii* Hook f. (Balanophoraceae).
Kuijt, J and Lye, D. - The return of the isophasic filaments – the early *Arceuthobium* endophyte.
Maass, E. *et al.*. - *Hydnora* - the ingenious genus.

Malécot, V. - Biogeography of Olacaceae - paleobotanical and phylogenetic congruence.
McNeal, J.R. *et al.* - Evidence for photosynthetic potential across the parasitic plant genus *Cuscuta* using complete plastid genome sequences.
Musselman, L.J. - Parasitic weeds in world agriculture–the best of times, the worst of times.
Nickrent, D. and Der, J. - Santalaceae: phylogeny, taxonomy, and biogeography.
Press, M.C. - Physiological traits of root hemiparasitic Orobanchaceae (ex-Scrophulariaceae): implications for community structure and function.
Sherman, T.D and Vaughn, K.C. - An ultrastructural overview of adaptations that make dodders (*Cuscuta* spp.) efficient parasites.
Westwood, J. - Molecular biology of parasitism in *Orobanche*.
Wilson, C.A. and Calvin, C.L. - Character divergences and convergences in canopy dwelling Loranthaceae.
Wolfe, A. *et al.* - Phylogeny and biogeography of Orobanchaceae.
Wolfe, A.D. and Arguedas, N. - Patterns of evolution in *Hyobanche* L. (Orobanchaceae), part II.

A MISTLETOE (*SCURRULA PULVERULENTA*) AND AN UNUSUAL HOST PLANT (*ARAUJIA SERICIFERA*)

Araujia sericifera (Asclepiadaceae), cruel plant, is a liana native to Brazil reported as naturalized in western Europe. I have seen its normally developed fruits and seeds only three times: about 1970 in the Hanbury Botanic Gardens (Italy), about 1990 in hedges of a motor-way not far from Milan (Italy) and last year in an orchard in the mountains of Riviera Ligure west of Genoa (Italy). In all three places the climate is Mediterranean with occasional frosts in winter and warm, dry summer. The mistletoe *Scurrula pulverulenta* was introduced about 1980 into Europe using fresh berries received from Shillong (Eastern India). It is said to be native in Kashmir and acclimatized in the Hanbury Gardens on *Citrus* hosts. I am studying a plant of *S. pulverulenta* derived from a seed I placed on the stem of *A. sericifera*. The hemiparasite was able to grow to a size of about 50 cm in spite of the very thin stem of the host (only 1.5 cm at 1 m above soil level) where it germinated. I expected a reduced growth, flowering and fruiting of the host-plant, but in September 2004 it was full of flowers in the upper part (about 4 m high) with about 15 nearly ripe fruits. There were several seedlings of *A. sericifera* climbing up in different parts of the orchard, thus confirming that the seeds of last year have germinated regularly and successfully. I will monitor both plants and eventually try the germination of another mistletoe on the host because that epiparasitism might lead to a better understanding of the relationship between host and parasite.

G. Grazi.

PROMOTION OF GREEN MANURING TO COMBAT *STRIGA* IN TANZANIA

Continuous production of maize, sorghum or upland rice without using manure or fertilisers has led to a decline in soil fertility and a build up of *Striga asiatica* in many areas of Tanzania. Rice yields for example have fallen by between 30 and 70% over the past 20 years as *Striga* levels have increased. Farmers harvest little more than 300 kg ha^{-1} from severely infested fields. There is strong market demand for quality aromatic rice so farmers in affected areas, including Kyela district in the southern highlands and Matombo district in the Ulugulu mountains of Morogoro region, are keen to reverse the decline in yield. Farmer groups in Kyela participating in a project funded by the UK DFID Crop Protection Programme learned from on-farm trials with urea fertiliser that *Striga* is an indicator of low soil fertility. Prior to working with the project the farmers had little knowledge of *Striga* other than observing that it is found in fields where cereal crops grow poorly. Yields of rice were increased by 40% with an associated 60% reduction in *Striga* infestation when fertiliser was applied. However lack of cash at the beginning of the season and limited availability discourages farmers from buying inorganic fertilisers. Subsequently the project introduced the idea of a legume-rice rotation to farmers in two villages in Kyela to provide a low-cost locally sustainable alternative. Since October 2002 rotation of rice with the green manure 'marejea' (*Crotalaria ochroleuca*) or the pulse pigeon pea has been promoted by extension officers in Kyela and has also been introduced to communities in Matombo. Initially extension and research staff organised farmer field days at sites in the two villages where use of *C. ochroleuca* and an improved high yielding cultivar of pigeon pea were introduced, and arranged farmer exchange visits with farmers from other villages. The process of farmer evaluation of green manure, initiated by researchers, became farmer driven. By 2004 the rotations had been implemented at well over 100 sites and demand for seed has risen so that by 2005 both legumes will be in use across 16 villages. Promotion work is also being undertaken with village primary school teachers in both districts to spread knowledge of the cereal/legume rotations through agricultural science classes and school demonstration plots.

C. ochroleuca biomass contains approximately 3.5% N in shoots and 1.3% in root so with dry matter yields of 3 to 4 t ha^{-1} significant levels of nutrient are available to subsequent crops. The green manure also acts to reduce the *Striga* seed bank because it produces germination stimulant in its root exudates: in laboratory tests, exudates from 10 day old seedlings stimulated 34% germination of *S. asiatica* compared to 57% stimulated by maize root exudates. Results from up-scaling the legume-rice rotations to farmer management are promising and increasing adoption is taking place. Rice yields on 15 farms in Kyela in 2003, where *C. ochroleuca* was grown the previous year, averaged 2408 kg ha^{-1} compared 1042 kg ha^{-1} under continuous rice, with associated reductions in *Striga* infestation. In 2004 farmer's rice yields across sites in five villages were again on average more than 100% higher following *C. ochroleuca* or pigeon pea than on plots in continuous cereal production. An additional significant advantage of using *C. ochroleuca* is that it suppresses weeds. Most farmers do not find it necessary to weed the green manure itself and have weeded subsequent rice crops only once, compared to the two to three hand weedings needed in continuous rice, representing a considerable saving of labour. *C. ochroleuca,* provides a low cost, locally sustainable approach to soil fertility and hence *Striga* management. Growers can use farm-saved seed and are now passing on supplies to neighbours and selling seed to farmers in the wider community. One group in Kyela is setting up a shop to provide an outlet for the seed and to encourage greater adoption.

A.M. Mbwaga, Ilonga Agricultural Research Institute, Tanzania.
C. R. Riches, Natural Resources Institute, University of Greenwich, UK.

STUDIES ON *HYDNORA*

Among activities on parasitic plants in the Department of Biological Sciences at Old Dominion University, Norfolk, USA, Dr Kushan Tennakoon has joined Lytton Musselman from Sri Lanka for a sabbatical period to study the functional attributes of the genus *Hydnora*. This is a group of rare parasitic angiosperms growing on the roots of *Euphorbia* and *Acacia* species in southern Africa, some parts of the Arabian peninsula and Madagascar. Due to its furtive nature this genus is poorly studied and the new investigations include studies of the anatomy of *H. triceps* and *H. africana* and their haustorial structure, using light and electron microscopy, and of the factors governing the movement of assimilates from the hosts to the parasite.

TAXONOMY OF BALANOPHORACEAE IN BRAZIL

A study is in progress at the Botanical Gardens Research Institute in Rio de Janeiro on a revision of the taxonomy of the Balanophoraceae, including the genera *Langsdorffia, Ombrophytum, Lathrophytum, Scybalium, Lophophytum* and *Helosis* in Brazil. The scientists involved would welcome any assistance that readers of Haustorium can provide in the form of information on herbarium collections and duplicate herbarium specimens from other parts of the world, photographs, literature, etc. Any help or advice should please be passed to Dr Leandro Cardoso, Instituto de Pesquisas, Jardim Botânico do Rio de Janeiro, Rua Pacheco Leão, 915, Rio de Janeiro CEP 22460-030, Brazil.
email: leandrocardoso@msn.com
(With thanks to Jan Bartlett for translation.)

BECA LAUNCHED IN NAIROBI

The Biosciences Eastern and Central Africa (BECA) was officially launched in Nairobi, Kenya by the country's Agriculture Minister Kipruto arap Kirwa. The Minister reiterated the country's support for the use of science and technology to increase food production.

BECA consists of a network of institutional nodes and a hub, located at the International Livestock Research Institute, in Nairobi, Kenya. The hub provides a common biosciences research platform, research-related services, and capacity building and training linked to a network of laboratories, universities and other institutions throughout eastern and central Africa. Prof. James Ochanda, BECA Coordinator, said the facility offers a unique opportunity for African scientists to access state-of-the art biosciences laboratory facilities and training to develop technological innovations to help relieve hunger in Africa.

Minister Kipruto arap Kirwa called for rapid adoption of new agricultural technologies to help in the fight against *Striga* weed and stem borer whose damage to maize is said to cost sub-Saharan Africa up to US $ 7 billion and US$ 90 million annually, respectively. He said Kenya would increase investment in agricultural research in general to meet the challenges of food requirements. He commended NEPAD for striving to harness science and technology for Africa's sustainable development.

Following a NEPAD request, Canada pledged C$30 million of the Canada Fund for Africa to support the facility. The Fund has so far released C$4.5 million to support the planning and design phase of BECA.

For more information contact Daniel Otunge of the Kenya Biotechnology Information Center at dotunge@absfafrica.org

(From Crop Biotech Update December 10, 2004)

OBITUARY – ROBERT J. CARSKY

20 April 1955 – 6 November 2004

His colleagues at IITA and WARDA have reported with sadness that in the recent turmoil in Côte d'Ivoire, Bob Carsky was tragically killed when a bomb struck the French school in Bouaké where he was sheltering. Bob, an American citizen, had worked for IITA and more recently for WARDA over a period of 15 years as an agronomist, working closely with and for local farmers. His studies had included intensive field work on *Striga*. To quote a long-time colleague, Dr Christian Noble, 'He constantly adapted his approach to work on solutions for those agricultural problems that haunted farmers most.' He left a wife and three children in the US. He will be sorely missed.

THE MAILING LIST

The current circulation of Haustorium is approximately 360, about 220 by email and 140 by airmail. We are always seeking to reduce mailing costs (which are at present kindly borne by Old Dominion University) and any readers receiving this as hard copy who are prepared to receive by email are asked to contact Chris Parker accordingly. Those already receiving by email are asked to advise any change of address. Meanwhile, contact has been lost with the following:

Dr Dana Berner in USA
Dr Pavol Elias in Slovakia
Dr Govind Khattri in Nepal
Dr H.C. Lakshmi in Karnataka, India
Mr Kaddour Saffour in Morocco
Dr A. Zemrag in Morocco
Dr Sevda Atanasova, lately in The Netherlands
Dr Awad Farah in Saudi Arabia (or Sudan?)
Dr Are Rogler in Norway

If anyone can help us re-establish contact with any of these individuals it will be appreciated by all concerned.

IUFRO WORLD CONGRESS

The World Congress of the International Union of Forestry Research Organizations, to be held in Brisbane, Australia from August 8-13, 2005, will include a session on 'Stem and shoot fungal pathogens and parasitic plants: the value of biological diversity'.

For any further detail contact Simon Shamoun sshamoun@nrcan.gc.ca

COST 849 - PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

This programme, funded by European Union via European Science Foundation, has been able to arrange an increased number of meetings in 2004. Most recently there have been meetings in Wageningen, Bucharest, Naples and Cordoba. The programmes, abstracts and/or reports of these meetings are on the COST849 web-site (http://cost849.ba.cnr.it/) or will be added in due course. More details appear below, together with lists of paper presented and the corrected list of papers presented at the meeting in Nicosia in May.

COST 849 MEETINGS

Herbicide testing for control of broomrape held in Nicosia, Cypress, 13-15 May, 2004. The corrected list of papers presented at this meeting is as follows:

Reuven Jacobsohn - Potential activities to be promoted on herbicide testing for broomrape control.
Diego Rubiales - *Orobanche* spp. problem in Europe. Perspectives for cooperative actions in the frame of COST 849.
Nicos Vouzounis - Broomrape problem and its chemical control in Cyprus.
Salvador Nadal - The status of broomrape and its control in Spain.
Joseph Hershenhorn - Control of *Orobanche aegyptiaca* in tomatoes using sulfosulfuron.
Maria Chrysayi-Tokousbalides - Broomrape problem in Greece. Strategies of control.

Mechanisms of susceptibility and resistance in parasitic angiosperm-host symbioses: a comparative approach held in Wageningen, The Netherlands, 13-15 October, 2004. Papers presented and discussed were:

John Yoder - Haustorial signalling and development: *Triphysaria* as a model.
Danny Joel - Structural development of haustoria in *Orobanche.*
Malcolm Press - Haustorial structure/function relations.
Radoslava Matusova - Biosynthesis of germination cues.
Sissy Lyra - Induction of *Orobanche* seed germination by stimulants.
Eliane Dumas-Gaudot - Plant-mycorrhizas interaction.
Hans Helder - Plant-nematode interactions.
René Geurts - Legume/rhizobia interactions.
Philippe Délavault - Early molecular responses of host and non host roots infected by *Orobanche* spp.
Ana Maria Maldonado - Proteomics as a high throughput global approach to understand parasitic angiosperm-host symbioses cues.
Patricia Letousey - Molecular events in resistant and susceptible sunflowers infested by *O. cumana.*
Sun Zhongkui - *Arabidopsis* as a model to study germination stimulant formation.
Patrick Thalouarn - Comparison of host root responses to *Orobanche* spp and other pathogens.
Alex Levine - The role of active oxygen species in *Orobanche* infection.
Julie Scholes - Host resistance in rice
Bob Vasey - Non-host resistance in *Arabidopsis.*
Maurizio Vurro - Natural compounds: tools to defend host plants from parasite aggression
Maria Pacureanu - Sunflower resistance.

Use of natural compounds for parasitic plant management held in Naples, Italy, 29-31 October, 2004. Papers presented and discussed were:

Anna Andolfi *et al.* - Plant and fungal bioactive metabolites as stimulants for germination of *Orobanche ramosa* seeds.
Anna Andolfi *et al.* - Fungal toxins in the control of the parasitic weed *Orobanche ramosa.*
Harro Bouwmeester *et al.* Manipulation of germination stimulants for control.
Maria Chrysayi-Tokousbalides and Konstantinos Aliferis - Studying the mode of action of fungal phytotoxins.
E. Dor and J. Hershenhorn - Metabolite from *Inula viscosa* is toxic to dodder (*Cuscuta campestris*)
Stephen Duke and Jim Westwood - The potential for genetically engineering natural phytotoxins into crops for parasitic weed resistance.
Garifalia Economou *et al.* - Germination response of *Orobanche* populations to GR24 and to a new natural product.
J. Hershenhorn *et al.* - *Fusarium moniliforme* as a new pathogen of parasitic plant *Orobanche* sp.
Francisco Macías *et al.* - New chemical clues for sunflower-broomrape host-recognition.
Alice Nielsen and Jens Streibig - Root exudates from sorghum responsible for *Striga hermonthica* (Del.) Benth. germination.
A. Pérez-de-Luque *et al.* - Induction of systemic resistance in pea and faba bean to crenate broomrape (*Orobanche crenata*) by exogenous application of benzothiadiazole.
Peter Tóth and Ľudovít Cagáň - Possible role of secondary metabolites emitted by parasitic weeds in attraction of insects.
Maurizio Vurro and Angela Boari - Natural compounds: weapons against parasitic plant aggression.
Klaus Wegmann - Search for inhibitors of the exoenzymes of the *Orobanche* radicle.
Nadjia Zermane - Secondary metabolites of rhizobacteria and perspectives of their use for biocontrol of *Orobanche* spp.
Binne Zwanenburg - The quest for natural germination stimulants. A critical account on the structure and chemistry of compounds with claimed germinating activity.

Breeding for *Orobanche* resistance in sunflower held in Bucharest, Romania, 4-8 November, 2004. Papers presented and discussed were:

Breeding methodologies:
B. Pérez - Sources of broomrape resistance in sunflower.

Skoric - Transferring resistance traits from wild *Helianthus* species.
CC Jan - Developing germplasm pools having wild *Helianthus* genes in domestic background.
Christov - Broomrape resistance in interspecific hybrids of sunflower.
R. Batchvarova - The use of mutagens.
Genetic mapping:
Patrick Thalouarn - Sunflower amphiploids and genetic diversity for broomrape resistance.
B. Perez-Vich - Mapping broomrape resistance in sunflower.
André Bervillé - Marker-assisted selection in sunflower resistance breeding.
Z. Satovic - Mapping broomrape resistance in faba bean.
Haussmann - Marker assisted breeding for *Striga* resistance in sorghum.
Breeding lines for broomrape resistance:
Pacureanu Joita – Breeding lines for broomrape resistance in Romania.
Kotoula-Syka – ditto in Greece.
B. Pérez-Vich – ditto in Spain.
Shindrova – ditto in Bulgaria.
Kitain – ditto in Israel.
Skoric – ditto
in Serbia and Montenegro.
Resistance Mechanisms:
Thalouarn - Resistance mechanisms in sunflower.
Wegmann - Manipulation of germination stimulants.
Boumeester - Manipulation of stimulant biosynthesis.
Rubiales - Broomrape resistance in legume species.
Race Differentiation in Orobanche cumana:
Joel - How can a farmer identify the race in a field?
Melero - *O. cumana* race differentiation in Spain.
Pacureanu-Joita - ditto in Romania.
Kitain - ditto in Israel.
Batchvarova – ditto in Bulgaria.
Economou - ditto in Greece.
L. Molinero - Diversity within populations of *O. cumana*.

Management of parasitic weeds held in Cordoba, Spain, 18-20 November, 2004. Papers presented and discussed were:

Robert Bulcke - Parasitic weeds - distribution and strategies of control in Belgium.
Henry Darmency – ditto in France.
Klaus Wegmann – ditto in Germany.
Pasquale Montemurro - ditto in Italy.
Nikos Vouzounis – ditto in Cyprus.
G. Economou – ditto in Greece.
Goran Malidza – ditto in Serbia.
Hanan Eizenberg – ditto in Israel.
Hanan Eizenberg - Modelling parasite development - a predictive tool for timing herbicide applications.
Svend Christiansen - How precision farming can be applied for parasitic weed management?
Yaacob Goldwasser - Management of *Cuscuta campestris* in tomato.
Alistair J. Murdoch - Linking laboratory and field studies of dormancy in parasitic plants: When is delayed planting an option for integrated control?
A. Pérez-de-Luque - Sowing date, chemical control and host resistance: effect on establishment and development of *O. crenata* in faba bean.
D. Rubiales - Integrated control of broomrape in pea.
C. García-Galindo - Natural products and allelopathy for parasitic weeds management.
Jesús Jorrín - Molecular approximation for the control of broomrape.
Rafael De Prado - Herbicide resistance – mechanisms and global overview.
Baruch Rubin - Risk of herbicide-resistance evolution in parasitic weeds.
Giovanni Dinelli - The use of molecular markers for the study of weed populations.
Goran Malidza - Control of broomrape in imidazolinone-tolerant sunflower hybrids.
Eleni Kotoula - Glyphosate for broomrape control in solanaceous crops.
Regional Project – assessment of Orobanche development model as a tool for Orobanche management:
Hanan Eizenberg - Introduction and overview.
Hanan Eizenberg - Practice of processing tomato cropping in Israel.
Falia Economou.- ditto in Greece.
Nikos Vouzounis.- ditto in Cyprus.
Pasquale Montemurro – ditto in Italy.
Hanan Eizenberg - Degree days- a predictive tool for *Orobanche* development in certain crops.

THESIS

Brenda J. Grewell (PhD, University of California, Davis, USA, September 2004)
Species diversity in Northern California salt marshes: functional significance of parasitic plant interactions.

I studied how parasitic plant interactions contribute to species coexistence in tidal wetlands of northern California. First, I address the effects of the native parasite *Cuscuta salina* on species interactions and plant community structure. I showed that *Cuscuta* is restricted to nutrient poor areas with significant canopy gaps and high species diversity. I examined timing, level, and frequency of host infectivity and identified *Plantago maritima* as the primary host. I experimentally removed *Cuscuta* from the community and measured host fitness, rare plant fitness, and plant community response. *Cuscuta* reduction of host biomass and reproductive effort resulted in indirect positive effects on a rare hemiparasite, *Cordylanthus mollis,* and enhanced plant community diversity.

Then I present results demonstrating how parasitic plant – host interactions ameliorate physical stress conditions and generate environmental heterogeneity. Experimental bare plots, artificially shaded bare plots, and parasite removal plots across intertidal elevations were compared to controls with hemiparasites (*Cordylanthus mollis* and *Cordylanthus maritimus* ssp. *palustris*) at two coastal California sites representing a steep environmental stress gradient. Over three years, plant species richness was enhanced with parasites at both locations. Parasitic plants improve sediment salinity and redox potential, and parasite-generated habitat heterogeneity contributes to species coexistence.

Lastly, I present results of an experimental reintroduction of an endangered hemiparasite (*Cordylanthus mollis*) to a restoration site in the Suisun Marsh of the San Francisco Estuary, California. I tested disturbance management methods for enhancement of plant establishment and fitness. I identified critical life stages and used failure time survival analysis models for a demographic comparison of restoration and reference populations. I demonstrate that successful restoration requires a unique, productive host community to support the introduced parasite load. Disturbance-gap creation is a successful restoration technique that will enhance rare plant establishment and fitness, but benefits can be offset by exotic plant invasions. Applied conservation significance of the study points to a critical need for regional invasive plant control as the first step in restoration efforts.

Overall, my dissertation clarifies the functional role of parasitic plants within mid-Pacific Coast salt marshes of North America. Results demonstrate that preferential parasitism, spatial contingency of species interactions, and creation of habitat heterogeneity through parasitic amelioration of physiological stress conditions all play a role in supporting coexistence within the salt marsh community.

CD-ROM

CABI Crop Protection Compendium 2004 Edition. This latest edition has been comprehensively updated with the addition of over 300 new datasheets (now totalling 2100 pests, diseases, weeds and natural enemies), new search facilities, a new LUCID key to 425 weeds, and new library documents. Parasitic weed species having fully illustrated datasheets with distribution maps, host range, biology, ecology, control methods etc include *Alectra vogelii*, ten *Arceuthobium* spp., four *Cuscuta* spp., five *Orobanche* spp. and six *Striga* species.

The Compendium is available to individuals either as a one-off CD-ROM, or in the form of internet access (annually) for £70 (US$100) via CABI in UK (orders@cabi.org) or in USA (cabi-nao@cabi.org) or via the web-site (www.cabicompendium.org/cpc)

GENERAL WEB SITES

For individual web-site papers and reports see LITERATURE

For information on the International Parasitic Plant Society, past and current issues of Haustorium, etc. see: http://www.ppws.vt.edu/IPPS/

For past and current issues of Haustorium see also: http://web.odu.edu/haustorium

For the ODU parasite site see: http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page

For Lytton Mussleman's *Hydnora* site see: http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/lecturesandarticles

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rmrs.nau.edu/misteltoe/welcome.html

For information on activities and publications of the parasitic weed group at the University of Hohenheim see: http://www.uni-hohenheim.de/~www380/parasite/start.htm

For information on, and to subscribe to, PpDigest see: http://omnisterra.com/mailman/listinfo/pp_omnisterra.com

For information on the EU COST 849 Project and reports of its meetings see: http://cost849.ba.cnr.it/

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' the address is: http://www.omnisterra.com/bot/pp_home.cgi

For a description and other information about the *Desmodium* technique for *Striga* suppression, see: http://www.push-pull.net

For information on EC-funded project 'Improved *Striga* control in maize and sorghum (ISCIMAS) see: http://www.plant.dlo.nl/projects/Striga/

LITERATURE

* indicates web-site reference only

Aĭmanbetov, M.Z. and Azhbenov, V.K. 2004. Plant protection in Kazakhstan. Zashchita i Karantin Rastenii 2004 (3): 18-21. (Noting *Cuscuta* spp. among quarantine weeds of Kazakhstan.)

