HAUSTORIUM

PARASITIC PLANTS NEWSLETTER

OLD DOMINION UNIVERSITY

December 1978
No. 1

Hauatorium - Purpose and Scope

The recent Striga/Orobanchace 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 Orobanchace species. Comments 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 Sterilisation

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


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.


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:

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

L. Musselman
Department of Biological Sciences
Old Dominion University
Norfolk, Virginia 23508
USA
STIGA 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 km². 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.
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 P. 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. Cmelin) 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 parasitic gymnosperm, Parasitaxis ustus (Vieill.) 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. Wolwinkel 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 diguan, 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. Hsiao 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 Hsiao and Pavlista, were those showing that exposure of Striga seeds to the natural stimulant strigol or the synthetic analogue GR7 during the pre-conditioning 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. Ogbon 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. Eleee 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. Yadura 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.) Mig. 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. Kwaak.

Thestrum 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-Imaleh 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 hence 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. Schilheter, 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-Imaleh 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. Saghiri 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).
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 cowpea 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 subsistence 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 subsistence 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 vogaelli, 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. Ferede


Literature

Russell, G. E. Plant breeding for pest and disease resistance. Butterworth, 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.

Chris Parker  
Weed Research Organization  
Yarnton  
Oxford OX5 1PF  
United Kingdom

Lytton Musselman  
Department of Biological Sciences  
Old Dominion University  
Norfolk, Virginia 23508  
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. __________________________  a2. __________________________
       family                      family
   b1. __________________________  b2. __________________________
       genus                      genus
   c1. __________________________  c2. __________________________
       species with author       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)
   __________________________

10. Recent or significant publication with complete citation. Limit two (optional information).
    a. __________________________
    b. __________________________
Rafflesiaeae 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. Jaffari 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. Bussian 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-Rayya

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. Saghiri) and the full-time work of two 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 conditions.

3) Glyphosate at low rates (60 - 160 gr acid equivalent 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. orobancheoides* 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 *Alyssandra vaginalis*.

Norman P. Upton

**Literature**


L. J. Musselman

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 the 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 through phloem tissue normally, yet the overwhelming association of conduction, tissue between parasitic 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, increased cell division, etc. Such host responses are common with most pathogens, whether or not they are animate.

Accompanying these events is a source-sink relationship, with a migration of sugars and inorganic ions (F, K, S, Mg) to the infection sites. The loss of these nutrients to the host 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 (in 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 the 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, cause 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 8,500 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: Scharf, R. F., F. G. Hawksworth, and B. J. Erickson. 1976. Mistletoe literature of the world: A user's guide to a PAMLUS 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. Hawksworth, 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 Bureau (CAB) have just released a sample issue of their new "Biocontrol News and Information". This contains several pages of news items on biological control and some 500 relevant abstracts selected from their various abstract journals. Each issue will also contain a review article and the topic of this first issue is by chance "The 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 prospects for biological control of all four major 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, Information 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 Orobancheae (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 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 address 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

IPSRC 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 this meeting. For information contact: Dr. Hr C. Weber, Bio, V. Univ. Ulm, D-7900 Ulm, West Germany.

Index of Current Research - Response to this program (see RAUSTATUM 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
Weed Research Organization
Yarnton
Oxford OX5 1PF
U.K.

L. J. Musselman
Department of Biological Sciences
Old Dominion University
Norfolk, VA 23508
U.S.A.
<table>
<thead>
<tr>
<th>Parasite Generic Name</th>
<th>Host Generic Name</th>
<th>Intensity of Infestation</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. campestris Yunk.</td>
<td>Alhagi maurorum (W)</td>
<td>S</td>
<td>Jordan Valley</td>
</tr>
<tr>
<td></td>
<td>Corchorus olitorius (C)</td>
<td>L</td>
<td>Alrousuifa</td>
</tr>
<tr>
<td></td>
<td>Prosopis frutecta (W)</td>
<td>S</td>
<td>Jordan Valley</td>
</tr>
<tr>
<td></td>
<td>Trifolium alexandrinum (C)</td>
<td>L</td>
<td>Zarqa</td>
</tr>
<tr>
<td>C. epilinum Whichl.</td>
<td>Artemisia herba alba (W)</td>
<td>S</td>
<td>Yajouz</td>
</tr>
<tr>
<td></td>
<td>Nicotiana tabacum (C)</td>
<td>L</td>
<td>Greenhouse</td>
</tr>
<tr>
<td>C. monogyna Vahl.</td>
<td>Citrus deliciosa (C)</td>
<td>L</td>
<td>Kreimeh</td>
</tr>
<tr>
<td></td>
<td>Vitis vinifera (C)</td>
<td>M</td>
<td>Irbid</td>
</tr>
<tr>
<td>C. planiflora Ten.</td>
<td>Capparis spinosa (W)</td>
<td>L</td>
<td>Karak</td>
</tr>
<tr>
<td>V. cruciatum Sieb.</td>
<td>Amygdalus communis (C)</td>
<td>S</td>
<td>Wadi Shu'aib, Ajlun</td>
</tr>
<tr>
<td></td>
<td>Crataegus azarolus (F)</td>
<td>L</td>
<td>Ajlun</td>
</tr>
<tr>
<td></td>
<td>Olea europaea (C)</td>
<td>None/S</td>
<td>Jarash to Ajlun</td>
</tr>
<tr>
<td></td>
<td>Punica granatum (C)</td>
<td>M</td>
<td>Wadi Shu'aib</td>
</tr>
<tr>
<td></td>
<td>Quercus sp. (F)</td>
<td>L</td>
<td>Kufra abl</td>
</tr>
<tr>
<td></td>
<td>Retama raetra (F)</td>
<td>L</td>
<td>Arda Rd.</td>
</tr>
<tr>
<td></td>
<td>Rhamnus palustris (F)</td>
<td>S</td>
<td>Ajlun to Wadi rumma</td>
</tr>
</tbody>
</table>

1 W = wild
2 S = severe
3 C = cultivated
4 L = light
5 M = moderate
6 F = forest treat
7 Locations are shown on the attached map.
IPSPKG 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. Saghri - 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, exchange 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 yet 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. IPSPKG 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. Additional 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 pur-
chased 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 Arothronia (the only mistletoe genus
that occurs in both Old and New Worlds).