Al-Eryan, M.A.S., Altahtawy, M.M.M., El-Sherief, H.K. and Abu-Shall, A.M.H. 2003. Phenological stages of the parasitic weeds *Orobanche crenata* Forsk. as a guide for collecting a parasitoid-free *Phytomyza orobanchia* Kalt. Egyptian Journal of Biological Pest Control 13:105-109. (In Egypt, the best time to collect *P. orobanchia* pupae free of the hymenopteran parasite *Tetrastichus phytomyzae* was when spikes were still fleshy in April.)

Al-Iraqi, R.A. 2003. Effect of some plant powders against Khapra beetle *Trogoderma granarium* Everts (Dermestidae: Coleoptera). Arab Journal of Plant Protection 21: 96-101. (Powders prepared from *Cuscuta chinensis* and *Orobanche aegyptiaca* had some detrimental effects on *T. granarium* but less than those prepared from *Ricinus communis*.)

Ángeles Castillejo, M., Amiour, N., Dumas-Gaudot, E., Rubiales, D. and Jorrín, J.V.2004. A proteomic approach to studying plant response to crenate broomrape (*Orobanche crenata*) in pea (*Pisum sativum*). Phytochemistry 65: 1817-1828. (Susceptible and resistant pea lines were compared by 2-D electrophoresis. Proteins showing pronounced qualitative or quantitative differences were identified, revealing parasite-induced changes in carbohydrate and nitrogen metabolism and defence proteins.)

Annapurna, D., Rathore, T.S. and Geeta Joshi 2004. Effect of container type and size on the growth and quality of seedlings of Indian sandalwood (*Santalum album* L.). Australian Forestry 67: 82-87. (Growth and development of *S. album* on *Cajanus cajan* was better in 600 ml 'root trainers' than in 1000ml plastic bags or plastic containers.)

Anon 2004. Biennial workshop of AICRIP-WC. Weed News 4(2): 1. (Noting that, in India, *Striga* in sugarcane, *Orobanche* in tomato, potato and eggplant, and *Cuscuta* in carrot and coffee are 'creating major problems'.)

Bach, C.E. and Kelly, D. 2004. Effects of forest edges, fruit display size, and fruit colour on bird seed dispersal in a New Zealand mistletoe, *Alepis flavida*. New Zealand Journal of Ecology 8: 93-103. (Birds prefer red fruit but orange fruit are also taken.)

Barcelona, J.F. and Fernando, E.S. 2002. A new species of *Rafflesia* (Rafflesiaceae) from Panay Island, Philippines. Kew Bulletin 57: 647-651. (A new species, *Rafflesia speciosa*, is described, while *R. patma, R. kerrii, R manillana* and *R. schadenbergiana* are also discussed.)

Berg, S., Krause, K. and Krupinska, K. 2004. The *rbcL* genes of two *Cuscuta* species, *C. gronovii* and *C. subinclusa*, are transcribed by the nuclear-encoded plastid RNA polymerase (NEP). Planta 219: 541-546. (Describing the unusual situation in which a gene normally transcribed by plastid-encoded RNA polymerase is transcribed by nuclear-encoded RNA polymerase. Promoter regions of the genes appear to have been modified to be recognized by specific polymerases.)

Bisht, N.C., Burma, P.K. and Deepak Pental 2004. Development of 2,4-D-resistant transgenics in Indian oilseed mustard (*Brassica juncea*). Current Science 87: 367-370. (Suggesting the possibility for use of 2,4-D to control *Orobanche* spp.)

Boukar, O., Kong, L., Singh, B.B., Murdock, L. and Ohm, H.W. 2004. AFLP and AFLP-derived SCAR markers associated with *Striga gesnerioides* resistance in cowpea. Crop Science 44: 1259-1264. (Describing development of a marker that may be useful in breeding programs.)

Brand, J., Jones, P. and Donovan, O. 2004. Current growth rates and predicted yields of sandalwood (*Santalum spicatum*) grown in plantations in south-western Australia. Sandalwood Research Newsletter 19: 4-7. (Describing the successful commercial cultivation of *S. spicatum*, established by direct seeding next to 1-2 year old *Acacia acuminata* and reporting yields of timber and seed.)

Bull, E.L., Heater, T.W. and Youngblood, A. 2004. Arboreal squirrel response to silvicultural treatments for dwarf mistletoe control in Northeastern Oregon. Western Journal of Applied Forestry 19: 133-141. (Partial or total removal of any Douglas fir with large witches brooms caused by *Arceuthobium* sp. tended to reduce the populations of red squirrel and northern flying squirrel.)

Butaud, J-F., 2004. *Santalum insulare* (Bertero ex A. DC.): distribution and ecology. Sandalwood Research Newsletter 19: 1-4. (Describing the distribution of the Polynesian sandalwood, *S. insulare*, in French Polynesia, Cook and Pitcairn Islands only, its ecology and its uses, for carving and for cosmetic and medicinal purposes.)

CABI. 2004. CABI Crop Protection Compendium 2004 Edition (CDRom). Wallingford, UK: CAB International.. (See item above.)

Cagáñ, L'. and Tóth, P. 2003. A decrease in tomato yield caused by branched broomrape (*Orobanche ramosa*) parasitization. Acta Fytotechnica et Zootechnica 6: 65-68. (In Slovakia, infestations of 10-20 shoots of *O. ramosa* per tomato plant were estimated to reduce yields by 43-53%.)

Ciosek, M.T. 2002. (Station of *Orobanche coerulescens* Stephan ex Wild. in Bohukaly near Terespol (Podlaski Przelom Bugu).) (in Polish) Acta Scientiarum Polonorum – Biologia 1: 5-7. (Confirming the only know occurrence of *O. coerulescens* in Poland.)

CSIRO Entomology. 2004. Climex species report. In: CABI. 2004. CABI Crop Protection Compendium 2004 Edition (CDRom). (Sample reports on the use of the CLIMEX climate matching programme to predict potential spread of invasive species, include one on *Striga asiatica,* suggesting that large areas of Central and South America could be infested.)

Dadon, T., Nun, N.B. and Mayer, A.M. 2004. A factor from *Azospirillum brasilense* inhibits germination and radicle growth of *Orobanche aegyptiaca.* Israel Journal of Plant Sciences 52: 83-86. (A factor from *A. brasilense*, thought to be a small peptide, inhibited germination of *O. aegyptiaca* perhaps due to competition at the site of action of the germination stimulant. Similar effects were shown with certain synthetic peptides.)

Douthwaite, B., Delve, R., Ekboir, J. and Twomlow, S. 2003. Contending with complexity: the role of evaluation in implementing sustainable natural resource management. International Journal of Agricultural Sustainability 1: 51-66. (Three studies of 'Monitoring and Evaluation' in participatory research included one on integrated control of *Striga hermonthica* in N. Nigeria.)

Eizenberg, H., Colquhoun, J. and Mallory-Smith, C.A. 2004. The relationship between temperature and small broomrape (*Orobanche minor*) parasitism in red clover (*Trifolium pratense*). Weed Science 52: 735-741. (Providing a detailed plot of *O. minor* development against growing degree days (GDD) with the aim of optimising the timing of control measures, especially those involving herbicide applied before parasite emergence.)

Eizenberg, H., Goldwasser, Y., Golan, S., Plakhine, D. and Hershenhorn, J. 2004. Egyptian broomrape (*Orobanche aegyptiaca*) control in tomato with sulfonylurea herbicides - greenhouse studies. Weed Technology 18: 490-496. (Concluding that 3 post-emergence applications or one pre-planting plus 2 post-emergence applications of either rimsulfuron or MON 37500 could give excellent selective control of *O. aegyptiaca* in tomato. HOE 404 and SL-160 were less selective.)

Ellis-Jones, J., Schulz, S., Douthwaite, B., Hussaini, M.A., Oyewole, B.D. and Olanrewaju, A.S. 2004. An assessment of integrated *Striga hermonthica* control and early adoption by farmers in Northern Nigeria. Experimental Agriculture 40: 353-368. (Confirming significant benefits from a sequence of soyabean trap crop followed by a *Striga*-resistant maize variety.)

Elzein, A., Kroschel, J. and Müller-Stöver, D. 2004. Optimization of storage conditions for adequate shelf-life of 'Pesta' formulation of *Fusarium oxysporum* 'Foxy 2', a potential mycoherbicide for *Striga*: effects of temperature, granule size and water activity. Biocontrol Science and Technology 14: 545-559. (Different sizes of 'Pesta' granules based on fresh and dried chlamydospore-rich biomass, microconidia, or a mixture of mycelia and microconidia, were assessed for viability after different periods under different temperatures and moisture contents. Low storage temperature was most important for good longevity.)

Emmett, T. 2004. Sandalwood growers network gains momentum. Sandalwood Research Newsletter 19: 7 (Describing the establishment and activities of a group of 60 members involved in cultivation of *Santalum spicatum* in Western Australia.)

Encheva, J., Christov, M., Köhler, H., Shindrova, P., Echeva, V. and Friedt, W. 2004. Specific hybrids between *Helianthus annuus* and *H. tuberosus*: RAPD analysis, disease resistance, combining ability. Bulgarian Journal of Agricultural Science 10: 169-175. (Hybrids between *H. annuus* and *H. tuberosus* included line R.104 with resistance to the local race of *Orobanche cernua*.)

Escher, P., Eiblmeier, M., Hetzger, I. and Rennenberg, H. 2004. Spatial and seasonal variation in amino compounds in the xylem sap of a mistletoe (*Viscum album*) and its hosts (*Populus* spp. and *Abies alba*). Tree Physiology 24: 639-650. (Concluding that glutamine delivered by the host xylem sap is converted, in *V. album*, to arginine and that the organic carbon liberated from glutamine contributes significantly to the parasite's heterotrophic carbon gain. Also that accumulation of arginine in mistletoe is an indication of excess N supply as a result of the uptake of amino compounds from the host xylem sap and a lack of phloem uploading.)

Escher, P., Eiblmeier, M. and Rennenberg, H. 2004. Differences in the influx of glutamine and nitrate into *Viscum album* from the xylem sap of its hosts. Plant Physiology and Biochemistry 42: 739-744. (Reporting mistletoe preference for glutamine over organic N.)

Ezeaku, I.E. and Gupta, S.C. 2004. Development of sorghum populations for resistance to *Striga hermonthica* in the Nigerian Sudan Savanna. African Journal of Biotechnology 3: 324-329. (In a programme of pedigree breeding based on 6 elite sorghum lines and the *Striga*-resistant varieties SRN 39 and IS 9830, SRN 39 proved to be the more useful donor parent for *Striga*-resistance. ICSV 00090 NG, a cross between ICSV 111 and SRN 39 gave the highest grain yield.)

Galindo, J.C.G., Macías, F.A., García-Díaz, M.D. and Jorrín, J. 2003. Chemistry of the host-parasite interactions. In: Macías, F.A., Galindo, J.C.G. and Molinillo, J.M.G. (eds) Allelopathy: Chemistry and Mode of Action of Allelochemicals. Boca Raton, USA: CRC Press, pp. 83-104. (A very thorough, comprehensive review of natural and synthetic germination stimulants and haustorial initiators of *Orobanche, Striga* and related parasities, and suggesting a role for sesqiterpene lactones in the germination of *Orobanche cumana* by sunflower.)

Ghosh, P. and Das, D. 2004. A preliminary census and taxonomic survey of host-plant diversity of *Cuscuta reflexa* Roxb. in the Uttar Dinajpur District of West Bengal. Environment and Ecology 22: 459-461. (Fifty-two species, representing 46 genera and 24 families were recorded as hosts of *C. reflexa*, including only one monocot, *Phoenix sylvestris.*)

Ghosh, R.B., Debabrata Das and Maji, U.K. 2002. A preliminary census of host plants of *Dendrophthoe falcata* (Linn.f.) Ettings in the tropical gardens of India. Journal of Economic and Taxonomic Botany 26: 517-523. (Listing 37 species of tree, 19 shrubs and 5 climbers.)

Gibot-Leclerc, S., Corbineau, F., Brault, Sallé, G. and Comé, D. 2004. Responsiveness of *Orobanche ramosa* L. seeds to GR 24 as related to temperature, oxygen availability and water potential during preconditioning and subsequent germination. Plant Growth Regulation 43: 63-71. (Confirming 20^0 C as optimum temperature for both conditioning and germination but preconditioning requiring only 1% oxygen whereas germination requires 3%.)

Gontcharov, S.V., Antonova, T.S. and Araslanova, N.M. 2004. Sunflower breeding for resistance to the new broomrape race. Helia 27: 193-198. (Finding that almost all VNIIMK-released inbred lines are susceptible to the new F race of *Orobanche cumana* in Spain, with only VK-623 exhibiting resistance, but this unfortunately based on recessive genes.)

Griffitts, A.A., Cramer, C.L. and Westwood, J.H. 2004. Host gene expression in response to Egyptian broomrape (*Orobanche aegyptiaca*). Weed Science 52: 697-703. (Showing patterns of spatial expression of several host genes in response to parasitism and implicating a predominantly localized wound/pathogen response.)

Hassan, E.A., El-Akkad, S.S., Moustafa, S.M. and El-Awadi, M.E. 2004. Histochemical aspects of penetration and vascular connection of broomrape haustoria in the host root, and the possible implication of phenylpropanoids. International Journal of Agriculture and Biology 6: 430-434. (Showing that accumulations of lignin and phenylpropanoids occurred naturally at junctions between primary and secondary roots in normal pea roots but were intensified at the junction between host root and the haustoria of *Orobanche crenata*.)

Haussmann, B.I.G., Hess, D.E., Omanya, G.O., Folkertsma, R.T., Reddy, B.V.S., Kayentao, M., Welz, H.G. and Geiger, H.H. 2004. Genomic regions influencing resistance to the parasitic weed *Striga hermonthica* in two recombinant inbred populations of sorghum. Theoretical and Applied Genetics 109: 1005-1016. (Identifying a major QTL from the gene locus, lgs – low stimulation of striga germination – from a low-stimulant line. This line shared several QTL with another line exhibiting "mechanical" resistance.)

Howell, B.E. and Mathiasen, R.L. 2004. Growth impacts of *Psittacanthus angustifolius* Kuijt on *Pinus oocarpa* Schiede in Honduras. Forest Ecology and Management 198: 75-88. (Noting severe effects of *P. angustifolius* on *P. oocarpa*, involving 50% reduction in volume increment over a three year period.)

Jayasinghe C., Wijesundara, D.S.A., Tennakoon, K.U. and Marambe, B. 2004. *Cuscuta* species in the lowlands of Sri Lanka, their host range and host-parasite association. Tropical Agricultural Research. 16: 223-241. (Confirming at last that, as we believed, the common *Cuscuta* sp. of lowland Sri Lanka is indeed not *C. chinensis* but almost certainly ('similar to') *C. campestris*, with a wide range of hosts, the most favoured being *Mikania 'cordata'* (= *M. micrantha*?) and *Wedelia trilobata*, but including rice, penetrated only via the mid-ribs. *C. reflexa* occurs in the highlands.)

Jha, A.K. and Khanna, K.K. 2002. Some new plant records for Madhya Pradesh. Journal of Economic and Taxonomic Botany 26: 619-621. (A first record of *Viscum angulatum* in Madhya Pradesh.)

Jiang Fan, Jeschke, W.D. and Hartung, W. 2004. Abscisic acid (ABA) flows from *Hordeum vulgare* to the hemiparasite *Rhinanthus minor* and the influence of infection on host and parasite abscisic acid relations. Journal of Experimental Botany 55: 2323-2329. (Describing detailed effects of N levels and host-parasite attachment on ABA levels – generally much higher in unattached *R. minor* than in un-parasitised barley. Even higher in attached *R. minor* but only slightly increased in parasitised barley. In spite of higher ABA levels, stomata remain open in attached parasite, whereas they are generally closed in unattached plants.)

Jiang Fan, Jeschke, W.D. and Hartung, W. 2004. Solute flows from *Hordeum vulgare* to the hemiparasite *Rhinanthus minor* and the influence of infection on host and parasite nutrient relations. Functional Plant Biology 31: 633-643. (*R. minor* attached to the host *H. vulgare* had 15-fold greater shoot weight but only 2-fold greater root weight than unattached plants. The host suffered 30-50% reduction in shoot growth mainly due to depleted N and P, but little reduction in roots. Many other detailed data on mineral levels in host and parasite.)

Kaya, Y., Demırcı, M. and Evcı, G. 2004. Sunflower (*Helianthus annuus* L.) breeding in Turkey for broomrape (*Orobanche cernua* Loeffl.) and herbicide resistance. Helia 27: 199-210. (Four lines of sunflower resistant to the F race of *O. cernua* showed varying response to new races but Pioneer hybrid P-4223 recorded high seed yields and showed resistance to broomrape in all locations in 2003.)

Kaya, Y., Evcı, G., Pekcan, V. and Gucer, T. 2004. Determining new broomrape-infested areas, resistant lines and hybrids in Trakya Region of Turkey. Helia 27: 211-218. (Reporting an increase in infested areas from 3% in 1995 to 35% in 2002, and widespread development of new virulent races. Few varieties proved resistant to *Orobanche cernua* in more than one or two localities, but Pioneer hybrid PR-64-A95 showed resistance in all of 6 localities tested.)

Keith, A.M., Cameron, D.D. and Seel, W.E. 2004. Spatial interactions between the hemiparasitic angiosperm *Rhinanthus minor* and its host are species-specific. Functional Ecology 18: 435-442. (*R. minor* plants growing close to the vigorous host *Festuca rubra* was less vigorous than those further away but also caused more reduction of the host. These differences did not occur significantly with the less vigorous *F. ovina*.)

Kelly, D., Ladley, J.J. and Robertson, A.W. 2004. Is dispersal easier than pollination? Two tests in New Zealand Loranthaceae. New Zealand Journal of Botany: 89-103. (The mistletoes *Peraxilla tetrapetala* and *Alepis flavida* are both pollinated and dispersed by the bellbird (*Anthornis melanura*). Reproductive performance of only *P. tetrapetala* was reduced by limited pollination in some years.)

Kourmanova, A.G., Soudarkina, O.J., Olsnes, S. and Kozlov, J.V. 2004. Cloning and characterization of the genes encoding toxic lectins in mistletoe (*Viscum album* L). European Journal of Biochemistry 271: 2350-2360. (Comparing the genes, mRNA levels and protein sequence and carbohydrate specificity of three lectin genes, MLI, MLII, and MLIII.)

Kutyna, I. and Wlodarczyk, E. 2004. (The occurrence of the mistletoe (*Viscum album* L.) in the selected areas of the city of Szczecin and in the areas adjacent to the Chemical Plant "Police" and the Power Station "Dolna Odra".) (in Polish) Folia Universitatis Agriculturae Stetinensis, Agricultura.93: 197-206. (The main hosts for *V. album* were *Populus nigra, Betula pendula* and *Robinia pseudoacacia*.)

Kutyna, I. and Wlodarczyk, E. 2004. (The heavy metals, sulphur and fluorine content in mistletoe (*Viscum album* L.) within the area of Szczecin Region.) (in Polish) Folia Universitatis Agriculturae Stetinensis, Agricultura 93: 207-217. (Showing high levels of sulphur and fluorine near chemical plants, of fluorine and lead along roads, and of cobalt and copper in rural areas due to fertilizer and pesticide application.)

Lin LieChwen, Chiou WenFei and Chou ChengJen 2004. Phenylpropanoid glycosides from *Orobanche caerulescens.* Planta Medica 70: 50-53. (Phenylpropanoid glycosides from *O. caerulescens* inTaiwan included five known and two new compounds. All showed higher antioxidant activity than resveratrol from grape.)

Ma, Y.Q. Cheng, J.M., Inanaga, S. and Shui, J.F. 2004. Induction and inhibition of *Striga hermonthica* (Del.) Benth. germination by extracts of traditional Chinese medicinal herbs. Agronomy Journal 96: 1349-1356. (Among 383 herbs tested, extracts from *Acorus gramineus, Agrimonia pilosa, Areca catechu, Citrus tangerina, C. reticulata, Cudrania cochinchinensis, Nardostachys chinensis, Oldenlandia diffusa, Portulaca oleracea, Scrophularia ningpoensis* and *Semiaquilegia adoxoides* stimulated at least 50% germination of *S. hermonthica*, while 15 others strongly inhibited germination including *Curcuma longa* which caused complete inhibition.)

Maiti, R.K. and Singh, V.P. 2004. Biotic factors affecting pearl millet (*Pennisetum glaucum* (L.) R. Br.) growth and productivity - a review. Crop Research (Hisar) 27: 30-39. (Reviewing a range of pests, diseases and weeds of pearl millet including *Buchnera hispida* and *Rhamphicarpa fistulosa*.)

Marley, P.S., Shebayan, J.A.Y., Aba, D.A. and Idem, N.U.A. 2004. Possibilities for control of *Striga hermonthica* in sorghum (*Sorghum bicolor*) using neem (*Azadiractha indica*) and parkia (*Parkia biglobosa*)-based products. International Journal of Pest Management 50: 291-296. (Numbers of *S. hermonthica* significantly reduced and crop yield increased by treatments with both neem and parkia, but abstract does not indicate rates of use.)

Mathiasen, R., Flores, A., Miranda, H. and Cadio, L. 2004. First report of *Arceuthobium vaginatum* subsp. *vaginatum* on *Pinus pseudostrobus.* Plant Disease 88: 1046. (A severe infestation recorded from Sierra Madre Oriental, Nuevo Leon, Mexico.)

Meinzer, F.C., Woodruff, D.R. and Shaw, D.C. 2004. Integrated responses of hydraulic architecture, water and carbon relations of western hemlock to dwarf mistletoe infection. Plant, Cell and Environment 27: 937-946. (Detailed studies of the effects of *Arceuthobium tsugense* on western hemlock showed serious interference with water use, 50% reduction in photosynthesis and 35% reduction in leaf nitrogen levels.)

Mikhalko, M.M. 2004. On southern borders. Zashchita i Karantin Rastenii 2004(4): 12-15. (Recording the occurrence of *Cuscuta campestris* and *C. monogyna* as quarantine organisms in the Rostov region of Russia.)

Moss, S.R., Cussans, J.W., Perryman, S.A.M. and Hewitt, M.V. 2004. The Broadbalk long-term experiment at Rothamsted: what has it told us about weeds. Weed Science 52: 864-873. (*Odontites vernus* among the top 12 species on permanent wheat plots receiving no herbicide and no fertilizer over the past 150 years, but being much less common on plots receiving 96 kg/ha N fertilizer annually.)