EREMOLEPIDACEAE. This rare South American group contains 3 genera - Antidaphne,
Eremolepis, and Rubraclon. Its affinities are somewhat obscure as it seems to have rela-
tionships 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 varie-
ties 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 Okoeyt, 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 entre les Scrophulariaceae et les Orobancheae. Bull. Soc. Bot. Fr., 126, Lett. Bot. 4, 453-460. The morphological reduction and specialization of the haustorium of the Scrophulariaceae and Orobancheae has long fascinated botanists. The subject of this paper is the morphology of the tuber-like organs found in some genera (e.g. *Xylanthe, 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 yielded 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 *Cucueta* (*C. approximata*) and four of *Orobanche* (*O. ramosa*, *O. aegyptiaca*, *O. cersma*, *O. crenata*) are included. The corollas of *O. cersma* (p. 168) are much bluer and more flared at the mouth than some strains grown at WRO.
Mushtaqe, 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 bangweulea* (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 Omkruiden. *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). Sornyakiparasyr i bor'ba s nimi. Moscow, USSR. Rossel'khozizdat. 72 pp (in Russian). Detailed description of *Cuscuta Orobancha* 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:

<table>
<thead>
<tr>
<th>C. Parker</th>
<th>L. J. Musselman</th>
</tr>
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<tbody>
<tr>
<td>Weed Research Organization</td>
<td>Department of Biological Sciences</td>
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<td>Begbroke Hill</td>
<td>Old Dominion University</td>
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<td>Norfolk</td>
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<td>Oxford OX5 1PF</td>
<td>Virginia 23508</td>
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<td>UK</td>
<td>USA</td>
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</table>

**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:

<table>
<thead>
<tr>
<th>Variety</th>
<th>S. gesnerioides from cowpea</th>
<th>Alectra vogelii from cowpea</th>
<th>indigo cowpea</th>
<th>peanut cowpea</th>
<th>bambara nut</th>
</tr>
</thead>
<tbody>
<tr>
<td>blackeyes</td>
<td>24</td>
<td>13</td>
<td>0</td>
<td>19</td>
<td>65</td>
</tr>
<tr>
<td>rhenoster</td>
<td>12</td>
<td>24</td>
<td>0</td>
<td>11</td>
<td>84</td>
</tr>
<tr>
<td>var. 88-63</td>
<td>17</td>
<td>11</td>
<td>0</td>
<td>16</td>
<td>76</td>
</tr>
<tr>
<td>local (Nigeria)</td>
<td>21</td>
<td>11</td>
<td>0</td>
<td>9</td>
<td>49</td>
</tr>
<tr>
<td>Ife brown</td>
<td>12</td>
<td>19</td>
<td>14</td>
<td>78</td>
<td></td>
</tr>
<tr>
<td>TVV4557</td>
<td>2</td>
<td>8</td>
<td>5</td>
<td>46</td>
<td></td>
</tr>
</tbody>
</table>

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 the legume family. Other strains have been found to be specific to tobacco, Jacquemontia tannifolia (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 lindo (*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 throughout 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-parasite 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 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-rayana

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 Ecuador, Venezuela, and Colombia for research into 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

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 on parasitic weeds. The cost, however, is very high even by today's 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, chrysanthemum 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. I. 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 Orobancheae 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 Development-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:

C Parker  
Tropical Weeds Lab  
Weed Research Organization  
Oxford OX5 1PF  
England  

L J Musselman  
Biological Sciences  
Old Dominion University  
Norfolk, Virginia 23508  
USA
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 time 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 physicians 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 indecera Choisy*, *C. indecera 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 "Macchin del trigo") was very noxious in wheat 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. R. 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 parathion 1-2%.

In the case of heavier infestations, we have obtained interesting results with the preemergence herbicides Chloropropan (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 Valllo Medio de Rio Negro.

Seed cleaning in our area involves a separator with velvet-like rollers and/or magnetic separator (Gomper) 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. The 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).


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 xenogosin (meaning recognizing strangers), was derived from gum tragacanth.

Tsivion, Y. 1981. Suppression of axillary buds of its host by parasitising Cuscuta. l. Competition among sinds 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 P. 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. Zashchita 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?

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 und entwicklungswweise. 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 thathaustoria 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 Orobanchez. Pl. Syst. Evol. 136: 217-32. The author suggests that the specialized parasitic organ of the Orobanchez 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.


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.

Chris Parker
Tropical Weeds Group
Weed Research Organization
Yarnton
Oxford OX5 1PF
U.K.

Lytton J. Musselman
Department of Biological Sciences
Old Dominion University
Norfolk, Virginia 23508
U.S.A.
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 Orobanche crenata and broadbeans.

Embryos contained in mature seeds of Orobanche 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 twined 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.


*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 related 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 "Colletes 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. euphrasioioides (=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. euphrasioioides.
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 \text{ mm} \text{ long} (versus 0.03 \text{ 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. 1.

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 carbonées entre l'hôte (Pelargonium zonale) et le parasite (Cuscuta lupuliformis) Brell. Soc. Bot. Fr.: 177 Actualités 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.

Fer, A. 1981. Recherches sur le voies de transport impliquées dans l'alimentation, dune phanérogame parasite sur des feuilles isolées parasites 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. Vsknii 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 methods 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.

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 showed low stimulant character comparable to that of the known resistant variety Pramida.


1981. Studies on indigo witchweed, the American strain of Striga gesnerioides (Scrophulariaceae). Weed Sci. 29: 599-596. 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.

Cetinosoy, S. 1980. Studies on the determination of effective chemical against Melampyrum arvensis L. harmful in cereal fields in Central Anatolia. Turkey Plant Protection Research Annual, Arastirm Dairesi Baskanligi Sayi 15: 118-119. Melampyrum arvensis 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.


Petzoldt, K. 1981. Control of Orobanche crenata Forsk. in broadbeans (Vicia faba) by means of combined cultivation and plant protection measures. Z. Pflanzenkrank. u. Pflanzensch. 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 Corallorrhiza trifida Chat. (Orchidaceae) to organs of attachment of parasitic angiosperms. Ber. 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 achorophyllous 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.
C Parker  
Weed Research Organization  
Begbroke Hill, Yarnton  
Oxford OX5 1PF  
U.K.

Lytton Musselman  
Department of Biological Sciences  
Old Dominion University  
Norfolk, Virginia 23508  
U.S.A.
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 realise 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.

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 WRC (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 glass fibre 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
3rd International Parasitic 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, Yarnoton, 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 Hayne 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, circumcissile or non-circumcissile 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. Muselman and F.F. Bebawi University of Khartoum*

**A 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_Po. 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. hemonthica 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 Okonko's (1964) evidence in favor of a dual function of the xylem in S. hemonthica.

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

POLLINATORS OF HYDORA AFRICANA (Hydnoraceae) is one of the most bizarre of all genera of flowering plants due to its cryptic subtropical parasitic nature and tropical distribution. Hydnoraceae contains only two genera, Hydora and Prospanche. Prospanche is New World while Hydora is palaeotropical and reaches its greatest diversity in Africa. The family has been monographed by Hems (1935) and is included in Rijl's treatment of parasitic flowering plants (1969). Recently, Visser (1981) has included Hydora africana in his volume on South African parasitic seed plants. Information on the biology and parasitism of Hydora is, however, sorely lacking. We present here our observations on Hydora abysinica 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.

ALBINO STRIGA HEMONTHICA

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

EFFECT OF BURIAL ON SEED VIABILITY IN STRIGA HEMONTHICA

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 Maulum
University of Khartoum
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.

Hydnora abyssinica 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 astrigent flavor of the fresh rhizome, perhaps attributable to the concentration of polyphenols.

Golden Bough

The 'Golden Bough' emulate 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 Pilostyles hamiltonii C.A. Gardner (Rafflesiaceae) in stems of Davesia, Aust. J. Bot. 30:1-9. The Rafflesiaceae is a remarkable family of obligate parasites representing the ultimate in vegetative reduction. The flowers of Rafflesia are the largest known, those of Pilostyles 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 Pilostyles, is a welcome addition. The work reported here largely corroborates the study by Rutherford on North American Pilostyles. In the vegetative state, Pilostyles occurs as thin strands of parenchyma cells in the secondary phloem of the host. At flower initiation Pilostyles 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 Striga by means of urea. Experientia 38, 559-560. In vitro, urea at 200 and 400 mg/l caused severe inhibition of radicle growth in S. hermonthica. Ammonium sulphate had a moderate effect only at 800 mg/l and sodium nitrate had none.

Babiker, A.G.T. and Hammad, A.M. 1982. Factors affecting the activity of GR7 in stimulating germination of Striga hermonthica (Del.) Benth. Weed Research 22 (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. G. 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 IAA 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.


Striga Training Course

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 INTORMIL (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 (CASFA). 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 Vogelli in Botswana

Alectra vogelli 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. vogelli. Bambara groundnut (Vigna subterranea) is a well known host of A. vogelli 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.

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.

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
lack of host specificity in the species, Indigofera daeoides (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

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. Cynocormium (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 WC1E 7HX, U.K.

IMPORING 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

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.


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 Ureich, K. 1981. (Morphological characteristics of the berries of Viscum album and their taxonomic importance). Beiträge 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.
Ruijt, 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.

Ruijt, 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, Boul-aux-Dois 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.


Wolsinkel, P. 1982. Is enhanced phloem unloading in plants parasitised by Cuscuta restricted to the site of attachment? Annals of Botany 55, 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 TTPC at US$1 per issue. Material from HAUSTORIUM may be reprinted provided that appropriate credit is given.

L.J. Musselman: Box 120, American Embassy Khartoum, APO New York 09668 / USA.

C. Parker: Weed Research Organization, Begbroke Hill, Sandy Lane, Yarnton, Oxford OX5 1FF, U.K.
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. IOC/IDFA 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.

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**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: ________________________________
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.

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.)

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 CIB is prepared to assist with help from the taxonomist for the Commonwealth Institute of Entomology who are themselves hampereed in their studies by the scarcity of good accurately labelled specimens for study.

What is needed is a 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 Biological Control, Silwood Park, Imperial College, Ascot, Berks, SL5 7PY, UK.

D.J. Greathead, CIB, UK

REQUEST FOR INFORMATION ON RAFFLESIA

Mr. Takashi Sato, Kawahara-CHO 2552, Mizushahi, 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.

STIGRA PUBLICATIONS FROM ICRIASS 1.) Proceedings of the Second International Striga workshop, October 5-8, 1981 (Published by ICRIASS; 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. Ramalah, C. Parker, J.J. Vassudева Rau 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.

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 National 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


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 vogeli* 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 für Pflanzenphysiologie* 101(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**


Bhush, S.K., M. Balasundaran, and M. Ali. 1983. Possible pea 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 peas, 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.]


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


Bernhardt, P. and R.B. Knox. 1983. The stigmatic papilae 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 papilae 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 IFFC at USS1 per issue. Material from *HAUSTORIUM* may be reprinted provided that appropriate credit is given.

C. Parker: Weed Research Organization, Bogbrooke Hill, Yarnton, Oxford OX5 1PF, UK

L.J. Musselman: Dept. of Biological Sciences, Old Dominion Univ., Norfolk, VA 23529, USA
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.

(continued on reverse)
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.

THIRD INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS
MAY 1984

ADVANCE REGISTRATION FORM

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
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, Aetanthis, Struthanthus, Phrygilathus, Psittacanthus, Isocactus, Oreocnathus, Alepis, Illoestylus, Trilepida, 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 commercial 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 (DxE) Quinier cv. "T2/4"; Populus x euramericana (Dode) "Bergerac" (BBG); 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
cytological 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 holfast 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
phellem cells which are characterized by:
1. a secretion of polyphenols 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
rupture these barriers. Moreover, the
secretion of polyphenols and the
lignification of cell walls were much
greater. In the intermediate cultivars,
1214 and BBG, 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 banks 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 BBG was
just the opposite whereas 1214 and BBG
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 Université,
Paris, France.