Müller-Stöver, D., Thomas, H., Sauerborn, J. and Kroschel, J. 2004. Two granular formulations of *Fusarium oxysporum* f.sp. *orthoceras* to mitigate sunflower broomrape *Orobanche cumana.* BioControl 49: 595-602. (Compared with granules based on sodium alginate, granules prepared from wheat flour kaolin (‘Pesta’) gave higher activity against *O. cumana* but showed shorter shelf life.)

Mureithi, J.G., Gachene, C.K.K. and Ojiem, J. 2002. The role of green manure legumes in smallholder farming systems in Kenya: the Legume Research Network Project. Tropical and Subtropical Agroecosystems 1(2/3): 57-70. (A review of green manure research in Kenya with comment on its value for suppression of *Striga hermonthica*.)

Nadal, S., Moreno, M.T. and Cubero, J.I. 2004. Registration of 'Retaca' faba bean. Crop Science 44: 1865. (A new faba bean variety developed in Spain, susceptible to *Orobanche crenata* but tolerating relatively high doses of glyphosate.)

Nadler-Hassar, T., Goldshmidt, A., Rubin, B. and Wolf, S. 2004. Glyphosate inhibits the translocation of green fluorescent protein and sucrose from a transgenic tobacco host to *Cuscuta campestris* Yunk. Planta 219: 790-796. (Glyphosate applied to host plants caused a decrease in sucrose and green fluorescent protein translocation to *Cuscuta* within three days.)

*Neel, M.C. and Cummings, M.P. 2004. Section-level relationships of North American *Agalinis* (Orobanchaceae) based on DNA sequence analysis of three chloroplast gene regions. BMC Evolutionary Biology 4: http://www.biomedcentral.com/1471-2148/4/15 (Provides molecular systematic data to support the monophyly of *Agalinis*. Also reveals a single evolutionary reduction in chromosome number, from n = 14 to 13.)

Olakojo, S.A. 2004. Evaluation of some maize inbred lines for tolerance to *Striga lutea* (Lour) in Southern Guinea savanna ecology. Journal of Food, Agriculture & Environment 2:256-259. (Among 8 inbred lines tested in northern Nigeria, inbred lines 0107-17 and 0108-20 combined genes for both *Striga* tolerance and higher grain yield.)

Olakojo, S.A., Ogunbodede, B.A. Makinde, J.O. and Ogundiya, M.O. 2004. Performance of newly developed *Striga lutea* tolerant maize genotypes under artificial *Striga* infestation. Journal of Food, Agriculture & Environment 2: 260-264. (Maize lines Advance NCRE-STR, 9022-13 and ACr97STR syn Y showed resistance to *S. asiatica* and gave higher yields compared with the susceptible hybrid 8338-1 and the resistant 9022-13.)

Omanya, G.O., Haussmann, B.I.G., Hess, D.E., Reddy, B.V.S., Kayentao, M., Welz, H.G. and Geiger, H.H. 2004. Utility of indirect and direct selection traits for improving *Striga* resistance in two sorghum recombinant inbred populations. Field Crops Research 89: 237-252. (Emphasising the importance of multilocational trials to achieve stable *Striga* resistance.)

Padi, F.K., Denwar, N.N., Kaleem, F.Z., Salifu, A.B., Clottey, V.A., Kombiok, J., Haruna, M., Hall, A.E. and Marfo, K.O. 2004. Registration of 'Apagbaala' cowpea. Crop Science 44: 1486. (Selected from a three-way cross between IT82E-16, 'Prima' and 148-1, Apagbaala has high grain yields and resistance to *Striga gesnerioides* for use in northern Ghana.)

Padi, F.K., Denwar, N.N., Kaleem, F.Z., Salifu, A.B., Clottey, V.A., Kombiok, J., Haruna, M., Hall, A.E. and Marfo, K.O. 2004. Registration of 'Marfo-Tuya' cowpea. Crop Science 44: 1486-1487. ('Marfo-Tuya', Reg. no. CV-220, PI 633740, a new cowpea cultivar developed from the cross Sumbrisogla/518-2 for northern Ghana, with resistance to *Striga gesnerioides*.)

Pérez-de-Luque, A., Sillero, J.C., Moral, A., Cubero, J.I. and Rubiales, D. 2004. Effect of sowing date and host resistance on the establishment and development of *Orobanche crenata* in faba bean and common vetch. Weed Research 44: 282-288. (Confirming reduced numbers of *O. crenata* emerged on partially resistant varieties of faba bean (Baraca) and vetch (A01) with early sowing, comparable with delayed sowing of susceptible varieties; but curiously lacking crop yield data.)

Pérez-Vich, B., Akhtouch, B., Knapp, S.J., Leon, A.J., Velasco, L., Fernández-Martínez, J.M. and Berry, S.T. 2004. Quantitative trait loci for broomrape (*Orobanche cumana* Wallr.) resistance in sunflower. Theoretical and Applied Genetics 109: 92-102. (The results suggest that resistance to *O. cumana* in sunflower is controlled by a combination of qualitative, race-specific resistance genes affecting the presence or absence of broomrape and a quantitative non-race specific resistance affecting their number.)

Pérez-Vich, B., Aktouch, B., Mateos, A., Velasco, L., Jan, C.C., Fernández, J., Domínguez, J. and Fernández-Martínez, J.M. 2004. Dominance relationships for genes conferring resistance to broomrape (*Orobanche cumana* Wallr.) in sunflower. Helia 27: 183-192. (A range of sources of resistance to the F race of *Orobanche cumana* from wild and cultivated lines were tested. Different dominance reactions and inheritance mechanisms were observed.)

Piven', V.T., Shulyak, I.I. and Muradasilova, N.V. 2004. Protection of sunflower. Zashchita i Karantin Rastenii 2004(4): 42-51. (Including reference to occurrence of *Orobanche cumana*.)

Plaza, L., Fernández, I., Juan, R., Pastor, J. and Pujadas, A. 2004. Micromorphological studies on seeds of *Orobanche* species from the Iberian Peninsula and the Balearic Islands, and their systematic significance. Annals of Botany 94: 167-178. (Presenting a key to 33 *Orobanche* spp. based mainly on ornamentation of the seed coat, detail of the periclinal walls allowing initial separation of 4 groups, further separation based on e.g. thickness of anticlinal walls, presence/absence of a trough, relative depth, etc.)

Pujadas Salvà, A.J. 2003. (*Orobanche flava* Mart. ex F.W. Schultz (Orobanchaceae) in the Iberian

Peninsula.) (in Spanish) Anales del Jardín Botánico de Madrid 60: 387-393. (*O. flava* is reported on *Aconitum vulparia. O. flava* var. *flava* occurs in the Pyrenees and var. *albicans* in the Cantabrian Mountains.)

Pujadas Salvà, A.J. and Crespo, M.B. 2004. A new species of *Orobanche* (Orobanchaceae) from south-eastern Spain. Botanical Journal of the Linnean Society 146: 97-102. (Describing a new species, *Orobanche portoilicitana,* parasitising *Centaurea* spp. on sand dunes in southern Spain, previously identified as *O. olbiensis*.)

Puustinen, S., Koskela, T. and Mutikainen, P. 2004. Relatedness affects competitive performance of a parasitic plant (*Cuscuta europaea*) in multiple infections. Journal of Evolutionary Biology 17: 897-903. (When pairs of *C. europaea* plants infected the same *Urtica dioica,* relative size asymmetry between the competing parasites was significantly higher in the non-related infections compared to infections with siblings.)

Rank, C., Rasmussen, L.S., Jensen, S.R., Pierce, S., Press, M.C. and Scholes, J.D. 2004. Cytotoxic constituents of *Alectra* and *Striga* species. Weed Research 44: 265-270. (Identifying a range of iridoid glucosides and two glycosides in *Striga* and *Alectra* species with conceivable significance in the damaging effects of these parasites, and in variations in host tolerance.)

Sagitov, A.O. and Zharmukhamedova, G.A. 2004. Protection of cereal crops in Kazakhstan. Zashchita i Karantin Rastenii 2004(2): 13-15. (Listing the 'quarantine weed *Cuscuta*' among weeds of wheat in Kazakhstan.)

Sandler, H., Mason, J., Autio, W. and Bewick, T.A. 2004. Effects of repeat annual applications of dichlobenil on weed populations and yield components of cranberry. Weed Technology 18: 648-657. (Noting good control of *Cuscuta gronovii* by dichlobenil.)

Schwartz, G., Hanazaki, N., Silva, M.B., Izzo, T.J., Bejar, M.E.P., Mesquita, M.R. and Fernandes, G.W. 2003. Evidence for a stress hypothesis: hemiparasitism effect on the colonization of *Alchornea castaneaefolia* A. Juss. (Euphorbiaceae) by galling insects. Acta Amazonica 33: 275-279. (Branches of *A. castaneaefolia* that are attacked by a *Psittacanthus* sp. were more heavily infested by galling insects than non-parasitised branches.)

Shamoun, S.F., Ramsfield, T.D. and van der Kamp, B.J. 2003. Biological control approach for management of dwarf mistletoes. New Zealand Journal of Forestry Science 33: 373-384. (Reporting on work with fungi *Colletotrichum gloeosporioides* and *Neonectria neomacrospora* which attack shoots and berries, and the endophytic systems of *Arceuthobium* spp.)

Shaw, D.C., Watson, D.M. and Mathiasen, R.L. 2004. Comparison of dwarf mistletoes (*Arceuthobium* spp., Viscaceae) in the western United States with mistletoes (*Amyema* spp., Loranthaceae) in Australia - ecological analogs and reciprocal models for ecosystem management. Australian Journal of Botany 52: 481-498. (Reviewing and comparing the ecologies of the *Arceuthobium* spp. of N. America and the *Amyema* spp. of Australia and finding parallels in their ecological role in forests and woodlands, and their influence on stand- and forest-scale dynamics; e.g. both provide nesting resources for birds and mammals, and nutritional resources for a wider range of species and both interact with fire. Both are considered as pests but have the potential to serve as sensitive ecological indicators for their respective ecosystems.)

Slavov, SA., van Onckelen, H., Batchvarova, R., Atanassov, A. and Prinsen, E. 2004. IAA production during germination of *Orobanche* spp. seeds. Journal of Plant Physiology 161: 847-853. (Germination of *O. ramosa* and *O. cumana* seeds was accompanied by release of IAA within 24 hours, before 'germ tube' elongation. Free IAA within the seeds remained unchanged whether seeds germinated or not. ABA levels were not affected by germination.)

Solymosi, P., Horváth, Z., Piszker, Z. and Vecseri, C. 2004. (Taxonomical studies on *Orobanche cernua* Loefl. and *O. cumana* Wallr. in Hungary.) (in Hungarian) Növényvédelem 40: 361-364. (Reporting on a study of the morphology, distribution and hybridization of *O. cernua* and *O. cumana* in Hungary.)

Srivastava, S., Tripahi, R.D. and Dwivedi, U.N. 2004. Synthesis of phytochelatins and modulation of antioxidants in reponse to cadmium stress in *Cuscuta reflexa* – an angiospermic parasite. Journal of Plant Physiology 161: 665-674. (Inhibitory effects of cadmium on *C. reflexa* were similar to those on non-parasitic plants.)

Stefanović, S. and Olmstead, R.G. 2004. Testing the phylogenetic position of a parasitic plant (*Cuscuta*, Convolvulaceae, Asteridae): Bayesian inference and the parametric bootstrap on data drawn from three genomes. Systematic Biology 53: 384-399. (Analysis of nuclear, mitochondria, and chloroplast genes further refines the phylogeny of Convolvulaceae, but falls short of precisely fixing the position of *Cuscuta*.)

Tamis, W.L.M., van Heeswijk, J., van't Zelfde, M., van der Meijden, R. and Groen, C.L.G. 2003. (Digitization of the historic botanical survey lists of the province of Drenthe in the Netherlands.) (in Dutch) Gorteria 29: 157-169. (Historical botanical survey data recently digitised into FLORIVON-2 reveal a striking decline in distribution of *Rhinanthus angustifolius* over the period 1900-1950.)

Tarasenko, G.S. 2004. Phytosanitary quarantine in the southern Urals. Zashchita i Karantin Rastenii 2004(3): 10-11. (Noting *Cuscuta* among quarantine weeds of the Chelyabinsk region of Russia.)

Tavoljanskiy, N.P., Tikhomirov, V.T., Chiryaev, P.V. and Yakutkin, V.I. 2004. Results of immunological estimation of the original and breeding material of sunflower from VIS. Helia 40: 219-225. (A wide range of material screened for resistance to fungal diseases and *Orobanche cernua*. 'Almost all lines among the CMS (cytoplasmic male sterility) sources of the no-RET type remained free from broomrape.')

Valderrama, M.R., Román, B., Satovic, Z., Rubiales, D., Cubero, J.I. and Torres, A.M. 2004. Locating quantitative trait loci associated with *Orobanche crenata* resistance in pea. Weed Research 44: 323-328. (Reporting the development of a linkage map and the identification of two QTL that each explain about 10% of the resistance to *O. crenata*.)

Vasyutin, A.S. 2004. To prevent damage from quarantine weeds. Zashchita i Karantin Rastenii 2004(1): 30-32. (A list of quarantine weeds in Russia includes *Cuscuta* spp.)

Vysokopoyasnyĭ, A.I. 2004. Plant quarantine in Kuban. Zashchita i Karantin Rasteniĭ 2004(5): 12-14. (Quarantine weeds in Krasnodar region, southern Russia, include *Cuscuta* spp.)

Westbury D.B. 2004. *Rhinanthus minor* L. Biological Flora of the British Isles. Journal of Ecology 92: 906-927. (A comprehensive, authoritative review with particularly valuable discussions on ecology, host range, physiology, etc.)

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HAUSTORIUM 46
has been edited by Chris Parker, 5 Royal York Crescent, Bristol BS8 4JZ, UK (Email chrisparker5@compuserve.com), Lytton John Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk Virginia 23529-0266, USA (fax 757 683 5283; Email lmusselm@odu.edu) and Jim Westwood, Dept. of Plant Pathology, Physiology and Weed Science, Virginia Tech, Blacksburg, VA 24061-0331, USA (Email westwood@vt.edu). Send material for publication to any of the editors. Printing and mailing has been supported by Old Dominion University.

HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Plant Society

July 2005 **Number 47**

IPPS – RESULTS OF ELECTION

The newly elected Officers of the IPPS are:

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A MESSAGE FROM THE NEW PRESIDENT OF IPPS

Dear IPPS Members,

A new team was recently elected for the Executive Committee of our Society. May I thank all those who took part in these elections. May I also thank the Election Committee (Patrick, Jos and Gualbert) for conducting the elections efficiently and promptly.

This is also the time to send our cordial thanks to our colleagues who served as Executive Committee Members during the last four years: André Fer, the first IPPS President, Patrick Thalouarn, the Vice-President, Jos Verkleij, the Treasurer, Jim Westwood, the Editor, and Gualbert Gbehounou, the Member at-Large. I was honoured to work with them as the first IPPS Secretary. The previous Executive Committee had the difficult task of initiating the activity of the new Society, establishing the Constitution and registering the IPPS as an International Society. It was also in charge of the organization of the 8th International Symposium on parasitic weeds, which was held in South Africa last year.

The IPPS has developed only recently, with the objective to promote parasitic plant research and to help the scientific community in developing new effective means for the management of parasitic weeds. Accordingly, the first issues on our agenda are (a) the next IPPS Congress, and potential additional meetings; (b) further development of the Newsletter Haustorium; (c) Standardization of Parasitic Plants terminology. (d) Extending the number of IPPS Members.

Only very few parasitic plant species are known to cause damage in agriculture and forestry. Nevertheless their impact on world economy cannot be ignored and much effort is put every year worldwide in order to find means to reduce their damage. Yet, the mechanisms employed by these parasites are far from being understood. One group of noxious parasitic weeds belongs to the Orobanchaceae. A special symposium on this family was held last month at the International Botanical Congress (IBC2005) in Vienna, indicating the significance of parasitic plants both as vicious weeds and as a model for studies on the parasitic syndrome in plants. Indeed, parasitic plant research, as shown in this Symposium, has recently entered into a new era, when molecular biology allows major changes in the classification of some parasitic plant groups, and allows the understanding of some key mechanisms of this peculiar group of plants, offering the ability to further understand some key steps in their evolution, and identify genes that are involved in parasitism. One of the important contributions of molecular biology is the transfer of the genus *Striga* and of similar parasitic genera from the Scrophulariaceae to the Orobanchaceae. Another major contribution is the establishment of solid evidence that may soon lead to splitting the genus *Orobanche* into two or more genera, as already suggested by the late Prof. Edward Teryokhin in 1998.

Whereas the control of parasitic weeds was almost impossible until very recently, new means for its control are gradually emerging, based not only on the employment of some new herbicides and new resistances, but also on the employment of molecular biology for this sake. One can envisage further developments in this direction during the coming years. The IPPS will do its best to encourage a better communication between parasitic plant research groups in order to accelerate this momentum.

The publication of 'Haustorium' is a difficult task. Thanks to the Editors, Chris Parker, Lytton Musselman and Jim Westwood, this newsletter is prepared and distributed periodically to the benefit of all of us. The effort, thinking, and hard work that they contribute are highly appreciated. Diego Rubiales, the newly elected Editor of the IPPS will soon join them in an effort to strengthen the ties between IPPS members. Obviously the quality and content of the newsletter depend on contributions from all of us. Please make sure that you update us through 'Haustorium' with abstracts of new publications, dissertation summaries, research reports, interesting observations, and new questions for discussion.

We will soon decide on the venue for the next IPPS Congress, which is due for 2006. Any suggestions for a venue will be most welcome.

Danny Joel
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LITERATURE HIGHLIGHT - FINALLY, A *RAISON D'ÊTRE* FOR GERMINATION STIMULANTS

A long-standing question in parasitic plant biology has been what is the "natural" role for germination stimulants? After all, it does not seem to be in the host's best interest to synthesize and exude chemicals that serve only to stimulate parasite seed germination. The stock response to this question has been a vague presumption that germination stimulants probably serve as either phytoalexins or signals to microbes in the rhizosphere. Now, at last, we have some solid evidence on this subject. In a recent issue of Nature, Akiyama and co-authors (see reference in literature section below) show that strigolactones promote hyphal branching in arbuscular mycorrhizal fungi. They isolated a new variant of strigol, 5-deoxy-strigol, from *Lotus japonicus*, and demonstrated that this compound, sorgolactone, strigol, and the synthetic strigolactone GR24 all induce hyphal branching in *Gigaspora margarita* at very low concentrations. Orobanchol is also active in the branching assay (K. Akiyama, personal communication). 5-Deoxy-strigol was reported to be ca. 1/3 as active as (+)-strigol on *O. crenata* (Bergmann, G. et al., J. Plant Physiol. 42: 338-342, 1993) and seems to be a major component of the stimulant complex in sorghum (cv. Hybrid) and in maize (cv. Dent) (K. Yoneyama, unpublished results).

Arbuscular mycorrhizal fungi are obligate symbionts and hyphal branching is required for colonization of host roots. The production of strigolactones by the host makes sense in this context because the symbiosis with the mycorrhizal fungi is an ancient evolutionary association that provides a significant boost in nutrient acquisition. Thus, it appears that success by parasitic weeds is attributable in part to having developed the ability to eavesdrop on the chemical communication taking place between the host and mycorrhizal fungi, thereby gaining the spatial information needed to locate the host.

This work will help in refining our concepts of germination stimulants. The rhizosphere is a complex world, and chemical signals and mechanisms for their perception may be shared across diverse classes of organisms (see the review by Palmer *et al.* below). Parasitic plant research may thus contribute to understanding many other soil biotic interactions. Another implication is that crop protection strategies based on eliminating host production of germination stimulants may not be as simple as initially conceived. We will have to balance the disruption of parasite germination signalling with the preservation of vital symbiotic interactions.

Jim Westwood, Virginia Tech, Blacksburg, USA and Koichi Yoneyama, Utsonomiya University, Japan.

FIGHT *STRIGA* WITH 'UA KAYONGO' HYBRID MAIZE!

For many years now, Kenyan farmers in Nyanza and Western Provinces have suffered from the parasitic weed commonly known as *Striga* as it destroys their cereal crops, particularly maize. *Striga* has invaded approximately 200,000 hectares of Kenyan cropland resulting in losses of about KSh 800 million each year. It is also the major contributor of food insecurity among thousands of households in west Kenya as it causes yield losses of this major staple food crop. To fight the threat of *Striga*, farmers in Kenya will soon have a new maize hybrid Ua Kayongo that is coated with 'Strigaway'TM herbicide that kills *Striga*.

This revolutionary maize technology literally kills the germinating *Striga* seeds as they attempt to infect the maize plants. Among scientists, this technology is known as Imazapyr Resistance-maize (IR-maize) or the Clearfield system. It is based upon a naturally occurring herbicide resistance by maize that was first identified by researchers at BASF, a supplier of agro-chemicals, and was later incorporated into Kenyan maize varieties by African plant breeders at the International Maize and Wheat Improvement Center (CIMMYT) and the Kenya Agricultural Research Institute, (KARI). Currently, three seed companies, Kenya Seed, Lagrotech and Western Seed are producing the new hybrid maize for field testing during the upcoming cropping season (long rains 2005) and are expected to commercialize their seed during the following season (short rains 2005-2006). Recently, representatives of the three seed companies met and agreed to market this new maize hybrid under the common commercial name Ua Kayongo H1 (*Striga* killer).

The African Agricultural Technology Foundation (AATF) was recently established to assist African farmers access appropriate technologies. One of its identified priorities is the introduction of IR-maize technology to the farming communities of west Kenya. To achieve this goal, AATF is in partnership with CIMMYT, KARI, and BASF and seeks further collaboration of NGOs (We RATE - SACRED-Africa, SCODP, FORMAT), seed companies and their distribution network and stockists (Kenya Seed, Lagrotech, Western Seed), international organizations such as TSBF-CIAT and others in disseminating the IR-maize technology to fight *Striga*. This partnership will establish extensive field demonstrations and conduct numerous field days to promote Ua Kayongo H1 throughout Nyanza and Western Provinces during the next three cropping seasons. We RATE is an alliance of NGOs, farmer associations and research organizations that establishes different recommended technologies and facilitates farmer adaptation to these technologies and their incorporation into smallholder practice.

Ua Kayongo H1 is planted and managed in the same way that farmers currently grow their maize. However, as is recommended with all commercially available maize seed coated with insecticide and fungicide, farmers should wash their hands after handling Ua Kayongo. They should also not handle other seeds before they wash off the StrigawayTM herbicide as this may affect germination of the other crops. Ua Kayongo can be intercropped with legumes, but the two must not be planted in the same hole, as the StrigawayTM herbicide is likely to affect the legume seed. For long-term control of *Striga*, Ua Kayongo should be combined with other *Striga* management technologies, such as the Push-Pull system, or MBILI planted with groundnut, golden gram, soyabean or lablab. One recently identified advantage of using Ua Kayongo is that the first weeding is less tedious due to the reduced number of weeds near the young maize seedling.

During the upcoming long rains 2005, the partnership to fight *Striga* will showcase this technology through numerous Ua Kayongo demonstration plots in *Striga*-infested areas and conduct farmer-managed trials to demonstrate the efficacy of the technology in farmers' fields. The partners will also distribute Ua Kayongo to over 16,000 households and conduct several farmer field days and other activities including a travelling workshop in June 2005.