PROCEEDINGS OF ALL
THREE PARASITIC WEEF
SYMPOSTIA STILL
AVAILABLE
Proceedings of the
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Symposium on
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"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, U.S.A., for USS15.00 and USS1.00 for
postage in the USA and USS2.00 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

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-buty]l, sethoxydim, NC-302, and chlorazifop, each being mixed with the oil at 1.8 μl product per 2 μl 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

technical papers began with the session on mistletoes and Hydnoraaceae. 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 Orobancheaceae. 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 outcrossover. The implications of this for the breeder—resilience, 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 Orobancheaceae. 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 Lathyrus and their ecology was presented. A study of Rhinanthus angustifolius 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 ratio 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 *Oscutta*. A special review paper on control in alfalfa highlighted 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 *Oscutta relexa*. The next discussed the spread of *C. campestris*, *C. pedicellata*, and *C. hyalinana* 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 prosculum, 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. Mour, and M. C. Saxena who attended to so many details which ensured the success of the symposium. Our hearty thanks for all this help.
Chris Parker presided at the informal business meeting on 9 May at the Aleppo symposium and called for suggestions for IPSFAC 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, P. Hawksworth, J. Ruijt, S. ter Borg, J. Dawson, M. Calder, and H. C. Weber.

One of the items discussed at the IPSFAC 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. Buchanan. 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. Blee, 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).

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


Enclosed with this issue of HAUSTRUM 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 Arceuthobiologists ever assembled. The symposium was organized by F.G. Haworth 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. Haworth, 240 West Prospect, Fort Collins, Colorado 80526 USA. Fifteen papers were presented under four broad topics:

* **BIOSYSTEMATICS, HOSTS, AND DISTRIBUTION.** Haworth and Wien updated recent taxonomic developments in the genus and summarized nine new taxa described since the appearance of their 1972 monograph. Kuo 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, Guzman, and Eshbaugh. Linhart discussed isozyme variation of two dwarf mistletoes in relation to their host species.

* **PHYSIOLOGY, ANATOMY, RESISTANCE.** Aloisi 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 Haworth summarized literature on insect and mite associates of dwarf mistletoes. The possibility of long-distance dispersal
by birds and mammals is described byNicholls, Hawksworth, and Merrill.

* ECOLOGY. Relationships between dwarf mistletoes and understory vegetation (habitat types) are reviewed by Mathiasen and Blake. Tinmin outlined the changes in community structure and function resulting from dwarf mistletoe infestation. The complex interrelationships 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 vogelii* 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 Cameroon. 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. *Orobanchus 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 fumers of treating seedlots with methyl bromide.

Not a new record, but one previously overlooked by weed specialists, is the presence of an established colony of *Orobanchus crenata* in Britain, well outside its main peri-Mediterranean distribution. First recorded in Essex in 1950, it has persisted there on *Vicia tetrasperma*. As it has so far only occasionally occurred on *Vicia 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 1JZ, 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

study of the floral biology of two mistletoes which are in competition for
the same pollinators, in this case
birds. The host mistletoe, A. michaelis,
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 Hydroa
johannis (=H. abyssinica) in Sudan).

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).

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).

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).

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 Baro, A. and
Garcia-Torres, L. 1984. Phytotoxicity
and yield response of broad bean (Vicia
faba) to glyphosate. Weed Science
32:445-450. (A useful study of the
response of faba bean to glyphosate
application (in the absence of
Orobanchus 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
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)

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8. Main taxonomic groups:

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8c. Species

8d. Family

8e. Genus

8f. Species

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8h. Genus

8i. Species

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10b. Second emphasis

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OLD DOMINION UNIVERSITY
Department of Biological Sciences
Norfolk, Virginia 23508 USA

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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 INTSORIL 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 INTSSORIL for willingness to keep Haustorium alive.

The Editors

Since the original description and naming of Striga baumanni by Engler in 1897 (Bot. Jahrb., 23: 515-516 and pl. 12, fig. 0-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 baumanni 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 supply 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 shrivel. 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 baumanni 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 camose-thicken, papillose inside, 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.

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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 ERC-funded project is in progress on the resistance of Vicia faba beans to Orobanche crenata.

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

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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.)

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Maateth, J.D., G. Montenegro, A.M. Walockiáski. 1985. Host infection and flower formation by the parasite
Tripterix 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.)


Nolas, 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.)

Gupta, A., M. Singh. 1985. Mechanism of parasitism by Cuscuta reflexa: distribution of cytokinins in different regions of the parasite vine. Physiologia Plantarum 63 (1), 76-78. (Cytokinin is shown to be particularly high in the concave portion of the haustorial region.)

Obilana, T.A. 1984. Inheritance of resistance to Striga (Striga hermonthica Benth) in sorghum. Protection Ecology 7 (4), 305-311. (Inheritance of the resistance in line 187 is shown to be polygenic, based on 2 to 5 genes. Susceptibility is dominant over resistance.)

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, Distribution, 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 Porsk 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. Untersuchungen an australischen und neuseeländischen Loranthaceae/Visaceae 3 Granulahaltige Xylem-Leitbahnen, Beitrag zur Biologie 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. Beitrag zur Biologie der Pflanzen 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 chloromequat.)

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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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 INSOMIL 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 hermontica 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. intermias 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. hermontica but has broader leaves and a dense covering of fine hairs and spikes of brick-red flowers up to 2 cm long.

A close examination of this population showed that it is perennual with a system of rhizomes several cm thick from which adventitious buds produce aerial shoots. The aerial parts also have a parasitic 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, lack of a sponsor! It is still not too late to send your forms to L J Musselman.

A TUBEROUS HAUSTORIUM OF THONNINGIA SANGUINAEA (BALSAMOPHYLACEAE) GROWING ON EUPHORIA BRASILIENSIS.

In 1985 a tuber 8 cm in diameter was sent to Kew from Quesaco where it was collected by Mr P. G. Hall of the Natural Resources Department, Commonwealth Development Corporation. It was said that Thonningia angulifera was conspicuous as red rosebuds 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, Linekoria pappus 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 than the rubber. According to the Anatomy of the Dicot, tuberous rhizomes in the Balanophoraceae range in size from a small notch to a human head. Striga geonomoides 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 analogous function in these two parasites from totally unrelated families each-producing tuberous haustoria? (See figure on page 4).

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

FOURTH SYMPOSIUM ON PARASITIC WEEKS, SUMMER 1987.

Plans are proceeding for our next IPSPG meeting which will be held in Germany during the summer of 1987 at the Phillips 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 diarrhoea and menstrual disorders called in Somali, dinsi. Because of its resemblance to turtucus (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 Chlamydophyllus 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.

Ayesa Yusuf and L J Musselman

EFFECT OF FERTILIZER ON STRIGA COIUN IN WHEAT

An experiment on the long range effect of continuous cropping and manuring on Joash wheat rotation is in progress at the Agricultural Research Station of the University of Agricultural Sciences at Sirigupp 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 P2O5 (0, 40, and 80 kg/ha) and two levels of K2O (0 and 40 kg/ha). The experiment is laid out in a 3 x 2 partially unfounded design with four replications.

The crop of Hy. jowan-GSH-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 P2O5 levels and K2O level did not show any influence on the Striga count. The data indicates that the intensity of Striga is greater in N poor soils.

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

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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 Riegman 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, C, Zavadia, 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.)

Iranzarg, M. 1983. New records of Cuscuta (Cuscutaceae) from Iran. Iranan 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. ITIA 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 flowering form of S. asiatica are of more local importance. Another species, perhaps S. pascei, has also been noted on maize. A second article describes the discovery...
of resistance to S. gesnerioides in the cowpea variety Sultana-2 and the transfer of the resistance into varieties with insect resistance.

Vasudeva Rao, M. J. 1985. Techniques for screening cowpeas for resistance to Striga. Information Bulletin 20, ICAR. (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 CIC Press in 1986.)

Kuijt, J., Bray, D., Olson, R. 1985. Anatomy and ultrastructure of the endophytic system of Pileostyles thrutberi (Saxifragaceae). 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 vestigial.)


Scrophulariaceae Research Newsletter 1(2). (This may be of interest to HLSTPRM 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 (Visco- aceae). American Journal of Botany 72: 1220-1224. (This miniature mistletoe with shoots only 2-3 mm long on Euphorbia herinae is shown to have functional phloem elements, unlike some other reduced mistletoe species.)

Clay, K., Desent, 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 lannah and Procepus 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.)

Blicherger, 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 parasitae.)

Sobai, A., Shivan, L. R. 1985. Seed germination and seedling growth in Sophora 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 wakening 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.)

Adzai, M. G., Olvin, 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.)


HAUSTORIUM is edited by L. J. Musselman, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23508 USA and by C. Parker, Tropical Weeds, Weed Research Organization, Begbroke Hill, Yarnton, Oxford OX5 IPF UK. Send material for publication in HAUSTORIUM as well as requests for copies to either editor.

This issue of HAUSTORIUM was reproduced and mailed to you by the Sorghum/Millet Collaborative Research Program, INTSORML. This collaborative research program is supported by a grant from the United States Agency for Internation Development, Contract Number DAN-1254-G-SS-5065-00.
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 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 to exist at the new site and has been awarded a two-year contract to continue work on Striga gesnerioideae and Elechtr vogelii on cowpea. The aim will be to continue evaluating resistant material for IITA and Botswana and to identify the mechanism of resistance in the cowpea.

Chris Parker will be leaving this and other work at IARS in the hands of John Terry, Anita Wilson and Tegesa 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 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, 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 HAUSTORIIUM, 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 structure 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 hemionthica, 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

This symposium was held in Wageningen, The Netherlands. The proceedings have now been published under the title of Biology and Control of Orobanche, edited by S. J. ter Borg. This is an attractively 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; domancy, 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, Bornesteeg 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 47.75.61.03.9, Amrobank, Wageningen, The Netherlands.

LITERATURE


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 brochure 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 pathogenetically, a phenomenon which should be looked for in agronomically important species).


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


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. coerulescens 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 600 l/ha).

Aalders, A. J. G. and R. Pieters. 1986. In vitro testing with 2,3,5-triphenyl tetrazolium chloride (TTC) of Orobanche coerulescens seed metabolism. FABIS Newsletter, 13:35-37. TTC can be used to confirm the viability of O. coerulescens 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 common 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 GR34, 2RS and 3RS promoted up to 80% germination at 0.1 mm, the first evidence for effect of these compounds on non-parasitic plants).

Nisar, M., S. Akbar, M. Taj. 1985. Anti-inflammatory activity of Cucurbita chinesis. Poteriterapia 56:315-317. (This parasite is used as an anti-arthritis drug in India. It is not clear if C. chinesis is the only species with this activity).

Fer, A. and M. Capdepon. 1985. Un aspect méconnu due parasitisme des angiospermes: L’existence d’une sécrétion de substances au niveau des sucros de cucurbitaceae. 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 photosyntheate 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 Schrophulariaceae. 83 pp. PhD Dissertation, Botany, Miami University, Oxford, Ohio. (Based on pollen morphology, the author suggests that the parasitic Schrophulariaceae, all in the subfamily Rhinanthoideae, show closer affinity with the Orobanchaceae than with the other subfamily, Antirrhinoideae, of the Schrophulariaceae).


STRIGA LATERICEA 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 Nepper 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.

HAUSTORIUM was word processed and designed by Ruth M. Carr and produced at the International Plant Protection Center, Oregon State University, Corvallis, OR 97331, USA. This collaborative research program is supported by a grant from the U.S. Agency for International Development, Contract No. 86-CRSR-2-2869.
CACTI AS PARASITES? It has long 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 dilleniana was found growing on Aesculus, Lagerstroemia, Pinus, Sapindus, 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 "Foerth 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:


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.


———. 1987. Contribution a l'étude 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.)


Musselman, L. J. and J. H. Visser. 1987. Hydrona johannis in southern Africa. Dinteria 19: 77-82. (The plant known in Namibia and other parts of southern Africa as Hydrona solmsiana is shown to be the same as Hydrona johannis which is common in parts of Sudan and Ethiopia and perhaps elsewhere. Reference to Hydrona 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'étude de la biologie des phanerogames parasites: Recherche sur Osynis 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.)


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.
ALECTRA AND STRIGA ASPERA IN BURKINA FASO

As part of field surveys of parasitic weeds with ICRISAT, we have noticed Alectra vogelli 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 occurrence in Burkina Faso. The Flora of West Tropical Africa (FWTA) records A. vogelli from Nigeria, Ghana, and Guinea. Recently Parker (1984) reported A. vogelli on cowpeas in Mali. According to FWTA, this parasite is a serious pest at least one site in Cameroon. In southern Africa it is reported to be serious on cowpeas, groundnuts and bean beans. We have not seen it on beans 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.