For more information on the partnership to fight *Striga*, please contact:
African Agricultural Technology Foundation
P.O. Box 30709, Nairobi 00100, Kenya.
Email: aatf-information@cgiar.org
You can also contact:
CIMMYT: cimmyt-kenya@cgiar.org
Dascot Ltd: dascot@nbi.ispkenya.com

(reproduced from the web-site http://www.africancrops.net/striga)

FAO PROJECTS ON PARASITIC WEEDS

FAO is executing two regional projects on integrated management of parasitic weeds. One, in collaboration with ICARDA, for *Orobanche* management in leguminous crops, includes countries from North Africa (Morocco, Algeria, Tunisia, Egypt and Sudan), Near East (Syria), and Ethiopia. The second project, for *Striga* control, started recently in Benin, Togo, Burkina Faso, Niger, Mali and Senegal . The main objective of these projects is to strengthen management capabilities of technical field staff and farmers; to establish a sustainable network for collecting and disseminating information on new control alternatives for parasitic weeds, and to enhance public awareness of the problems. These projects are the first steps in a long-term program since it is estimated to take a 4-5 year project for the management of parasitic weeds. The main activities of the projects are training of technicians (extension workers and other agents working with farmers) and farmers. In each of the countries one Training of Trainers (TOT) was implemented as well as two Farmers Field Schools (FFS) with the participation of an average of 25 farmers in each of the schools for two cropping seasons. The curriculum of FFS includes training on eco-biology of the parasitic plants (life cycle, importance of seed bank in soil and others) and control methods (rotation, use of post-emergence herbicide treatments, preventing flowering). In addition, the project on *Orobanche* has included training to prevent entry of exotic parasitic weeds, e.g. *Orobanche crenata.* into Ethiopia and Sudan. Both projects also include training in biological control. The *Orobanche* project will start its second cropping season soon while the *Striga* project is just starting its work plan. Both programs are carried out with the collaboration of the expertise available in the countries and in the region.

Ricardo Labrada, FAO, Rome.

THESES

Talia Nadler-Hassar (PhD, Hebrew University of Jerusalem, Israel, June 2004)
Amino acid biosynthesis inhibitors, and their effect on assimilates and nutrients translocation between the field dodder (*Cuscuta campestris* Yuncker) and its hosts
(Supervision: Prof. Baruch Rubin)

Cuscuta campestris Yuncker (field dodder) is a nonspecific above-ground holoparasite, totally dependent on a host plant for assimilates, nutrients and water supply. The parasite uses haustoria to penetrate the host and make contact with its vascular bundles. An established parasite employs a strong sink ability (super sink) and competes against the host's sinks for assimilates and solutes. The strong sink ability of the parasite combined with its wide geographical distribution and wide range of hosts, makes *C. campestris* an extremely damaging weed that causes heavy loss of yield. Many groups of herbicides are unsuitable for *C. campestris* control since they act on target sites that either do not exist or are not essential to the parasite. Also, close association between host and parasite necessitates the use of herbicides that would only harm the parasite. Glyphosate and acetolactate synthase (ALS) inhibitors belong to a group of amino acid biosynthesis inhibitors (AABI) reported to be somewhat effective in *C. campestris* control. Glyphosate inhibits the biosynthesis of aromatic amino acids by inhibiting the enolpyruvylshikimate-3-phosaphate (EPSPS) and ALS inhibitors obstruct the biosynthesis pathway of branched chain amino acids. AABI are also reported to inhibit translocation of assimilates in treated plants. The damage caused to plants treated with these herbicides may be alleviated by adding the missing amino acids to the growing medium.

As *C. campestris* operates as a "super-sink" when attached to a host, it should not then be affected by AABI since it has an alternative source for amino acids. The fact that these herbicides are somewhat effective in *C. campestris* control suggests that another mechanism is involved in the parasite injury. The hypothesis for this study will be that the parasite dies due to inhibited translocation of assimilates and solutes from the host, whereas lack of amino acids is a minor factor. The objectives of this work were: to determine if the *C. campestris* has functional amino acid biosynthesis (AAB) pathways and if so how they are influenced by AABI herbicides; to elucidate the AABI mode of action in host-parasite associatio; and to better understand the relationship between the *C. campestris* and its host under the influence of these herbicides.

The response of *C. campestris* seedlings to different AABI was evaluated by measuring the shoot length of parasite seedlings 4 days after sowing (DAS) without a host in Petri dishes filled with coarse sand and different concentrations of glyphosate or ALS inhibitors (sulfonylureas, imidazolinones, triazolopyrimidines and pyrithiobac). The I_{50} values (the herbicide concentration that causes 50% inhibition of shoot elongation) of *C. campestris* in each herbicide were calculated from dose response curves and compared to those of suitable sensitive and herbicide resistant species. In order to test the response of parasitized *C. campestris* to various AABI, the parasite was grown in association with Roundup Ready (RR) soybeans RR sugar beet and sulfonylurea resistant (SuR) tomatoes and exposed to high herbicide rates. Both assays conducted on independent seedlings of *C. campestris* and those attached to a host revealed that the parasite was tolerant to high concentrations of AABI. The I_{50} value of *C. campestris* seedlings for glyphosate was 8, 330 and 650-fold higher then those of RR cotton, regular cotton and sorghum seedlings respectively and the I_{50} values for *C. campestris* and sorghum in chlorsulfuron (ALS inhibitor) were 500µM and 0.004µM. The response of *C. campestris* seedlings to AABI is unique since when exposed under the same conditions to trifluralin (a microtubule assembly inhibitor) the I_{50} of *C. campestris* seedlings was similar to that for sorghum roots. Attached *C. campestris* plants were also tolerant to AABI herbicides, half of those on SuR tomato and RR sugar beet survived and recovered from commercial herbicide rates sprayed on the host and parasite, leading to the assumption that under field conditions well established *C. campestris* could survive and recover from AABI application and harm the crop.

The evaluation of EPSPS and ALS response to AABI was done after establishing that these enzymes are active in *C. campestris*. Shikimate accumulation in parasite seedlings exposed to glyphosate indicated that *C. campestris* has an active, glyphosate sensitive EPSPS. As a substrate of EPSPS, shikimate accumulates rapidly in sensitive plant tissues treated with glyphosate. The presence of an active ALS in *C. campestris* was established directly on plant protein extracts. The ALS assays showed that the parasite has an active ALS enzyme, possibly less sensitive to sulfonylureas (rimsulfuron, chlorsufuron, sulfometuron) and imidazolinones (imazaquin) than other non-parasitic plants.

To test the effect of glyphosate on the translocation between the host and parasite, *C. campestris* was allowed to parasitize a transgenic tobacco host that expresses the green fluorescent protein GFP. The GFP under the control of the *Arabidopsis thaliana* sucrose transporter (*At*SUC2) promoter is expressed exclusively in the companion cells of source tissues from which it enters the sieve elements via the plasmodesmata and is translocated and unloaded symplastically at sink tissues. A confocal laser scanning microscope and Immune blots with specific GFP antibodies detected GFP accumulation in the parasite between 14 and 25 DAS. Glyphosate applied to the host 22 DAS led to shikimate accumulation in the parasite one day after glyphosate treatment (DAGT) and a significant reduction in GFP accumulation 2 DAGT. Glyphosate caused a similar reduction in [^{14}C] sucrose translocation between the tobacco host and parasite. The results from this part of the work indicate that glyphosate inhibits translocation between tobacco and *C. campestris* but since the host is not glyphosate resistant it is impossible to determine whether the inhibition is due to the damage caused to the host or to the parasite.

To pinpoint the exact cause for this inhibition, *C. campestris* was attached to regular (sensitive) and transgenic soybeans resistant to glyphosate (RR). Both soybean hosts were used to compare the movement of [^{14}C] glyphosate from a RR and sensitive host to *C. campestris* and to determine if glyphosate has a different effect on the movement of [^{14}C] sucrose and [^{14}C] phenylalanine from host to parasite. In all assays carried out, *C. campestris* acted as a 'super sink' and rapidly accumulated up to 70% of the total translocated [^{14}C] glyphosate, and up to 40% of the translocated [^{14}C] sucrose and [^{14}C] phenylalanine. The accumulation of [^{14}C] in *C. campestris* following the application of [^{14}C] phenylalanine supports the postulation that the host can serve as an alternative source for amino acids. However, unlike the inhibiting effect glyphosate had on translocation between tobacco and *C. campestris*, the herbicide did not inhibit [^{14}C] sucrose translocation from RR and regular soybeans to *C. campestris*. This could be attributed to the partial tolerance of soybean to glyphosate.

In conclusion, this research revealed the high tolerance of *C. campestris* seedlings to AABI and the parasite's ability to recover from high rates of these herbicides while parasitizing resistant host plants. Tolerance to ALS inhibitors could be attributed to a resistant target site but the resistance mechanism to glyphosate is yet to be investigated. The inhibiting effect of glyphosate on the translocation from tobacco to *C. campestris* supports the hypothesis that glyphosate treated *C. campestris* is affected at least partially by the lack of assimilates and solutes. This research did not define whether glyphosate inhibits translocation in the host or the parasite but the tolerance of *C. campestris* seedlings to glyphosate may lead to the conclusion that glyphosate inhibits translocation in the host.

Rosemary Ahom (PhD University of Nigeria, Nsukka, Nigeria, January, 2005)
Studies on management of *Striga hermonthica* (Del.) Benth. in maize with inter crop, trap crop varieties and nitrogen fertilization in Benue State, Nigeria. (Supervision: Dr O.U. Okereke)

In this project, studies on the management of *S. hermonthica* in maize with intercrops, trap crop varieties and nitrogen fertilization were conducted in a relatively highly *Striga*-infested area in Benue State, Nigeria with the aim of demonstrating to the small scale, resource-poor farmers the benefits of using these techniques in combination to reduce the severity of this devastating weed on maize production. The three management strategies used as an integrated *Striga* management (ISM) package here fit into the cultural practices of the small-scale farmer in Benue State and it was hoped that they would facilitate easy adoption. To achieve these aims, three studies were carried out.

The first step was an extensive and intensive survey in year 2000 to determine the extent of *Striga* infestation in the three agricultural zones in Benue State (latitude 6°30'E and 8°10'N and longitude 8°E and 10°N), with a typical Southern Guinea Savannah vegetation. The second study was a field trial in a naturally heavily *Striga*-infested area in Eastern agricultural zone in Benue State to determine the possible effects of intercropping and N-fertilization on *Striga* infestation using two maize varieties intercropped with either soybean or sesame at three levels of N- application (0, 60, and 120 $kgNha^{-1}$). The experiment was laid out as a factorial in randomized complete block design (RCBD) with three replications. This study was aimed at demonstrating the advantage of an integrated package for suppression of *S. hermonthica* parasitism on maize using cultural practices familiar to the small-scale farmer. The third study, which was a follow-up to the second study, was conducted in year 2001. Since the trap-crops (soybean and sesame) used in the field trial in year 2000 differed in their ability to reduce or suppress *S. hermonthica*, a laboratory assay was designed to screen a large number (17) of sesame varieties and 13 pigeon pea accessions for their efficacy in stimulating *S. hermonthica* seed germination *in vitro.* The design of the experiment was completely randomized design (CRD) with four replications. Since varietal differences exist between and within trap-crops and among *Striga* strains, the aim of this screening was to find out the varieties of the test crops that are more efficient or very efficient in inducing suicidal seed germination in *S. hermonthica* strains in Benue State. The *Striga* seeds used were therefore collected from Benue State to forestall the problem of strain variation in *S. hermonthica.*

The extensive and intensive surveys conducted were successful in establishing the status of *Striga* as a serious weed and a major constraint to maize production in Benue State. It was found that the crop management practices employed by farmers in the state are not helping the problem of *Striga* infestation. This is the major reason why farmers cannot cope with *Striga* parasitism on maize and some have stopped growing the crop.

The field trial achieved the aim of demonstrating the advantage of using an ISM package to reduce the severity of *Striga* infestation and thus increasing maize yields where soybean was intercropped with maize. But with sesame, which was more efficient than soybean as an intercrop in reducing *Striga* infestation, yield advantage of maize was not obvious. Optimum plant population and spatial arrangement of maize and sesame in the mixture may not have been used. This needs to be verified.

The laboratory assay confirmed the variability between and within the pigeon pea and sesame varieties screened. On the whole, pigeon pea was more efficient in stimulating seed germination in *S. hermonthica* compared to sesame. On this basis, the pigeon pea accessions were grouped as follows: very high stimulant production varieties (TCC 1035, Cita 4, TCC 6, TCC 8126, Cita 3, TCC 87 and Cita 2); high stimulant production varieties (TCC 2, TCC 8127, TCC 151, and Cita 1); and moderate stimulant production varieties (TCC 8 and TCC 8129).

For sesame, the following groups were established: high stimulant production varieties (69B – 882 and Yandev 55); moderate stimulant production varieties (Ex-Pankshin-98, 73A – 79B, Cross-95, E-8, Ncriben – 01M, 73A-82B, 60-2-3-1-8B and Ciano-16); low stimulant production varieties (Yandev-75, Type-4, Ciano-27, Eva and 69-1-1); and very low stimulant production varieties (Pachequeno and Ncriben-03L).

In conclusion, *S. hermonthica* is a major constraint to maize production in Benue State. At the moment the crop husbandry practices used by farmers in Benue

State are not efficient in tackling *Striga* problem. It is concluded that ISM is more beneficial in reducing or contending *Striga* problem. Varietal differences exist among trap crops in their efficacy in stimulating suicidal seed germination in *S. hermonthica* and consequently reduction or control of *Striga* parasitism on cereals.

Recommendations are made for the adoption of appropriate procedures by farmers and for further research where this is required.

SANDALWOOD

The latest issue of Sandalwood Research Newsletter announces that publication is ceasing after Issue 20, released in April 2005. However, further information on the Forest Products Commission (FPC)'s interest in tropical and arid sandalwood establishment and management can be found on the FPC web-site (see below). It also announces that the Asia-Pacific Regional Sandalwood Workshop will be held in Suva, Fiji in October 2005. For further details contact Mr Sairusi Bulai, SPC Regional Forestry Adviser, SPC Private Mail Bag Suva, Fiji or via sairusib@spc.int (fax 679-3305212).

NON-WEEDY HEMIPARASITIC SCROPHULARIACEAE (OROBANCHACEAE)

Thirteen papers from the symposium held in Wageningen in April 2004 have now been published in full in Folia Geobotanica 40: 113-318, together with an Introduction and Synthesis. Copies of this attractive special volume are available from Opulus Press for 20 euros plus postage. To order and/or to view abstracts of these 13 papers, see www.opuluspress.se The individual papers will be noted in Haustorium 48. Meanwhile copies of the booklet with abstracts of all 30 oral and poster presentations (listed in Haustorium 45) are still available from Siny ter Borg at Hamelakkerlaan 11, 6703 EE Wageningen, The Netherlands.

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If you received this issue by airmail, do please consider changing to our email mailing list in future. You will receive it sooner, be able to file it electronically, with benefit of searchability, while also saving our costs of distribution.

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Chris Parker will be pleased to hear from you on any of these points..

GENERAL WEB SITES

For individual web-site papers and reports see LITERATURE

For information on the International Parasitic Plant Society, past and current issues of Haustorium, etc. see: http://www.ppws.vt.edu/IPPS/

For past and current issues of Haustorium see also: http://web.odu.edu/haustorium

For the ODU parasite site see: http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page

For Lytton Mussleman's *Hydnora* site see: http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/lecturesandarticles

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rmrs.nau.edu/misteltoe/welcome.html

For information on activities and publications of the parasitic weed group at the University of Hohenheim see: http://www.uni-hohenheim.de/~www380/parasite/start.htm

For information on, and to subscribe to, PpDigest see: http://omnisterra.com/mailman/listinfo/pp_omnisterra.com

For information on the EU COST 849 Project and reports of its meetings see: http://cost849.ba.cnr.it/

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' the address is: http://www.omnisterra.com/bot/pp_home.cgi

For a description and other information about the *Desmodium* technique for *Striga* suppression, see: http://www.push-pull.net

For information on EC-funded project 'Improved *Striga* control in maize and sorghum (ISCIMAS) see: http://www.plant.dlo.nl/projects/Striga/

For the work of Forest Products Commission (FPC) on sandalwood, see: www.fpc.wa.gov.au

LITERATURE

* indicates web-site reference only

NB Chris Parker will be pleased to provide authors' contact addresses wherever possible, on request.

*African Agricultural Technology Foundation. 2005. Fight *Striga* with Ua Kayongo hybrid maize! http://www.africancrops.net/striga (see full extract in text above.)

Ahonsi, M.O., Berner, D.K., Emechebe, A.M. and Lagoke, S.T. 2004. Effects of ALS-inhibitor herbicides, crop sequence, and fertilization on natural soil supressiveness to *Striga hermonthica*. Agriculture, Ecosystems and Environment 104: 453-463. (Pot experiments with a soil from Ibadan, Nigeria provide rather striking evidence for the importance of microbial soil-suppressiveness of *S. hermonthica,* its enhancement by rotation with soybean, and/or nitrogen fertilization, and its reduction after application of ALS inhibiting herbicides.)

Akiyama, K., Matsuzaki, K. and Hayashi, H. 2005. Plant sesquiterpenes induce hyphal branching in arbuscular mycorrhizal fungi. Nature 435: 824-827. (Spores of the AM fungus *Gigaspora margarita* germinate without need for a stimulus but fail to show hyphal branching and further development in the absence of a stimulant, now identified as 5-deoxy-strigol. See further comment above.)

Andolfi, A., Boari, A. Evidente, A. and Vurro, M. 2005. Metabolites inhibiting germination of *Orobanche ramosa* seeds produced by *Myrothecium verrucaria* and *Fusarium compactum*. Journal of Agricultural and Food Chemistry. 53:1598-1603. (Eight fungal compounds (1-10 µM concentrations) showed inhibitory activity to seed germination.)

Ang, S.L.P. and Yong, J.W.H. 2005. A protocol for *in vitro* germination and sustainable growth of two tropical mistletoes. Plant Cell, Tissue and Organ Culture 80: 221-228. (Describing germination and sustained growth of *Dendrophthoe pentandra* and *Macrosolen cochinchinensis* using Murashige and Skoog (MS) media supplemented with coconut water (15-20% v/v) in ventilated culture vessels. *D. pentandra* was somewhat easier to culture than *M. cochinchinensis*.)

Anjum Perveen and Mohammad Qaiser. 2004. Pollen flora of Pakistan - XLI. Cuscutaceae. Pakistan Journal of Botany 36: 475-480. (Study of the pollen from 11 *Cuscuta* spp. by light microscopy and SEM showed 3 types – a *C. reflexa* type, a *C. capitata* type and a *C. campestris* type. A key to species based on pollen characteristics is presented.)

Arunachalam, A., Adhikari, D., Sarmah, R., Majumder, M. and Khan, M.L. 2004. Population and conservation of *Sapria himalayana* Griffith. in Namdapha national park, Arunachal Pradesh, India. Biodiversity and Conservation 13: 2391-2397. (*S. himalayana* in Rafflesiacese is on the brink of extinction, due to loss of habitat and narrow host range, locally observed to be a woody vine, *Tetrastigma* sp.)

Babalola, O.O., Sanni, A.I. and Odhiambo, G.D. 2004. Isolation of rhizobacteria associated with maize and assessment of their potential for use in *Striga hermonthica* (Del.) Benth. suicidal germination. Journal of Tropical Microbiology 3(1): 64-70. (Apparently suggesting potential for *Enterobacter sakazakii, Pseudomonas* sp. and *Klebsiella oxytoca* as biocontrol agents in Kenya, but abstract not at all clear.)

Bach, C.E. and Kelly, D. 2004. Effects of forest edges on herbivory in a New Zealand mistletoe, *Alepis flavida*. New Zealand Journal of Ecology 28: 195-205. (Leaf herbivory by possums was sometimes greater on forest edges than in forest interior. Differences in damage from insects was less consistent.)

Baker, F.A. and Knowles, K.R. 2004. Case study: 36 years of dwarf mistletoe in a regenerating black spruce stand in Northern Minnesota. Northern Journal of Applied Forestry 21(3): 150-153. (Recording the re-establishment of a severe infestation of *Arceuthobium pusillum* in black spruce when very few small trees were left after felling, emphasising the need for complete clearing to prevent infection of new plantings.)

Benvenuti, S., Pompeiano, A., Macchia, M. and Miele, S. 2004. Evaluation of an experimental stimulant for germination induction of hemp broomrape (*Orobanche ramosa* L.) in tobacco crops (*Nicotiana tabacum* L.). Italian Journal of Agronomy 8: 17-28. (Nijmengen 1 ex BASF applied to the field before planting (dose not stated in abstract) reduced *O. ramosa* seed numbers in upper 10 cm of soil by 75% but was less effective below this depth.)

Boulet, C., Boutin, F., Théodet, C., Esbérard, E. and Thalouarn, P. 2004. (*Odontites luteus*, vineyard root parasite.) (in French) Phytoma 576: 32-35. (*O. luteus* is strongly suspected to be the cause of vine death in a vineyard in southern France. Haustoria are described from the vine roots.)

Braby, M. F. 2005. Afrotropical mistletoe butterflies: larval food plant relationships of *Mylothris* Hübner (Lepidoptera: Pieridae). Journal of Natural History 39: 499-513. (Reviewing the known food plants of *Mylothris* spp., several of which are closely associated with parasitic Santalales and concluding that *Mylothris* had its major period of evolution and adaptive radiation on the Loranthaceae.)

Brandt, J.P., Hiratsuka, Y. and Pluth, D.J. 2004. Collecting and storing seeds of *Arceuthobium americanum* from *Pinus banksiana*. Canadian Journal of Plant Pathology 26: 397-402. (Stockinet was used to intercept 62% of discharged seeds. After storage in sealed jars at 2^{o}C, germination was 60-70% after 300 days, declining to 11-30% after 2 years.)

Buschmann, H., Kömle, S., Gonsior, G. and Sauerborn, J. 2005. Susceptibility of oilseed rape (*Brassica napus* ssp. *napus*) to branched broomrape (*Orobanche ramosa* L.). Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz 112: 65-70. (Pot experiments showed contrasting virulence of 2 German populations of *O. ramosa*, also differing reactions of summer ('Jumbo') and winter ('Akela') varieties of rapeseed, suffering 70 and 58% biomass reduction respectively.)

Chauvel, B., Dessaint, F., Lonchamp, J.P. and Gasquez, J. 2005. (Survey on invasive weed species in France.) (in French) Phytoma 578: 16-20. (Reporting a survey of 5 invasive weed species, including *O. ramosa*.)

Daugherty, C. and Mathiasen, R. 2005. First report of chihuahua pine dwarf mistletoe (*Arceuthobium gillii*) on apache pine (*Pinus engelmannii*). Plant Disease 89: 106. (A first report of *A. gillii* on *P. engelmannii*, in Arizona, perhaps associated with severe infection of nearby chihuahua pine (*P. leiophylla* var. *chihuahuana*.).)

Devkota, M.P. and Glatzel, G. 2004. Feedback of water stress on wood properties of trees: experiments with mistletoes on *Rhododendron arboreum* Sm. Ecoprint 11(1): 13-17. (Infestation by *Scurrula elata* causes death of *R. arboreum* branches distal to the haustorial atachment, but is shown to have no significant effect on wood properties of the branch proximal to the attachment.)