CUCSCUTA SPECIES AS CONTAMINANTS IN SEED SHIPMENTS

During the past several years, we have been investigating the occurrence of Cuscuta spp. in commercial 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 superficially resembles C. pentagona but has different corolla lobes. Preliminary work indicates that seed surface characteristics may be useful in distinguishing among species.


K. V. Ramaiah, S. B. Sata, L. J. Musselman
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

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

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
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., Netzy, 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 commitment 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-DMBO) 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 DMBO 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.)

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.

HAUSTORIUM is edited by Lytton Musselman, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA and Chris Parker, Agricultural Research Service, Post Office Box 32477, Addis Ababa ETHIOPIA and is supported in part by grant CSRS 86-CRSR-2-2869 of the U.S. Department of Agriculture awarded to Old Dominion University. Send material for publication to either editor and requests for copies to L. J. Musselman.

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(HAUSTORIUM 18 was mailed 9 November 1987)

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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 Alectra vogelii is AND COWPEA: STUDIES commonly found as IN THE SOUTHERN parasite of cowpea REGION OF BOTSWANA 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 Setsswana language. Both are given the generic name matabele or mabelo 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 Dolichos lablab is being extended to farmers in the region but despite monitoring no parasitism by A. vogelli has been reported. Similarly, the perennial legume Macroptilium atropurpureum (siratro) which is also being evaluated for its fodder potential by FSSR has not yet been parasitized by A. vogelli.

Philip Bacon, FSSR, Lobatse, Botswana

WEEDY POPULATIONS OF OROBOanche 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 parasitic 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.

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

VESICULAR-ARBUSCULAR MYCORRHIZAE (VAM) IN STRIGA--AN UNDESIRED 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

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.
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 capitulate 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; capitulate 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 worldwide, 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. subinclusa, and lacking in C. californica and C. sandwichiana.

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 characters may be very polymorphic.

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

POST EMERGENCE CONTROL OF OROBASENE CERNAEA 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.

LITERATURE

Kuijt, J. 1988. Monograph of the Eremolepidaceae. Systematic Botany Monographs. Volume 18. (The Eremolepidaceae is a mistletoe family entirely restricted to South America, Mexico, and the Caribbean. This is a monograph of the three genera and 12 species of the family).

1988. Revision of Tristerix (Loranthaceae). Systematic Botany Monographs. Volume 19. (This is a taxonomic treatment of one of the most fascinating groups of South American mistletoes including some with large flowers, T. grandiflorus, and a leafless parasite of cacti, T. aphylus.


Gedalovich, E. and J. Kuijt. 1987. An ultrastructural study of viscin tissue of Phthirus a pyrifolia (H.B.K.) Eichler (Loranthaceae). Protoplasma 137: 145-155. (One of the best known features of many mistletoes is the extremely sticky nature of the fruit. This "glue," viscin, plays an important role in the early life of the seedling, enabling the parasite to stick to its potential host. This is a study on the structure of the cells which produce the viscin).


alleviate damage but did not prevent eventual establishment on sorghum. Peat and organic soils enhance stimulant production and accelerated striga emergence).


van Hulst, R., A. Theriault, and B. Shipley. 1986. The systematic position of the genus Rhinanthus (Scrophulariaceae) in North America. Canadian Journal of Botany 64: 1443-1449. (Using seed proteins and morphology, it is suggested that the North American plants be known as R. minor var. minor and R. minor var. borealis. The techniques used in this study may have value in related root parasites).

van Hulst, R., B. Shipley and A. Theriault. 1987. Why is Rhinanthus minor (Scrophulariaceae) such a good invader?

Canadian Journal of Botany 65: 2373-2379. (This hemiparasite is apparently an effective invader in relatively unproductive grassland because its finite rate of increase is a nonlinear function of the biomass of the surrounding vegetation being maximized when the surrounding vegetation is dense enough to allow effective root parasitism but not so dense that plants are outcompeted for light).


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).

Becker, H. and H. Schmoll. 1987. Mistel. Arzneipflanze. Brauchtum. Kunstmotive im Jugendstil. Wissenschaftliche Verlagsgesellschaft, Stuttgart. (Artful and delightful would be two adjectives to describe this hardbound volume in German dedicated to the medical uses and motif of the mistletoe in art. The combination of subjects-medicine and art-seems unusual but then we are dealing with an unusual plant. The first part of the book deals with medical aspects emphasizing the use of mistletoes in cancer therapy. The second part of the book deals with the mistletoe motif. For North Americans, it is difficult to imagine the pervasive use of the mistletoe motif. Such uses are lavishly illustrated in the book in such diverse forms as light fixtures, tableware, combs, vases, furniture, jewelry, and art).

HAUSTORIUM is edited by L. J. Musselman, Department of Biological Sciences, Old Dominion University, Norfolk, VA, 23529-0266, USA, and Chris Parker, Agricultural Research Service, Post Office Box 32477, Addis Ababa, ETHIOPIA, and is supported in part by grant CSRS 86-CRSR-2-2869 of the U.S. Department of Agriculture awarded to Old Dominion University. Send material for publication to either editor and requests for copies to L. J. Musselman.

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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 an exhaustive 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 Carliquist 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 Recherche Agronomique Appliquée 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 mauretanica* 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 mauretanica* 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 (Carquist 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 adobe-like 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. Carquist, Rancho Santa Ana Botanic Garden

**OROBANCHE IN NEPAL** A survey trip in January 1988 to assess the *Orobanchne* problem in *Brassica* oilcrop growing areas of Nepal was sponsored by IDRC, Canada, and Nepal Agricultural Association. *Orobanchne* 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 *Orobanchne* in the high hills though we found reports of its occurrence in hills as high as 3800 m in Manang district. *Orobanchne 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 *Orobanchne* had a 20% yield loss according to the National Olie-seed Development Project at Nawalpur. In the farmer’s fields, toria following rice apparently had less *Orobanchne* than toria following maize or jute.

♦ M. J. Vasudeva Rao, ICRI SAT,
♦ 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 Elisa 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. Epieoe, USDA, Whiteville Methods Development Center

**COMBATING STRIGA AT AFRICA WORKSHOP** About fifty scientists from many nations met at the International Institute of Tropical Agriculture (IITA) in Ibadi, 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

CUCUMA IN PULSES

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 unguiculata, V. radiata, V. aconitifolia, Cicer arietinum, Cajanus cajan, Medicago sativa, Crotalaria 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, Cymoposis tetragonoloba. Resistant crops are Macrotyloma uniflorum, Gossypium spp., pomeae 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 WORK - Orobanche is a SHOP ON OROBANCHE serious root parasite 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 accommodation 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 7262876 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, Philipps-Universitat, Lahnberge, 3550 Marburg, West Germany.