Doran, J., Thomson, L., Brophy, J., Goldsack, B., Bulai, P., Faka'osi, T. and Mokoia, T. 2005. Variation in the heartwood oil composition of young sandalwood trees in the South Pacific (*Santalum yasi*, *S. album* and F1 hybrids in Fiji, and *S. yasi* in Tonga and Niue. Sandalwood Research Newsletter 20: 3-7. (Non-destructive coring of trees of different age showed large plant to plant variation in oil quality, and hence scope for selection and breeding. It also suggested rotation lengths of 25-30 years could be more realistic than the current 15-20.)

Eizenberg, H., Calquhoun, J and Mallory-Smith, C. 2005. A predictive degree-days model for small broomrape (*Orobanche minor*) parasitism in red clover in Oregon. Weed Science 53: 37-40. (Reporting a refinement of the model described by Eizenberg *et al*., 2004, noted in Haustorium 46.)

Eizenberg, H., Plakhine, D., Landa, T., Achdari, G., Joel, D.M. and Hershenhorn, J. 2004. First report of a new race of sunflower broomrape (*Orobanche cumana*) in Israel. Plant Disease 88: 1284. (Recording a newly virulent race of *O. cumana* from several localities in Israel.)

El-Akkad, S.S., Hassan, E.A. and Ali, M.E. 2002. Phenolic acid changes during *Orobanche* parasitism on faba bean and some other hosts. Egyptian Journal of Biology 4: 37-44.

El-Hammady, M., Albrechtsen, S.E., Abdelmonem, A.M., El-Abbas, F.M.A., Rasmi, M.R. and Ghazalla, W. 2004. Interaction and frequencies of seed-transmitted faba bean (*Vicia faba* L.) viruses under natural conditions. Arab Universities Journal of Agricultural 12: 851-866. (Some viruses were translocated from infected faba bean plants into *Orobanche* (?*crenata*) sp. but the viruses were not detected in mature, dry broomrape plants or in their seeds.)

El-Kassas, Karem El-Din, Z., Beale, M.H., Ward, J.L. and Strange, R.N. 2005. Bioassay-led isolation of *Myrothecium verrucaria* and verrucarin A as germination inhibitors of *Orobanche crenata*. Weed Research 45: 212-219. (The fungus *Myrothecium verrucaria* (= *M. atroviride*) completely suppressed *O. crenata* at 12.5 x 10^{6}

spores per ml soil, without causing apparent damage to faba bean. The active ingredient was identified as verrucarin A.)

Elzein, A. and Kroschel, J. 2004. *Fusarium oxysporum* Foxy 2 shows potential to control both *Striga hermonthica* and *S. asiatica*. Weed Research (Oxford) 44: 433-438. (Under glasshouse conditions *Fusarium oxysporum* isolate Foxy 2 suppressed *S. asiatica* as well as *S. hermonthica* but had no effect on *S. gesnerioides*.)

Elzein, A. and Kroschell, J. 2004. Influence of agricultural by-products in liquid culture on chlamydospore production by the potential mycoherbicide *Fusarium oxysporum* Foxy 2. Biocontrol Science and Technology 14: 823-836. (Cotton seed cake, maize stover, wheat and triticale stillage were compared as substrates for the culture of *F. oxysporum* Foxy 2 with and without UV light and agitation. Particularly successful was the combination of 0.5% (w/v) maize stover plus 20% (v/v) wheat-based stillage and agitation at 200 rpm.)

Encheva, J., Christov, M., Todorova, M., Shindrova, P. and Encheva, V. 2004. New sunflower restorer lines, developed by direct organogenesis method from intergeneric cross *Helianthus annuus* (cv. Albena) x *Verbisina helianthoides* (Genera Verbisina) - disease resistance, combining ability. Bulgarian Journal of Agricultural Science 10: 417-422. (The direct organogenesis method was used for production of new forms from the intergeneric cross between *Helianthus annus* and '*Verbisina (?Verbesina) helianthoides* Some progeny exhibited resistance to *Orobanche cumana*.)

Farah, A.F. and Al-Abdulsalam, M.A 2004. Effect of field dodder (*Cuscuta campestris* Yuncker) on some legume crops. Scientific Journal of King Faisal University (Basic and Applied Sciences) 5(1): 103-113. (A pot experiment with 12 legume crops showed most susceptible (over 50% reduction) were lablab, lentil, chickpea, faba bean, alfalfa and fodder pea; intermediate were fenugreek, Egyptian clover (*Trifolium alexandrinum*), lupin and garden pea; and least affected (less than 10% damage) *Phaseolus vulgaris* and *Lathyrus sativus*.)

Folia Botanica. 2005.

Gethi, J. G. and Smith, M.E. 2004. Genetic responses of single crosses of maize to *Striga hermonthica* (Del.) Benth. and *Striga asiatica* (L.) Kuntze. Crop Science 44: 2068-2077. (When inbred lines from TZL, *Z. diploperennis* (Diplo) or 'low emergence stimulant' (LE) pools were crossed with susceptible lines, Diplo and LE pools were best sources for *S. hermonthica* resistance and TZL and LE pools for *S. asiatica*.)

Gethi, J.G., Smith, M.E., Mitchell, S.E. and Kresovich, S. 2005. Genetic diversity of *Striga hermonthica* and *Striga asiatica* populations in Kenya. Weed Research 45: 64-73. (AFLP analysis showed low genetic diversity for these species, sampled extensively from three regions in Kenya.)

Ghotbi, T., Shahraeen, N. and Winter, S. 2005. Occurrence of tospoviruses in ornamental and weed species in Markazi and Tehran Provinces in Iran. Plant Disease 89: 425-429. (A new virus sp., tomato varamin virus, was detected in a range of weed species, including a *Cuscuta* sp.)

Göbel, T. 2004. *Nuytsia floribunda* and *Viscum album,* medicinal plants for psychosis and cancer. (in German) Stuttgart, Germany: Verlag Freies Geistesleben, 172 pp. (The morphology, the peculiarities and the ecology of these two species are fully described and discussed. 'Goetheanistic' and 'anthroposophic' approaches lead to the conclusion that the two mistletoes somehow correlate with two disease developments in human beings and therefore could be used as remedies against them.) (With thanks to Dr G. Grazi.)

Gonsior, G., Buschmann, H., Szinicz, G., Spring, O. and Sauerborn, J. 2004. Induced resistance – an innovative approach to manage branched broomrape (*Orobanche ramosa*) in hemp and tobacco. Weed Science 52: 1050-1053. (Confirming the potential for the salicylic acid analogue BTH ('Bion') to suppress *O. ramosa* in hemp and tobacco when applied as a drench 2 weeks after planting. A strain of *Pseudomonas* sp. ('Proradix') was a little less active, while an extract of the alga *Ascophyllum nodosum* ('Fruton') was toxic.)

Haidar, M. A., Iskandarani, N., Sidahmed, M. M. and Darwish, R. 2005. Susceptibility of *Orobanche ramosa* and potato tolerance to rimsulfuron. Crop Protection 24: 7-13. (Single or repeated applications of rimsulfuron at 20-50 g/ha significantly reduced *O. ramosa*, but most potato varieties tested were seriously damaged. Cultivars Timate and Score were more tolerant but yields were not increased?)

Hao Shen, WanHui Ye, Lan Hong, HongLin Cao and ZhangMing Wang, 2005. Influence of the obligate parasite *Cuscuta campestris* on growth and biomass allocation of its host *Mikania micrantha*. Journal of Experimental Botany 56: 1277-1284. (Infestation by *C. campestris* reduced fresh weight of *M. micrantha* by 98% after 72 days and completely prevented flowering; but there was some recovery later.)

Hawkeswood, T.J. and Turner, J.R. 2004. Observations on the habitat and an apparently new larval host plant of *Phalaenoides glycinae* (Lewin, 1805) (Lepidoptera: Noctuidae: Agaristinae) in the Sydney district, New South Wales, Australia. Giornale Italiano di Entomologia 11(51): 151-156. (Larvae of *P. glycinae* observed feeding on *Amyema gaudichaudii.*)

Ho JiauChing, Chen ChiuMing, Li ZhiQiang and Row LieChing. 2004. Phenylpropanoid glycosides from the parasitic plant, *Aeginetia indica*. Journal of the Chinese Chemical Society 51: 1073-1076. (Two new phenylpropanoid glycosides identified from *A. indica* in Taiwan.)

Joita-Păcureanu, M., Veronesi, C., Raranciuc, S. and Stanciu, D. 2005. The interaction parasite-host plant, in the system *Orobanche cumana* Wall. (*Orobanche cernua* Loefl.) - *Helianthus annuus* L. Romanian Agricultural Research 19/20: 7-11. (Referring to a new race F of *O. cumana* controlled by a single dominant gene. Also comparing races from Turkey, Spain and Yugoslavia with two from Romania.)

Jones, C. 2005. Indian sandalwood: genetic and oil diversity and biochemistry of the Australian germplasm collection. Sandalwood Research Newsletter 20: 7-8. (Describing a study from which results will be published elsewhere.)

Kim, A.K., Ellis, D.J., Sandler, H.A., Hart, P., Darga, J.E., Keeney, D. and Bewick, T.A. 2004. Genetic diversity of dodder (*Cuscuta* spp.) collected from commercial cranberry production as revealed in the *trn*L (UAA) intron. Plant Molecular Biology Reporter 22(3): 217-223. (Two ecotypes were identified that corresponded with two peak seedling emergence times. One ecotype showed greater sequence similarity to *C. gronovii*, while the other, more abundant, ecotype showed greater similarity to *C. attenuata.*)

Kong JingLin, Du XiuBao, Fan ChongXu, Xu JianFu and Zheng XiaoJun. 2004. Determination of primary structure of a novel peptide from mistletoe and its antitumor activity. Acta Pharmaceutica Sinica 39: 813-817. (The primary structure of a peptide, named viscotoxin B2, from *Viscum coloratum* is presented. together with evidence for its anti-tumour activity.)

Lendzemo, V.W., Kuyper, T.W., Kropff, M.J. and van Ast, A. 2005. Field inoculation with arbuscular mycorrhizal fungi reduces *Striga hermonthica* performance on cereal crops and has the potential to contribute to integrated *Striga* management. Field Crops Research 91(1): 51-61. (Inoculation of maize and sorghum with the arbuscular mycorrhizal (AM) fungi *Glomus clarum* and *Gigaspora margarita* resulted in significant 30-50% reductions in numbers and dry weight of *S. hermonthica.*)

Lethbridge, B. 2005. Field grafting of quandong (*Santalum acuminatum*). Sandalwood Research Newsletter 20: 1-2. (Reporting the successful grafting of *S. acuminatum* onto both *S. spicatum* and *S. acuminatum*. This technique may be useful in allowing the establishment of high quality fruiting scions onto other sandalwood trees before or after their own productive life.)

Liao GwoIng, Chen MingYih and Kuoh ChangSheng. 2005. Pollen morphology of *Cuscuta* (Convolvulaceae) in Taiwan. Botanical Bulletin of Academia Sinica 46(1): 75-82. (LM, SM and TEM studies confirmed different pollen morphology in the Grammica spp. *C. campestris, C. australis* and *C. chinensis*, and in the Monogyna sp. *C. japonica*, vars. *japonica* and *formosana*.)

Malécot, V., Schatz, G.E. and Bosser, J. 2003. (Synoptic revision of *Phanerodiscus* Cavaco (Olacaceae) in Madagascar.) (in French) Adansonia 25. 119-128. (Three species recognised, including the new *P. capuronii* (replacing the invalid name *C. louveli*). *P. perrieri* var. *orientalis* is transferred to *Anacolosa pervilleana*.)

Manen, J.F., Habashi, C., Jeanmonod, D., Park JeongMi and Schneeweiss, G.M. 2004. Phylogeny and intraspecific variability of holoparasitic *Orobanche* (Orobanchaceae) inferred from plastid *rbcL* sequences. Molecular Phylogenetics and Evolution 33: 482-500. (Further characterizing relationships within the Orobanchaceae using 106 specimens representing 28 *Orobanche* species. Intraspecific variation was low, and not correlated with host range.)

Marley, P.S. and Shebayan, J.A.Y. 2005. Field assessment of *Fusarium oxysporum* based mycoherbicide for control of *Striga hermonthica* in Nigeria. BioControl 50: 389-399. (Field trials with *F. oxysporum* isolate PSM 197, using 5-10 g (per hill?) reduced *S. hermonthica* and increased yields of sorghum, suggesting potential for further development.)

Marvaldi, A.E. 2005. Larval morphology and biology of oxycorynine weevils and the higher phylogeny of Belidae (Coleoptera, Curculionoidea). Zoologica Scripta 34(1): 37-48. (Including new information on the Argentinian species *Hydnorobius hydnorae* whose larvae develop inside the flower and fruit bodies of *Prosopanche americana*.)

Mathews, S. 2005. Phytochrome evolution in green and nongreen plants. Journal of Heredity 96:197-204. (Review of phytochrome evolution, including insight from *Orobanche minor*. Phytochrome and cryptochrome genes in parasitic species can evolve under relaxed evolutionary constraints and may take on new functions.)

Mathiasen, R., Haefeli, M. and Marcus, N. 2005. Southwestern dwarf mistletoe, *Arceuthobium vaginatum* subsp. *cryptopodum*, found parasitizing *Picea pungens* in Colorado. Plant Disease 89: 106. (A first report of this species on *Picea*, perhaps associated with heavy infection of a nearby ponderosa pine.)

Matusova, R., van Mourik, T. and Bouwmeester, H.J. 2004. Changes in the sensitivity of parasitic weed seeds to germination stimulants. Seed Science Research 14: 335-344. (Confirming the tendency of both *Striga hermonthica* and *Orobanche cumana* to develop secondary dormancy after prolonged conditioning.

Menkir, A., Kling, J. G., Badu-Apraku, B., and Ingelbrecht, I. 2005. Molecular marker-based genetic diversity assessment of *Striga*-resistant maize inbred lines. Theoretical and Applied Genetics 110:1145-1153. (41 *Striga*-resistant maize inbred lines were found to reflect clear genetic variation, suggesting that the genetic potential exists to improve maize resistance to *Striga*.)

Mishra, J.S., Bhan, M., Moorthy, B.T.S. and Yaduraju, N.T. 2004. Bio-efficacy of herbicides against *Cuscuta* in blackgram [*Vigna mungo* (L.) Hepper]. Indian Journal of Weed Science 36(3/4): 278-279. (*Cuscuta* sp. was significantly reduced and crop yield improved by pre-emergence pendimethalin or fluchloralin at 1 kg/ha, and by post-emergence imazethapyr 50 g/ha or glyphosate 15-50 g/ha.)

Moorthy, B.T.S., Mishra, J.S., Bhan, M. and Dubey, R.P. 2004. Effect of different densities of *Cuscuta chinensis* on lentil and chickpea. Indian Journal of Weed Science 36(3/4): 221-223. (The losses in seed yield due to increasing densities of *C. chinensis* (or maybe C. *campestris*?) ranged from 20 to 95% in lentil and 28 to 100% in chickpea.)

Moorthy, B.T.S., Bhan, M. Mishra, J.S. and Dubey, R.P. 2004. Effect of different densities of *Cuscuta* on varieties of niger [*Guizotia abyssinica* (L. f.) Cass]. Indian Journal of Weed Science 36(3/4): 249-252. (Varying numbers of *Cuscuta* (*campestris*?) seeds per m^2 reduced niger seed yields by 52-99%. Among 5 varieties of niger, GA10 proved most susceptible and Ootacamund most tolerant.)

Morrison, J.R., Sandler, H.A. and Romaneo, L.K. 2005. Management of swamp dodder (*Cuscuta gronovii* Willd.) in cranberry may be enhanced by the integration of a nontoxic household cleaner. Crop Protection 24: 1-6. (While white vinegar and a liquid dish detergent failed to show selectivity, the household cleaner 'Simple Green' as a 20% solution was damaging to *C. gronovii* and more selective than glyphosate.)

Mower, J.P., Stefanovic, S., Young, G. J. and Palmer, J.D. 2004. Plant genetics: gene transfer from parasitic to host plants. Nature (London) 432: 165-166. (Evidence for direct transfer of the mitochondrial *atp1* gene from *Cuscuta* and *Orobanche* to *Plantago*.)

Musambasi, D., Chivinge, O.A., Bunya, D.R. and Mabasa, S. 2005. The role of different component crops grown in association with maize and their residues in controlling *Striga asiatica* (L.) Kuntze in Zimbabwe. Crop Research (Hisar) 29(1): 47-55. (Two pot experiments involving live or crop residues of cowpea, soyabean, field bean, groundnut or sweet potato caused varying suppression of *S. asiatica*.)

Musambasi, D., Rimawu, S., Chivinge, O.A. and Mariga, I.K. 2005. The residual effects of multi-purpose trees and cowpea cultivars on witchweed [*Striga asiatica* (L.) Kuntze] density and maize grain yield under dryland crop production system in Zimbabwe. Crop Research (Hisar) 29(1): 56-62. (The residual effects of *Sesbania sesban* and *Sesbania macrantha* and 3 cowpea cultivars (IT 90K-59, IT 18 and Kavara) grown in *S. asiatica*-infested fields for 2 consecutive seasons, were mostly non-significant, but *S. sesban* caused some reduction in *S. asiatica* numbers.)

Nekouam, N. and Marley, P.S. 2003. Micro-organisms associated with *Striga hermonthica* and rhizosphere soil in the Nigerian savannah - isolation and evaluation for possibilities in biological control of the witchweed. In: Jamin, J.Y., Seiny Boukar, L. and Floret, C. (eds) Savanes africaines: des espaces en mutation, des acteurs face à de nouveaux défis. Actes du colloque. Garoua, Cameroun, 27-31 mai 2002: pp. 5-21. (The 6 most promising fungal species were *Fusarium oxysporum*, other *Fusarium* (2 isolates unidentified), *Curvularia* sp., *Aspergillus niger* and *A. terreus*.)

Nikolova, L. 2004. Results from interspecific hybridization between *Helianthus grosseserratus* Martens and *H. annuus* L. Bulgarian Journal of Agricultural Science 10(3): 291-298. (Resistance to *Orobanche cumana* was found in different progenies of the interspecific hybrids of *H. grosseserratus.*).

Nikolova, L., Christov, M., Seiler, G. 2004. Interspecific hybridization between *H. pumilus* Nutt. and *H. annuus* L. and their potential for cultivated sunflower improvement. Helia 27: 151-162. (Some progenies proved resistant to *Orobanche cumana*.)

Nowak, A. and Nowak, S. 2004. The effectiveness of plant conservation: a case study of Opole Province, Southwest Poland. Environmental Management 34: 363-371. (Referring to the obligatory control of *Orobanche* and *Cuscuta* species, which may be counter to desirable conservation programmes.)

Osadebe, P.O., Okide, G.B. and Akabogu, I.C. 2004. Study on anti-diabetic activities of crude methanolic extracts of *Loranthus micranthus* (Linn.) sourced from five different host trees. Journal of Ethnopharmacology 95(2/3): 133-138. (The methanolic extract of *L. micanathus* (= *Ileostylus micranthus*) showed hypoglycaemic and anti-hyperglycemic activities in rats and is considered a potential alternative medicine for diabetes mellitus.)

Osadebe, P.O. and Ukwueze, S.E. 2004. A comparative study of the phytochemical and anti-microbial properties of the Eastern Nigerian species of African mistletoe (*Loranthus micranthus*) sourced from different host trees. Bio-research 2(1): 18-23. (Antimicrobial activity of *L. micranthus* (=*Ileostylus micranthus*) harvested from *Cola acuminata* and *Persea americana* was higher than that harvested from *Irvingia gabonensis, Pentaclethra macrophylla, Azadirachta indica* or *Baphia nitida*.)

Oswald, A. 2005. *Striga* control – technologies and their dissemination. Crop Protection 24: 333-342. (Discussing possible control methods and constraints on their adoption and describing extension techniques used in a project in western Kenya.)

Padi, F.K. 2004. Relationship between stress tolerance and grain yield stability in cowpea. Journal of Agricultural Science 142: 431-443. (Resistance to *Striga gesnerioides* among the characters considered.)

Palmer, A.G., Gao, R., Maresh, J., Erbil, W.K. and Lynn, D. G. 2004. Chemical biology of multi-host/pathogen interactions: chemical perception and metabolic complementation. Annual Review of Phytopathology 42: 439-464. (Review comparing *Agrobacterium tumefaciens* to *Striga asiatica* with respect to mechanisms of host signaling and pathogenesis.)

Parniske, M. 2005. Cue for the branching connection. Nature 435: 750-51. (Commenting on the Letter from Akiyama *et al.* – see above.)

Patel, D.M, Bhatt, D.C., Dodia, S.K. and Parmar, R.P 2004. Selection of host plants by *Cuscuta* L. species in semi-arid area of Visnagar, North Gujarat. Advances in Plant Sciences 17: 549-552. (48 hosts listed for '*Cuscuta* sp.' in N. Gujarat.)

Pérez-de-Luque, A., Rubiales, D., Cubero, J.I., Press, M.C., Scholes, J., Yoneyama, K., Takeuchi, Y., Plakhine, D., and Joel, D.M. 2005. Interaction between *Orobanche crenata* and its host legumes: unsuccessful haustorial penetration and necrosis of the developing parasite. Annals of Botany 95: 935-942. (Unsuccessful parasitism cannot be attributed to cell death in the host root; rather the darkening often observed is due to secretions from the host and necrosis of the parasite.)

Phoenix, G.K. and Press, M.C. 2005. Linking physiological traits to impacts on community structure and function: the role of root hemiparasitic Orobanchaceae (ex-Scrophulariaceae). Journal of Ecology (Oxford) 93: 67-78. (Reviewing the wide range of effects of hemi-parasitic Scrophulariaceae on the competitive balances between hosts and non-hosts and the resultant impacts at the community level, which may be positive as well as negative.)

Press, M. C. and Phoenix, G. K. 2005. Impacts of parasitic plants on natural communities. New Phytologist 166: 737-751. (An insightful review from the laboratory of the leading researcher in parasitic plant ecology, this article deals with the consequences of parasitism not only in the direct aspects which have been most studied but also in the effect on composition of plant communities and, reciprocally, the impact of plant communites on parasites as well as interactions at different tropic levels, and the abiotic environment.)

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MESSAGE FROM IPPS PRESIDENT

Dear IPPS Members,

Parasitic plant researchers are interested in both applied and basic aspects of these peculiar plants, i.e. biological aspects and practical aspects related to their management. Obviously the two are mutually linked and by handling them together we allow accelerated progress in both. Indeed, parasitic plant research is currently developing very rapidly thanks to the availability of novel methods in molecular biology.

Among others, three main aspects are under detailed investigation: (a) the taxonomic position of parasitic plants, leading to reassessment of the phylogenetic understanding of the main parasitic plant groups; (b) 'horizontal gene transfer', i.e. the possibility that genes are transferred through the haustorium during host–parasite interaction, and (c) analysis of gene expression during host- parasite interaction in both compatible and incompatible interactions. All these aspects were dealt with during the Botanical Congress in Vienna last summer, and represent the ongoing attempt to understand plant parasitism and to find novel ideas for the management of those parasites that cause economic losses due to their weedy habit.