LITERATURE


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).


HAUSTORIUM is edited by L. Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA, telex 623428 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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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

IPSPIRG 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 editor.

■ 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 Obermarchtal to hear and discuss 40 presented papers and 15 posters. Some 16 countries were represented, including 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 O. ramosa/O. aegyptiaca complexes (Musselman); while an unfamiliar name, O. salmii, was introduced by Bharati to describe an important species in Nepal, apparently close to O. cerna. The allozyme/iso-enzyme technique had been used by Verkleij to confirm that the outcrossing 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/varietiy-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. cerasa (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. cerasa, 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 Herzewick). The practical usefulness of ‘solarization’ had been extended by Abu-Ismail’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). Oue 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, imazetepyr, 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 (Tchaliakov). "Tolone" (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 cyclone 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, Gwogwor, 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. *Cycniun tubulatum* is common in marine soils in the Juba region of central Somalia. The large, showy white flowers open at night and have an 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 occurred.

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 Herbarium. 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. 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.

**LITERATURE**

is a thick stemmed, high climbing dodder which can kill mature citrus trees. Glyphosate provided excellent control.


Graves, J. D., M. C. Press and G. R. Stewart 1989. A carbon balance model of the sorghum-*Striga hermonthisca* host-parasite association. Plant, Cell and Environment 12:101-107. (*Striga hermonthisca* depends on the host for one third of its carbohydrate even after emergence. But 80% of the damage to the host is by its effects on host photosynthesis).

el-Haddar, E. 1988. First record of the parasitic plant *Cuscuta australis* in Tunisia. In Near East Working Group for Improved Weed Management Newsletter 5:2. ed. F. G. Americano. (Identification of dodders is often difficult and it could be that this report deals with *Cuscuta pentagona*, syn *C. campestris*, which closely resembles the related *C. australis*).


Minkin, P. J. and W. H. Eshbaugh. 1989. Pollen morphology of the Orobancheae and rhinanthoid Scoropopularies. Grana 28: 1-18. (The relationship between the Orobancheae and Scoropopularies has long been debated by botanists. This study indicates that the pollen of the subfamily Rhinanthoideae of the Scoropopularies more closely resembles pollen of the Orobancheae than non-parasitic Scoropopularies).


Netzly, D. H., J. L. Ropelo, G. Ejeta and L. G. Butler. 1988. Germination stimulants of witchweed (*Striga asiatica*) from hydrophobic root exudate of sorghum (*Sorghum bicolor*). Weed Science 36: 441-446. (Sorgoleones inhibit growth of lettuce and *Amaranthus* and may have a role as allelopathic agents, as well as stimulating *Striga*).

illustrated in full color; a mistletoe, Tapinanthus oleifolius (Loranthaceae) and Hybanche sanguinea) (Scrophulariaceae)."

Polhill, R. M. editor. 1989. The Golden Bough. A newsletter to foster bio-systematics of Loranthaceae and Viscaceae. (The most recent issue, number 11, is of especial value in listing all the genera of mistletoes. Copies may be obtained, free of charge, by writing the editor at: Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE England).


Vasudeva Rao, M. J., V. L. Chidley, and L. R. House. 1989. Estimates of grain yield losses caused in Sorghum [Sorghum bicolor (L.) Moench.] by Striga asiatica (L.) Kunze obtained using the regression approach. Agriculture, Ecosystem, and Environment 25: 139-149. (Funding agencies invariably ask the question "How much damage does Striga do?"- which is usually impossible to answer. This paper provides hard data on yield loss in sorghum. Predictions of loss range from 9.2 to 98%. Assuming only 10% of the hybrid sorghum crop in India is infested at levels realized in their work, the authors predict that the sorghum loss in India is about 53,000 (tons each year at a value of US$4.9 million).

Visser, J. H. 1989. Hydraena triceps. The Flowering Plants of Africa, 50 part 2. (This unusual plant was last collected by Dinter in 1888. One century later, the author collected it in western Namakwaland in the northern Cape Province. Perhaps its infrequent citing is due to the fact that it often flowers underground with insects entering through soil fissures. A beautiful watercolor accompanies this paper).


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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 Géteura 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.

HAUSTORIUM 21 was mailed 19 April 1989.
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 indices 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 incaus has yellow flowers with pink streaks while Loranthus brunnescens 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. incaus 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 *Thommosia sanguiinea* and the white wood rot fungus (*Fomes lingus*) on the lower portion of the hole ultimately lead to tree fall. All this results in losses not yet quantified.

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

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**STRIGA HERMENTHICA ON BARLEY IN ETHIOPIA**

*Striga hermenthica* is a common occurrence in sorghum and maize in many parts of Ethiopia. In 1988 it was found growing on teff (*Eragrostis tef*) in several fields in East and West Gojam and North Wello Administrative Regions. Last September *S. hermenthica* 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 teff 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

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**A NEW TERMINOLOGY FOR PARASITIC PLANTS**

Parasitic flowering plants have been studied 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.

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**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 8500 kg/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/m² for late counts, and 20 and 71 kg/ha per gm/m² *Striga* dry weight. *Striga* emerging early in the season was consistently more damaging than *Striga* emerging late. Only 20 *Striga* plants/m² late in the season were required to reduce yield by 50% in the lowest yielding trial while 43 plants/m² 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

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**LITERATURE**


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 OA/FAO).


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 blueberries, both species of the genus *Vaccinium*).


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


FIFTH INTERNATIONAL SYMPOSIUM ON PARASITIC WEEDS
NAIROBI, JUNE 1991
FIRST CIRCULAR-JANUARY 1990

If you wish to be placed on the mailing list for further announcements of the symposium, fill out this form and return it by April 15 1990 to:
Fifth Symposium on Parasitic Weeds
Parasitic Plant Laboratory
Old Dominion University
Norfolk, Virginia 23529-0266 USA

NAME (First, middle initial last):
TITLE:
ADDRESS (include mailing code):
TELEX:
ELECTRONIC MAIL:
Do you need an official invitation to attend?
Will you need financial assistance to participate?
TENTATIVE TITLE OF YOUR PRESENTATION:

Other information:

First Circular for Parasite Symposium
INDEX OF PARASITIC SEED PLANT WORKERS

Several years ago, an attempt was made to produce an index 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.