Yet some important aspects of parasitic weed management seem to be overshadowed by the new developments, and thus neglected by farmers and agricultural authorities. These are the 'primitive' approaches that limit seed transfer from infected areas and avoid seed import into non-infested areas. The gradual expansion of areas infested with various parasitic weeds like broomrape, witchweed, dodder and mistletoe definitely needs closer attention, and therefore, the recent COST849 workshop was dedicated to this subject, dealing with means for limiting *Orobanche* propagation and dispersal in agricultural fields.

Whereas scientific collaboration is essential for rapid progress in research, international cooperation is essential for limiting parasitic plant dispersal. While recognizing the usefulness of international cooperation in controlling parasitic weeds and in preventing their spread, and especially their introduction across national boundaries, we should ensure close coordination of measures directed to these ends, and act, each in his or her own country, to convince the local authorities on the necessity to implement sanitation measures against parasitic weeds locally and worldwide, to discuss the parasitic plant problem with Plant Protection Organizations (like EPPO, SEAPPO and NAPPO), and to coordinates the efforts among all countries to protect plant resources from the entry, establishment and spread of parasitic weeds.

The next IPPS Congress, which is due for 3-7 June 2007 in Charlottesville, Virginia (USA) will deal with all aspects of parasitic plants, whether weedy or native, and discuss both aspects of their biology and their management. A special session will be dedicated to the prevention of parasitic weed dispersal. The first circular will soon be issued and we are looking forward to your participation in this important event. Please plan to attend this meeting.

All parasitic plant researchers are encouraged to contact me or any member of the Executive Committee with concerns about the society or items that you would like to see addressed, including suggestions regarding the IPPS Congress. The society will remain strong if it meets the needs of its members.

Danny Joel, IPPS president
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LITERATURE HIGHLIGHT – GENE THIEVES, GENE DONORS

Parasitic plants have a growing reputation as thieves. Not only do they steal water and other resources from their hosts, it now seems clear that they are taking genes as well. This issue of Haustorium contains two literature items dealing with the transfer of genes between parasitic plants and their hosts (See Davis *et al*., 2005; Davis and Wurdack, 2004). In addition, the previous issue of Haustorium listed an article on this same subject (Mower *et al*., 2004).

Evidence for horizontal gene transfer (HGT) involving parasitic plants comes from phylogenetic studies based on gene sequences. In the case of Rafflesiaceae, the genes *matR* and *PHYC* (representing mitochondrial and nuclear genomes, respectively) place it solidly in the Malpighiales, while another mitochondrial gene, *nad1B-C*, strongly supports its placement in the host's family, Vitaceae (Davis and Wurdack, 2004). When viewed in the context of morphological evidence, it appears that the *nad1B-C* gene must have been obtained from a host and incorporated into the parasite's genome at some point in evolutionary history.

On the other hand, parasites may also be giving up genes to their hosts. HGT seems to occur in both directions, as members of the Plantaginaceae contain copies of a mitochondrial gene (*atp1*) that are very similar to those in Orobanchaceae or *Cuscuta* parasites (Mower *et al*., 2004). The latest example involves a fern that has acquired genes from a parasitic flowering plant. In this case, two mitochondrial genes (*matR* and *nad1B-C*) from the rattlesnake fern (*Botrychium virginianum*) appear to have moved in a single event from the Santalales (Davis *et al*., 2005).

HGT is not unique to interactions involving parasitic plants. Mitochondrial genes have been shown to move widely among plants without limitation by normal mating barriers (Bergthorsson *et al*., 2003). The mechanism by which HGT occurs remains unknown, and while viruses, bacteria, fungi, and insects have been proposed as potential vectors, the direct connections between parasitic plants and their hosts offers the simplest explanation. Recently, the nonparasitic, tropical shrub *Amborella trichopoda* has been hailed as the greatest gene thief among flowering plants, containing at least 26 foreign genes (Bergthorsson *et al*., 2004). As research on HGT expands, it will be interesting to see how parasitic plants compare to their nonparasitic counterparts.

On a related subject, a recent article by Randle and Wolfe (2005) suggests that the parasite *Hyobanche* (Orobanchaceae) absorbs the large subunit of Rubisco from its host. In this case, it is the protein that appears to move rather than the gene (*rbcL*). Rubisco protein was detected in the parasite despite the finding that the *Hyobanche rbcL* genes are non-functional and should not produce a complete protein.

All of this work raises questions about host-parasite connections and the transfer of materials among species. But one thing is clear; these plants are known thieves and we will need to keep a close watch on them.

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OROBANCHE CRENATA IN ETHIOPIA

An emerging, formidable challenge to rural communities in northern Ethiopia.

Initial infestation of *Orobanche crenata* was first reported in the late 1980s from a remote locality of south Wello region in northern Ethiopia. Immediately following the report, controversy ensued between different organizations over the exact identity of the parasitic weed. In the mid 1990s, however, it was confirmed that Ethiopia was, yet again, up against one of the dreaded scourges known in agriculture - *Orobanche crenata*. It has become increasingly difficult to grow pulse crops, the main source of dietary protein and cash for local farmers, economically, especially in the two badly hit districts of Kedijo and Kutaber.

According to elderly farmers, the weed was introduced via relief food aid during the famous Ethiopian famine in the mid 1980s. Faba bean and field pea were the two most susceptible hosts but the host range appeared to expand rapidly. After some time grass pea (*Lathyrus sativus*), lentil and chickpea succumbed to the pest. Chickpea, particularly, was until recently considered to be a suitable break crop. Complete crop failure of faba bean and field pea is now a common occurrence in the above two districts. As a result the land allocated to wheat is increasing in recent years since faba bean cultivation is scaled down because of the threat. The decline in faba bean production is depriving tef of a suitable rotation crop leading to progressively lowering yield performance of the latter.

The level of damage is already enormous for the small farmers affected but the impact that this noxious weed could potentially have on the country at large is even far greater if collective action is not taken to arrest the spread. Unconfirmed reports suggest that the infestation already affects many thousand hectares and that the weed was spotted further afield in south Tigray, Gonder and north Shewa, approximately in a 300 km radius from its origin. If this is true, it means the problem is getting out of hand and beyond the means of the country to launch an effective containment strategy.

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CUSCUTA SPP. IN INDIA

The genus *Cuscuta*, a stem parasite with branched climbing stem, is comprised of about 175 species world-wide. Of these, 12 species are reported from India. One of these species is severely infesting field crops such as niger (*Guizotia abyssinica)*, blackgram (*Vigna mungo)*, greengram (*Vigna radiate*), lentil, chickpea and linseed. However, there has always been confusion about the correct identification of the species. In most of the Indian literature, it is mentioned as *Cuscuta* spp. and in few cases, as *Cuscuta chinensis*. To identify the species correctly, *Cuscuta* seeds were collected from niger (Orissa), lucerne (Gujarat), blackgram/greengram (Andhra Pradesh) and linseed (Madhya Pradesh) and grown in pots with host plants. Photographs of *Cuscuta* vines, flowers, fruits and seeds were taken and sent to Mr. Chris Parker, U.K. and Dr. Lytton Musselman, Parasitic Plant laboratory, Virginia, USA for identification of the species of *Cuscuta* Both of them unanimously identified the species as *Cuscuta campestris* Yuncker due to following reasons.

'Capsules not circumscissile, corolla lobes are not keeled, the withered corolla is at the base of most of the capsules, lobes of calyx and corolla not thickened at their tips, filaments broadest at base, tapering distally'.

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INTEGRATED *STRIGA* MANAGEMENT

A pilot project on integrated *Striga* management (ISM) was conducted in Eastern Africa during the last three years. The project, deployed in Ethiopia, Eritrea, and Tanzania focused on the evaluation, through a farmer participatory approach, of the effect of combining multiple control options in reducing crop damage caused by *Striga*. The agronomic rationale for the pilot project was based on the belief that increased crop productivity and a more enhanced control of the parasitic weed, *Striga*, can be achieved by the synergistic combination of *Striga* resistant crop cultivars with one or more additional agronomic practices. Because damage caused by parasitic weeds is more severe on crops already under stress, we reasoned that an ISM package that integrates host plant resistance, soil fertility enhancement, and a water conservation measure will encourage a synergistic response that is greater than the sum of its components. Our ISM package therefore includes tied-ridging (where crops are planted on ridges and these ridges are tied together with other small ridges that run perpendicular to the crop rows and serve to hold rain water), nitrogen fertilizers (organic or inorganic sources), and a range of our *Striga* resistant varieties. We reasoned that the additional moisture captured through tied ridging would enhance fertilizer response, which in turn promotes not only better plant growth, but (at the right dose) may also help with *Striga* control. Subsistence farmers often find cost of inputs unaffordable unless a better return to their investment is assured. The objectives of this project, therefore, was 1) to promote a technology package that offers an effective control of *Striga*; 2) to establish a community-based, entrepreneurial seed production activity, and 3) to increase profitability for farmers involved in the ISM project by promoting new markets and products for a sustainable use of the ISM package.

In each country, impressive field responses were obtained in *Striga* control and in generating farmer enthusiasm and acceptance through the ISM package. However, interest in seed production and distribution as well as emergence of opportunities for market development varied in the three countries. Where effectively deployed, crop yields have been increased and *Striga* infestation reduced very dramatically. Sorghum grain yields as high as 5 tons per hectare were recorded in some farmers' plots that received the ISM package. In contrast, under severe *Striga* infestation, some of the local sorghum landraces grown with no input and only the local practice of hand weeding failed totally with no measurable yield recorded. The ISM package proved successful having been adopted by thousands of farmers in these three countries. In Ethiopia alone, over 6000 organized demonstrations have been conducted. Both governmental and non-governmental organizations (NGOs) participated in input distribution and testing. Over 100,000 farm families received seed of *Striga* resistant varieties via these channels of distribution and informal exchange with fellow farmers. Inputs (seed, fertilizers, and tied-ridging implements) were given for free to farmers initially, but participants were required to purchase inputs in subsequent seasons. Seed production has been targeted either through national seed programs or by organizing farmers into seed-growing cooperatives. In some cases, parastatal seed programs have taken up production of sorghum seed as a result of the significant farmer demand and interest in the *Striga* resistant sorghum varieties. Success in our attempts to develop market opportunities has been mixed, however. The greatest promise is in Tanzania where a local brewery has the capacity to purchase as much sorghum as can be made available if quality standards can be met. Currently, the brewery imports sorghum from South Africa. An organized body of stakeholders, the National Sorghum Forum in Tanzania, has recently succeeded in convincing the Government of Tanzania to also buy sorghum into the National Strategic Food Reserve, which provides an outlet for technology-adaptive farmers who often find themselves with low demand and collapsed farm prices at times of harvest. In Ethiopia, a local cookie factory has shown interest in adding sorghum in a composite flour mix if guarantees can be made for a uniform and acceptable quantity of grain on a regular basis. The biggest challenge, therefore, is in working with local authorities and non-governmental agencies in helping organize and empower farm communities so they can begin to participate and catalyze events and activities beyond the farm that often affect their livelihood.

The project was funded by the USAID Office of Foreign Disaster Assistance via INTSORMIL.

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BALANOPHORACEAE IN BRAZIL

During field work, we literally stumbled on an important discovery: a population of the little known *Lathrophytum peckoltii* Eichler, a monotypic genus, until then only found in the Atlantic Rain Forest, more precisely in the forests of Rio de Janeiro City. Its occurrence was lately confirmed in the Cerrado (states of Goiás and Minas Gerais).
These ecosystems represent two of the most endangered hotspots of the world. This taxon was very rarely collected since its discovery in 1867. The generic name comes from the Greek and its exact meaning is precisely "hidden-plant". The epithet is in honor of the Peckolt brothers, pharmacists and collectors of the type specimen. In 2004, for the first time, a population was photographed and collected for scientific studies. Forty three years elapsed since the last time it had been collected. Before that it had completely disappeared for 75 years. Hansen (1972) had considered it extinct because of the disappearance

of its habitat. *Lathrophytum* is very similar to *Ombrophytum*, except its androecium is the most reduced of all neotropical taxa. The inflorescence has a honey-like smell and was photographed being visited by bees and ants. The ants take almost all the anthers, probably pollinating some flowers on the way down. This population is being monitored and will soon be the subject of research on its biology. In 2004 another species was described to Brazil, *Lathrophytum rizzoi* Delprete, based on a collected material from the 1960's. Nowadays no population of this species is known. Brazil now has a count of 13 taxa of Balanophoraceae: one genera and four species of which are endemic to this country. Pictures of this and other Brazilian taxa can be found on the Parasitic Plant Connection website. This site also hosts probably the first *in loco* of *Scybalium glaziovii* Eichler, obtained in consecutive years in its type locality, the exuberant forest on Serra do Mar, on the Macaé de Cima Ecological Reserve in the state of Rio de Janeiro.

Once again allow me to reaffirm our wish to obtain material of taxa of Balanophoraceae that do not occur in Brazil, and the willingness of the herbarium of Rio de Janeiro Botanic Garden (RB) to trade duplicates of species that occur in our territory.

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RETIREMENT – JOS VERKLEIJ

Dr Jos Verkleij retired this month after a long and successful career in plant science which has included many studies on parasitic plants and involvement in the setting up of IPPS. A Symposium in his honour was held on Friday 27 January 2006. Presentations included several relating to metal tolerance in plants as well as:

Harro Bouwmeester (PRI, Wageningen) - Underground communication between host and parasitic plant.

THESES

Bipana Devi Acharya (Ph.D., BRA Bihar University, India, December, 2004)
Studies on control of *Orobanche aegyptiaca* Pers. by crop rotation using trap and catch crops.
(Supervision: Dr S.C. Srivastava, Dr G.B. Khattri)

In Nepal, there are two agronomically important *Orobanche* species, *O. aegyptiaca* and *O. cernua* causing a threat to a range of important crops, particularly, tori (*Brassica campestris* var. *toria*), sarson (*Brassica campestris* var *sarson*), rayo (*Brassica juncea*) and tobacco (*Nicotiana tabaccum*), grown in the plains (Terai) and dun valleys (Inner Terai). *O. aegyptiaca* attacks all four crops while *O. cernua* attacks solanaceous crops only.

The primary objective of the study was to search for trap crops for use in crop rotation in order to decrease the parasite seed bank in tori fields infested by *O. aegyptiaca.* Another objective was to evaluate tori as a catch crop.

In preliminary screening, 27 crop and fodder species were tested in the laboratory but only twelve could stimulate germination of *O. aegyptiaca*. Among these only cumin, radish and vetch allowed parasite attachment, while only cumin and radish supported further development.

Pot and field experiments were conducted for two years in soil naturally infested with *Orobanche aegyptiaca* to evaluate effects of 22 non-host crops on the *Orobanche* seed bank and seed viability. The two sites chosen were located in highly *Orobanche* infested areas of Nawalparasi district, an Inner Terai region of Central Nepal. *Orobanche* seed density in soil samples collected from pot/plot before planting and after harvest of each crop species was recorded using a technique slightly modified from that proposed by Ashworth, 1976 (Plant Disease Reporter 60: 380-383). Pre-plant and post-harvest data were compared in order to assess the effects of the test crops on *Orobanche* seed density. On this basis the investigated crop species could be classified into three categories: a) <u>Highly potential trap crops</u>: radish, lentil, linseed, fennel and cumin: b) <u>Moderately potential trap cros</u>: barley, onion and chickpea: and c) <u>Non-potential trap crop</u>: garlic, chilli, coriander, buckwheat, sunflower, French bean, pea, egg plant, potato, fenugreek, wheat and faba bean.

For the study of seed viability, *Orobanche* seed bags prepared in muslin cloth were buried 10 cm deep in the soil of all pots/ plots including fallow. The seed bags were kept buried in the soil throughout the crop season. The viability of the seeds was tested according to the method of

Aalders and Pieters, 1986 (in: S. J. ter Borg (ed.). Proceedings of a Workshop on Biology and Control of *Orobanche*. Wageningen, Netherlands: 140-149). Significant reduction in viability was found only under radish, lentil, chilli, fennel, barley, egg plant, maize, onion and fenugreek crops (cumin was not included in field trials).

The loss of viability in test crop treatments was greater than in control treatments, indicating that most of the non-host crops possess the ability to reduce *Orobanche* seed viability, although, the degree of reduction may vary from crop to crop. Viability loss was mainly due to germination induced by trap crops, but could also be due to soil factors and attack by soil microorganisms. Hence, the study suggests the option of using non-host crops in the crop rotation for reducing *Orobanche* seed density, rather than leaving *Orobanche* infested fields uncultivated.

A two-year field study was conducted at both experimental sites to evaluate effectiveness of tori plants as a catch crop. Tori was chosen due to following reasons: a) it is a one of the most ideal hosts of *O. aegyptiaca* in Nepal, b) it is easily and quickly grown, c) its cost of cultivation is low, d) the soil moisture regime needed for the crop is usually supplemented by winter rain d) prevailing temperature during the cropping period remains ideal for tori and *Orobanche* seed germination and, e) it could easily be sold in the local market as a green vegetable.

Two successive crops of tori were grown in each field. The first crop was planted at the usual sowing date (third week of October) and harvested in the third week of January, when *O. aegyptiaca* plants were flowering. The second crop was planted immediately after the harvest of the first crop. When the tori plants in the second crop were 1 month old (early flowering stage), they were harvested as green vegetable. At this stage *O. aegyptica* was at the early attachment stage – pre-caulome and tubercle, less than 5 mm in size. Soil samples were collected during pre-plant and post-harvest stages of each crop. *Orobanche* seed bank in soil samples was estimated as mentioned earlier.

On the basis of results obtained in the study, it can be said that, in spite of increased tori plant density in succeeding treatments, parasitization of the weed fail to increase. However, the reduction of the weed seed bank progressed with the increase of tori plant density. This seemed to have indicated that emergence of the parasite was depended not on host plant density but on population of parasitic seeds in the soil.

The second tori crop further decreased the parasitic seed bank, which was harvested in early flowering stages for vegetable uses. The climatic conditions, importantly temperature and soil moisture regimes were suitable for the growth of host plant and for *Orobanche* seed germination. From this study it can be concluded that the tori crop possesses all the necessary characteristics to be an ideal catch crop for the reduction of *Orobanche* seed bank.

Finally, it could be concluded that the inclusion of any of the crops listed as potential trap crops (radish, linseed, lentil and fennel) in crop rotation followed by the use of tori as a catch crop in the same field will be an effective measure to reduce *Orobanche* seed bank significantly in infested fields. The measures will be important components of an integrated management of *Orobanche* in our agronomic conditions.

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Jonne Rodenburg (PhD, Wageningen University, Wageningen, The Netherlands, October, 2005)
The role of sorghum genotype in the interaction with the parasitic weed *Striga hermonthica.*
(Supervision, Martin Kropff)

This thesis presents a study on the interaction between the parasitic weed *Striga* (*S. hermonthica* [Del.] Benth.) and the cereal crop sorghum (*S. bicolor* [L.] Moench). Its main objective was to find suitable measures for the selection of breeding material (crop genotypes) with superior levels of resistance or superior levels of tolerance to *Striga*. To meet this objective the physiological background of tolerance, the relation between *Striga* infestation, infection and yield loss and the effect of host genotype on *Striga* parasitism and reproduction were studied.

These host-parasite interactions were studied with 4-10 different sorghum genotypes differing in level and mechanism of defence against *Striga*. Field experiments carried out in Mali were used for yield assessments and development and validation of selection measures. Through pot and agar-gel experiments, aboveground resistance measures were validated with observations on below ground stages. Pot experimentation was also used to create infection response curves and to measure photosynthesis and chlorophyll fluorescence to develop tolerance measures.

Striga parasitism and reproduction, and the detrimental effect of *Striga* on crop yield can significantly be reduced through crop genotype choice. Maximum aboveground *Striga* number is a reliable selection measure for resistance. *Striga* flower stalk dry weight can be used to identify genotypes that reduce *Striga* reproduction. The maximum relative yield loss is a suitable selection measure for tolerance in susceptible genotypes, while for more resistant genotypes the relative yield loss per *Striga* infection seems more appropriate. For these tolerance measures, yield assessment of nearby uninfected controls is indispensable. Chlorophyll fluorescence, more precisely photochemical quenching and electron transport rate, may enable screening for tolerance without this requirement.

Sara Fondevilla (PhD, Córdoba University, Córdoba, Spain, June, 2005)
Resistance to crenate broomrape (*Orobanche crenata*) and foliar diseases in pea (Supervision, Diego Rubiales, Ana Mª Torres, Zlatko Satovic)

In this PhD different studies were conducted on resistance of pea (*Pisum sativum,*) to broomrape (*Orobanche crenata*), ascochyta blight (*Mycosphaerella pinodes*) and powdery mildew (*Erysiphe pisi*). Investigations concerning resistance to *O. crenata* are summarised as follows.

Orobanche crenata (crenate bromrape) represents the major constraint for pea production in Mediterranean areas (Rubiales *et al*., 2003). Only incomplete levels of resistance to broomrape have been identified in pea germplasm so far, suggesting that it is a polygenic trait. Higher levels of resistance have been found in wild relatives of cultivated pea (Rubiales *et al*., 2003; 2006; Pérez de Luque *et al*., 2005). Thus, knowledge of the genomic location and linkage to molecular markers of these genes would facilitate gene transfer to pea cultivars through marker-assisted selection (MAS).

With this aim a population consisting of 111 RILs-F_6 (Recombinant Inbred Lines) derived from a cross between *Pisum sativum* ssp. *syriacum*, an accession partially resistant to *O. crenata*, and the susceptible pea cv. *Messire* (*P. sativum* ssp. *sativum*), was analyzed and a linkage map was developed. This map covers 1214 cM and contains 3 morphological, 1 isozyme, 12 STS and 235 RAPD markers distributed in 9 linkage groups. Of these, 6 groups have been assigned to chromosomes using markers common with the consensus pea map.

The susceptibility of this RIL population to broomrape was screened at Córdoba, Spain in a plot heavily infested with *O. crenata* seeds. RILs were grown during 2003-2004 season in a complete randomised block design with three replicates, each having a row with ten plants of each family. Furthermore, in order to correct the possible differences in the density of *O. crenata* seeds in the soil between plots, each family row was surrounded by four rows, with 10 plants each, of the susceptible control cv. Messire. At the end of the crop cycle, the final number of emerged *O. crenata* shoots per individual host plant were scored for each RIL family and for the four adjacent rows of Messire check. In addition, host vigor was visually estimated using a 0-5 scale. QTL (Quantitative Trait Loci) analyses were performed by Windows QTL Cartographer 2.0 software and QTLs were identified by Simple Interval Mapping (SIM) and Composite Interval Mapping (CIM). Markers to be used as cofactors for CIM were selected by forward-backward stepwise regression. The threshold for the detection of a QTL was selected using permutation test suggested by Doerge and Churchill (1996).

The analysis of the mean number of shoots per plant of the susceptible control showed that the distribution of *O. crenata* seeds in the soil was quite homogeneous. However, parental lines showed substantial differences in *O. crenata* resistance. Thus, the female parent (*Pisum sativum* spp. *syriacum*) displayed 0.42 shoots per plant as a mean value while the male parent (pea cultivar *Messire*) reached an average value of 11 shoots per plant. An even wider range of variation was observed in the RIL population where this parameter followed a normal distribution. Three QTLs associated with resistance to broomrape were identified. Two of them, located in chromosomes 2 and 5 respectively, were situated in the same position as two QTLs identified for host plant vigor. These results reinforce previous studies suggesting that the number of broomrape shoots per plant is positively correlated with varietal vigour (Aalders and Pieters, 1987; Rubiales *et al*., 2004). Therefore, in order to identify QTLs associated with genetic resistance to broomrape but not with vigor, a resistance index was calculated. Simple regression was carried out using the score of vigor of each RIL family as an independent variable and the *O. crenata* score as a dependent variable. The regression corrected values (residuals), considered as the *O. crenata* resistance index, were multiplied by –1 in order to assign greater values to the more resistant plants and a constant (10) was added in order to avoid negative values. This index was successfully applied in the detection of one QTL involved in the resistance to this parasite but not associated with vigor. This QTL was located in chromosome IV and displayed a peak value of LOD of 3.86. This putative QTL explained 19 % of phenotypic variation of this trait and showed an additive genetic effect of 0.749.

References

Aalders, A.J.G. and Pieters, R. 1987. Resistance of *Vicia faba* to *Orobanche crenata*: true resistance versus hidden susceptibility. Euphytica 36: 227-236.

Doerge, R.W. and Churchill, G.A. 1996. Permutations test for multiple loci affecting a quantitative character. Genetics 142: 285-294.

Pérez de Luque, A., Jorrín, J., Cubero, J.I. and Rubiales D. 2005. Resistance against *Orobanche crenata* in pea (*Pisum* spp.) operates at different developmental stages of the parasite. Weed Research 45: 379-387.

Rubiales D., Pérez-de-Luque, A., Cubero J.I. and Sillero J.C. 2003. Crenate broomrape (*Orobanche crenata*) infection in field pea cultivars. Crop Protection, 22: 865-872

Rubiales, D., Moreno, M.T. and Sillero, J.C. 2006. Search for resistance to crenate broomrape (*Orobanche crenata*) in pea germplasm. Genetics Resources and Crop Evolution. In press.

COST 849 - PARASITIC PLANT MANAGEMENT IN SUSTAINABLE AGRICULTURE

This programme, funded by European Union via European Science Foundation, arranged 3 meetings in 2005, in Vienna, Austria; Reading, UK; and Newe-Ya'ar, Israel. The programmes, abstracts and/or reports of these meetings are on the COST849 web-site (http://cost849.ba.cnr.it/) or will be added in due course. More details appear below, together with lists of papers presented.

COST 849 MEETINGS

Genetic diversity of parasitic plants, held in Vienna, Austria, 18-19 July, 2005.

This was a discussion meeting with two main topics:

1. Taxonomy of parasitic plants and its implications on parasitic plant management.
2. Genetic diversity in parasitic plants (and the variety of molecular methods for its study).

Intended outputs include a list of actual and potential pest species of *Orobanche* and their host range, indicating the importance of each host on a four-stepped scale; also distribution maps for Europe and the Mediterranean, of the most important pest taxa.

Broomrape biology, control and management held in Reading, UK, 15-17 September, 2005.

Papers presented and discussed were:

Working Group 1: Broomrape germination biology:

Harro Bouwmeester *et al.* - Biosynthesis of germination stimulants of parasitic plants and their biological function.

Radoslava Matúšová *et al.* - The biosynthetic origin of strigolactone germination stimulants of the plant-parasitic *Striga* and *Orobanche* spp.

Nurit Bar Nun *et al.* - Inhibitors and stimulators of germination of *Orobanche*.

Zhongkui Sun *et al.* - Isolation and characterization of genes involved in the formation of germination stimulants for the parasitic weed, *Striga*.

Alistair Murdoch and Israel Dzomeku - Modelling seed dormancy and germination.

Danny Joel *et al.* - Influence of fluridone on seed conditioning and germination of *Orobanche* seeds.

Tom van Mourik - Processes and rates of *Striga hermonthica* seed bank depletion as a result of fallow and different crop covers.

Sissy Lyra *et al.* - Preliminary results on genetic analysis of Greek *Orobanche* populations using RAPDs.

Fred Rumsey - Taxonomic changes in *Orobanche* and related genera.

Working Group 2: Biological control:

Ziva Ansellem *et al.* - Transforming NEP1 toxin gene and other genes into two *Fusarium* spp. to enhance mycoherbicidal activity against *Orobanche* – failure, success, and progress.

Maurizio Vurro and Angela Boari - Compatibility of irrigation systems with application of broomrape biocontrol agents.

Angela Boari *et al.* - Use of fungal metabolites for broomrape suicidal germination.

Peter Toth *et al.* - Natural enemies of *Orobanche* species in Slovakia.

Sissy Lyra *et al.*- Biocontrol agents for *Orobanche* - a seaweed product: a new potential germination stimulant for *Orobanche ramose.*

Working Group 3: Resistance breeding:
Alejandro Pérez-de-Luque *et al.* - Involvement of protein cross-linking, peroxidase and β-1,3-endoglucanase in resistance of pea against *Orobanche crenata.*
Séverine Thoiron *et al.* - Search for a scheme of host responses to *Orobanche.*
Alexandre Lejeune *et al.* - Tomato/*O. ramosa* interaction: pathogen perception and defence elicitation.
Maria Joița Păcureanu *et al.* - Sunflower genotypes resistant to the most virulent populations of broomrape in Romania.
José M. Fernández-Martínez *et al.* - Resistance to new virulent *O. cumana* races.
Sara Fondevilla *et al.* - Mapping of quantitative trait loci for resistance to *Orobanche crenata* in pea.
Maria Carlota Vaz Patto *et al.* - Genetic variation in *Orobanche foetida* as revealed by AFLP analysis.

Working Group 4: Integrated control and biodiversity conservation:
Mónica Fenández-Aparicio *et al.* - *Orobanche crenata* control on legumes in various intercrops.
Eleni Kotoula-Sika and Garifalia Economou - Use of herbicide resistant crops in Greece for control of *Orobanche* and other weeds
Tal Lande *et al.* - New advances in chemical control of *Orobanche aegyptiaca* in tomato.
Nicos Vouzonis - Lessons learned from integrated control of *Orobanche* in Cyprus.
V. Jinga *et al.* - Control of *Orobanche* on sunflower and tobacco crops in România.
Hanan Eizenberg *et al.* - Minirhizotron- a new method for in-situ modelling of the underground development of *Orobanche*.
Duncan Westbury - *Rhinanthus minor* (yellow rattle) – grassland weed or the ecologist's friend?

Means for limiting *Orobanche* propagation and dispersal in agricultural fields held in Newe-Ya'ar, Israel, 4-6 December, 2005.

Papers presented and discussed were:

Orobanche infestation and economic impact:
D.M. Joel – The need to prevent further *Orobanche* spread.
D. Rubiales - The continuous *Orobanche* dispersal in Spain.
M. Delos - The occurrence of *Orobanche* in French agricultural areas.
D. Müller-Stover *et al.* – Occurrence of *O. ramosa* in Germany and prospects for its control.
M. Vurro and G. Domina- Development of the broomrape problem in Italy.
S. Lyra *et al.* – Variation in *Orobanche* populations in Greece.
G. Economou *et al*. - The extent of recent *Orobanche* infestation in Greece.
M. Pacureanu-Joita - *Orobanche* sp. in Romania - the impact of new races of the parasite in sunflower crop.
R. Batchvarova and S. Slavov- Broomrape expansion in Bulgaria.
Y. Goldwasser – Weedy *Orobanche* in Israel.
N. Vouzounis - Severity of parasitic weeds in Cyprus.
A. Uludag and M. Demiret - The *Orobanche* problem in Turkey and its economic impact.

Seed viability, germination and eradication:
A.M. Mayer – Metabolism of *Orobanche* seeds during conditioning and during germination.
Y. Kleifeld - Soil fumigation for broomrape seedbank control.
K. Wegmann – Stimulation of false germination in soil.
A. Murdoch and E. Kebreab - Temperature dependence of *Orobanche* germination and implications for the northward spread of *Orobanche* within Europe..
H. Eizenberg - The growing degree days (GDD) model for *Orobanche* germination and development.

Means to prevent seed production and dispersal:
T. Nadler-Hassar *et al.* - The mode of action of herbicides in host-parasite interaction.
M. Vurro *et al.* – Natural compounds for the management of broomrape seed germination.
R. Aly *et al.* – A new approach for parasitic weed control.
S. Meir *et al.* – Biotechnology and the management of weedy *Orobanche*.
J. Hershenhorn *et al.* – Integrated broomrape management in tomato based on resistant varieties and chemical control.
M. Pacureanu-Joita – Resistance and the development of virulent *Orobanche* races.
D.M. Joel - *Orobanche* control in manure processing.
R. Aly - Genetically engineered resistance to *Orobanche*.
J. Herschenhorn – *Orobanche* control in tomato.

Evolutionary developments of *Orobanche* under cultivation:

M. Pacureanu-Joita - Resistance and the development of virulent *Orobanche* races

G. Domina – Distribution of weed *Orobanche* species in Europe and the Mediterranean.

J. Sauerborn and J.H. Grentz - Potential distribution of *Orobanche* under current and predicted future climate.

D. Opatowski - EU regulations to limit weed infestation.

J. Verkleij - The *Striga* problem in Africa, a potential threat for Europe?

D.M. Joel and H. Manor - Emergency plan for broomrape control in Israel.

P. Warren - The branched broomrape eradication project in Australia.

Final discussions:

Discussion on a draft policy document for circulation to policy makers, highlighting the risks from *Orobanche* and the need to implement quarantine and seed production measures to prevent further *Orobanche* spread in Europe, in particular with the potential for climate change.

Discussion on research needed in support of the quarantine policy.

OTHER MEETINGS

International Botanical Congress, July 17-23, Vienna, Austria. Relevant oral and poster presentations are listed below. Numbers in brackets refer to the abstract in the full record of the meeting, available at: http://www.ibc2005.ac.at/program/abstracts/IBC2005_Abstracts.pdf

Joel, D.M. - Research on *Orobanche*: what do we know and what should we get to know? (1.7.1.)

Schneeweiss, G.M. *et al.* - Molecular phylogenetics and taxonomy of *Orobanche* L. (Orobanchaceae). (1.7.2.)

Verkleij, J.A.C. - *Orobanche*-host plant interactions: ecological and physiological aspects. (1.7.3.)

Murdoch, A.J. and Kebreab, E. - Predictive empirical modeling of *Orobanche* life cycle and seed ecology. (1.7.4.)

Satovic, Z. *et al.* - Population genetics in *Orobanche* species. (1.7.5.)

Park, J. *et al.* - Evolution of Ty1-*copia* and Ty3-*gypsy* retro-elements in holoparasitic *Orobanche* (Orobanchaceae). (1.7.6.)

Rubiales, D. *et al.* - *Orobanche* species as weeds and their management in sustainable agriculture. (1.7.7.)

Palmer, J.D. - Horizontal gene transfer in the evolution of plant mitochondrial genomes. (12.4.1.)

DePamphilis, C. - Evolution of RNA editing sites and its impact on phylogenetic signal in plant mitochondrial genes. (12.4.3.)

Nickrent, D.L. and Blarer, A. - Hydnoraceae and its systematic affinities with Piperales. (12.9.3.)

López-Curto, M. *et al.* - *Cuscuta jalapensis* parasite on *Coffea arabica* in Veracruz, México. (P 0259)

Malécot, V. and Nickrent, D.L. - Acquisition of root hemiparasitism and other life history traits in Santalales. (P 0479)

Khoshrang Golavar, S. and Kazempour Osaloo, S. - Pollen morphology of Orobanchaceae tribe Rhinantheae in Iran. (P 0553)

Krause, K. *et al.* - Evolution of plastid genomes within the parasitic flowering plant genus *Cuscuta.* (P 0606)

Rojas, M.M. *et al.* - Host specialization in *Orobanche foetida.* (P 1186)

Bennett, J.R. and Mathews, S. - Evolution of phytochromes in parasitic Orobanchaceae. (P 1187)

Roman, B. *et al.* - Genetic diversity in two variants of *Orobanche gracilis* Sm. [var.*gracilis* and var.*deludens* (Beck) A.Pujadas] from different regions of Spain. (P 1188)

Armstrong, J.E. - Hemiparasitism: a way station to holoparasitism or an evolutionary stable strategy? (P 1189)

Korol`kova, E.O. - Anatomical features of the stem structure in the *Orobanchaceae.* (P 1190)

Jus, M.A. - The figwort family (Scrophulariaceae Juss.) in Belarussian Flora. (P 1191)

Morawetz, J.J. and Wolfe, A.D. - Phenetic analyses of morphological traits in the *Alectra sessiliflora* complex (Orobanchaceae). (P 1192)

Stefanovic, S. and Olmstead, R.G. - Phylogeny and plastid genome evolution in the parasitic genus *Cuscuta* (Convolvulaceae). (P 1411)

de Vega, C. - Floral morphology, flower longevity, and nectar secretion patterns of the holoparasitic plant *Cytinus hypocistis* (L.) L. (Cytinaceae) growing on three different hosts. (P1671)

FORTHCOMING MEETINGS

International Workshop on faba bean breeding and agronomy, Cordoba Spain, 25-27 October, 2006. Further information from Ana Maria Torres, email: anam.torres.romero@juntadeandalucia.es

IPPS Congress, Charlottesville, Virginia, USA, 3-7 June, 2007. A first circular will shortly be sent to all Haustorium recipients.

GENERAL WEB SITES

For individual web-site papers and reports see LITERATURE

For information on the International Parasitic Plant Society, past and current issues of Haustorium, etc. see: http://www.ppws.vt.edu/IPPS/

For past and current issues of Haustorium see also: http://web.odu.edu/haustorium

For the ODU parasite site see: http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page

For Lytton Musselman's *Hydnora* site see: http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/lecturesandarticles

For Dan Nickrent's 'The Parasitic Plant Connection' see: http://www.science.siu.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see: http://www.rmrs.nau.edu/misteltoe/welcome.html

For information on activities and publications of the parasitic weed group at the University of Hohenheim see: http://www.uni-hohenheim.de/~www380/parasite/start.htm

For information on, and to subscribe to, PpDigest see: http://omnisterra.com/mailman/listinfo/pp_omnisterra.com

For information on the EU COST 849 Project and reports of its meetings see: http://cost849.ba.cnr.it/

For the Parasitic Plants Database, including '4000 entries giving an exhaustive nomenclatural synopsis of all parasitic plants' the address is: http://www.omnisterra.com/bot/pp_home.cgi

For a description and other information about the *Desmodium* technique for *Striga* suppression, see: http://www.push-pull.net

For information on EC-funded project 'Improved *Striga* control in maize and sorghum (ISCIMAS) see: http://www.plant.dlo.nl/projects/*Striga*/

For the work of Forest Products Commission (FPC) on sandalwood, see: www.fpc.wa.gov.au

LITERATURE

Abdel-Kader, M.M. and El-Mougy, N.S. 2001. Evaluation of different approaches of mycoherbicidal application for controlling *Orobanche crenata* in pea field. Egyptian Journal of Phytopathology 29: 69-82. (Field trials suggested that mycoherbicides based on *Trichoderma harzianum* and *T. viride,* applied as sprays and soil drench may be useful for controlling *O. crenata* in peas.)

Aflakpui, G.K.S., Gregory, P.J. and Froud-Williams, R.J. 2005. Carbon (^{13}C) and nitrogen (^{15}N) translocation in a maize-*Striga hermonthica* association. Experimental Agriculture 41: 321-333. (Showing that, once emerged, *S. hermonthica* depends on the host for only 22-59% of its carbon, but up to 100% of its nitrogen. The host was correspondingly depleted of only about 1% of its carbon but up to 10% of its nitrogen.)

Aizen, M.A. 2005. Breeding system of *Tristerix corymbosus* (Loranthaceae), a winter-flowering mistletoe from the southern Andes. Australian Journal of Botany 53: 357-361. (Showing that flowers of *T. corymbosus* are self fertile when hand-pollinated but that self pollination is rare in the field. Thus seed-set depends heavily on the declining numbers of over-wintering humming bird *Sephanoides sephaniodes.*)

Al-Eryan, M.A.S., Altahtawy, M.M.M., El-Sherief, H.K. and Abu-Shall, A.M.H. 2004. Efficacy of *Phytomyza orobanchia* Kalt. in reduction of *Orobanche crenata* Forsk. seed yield under semi-field conditions. Egyptian Journal of Biological Pest Control 14(1): 237-242. (Pupae of *P. orobanchia* were released on pots containing faba bean plus *O. crenata* (Forssk. not Forsk.) and were shown to cause a significant increase in insect parasite seed production.)

Allard, D.J., Petrů, M. and Mill, R.R. 2005. An ecological study of *Pedicularis dendrothauma*, an arboreal hemiparasitic epiphyte from Nepal. Folia Geobotanica 40(2-3): 135-149. (Reporting and describing a new species of *Pedicularis* growing as an epiphyte on the trunks of *Abies spectabilis*, forming parasitic attachments to the tree and to other associated epiphytes including mosses; also apparently behaving as a saprophyte on dead wood.).

Álvarez Puente, R.J. and Martínez Viciedo, Y. 2004. (*Dendropemon claraensis* Leiva (Loranthaceae), a new enemy of coffee trees.) (in Spanish) III Congreso 2004 Sociedad Cubana de Malezología, Memorias, Jardín Botánico Nacional, Habana, Cuba, April 2004: 108-110. (Describing the first observation of the endemic *D. claraensis* ('palo caballero') on coffee. It flowers and bears orange fruits all the year round, which are dispersed by birds.)

Ameloot, E., Verheyen, K. and Hermy, M. 2005. Meta-analysis of standing crop reduction by *Rhinanthus* spp. and its effect on vegetation structure. Folia Geobotanica 40(2-3): 289-310. (A quantitative literature review concluded that *Rhinanthus* spp. reduces above-ground biomass by an average 26% in the field. Grass and legume species are most reduced while non-leguminous dicots mostly benefit. Species number was increased in only 1 out of 4 studies.)

Amusa, N.A. and Adegbite, A.A. 2005. An overview of the present situation of the major economic field diseases of cowpea in the humid agro-ecologies of southwestern Nigeria. Proceedings of the 1st International Edible Legume Conference in conjunction with the IVth World Cowpea Congress, Durban, South Africa, 17-21 April 2005. pp. 1-11. (Reviewing the current situation of diseases, including parasitic plants, presumably *Striga gesnerioides* and *Alectra vogelii*.)

Arruda, R. and Carvalho, L.N. 2004. (Host specificity of *Struthanthus polyanthus* (Loranthaceae) in a Cerrado area at Serra de Caldas Novas State Park, GO, Brazil.) (in Portuguese) Bioscience Journal 20: 211-214. (Recording *S. polyanthus* on 9 hosts but highest levels on *Kielmeyera coriacea* and *Styrax ferrugineus*. Infestations were highest on horizontal rough-barked branches but also occurred on rough-barked vertical branches.)

Asiwe, J.A.N., Terblanche, H., du Toit, J. and van der Merwe, P. 2005. Cowpea germplasm enhancement at the Grain Crops Institute, Agricultural Research Council (ARC), Potchefstroom, South Africa. Proceedings of the 1st International Edible Legume Conference in conjunction with the IVth World Cowpea Congress, Durban, South Africa, 17-21 April 2005. pp. 1-5. (Parasitic weeds, presumably *Alectra vogelii*, noted to be among the constraints influencing the breeding programme.)

Aysan, Y. and Uygur, S. 2005. Epiphytic survival of *Pseudomonas viridiflava*, causal agent of pith necrosis of tomato, on weeds in Turkey. Journal of Plant Pathology 87: 135-139. (Showing that *P. viridiflava* may survive as an epiphytic population on *Orobanche ramosa.*)

Bekker, R.R. and Kwak, M. 2005. Life history traits as predictors of plant rarity, with particular reference to hemiparasitic Orobanchaceae. Folia Geobotanica 40(2-3): 231-242. (Thirty rare and 105 common plant species were appraised for life span, clonality, breeding system, seed production, seed dispersal and seed bank longevity. The vulnerability of 8 hemiparasitic Orobanchaceae (*s.l.)* is explained on the basis of these traits.)

Benharrat, H., Boulet, C., Theodet, C. and Thalouarn, P. 2005. Virulence diversity among branched broomrape (*O. ramosa* L.) populations in France. Agronomy for Sustainable Development 25: 123-128. (Populations of *O. ramosa* from varying host crops, including rapeseed, hemp and tobacco were compared for their virulence on a range of hosts. Results suggested that there are at least 2 'pathovars' which could be distinguished by molecular markers.)

Benvenuti, S., Dinelli, G., Bonetti, A. and Catizone, P. 2005. Germination ecology, emergence and host detection of *Cuscuta campestris*. Weed Research 45: 270-278. (Reporting on various aspects of *C. campestris* germination and attachment (to sugar beet), including a demonstration of phototropic behaviour towards a dark green target with relatively low red: far-red ratio.)

Botanga, C.J. and Timko, M.P. 2005. Genetic structure and analysis of host and nonhost interactions of *Striga gesnerioides* (witchweed) from central Florida. Phytopathology 95: 1166-1173. (Confirming narrow genetic variation in 4 populations of *S. gesnerioides* from *Indigofera hirsuta* hosts in USA, and their failure to develop beyond the tubercle stage on cowpea.)

Bowie, M. and Ward, D. 2004. Water and nutrient status of the mistletoe *Plicosepalus acaciae* parasitic on isolated Negev Desert populations of *Acacia raddiana* differing in level of mortality. Journal of Arid Environments 56: 487-508. (Results indicate that *P. acaciae* takes up nitrogen by both passive (via xylem) and active (via phloem) routes, but also that the host can limit or have a negative effect on the parasite. Results somewhat unexpectedly do not support the hypothesis that the mistletoe contributes to host water stress and mortality.)

Bullock, J.M. and Pywell, R.F. 2005. *Rhinanthus*: a tool for restoring diverse grassland? Folia Geobotanica 40(2-3): 273-288. (Proposing and demonstrating that *Rhinanthus* spp. can be used to suppress dominant grasses and *Trifolium repens* in fertile grassland, leading to greater species richness.)

Buschmann H., Fan, Z.W. and Sauerborn, J. 2005. Effect of resistance-inducing agents on sunflower (*Helianthus annuus* L.) and its infestation with the parasitic weed *Orobanche cumana* Wallr. Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz 112: 386-397. (Three foliar sprays of benzothiadiazole (BTH) at 250 mg/l reduced *O. cumana* by 71% without reducing sunflower biomass. Foliar applications of salicylic acid and acetylsalicylic acid gave comparable results. Also recording the non-selective action of 2,6-dichloroisonicotinic acid and negative results with *Bacillus subtilis, Trichoderma harzianum,* methyl jasmonate and harpin protein.)

Buschmann, H., Gonsior, G. and Sauerborn, J. 2005. Pathogenicity of branched broomrape (*Orobanche ramosa*) populations on tobacco cultivars. Plant Pathology 54: 650-656. (Nine cultivars of Virginia (flue-cured), Burley (light air-cured) and dark air-cured tobacco were all susceptible to two populations of *O. ramosa* but dark air-cured varieties were least affected.)

Cameron, D.D., Jun-Kwon Hwangbo, Keith, A.M., Geniez, J-M., Kraushaar, D., Rowntree, J. and Seel, W.E. 2005. Interactions between the hemiparasitic angiosperm *Rhinanthus major* and its hosts: from the cell to the ecosystem. Folia Geobotanica 40(2-3): 217-239. (Describing experiments to explore the direct effects of *R. major* on different individual species and resultant indirect effects on the plant community, as influenced by abiotic factors such as nutrient levels.)

Davis, C.C., Anderson, W.R., Wurdack, K.J. 2005. Gene transfer from a parasitic flowering plant to a fern. Proceedings of the Royal Society of London. Series B, Biological Sciences 272(1578): 2237-2242. (The rattlesnake fern, *Botrychium virginianum* (L.) Sw., an obligate mycotroph, is reported to have three mitochondrial gene regions with similarity to those of the Santalales. A horizontal gene transfer event is suggested to have occurred prior to the global expansion of the fern species.)

Davis, C.C. and Wurdack, K.J. 2004. Host-to-parasite gene transfer in flowering plants: phylogenetic evidence from Malpighiales. Science 306: 676-678. (Reporting a mitochondrial gene, *nad1B-C*, in *Raffesia* that appears to have come from the host *Tetrastigma*.)

de Andrade, M.J.G., Giulietti, A.M. and Guerra, M. 2005. Mitotic karyotype stability and meiotic irregularities in the families Loranthaceae Juss. and Viscaceae Miq. Caryologia 58: 70-77. (A detailed study of the chromosome number, interphase nuclear structure, prophase chromosome condensation patterns, and meiotic behaviour in 11 Brazilian species of Loranthaceae (all with $2n$=16) and 3 Viscaceae ($2n$=28).)

Dembélé, B, Dembélé, D. and Westwood, J.H. 2005. Herbicide seed treatments for control of purple witchweed (*Striga hermonthica*) in sorghum and millet. Weed Technology 19: 629-635. (Seeds of sorghum and millet were soaked for 5 minutes in solutions of 2,4-DB, dicamba, picloram or prosulfuron. 2,4-DB on sorghum reduced *S. hermonthica* emergence by up to 50% but selectivity was marginal. No other combinations proved selective.)

Diminic, D. and Hrašovec, B. 2005. (The role of diseases and pests in tree species selection in landscape architecture.) (in Croatian) Agronomski Glasnik 67: 309-325. (Observing that parasitic weeds can have a serious impact on some urban ornamental trees in Croatia.)

Domina, G., Greuter, W. and Mazzola, P. 2005. A note on the type of *Orobanche sanguinea* C. Presl (Orobanchaceae), nom. cons. prop. Taxon 54: 500-502. (To eliminate any future controversy over the application of the name *Orobanche sanguinea*, an epitype is designated.)

Ducarme, V. and Wesselingh, R.A. 2005. Detecting hybridization in mixed populations of *Rhinanthus minor* and *Rhinanthus angustifolius*. Folia Geobotanica 40(2-3): 151-161. (Reporting the use of RAPD and ISSR markers to detect hybrids not readily distinguished morphologically. The study confirmed that hybridisation occurred within 2 years in a mixed population in Belgium, while in an old population of *R. angustifolius* in The Netherlands, there was evidence of some introgression from *R. minor* into *R.*

angustifolius before the disappearance of *R. minor* from the population.)

Eizenberg, H., Shtienberg, D., Silberbush, M. and Ephrath, J.E. 2005. A new method for *in-situ* monitoring of the underground development of *Orobanche cumana* in sunflower (*Helianthus annuus*) with a mini-rhizotron. Annals of Botany 96: 1137-1140. (Describing clear Plexiglas mini-rhizotron plastic observation tubes, inserted into the soil, through which germination, penetration, and development of *Orobanche* can be monitored by mean of a mini-rhizotron camera.)

Feild, T.S. and Brodribb, T.J. 2005. A unique mode of parasitism in the conifer coral tree *Parasitaxus ustus* (Podocarpaceae). Plant, Cell and Environment 28: 1316-1325. (Lifting the veil considerably on this enigmatic species. Confirming that it does form 'bizarre graft-like attachments' to the roots of the conifer *Falcatifolium taxoides* and despite possessing chloroplasts, lacks significant photosynthesis. Transfer of carbon, however, apparently involves a fungal partner. The authors conclude that *P. ustus* behaves as a unique physiological chimera of mistletoe-like water relations and fungal-mediated carbon transfer from the host.)

Gacheru, E. and Rao, M.R. 2005. The potential of planted shrub fallows to combat *Striga* infestation on maize. International Journal of Pest Management 51: 91-100. (Concluding that on moderately *Striga*-infected and N-depleted fields, one-year fallows that stimulate *Striga* germination and produce high amounts of biomass such as *Sesbania sesban, Crotalaria grahamiana* and *Tephrosia vogelii* can reduce *Striga* and greatly increase maize yields, but on severely infected fields longer-term fallows may be needed. Six other fallow species gave less promising results.)

González-Verdejo, C.I., Barandiaran, X., Moreno, M.T., Cubero, J.I. and di Pietro, A. 2005. An improved axenic system for studying pre-infection development of the parasitic plant *Orobanche ramosa.* Annals of Botany 96: 1121-1127. (Sterilization of *O. ramosa* seeds by 0.5% formaldehyde + wetting agent for 20 minutes was found superior to sodium hypochlorite treatments. 8 days was optimal for seed conditioning at 24° C. Conditioned seeds once dried out could be kept for several months without requiring further conditioning.)

Grenz, J.H., Manschadi, A.M., Uygur, F.N. and Sauerborn, J. 2005. Effects of environment and sowing date on the competition between faba bean (*Vicia faba*) and the parasitic weed *Orobanche crenata.* Field Crops Research 93: 300-313. (Field trials in Turkey involved 2 sowing dates and 3 levels of parasite seed in the soil. Parasite number was a function of seedbank density and host root length density (RLD). Vegetative growth of the crop was little affected but yields were affected via reduced pod number. Delayed sowing reduced parasite growth more than host performance.)

Gressel, J. 2005. Problems in qualifying and quantifying assumptions in plant protection models: resultant simulations can be mistaken by a factor of a million. Crop Protection 24: 1007-1015. (Pointing out that the author's own model predicting that five herbicide-resistant *Striga* plants would appear per hectare per season was based on an inaccurate assumption that heterozygotes would be selected, and a heterozygous mutation frequency was used, while a recessive mutant frequency should have been used. A revised model would predict five resistant plants per million hectares per season.)

Grostad, T. and Halvorsen, R. 2005. (Some interesting plant finds from Sandefjord in Vestfold.) (in Norwegian) Blyttia 63: 23-24. (Noting the occurrence of *Cuscuta europaea* ssp. *europaea*.)

Haidar, M.A., Sidahmed, M.M., Darwish, R. and Lafta, A. 2005. Selective control of *Orobanche ramosa* in potato with rimsulfuron and sub-lethal doses of glyphosate. Crop Protection 24: 743-747. (Best results were obtained with a foliar application of rimsulfuron at 12.5 g ai/ha followed by three sequential applications of glyphosate at 100 g ai/ha.)

Hallett, S.G. 2005. Where are the bioherbicides? Weed Science 53: 404-415. (Reviewing the potential for plant pathogens as bioherbicides and noting parasitic weeds as a 'niche' use and recommending 'concerted effort' towards their development.)

Hamamouch, N., Westwood, J.H., Banner, I., Cramer, C.L., Gepstein, S. and Aly, R. 2005. A peptide from insects protects transgenic tobacco from a parasitic weed. Transgenic Research14: 227-236. (Transgenic tobacco plants containing a fusion of a parasite-inducible promoter to a gene for the antibiotic protein sarcotoxin IA have enhanced resistance to *Orobanche*.)

Horváth, Z., Békési, P. and Virányi, F. 2005. (Sunflower protection.) (in Hungarian) Növényvédelem 41: 307-331. (Presumably relating to *Orobanche cumana.*)

Jiang Fan, Jeschke, W.D. and Hartung, W. 2005. Contents and flows of assimilates (mannitol and sucrose) in the hemiparasitic *Rhinanthus minor/Hordeum vulgare* association. Folia Geobotanica 40(2-3): 195-203. (Presenting a model of carbon flow in host and parasite. Mannitol is an important component of *R. minor*, but was not detected in the host.)

Jiang Fan, Veselova, S., Veselov, D., Kudoyarova, G., Jeschke, W.D. and Hartung, W. 2005. Cytokinin flows from *Hordeum vulgare* to the hemiparasite *Rhinanthus minor* and the influence of infection on host and parasite cytokinins relations. Functional Plant Biology 32: 619-629. (Tracing the origin, movement and role of zeatin and related cytokinins in *R. minor* and its host barley, showing that zeatin content in the parasite increased vastly after attachment to the host, mainly as result of extraction from the host.)

JianQiu, Z. 2002. Handbook of contemporary vegetable pests and diseases: identification and management. Fully colored edition. Beijing, China: China Agricultural Press. 967 pp. (A catalogue of about 1300 pests and diseases, including parasitic weeds.)

Kaddour, S., Bouhache, M. and Bouya, D. 2005. Viability of crenate broomrape seeds (*O. crenata* Forsk.) when buried in a soil/olive pomace mixture: changes according to depth and duration of burial. Olivae No.103: 42-47. (Natural mortality of *O. crenata* seed in normal soil of 20-30% after 1-2 years, was increased to about 30-60% in a 1:1 mixture of soil with olive pomace (the residue from fruits after crushing).)

Kelly, D., Brindle, C., Ladley, J.J., Robertson, A.W., Maddigan, F.W., Butler, J., Ward-Smith, T., Murphy, D.J. and Sessions, L. 2005. Can stoat (*Mustela erminea*) trapping increase bellbird (*Anthornis melanura*) populations and benefit mistletoe (*Peraxilla tetrapetala*) pollination? New Zealand Journal of Ecology 29: 69-82. (Trapping stoats for 2 seasons increased abundance of bellbird strikingly but failed to significantly affect the pollination of *P. tetrapetala* in *Nothofagus solandri* forest.)

Kim HyunJong, Kwak InSeob, Lee BongSoo, Oh SeungBae, Lee HyunChul, Lee EunMi, Lim JaYoung, Yun YeoungSang and Chung BongWoo. 2005. Enhanced yield of extraction from *Gastrodia elata* Blume by ultrasonication and enzyme reaction. Natural Product Sciences 11: 123-126. (Relating to the extraction of phenolics from *G. elata* ('chunma') belonging to Orchidaceae, usually considered to be saprophytic but described in the abstract as a 'perennial parasitic herbaceous plant' growing in the woods of the central provinces of China, Korea and Japan.)

Knöpfl-Sidler, F., Viviani, A., Rist, L. and Hensel, A. 2005. Human cancer cells exhibit *in vitro* individual receptiveness towards different mistletoe extracts. Pharmazie 60: 448-454. (Detailed comparisons of pure viscotoxins and mistletoe lectins with commercial preparations Iscador(R)M, Iscador(R)Q and Abnobaviscum(R)Fraxini, on a range of human tumor cell lines and primary cancer cells.)

Kolseth, A-K., Lönn, M. and Svensson, B.M. 2005. Genetic structure in two meadow varieties of *Euphrasia*. Folia Geobotanica 40(2-3): 163-176. (Using AFLP to study the variation within and between two sub-species, *E. stricta* var. *suecica* (restricted to Gotland) and *E. stricta* var. *tenuis* (more widespread but declining). Concluding that there was significant variation both between and within varieties and populations, and that both forms should be the subject of conservation.)

Kuijt, J. and Lye, D. 2005. A preliminary survey of foliar sclerenchyma in neotropical Loranthaceae. Blumea 50: 323-355. (Using cleared leaves, three general categories of sclerenchyma are distinguished, and their systematic significance are discussed.)

Liao GwoIng, Kuoh ChangSheng and Chen MingYih. 2005. Morphological observation on floral variations of the genus *Cuscuta* in Taiwan. Taiwania 50(2): 123-130. (Recording a range of floral abnormalities observed in *C. campestris* in Taiwan.)

Lins, R.D., Colquhoun, J.B., Cole, C.M. and Mallory-Smith, C.A. 2005. Postemergence small broomrape (*Orobanche minor*) control in red clover. Weed Technology 19: 411-415. (Of a range of herbicides tested, only imazamox at 45 g/ha provided some selective control of *O. minor* though parasite seed production was not completely prevented. Glyphosate was non-selective.)

Marley, P.S., Kroschel, J. and Elzein, A. 2005. Host specificity of *Fusarium oxysporum* Schlect (isolate PSM 197), a potential mycoherbicide for controlling *Striga* spp. in West Africa. Weed Research 45: 407-412. (Confirming that *F. oxysporum* strain PSM 197, isolated in Nigeria, had wider pathogenicity than the 'Foxy-2' strain collected in Ghana, suppressing *Striga gesnerioides* as well as *S. hermonthica* and *S. asiatica*. It had only low activity on *Alectra vogelli*.)

Matusova, R., Kumkum Rani, Francel, W.A., Verstappen, W.A., Franssen, M.C.R., Beale, M.H. and Bouwmeester, H.J. 2005. The strigolactone germination stimulants of the plant-parasitic *Striga* and *Orobanche* spp. are derived from the carotenoid pathway. Plant Physiology, 139: 920-934. (Showing that inhibitors of carotenoid biosynthesis reduce maize, cowpea, and sorghum production of germination stimulants. A mechanism by which stimulants are produced from β-carotene is proposed.)

Mauromicale, G., Marchese, M., Restuccia, A., Sapienza, O., Restuccia, G. and Longo, A.M.G. 2005. Root nodulation and nitrogen accumulation and partitioning in legume crops as affected by soil solarization. Plant and Soil 271: 275-284. (Solarization increased soil temperatures by 9-15^{o} C and provided complete control of *O. crenata*. Nodulation of host roots was delayed and total nodule weight was reduced in the hottest season, but crop yields were increased by 300-900% thanks to control of the parasite and increased soil N.)

Mauromicale, G., Monaco, A.L., Longo, A.M.G. and Restuccia, A. 2005. Soil solarization, a nonchemical method to control branched broomrape (*Orobanche ramosa*) and improve the yield of greenhouse tomato. Weed Science 53:877-883. (Following the ban on use of methyl bromide in Europe, trials in Sicily, Italy have shown soil solarization to be a highly effective substitute. Covering moist soil with clear plastic for 2 months raised soil temperatures by at least 10^{o} C, completely prevented *O. ramosa* attack, and increased yields by 133-258%.)

Nadal, S., Moreno, M.T., Cubero, J.I. and Rubiales, D. 2005. Determinate faba bean young pod response to glyphosate and crenate broomrape (*Orobanche crenata*). Journal of Sustainable Agriculture 25: 19-27. (Describing the use of a short-season variety of faba bean as an economic catch crop, which stimulates germination but is harvested for fresh consumption before it can be affected by *O. crenata*.)

Nanni, B., Ragozzino, E. and Marziano, F. 2005. *Fusarium* rot of *Orobanche ramosa* parasitizing tobacco in southern Italy. Phytopathologia Mediterranea: 44: 203-207. (Noting damage from *Fusarium oxysporum* on *O. ramosa* without damage to tobacco and discussing possibilities for use in control.)

Okazawa, A., Trakulnaleamsai, C., Hiramatsu, H., Fukusaki, E., Yoneyama, K., Takeuchi, Y. and Kobayashi, A. 2005. Cloning of a cryptochrome homologue from the holoparasitic plant *Orobanche minor* Sm. Plant Physiology and Biochemistry 43: 499-502. (Reporting the cloning of blue light receptor gene, CRY1. The gene has high homology to other CRY genes and shows increased expression in darkness.)

Panetta, F.D. and Lawes, R. 2005. Evaluation of weed eradication programs: the delimitation of extent. Diversity and Distributions 11: 435-442. (Emphasizing the importance of surveillance, to ensure knowledge of the extent of a weed incursion (the 'delimitation' criterion), for eradication success, and referring to encouraging progress in the eradication of *O. ramosa* in Australia.)

Pérez de Luque, A., Jorrín, J., Cubero, J.I. and Rubiales, D. 2005. *Orobanche crenata* resistance and avoidance in pea (*Pisum* ssp.) operate at different developmental stages of the parasite. Weed Research 45: 379-387. (Avoidance/resistance mechanisms in *P. sativum* (Ps) and *P. fulvum* (Pf) accessions included lower root biomass in Ps573 and Pf14; lower establishment of tubercles on Ps624 and Pf651, perhaps associated with lignification, hypersensitivity or weak chemotropism; while Ps139 showed later failure of tubercles after establishment, perhaps associated with high peroxidase activity.)

Phoenix, D.K and Press, M.C. 2005. Effects of climate change on parasitic plants: the root hemiparasitic Orobanchaceae. Folia Geobotanica 40(2-3):205-216. (Reviewing a wide range of possible effects from climate change on parasitic plants and on the communities in which they occur.)

Rajanna, L., Shivamurthy, G.R., Niranjana, R. and Vijay, C.R. 2005. Occurrence of phloem in the haustorium of *Aeginetia pedunculata* Wall. - a root holoparasite of Orobanchaceae. Taiwania 50(2): 109-116. (Confirmaing the occurrence of phloem and callose deposition on sieve plates in the haustorium of *A. pedunculata*.)

Ramsfield, T.D., Shamoun, S.F. and van der Kamp, B.J. 2005. Infection of *Arceuthobium americanum* by *Colletotrichum gloeosporioides* and its potential for inundative biological control. Forest Pathology 35: 332-338. (An isolate of *C. gloeosporioides* applied to *A. americanum* on *Pinus contorta* var. *latifolia* caused some decrease in the reproductive capacity of the mistletoe but efficacy was highly variable and not significant.)

Randle, C.P. and Wolfe, A.D. 2005. The evolution and expression of *rbcL* in holoparasitic sister-genera *Harveya* and *Hyobanche* (Orobanchaceae). American Journal of Botany 92: 1575-1585. (Contrasting functional *rbcL* genes in *Harveya* with pseudogenes in *Hyobanche* and raising questions about the role of Rubisco in holoparasitic species. Also, and more surprisingly, Rubisco protein was detected in *Hyobanche*, suggesting that it was derived from the host.)

Rätzel, S. and Uhlich, H. 2004. (*Orobanche benkertii* sp. nov. (Orobanchaceae Vent.) and further *Orobanche* species from the northwest Caucasus mountains.) (in German) Feddes Repertorium 115: 189-211. (Surveys in the Russian Caucasus yielded two new species *Orobanche benkertii* and *O. laxissima,* several new subspecies, and new information on the endemic species *Orobanche gamosepala, O. grossheimii* and *O. inulae.*)

Revill, M.J.W., Stanley, S. and Hibberd, J.M. 2005. Plastid genome structure and loss of photosynthetic ability in the parasitic genus *Cuscuta.* Journal of Experimental Botany 56: 2477-2486. (Concluding that alterations in the plastid genomes of *Cuscuta* species are not coordinated with loss of photosynthesis.)

Riches, C.R., Mbwaga, A.M., Mbapila, J. and Ahmed, G.J.U. 2005. Improved weed management delivers increased productivity and farm incomes from rice in Bangladesh and Tanzania. Aspects of Applied Biology 75: 127-138. (Including a description of the development of a locally sustainable green manure approach to improving soil fertility and the productivity of rain-fed rice infested with *Striga asiatica* in S. Tanzania)

Rodenburg, J. 2005. The role of sorghum genotype in the interaction with the parasitic weed *Striga hermonthica*. Tropical Resource Management Papers 69, 138 pp. (Based on PhD thesis – see Theses above.)

Rodenburg, J., Bastiaans, L., Weltzien, E. and Hess, D.E. 2005. How can field selection for *Striga* resistance and tolerance in sorghum be improved? Field Crops Research 93; 34-50. (A detailed analysis of field experiments with ten sorghum genotypes grown with and without *Striga hermonthica* infestation over 3 years using varying *Striga* infestation levels. Providing valuable observations on the distinction between tolerance and resistance and their relative importance at different infestation levels, tolerance more so at low levels, resistance at high.)

Rohwer, J.G. and Rudolph, B. 2005. Jumping genera: the phylogenetic positions of *Cassytha, Hypodaphnis,* and *Neocinnamomum* (Lauraceae) based on different analyses of *trn*K intron sequences. Annals of the Missouri Botanical Garden 92: 153-178. (Indicating that *Hypodaphnis* is sister to all other Lauraceae, *Neocinnamomum* is close to *Caryodaphnopsis*, and that *Cassytha* is nested among the otherwise woody Lauraceae as sister group to a clade including all genera except *Hypodaphnis* and the Cryptocarya group.)

Ross, C.M. and Sumner, M.J. 2005. Ultrastructure of the fertilized embryo sac in the dwarf mistletoe *Arceuthobium americanum* (Viscaceae) and development of the caecum. Canadian Journal of Botany 83: 459-466. (Plant morphologists have long been fascinated with the the often greatly reduced embryos and associated structures in parasitic plants. This study documents the unusual persistent synergids and antipodals, recorded from few angiosperms.)

Roxburgh, L. and Nicolson, S.W. 2005. Patterns of host use in two African mistletoes: the importance of mistletoe-host compatibility and avian disperser behaviour. Functional Ecology 19: 865-873. (Confirming that in Zambia, the prevalence of mistletoes *Phragmanthera dschallensis* and *Plicosepalus kalachariensis* in a range of host trees, including *Acacia, Combretum, Ficus* etc species depended more on the preferences of the bird dispersers *Pogoniulus chrysoconus, Lybius torquatus* and *Cinnyricinclus leucogaster* for those trees, than the ability of parasite seedlings to establish.)

Samaké, O., Smaling, E.M.A., Kropff, M.J., Stomph, T.J. and Kodio, A. 2005. Effects of cultivation practices on spatial variation of soil fertility and millet yields in the Sahel of Mali. Agriculture, Ecosystems & Environment 109: 335-345. (In studies of soil fertility in a range of 'homefields' (not fallowed) and 'bushfields' (fallowed) regression analysis showed that millet yields were negatively correlated with infestation by *Striga hermonthica*.)

Shalaby, F.F., Ibrahim, H.M.M. and Hassanein, E.E. 2004. Natural biocontrolling activity of *Phytomyza orobanchia* (Kalt.) against *Orobanche crenata* and increasing its beneficial role by field releases of the fly adults. Egyptian Journal of Biological Pest Control 14(1): 243-249. (Surveys showed up to 97% natural infestation of *O. crenata* capsules by *P. orobanchia* and average levels of 50-60%. Release of adult flies significantly increased local infestation levels but also suggested little movement from the site of release.)

Shaw, D.C., Jiquan Chen, Freeman, E.A. and Braun, D.M. 2005. Spatial and population characteristics of dwarf mistletoe infected trees in an old-growth Douglas-fir – western hemlock forest. Canadian Journal of Forestry Research 35: 990-1001. (A survey in Washington State, USA, showed 25% *Tsuga heterophylla*, 29% *Abies procera* and 2% *A. amabilis* infected by *Arceuthobium tsugense* ssp. *tsugense*. Infested trees tended to be larger than uninfected and to act as foci of spread.)

Shukla, A.K. 2004. Pilot screening of toria germplasm against broomrape. Journal of Phytological Research 17(1): 121-122. (Of 250 genotypes of *Brassica campestris* var. *toria* evaluated in the field, 33 were infested by *Orobanche aegyptiaca*, the remainder unaffected.)

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