1. Name (first, middle initial, last):

2. Title (Dr., Prof., Ms, etc):

3. Position (Research assistant; supervisor, etc):

4. Institutional affiliation:

5. Department:

6. Complete mailing address:

7. Telecommunications:
7a. Phone:
7b. Telex:
7c. Cable:
7d. Electronic mail:

8. Specific research interest (s):

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. Ransome, 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, Clwvl, 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 Weiss (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--Haustrion is 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 haustorion 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 geaneriosides 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 Kuitj 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.

The cereals of Ethiopia, in order of importance, are: t'ef (Eragrostis teff), 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 not 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 southeastern 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 telling 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 Göttingen, 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, Theresia, and his family. His loss will be keenly felt by any of us who had the privilege of knowing him.

B. Finnan 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. Vareigal 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 ITB2D-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 attri-
butes 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.

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 rosasinensis and Cucurbito pepo to Cuscuta reflexa, as in the case of Cuscuta reflexa parasitizing on its own species (intraspecific parasitism). In all three cases the parasite can pass through the first stages of haustral development up to the penetration of the closed haustral cone into the plant which is attached. The further stages of development of functioning haustrum, 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 haustral cone, the development is continued until normal operating contacts to the host are resumed. Such a method of initiating the functioning of haustra could be found in all three cases of incompatibility mentioned above.

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

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**LITERATURE**


Coetze, J and B. A. Finneran. 1989. Translocation of lysine from the host Melicope simplex to the parasite dwarf mistletoe Korthalsella lindsayi (Viscaceae). New Phytophylgia 112: 377-381. (Results indicate that organic substances like lysine are translocated apoplastically probably through plasmodesmata).


Ellis, 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).


Jain, R. and C. L. Foy. 1989. Broomrapes (Orobanche spp.): a potential threat to U.S. broadleaf crops. Weed Technology 3: 608-614. (In pot culture peanuts, soybean, alfalfa, tobacco, and tomato were tested for susceptibility to Orobanche. The authors emphasize the potential danger to peanuts, however field tests were not conducted).


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).


Parker, C. 1990. Some observations on the prevention of Striga seed production by hand-pulling. In: Proceedings of the Ethiopian Weed Science Committee Sixth Annual Meeting, Addis Ababa, 1988, 53-58. (Concludes that hand pulling and removal need be done only every three weeks from onset of flowering).


Ramaiah, K. V., V. L. Chadley and L. R. House. 1990. Inheritance of Striga seed-germination stimulant in sorghum. Emphytica 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).


Tuquet, C., N. Farineau and G. Salle. 1990. Biochemical composition and photosynthetic activity of chloroplasts of Striga hermon-thica 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).

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: Dr. Joel K Ransom, Chief Organizer Fifth International Symposium on Parasitic Weeds International Maize and Wheat Improvement Center Post Office Box 25171 Nairobi KENYA PHONE: (254)-2-592208,592151 TELEX: 22040 TIRAD FAX: (254)-2-593499

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 (7), 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 Nalion- dele in southern Tanzania. The parasite has large yellow flowers, 10-15 cm across and a tubular shaped stigma. In the 1989/90 crop season preliminary observations were made National Trials sown at the same location. Severe A. vogelii infestation was observed in Cowpea Uniform Yield Trial, with the range from 94 to 287 A. vogelii per plant. In Tanzania, early Cowpea Maturing Variety Trial the range was from 20-242 A. vogelii per plant Groundnuts planted about 200m from A. vogelii infested plots were free of the parasite. Alectra vogelii has already been reported in some countries south of the Sahara viz. Zimbabwe, Botswana, South Africa, Burkina Faso, Mali, E and Ethiopia. The hemi-parasite has been reported to have a wide range of hosts which include cowpeas, groundnuts, bambara grot nuts, fodder legumes, pigeon peas and munusss.

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

MORE MONEY PROBLEMS FOR HAUSTORIUM!

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

LITERATURE

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Chessin, M. and Z. E. Zipf. 1990. Alarm systems in higher plants. The Botanical Review 56: 193-235. (Dwarf mistletoes are briefly mentioned but an alarm system is not involved because the initial insult is not challenged).

dePamphilis, C. W. and J. D. Palmer. 1990. Loss of photosynthetic chlororepiratory genes from the plastid genome of a parasitic flowering plant. Nature 348(6299): 337-339 + cover. (The plastid genome of *Epifagus virginiana*, a common member of the Orobanchaceae of Eastern North America, has lost most, if not all, of the 30 or more chloroplast genes for photosynthesis as well as other genes. This is in remarkable contrast to the chloroplast of *Striga asiatica* which has a typical complement of genes).


Gauslaa, Y. 1990. Water relations and mineral nutrients in *Melampyrum pratense* (Scrophulariaceae) in oligo- and mesotrophic boreal forests. Acta Oecologia 11(4): 525-537. (The parasite had a higher conductance for water in nutrient poor soil compared to more mesic areas. This may enable the parasite to capture more of the host’s nutrients).

Gauslaa, Y. and A. M. Odasz. 1990. Water relations, temperatures, and mineral nutrients in *Pedicularis dasyantha* (Scrophulariaceae) from Svalbard. Norway. Holartic Ecology 13: 112-121. (The transpiration rate of *P. dasyantha* was almost twice as high as *Dryas octopetala*, the most frequent host. Interestingly, the dense pubescence on the inflorescence is thought to reduce transpiration and as a result that part of the plant has a much higher temperature).


Enepper, D. A., R. A. Creager and L. J. Musselman. 1990. Identifying dodder seed as contaminants in seed shipments. Seed Science and Technology 18: 731-741. (*Cuscuta*, dodder, seeds are some of the most frequent contaminants of commercial seed shipments. This study describes the differences in seed structure among the three subgenera. Figure 3 is mislabelled).

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


Krause, D. and H-C. Weber. 1990. SEM observations on seeds of Striga spp. and Buchnera americana (Scrophulariaceae). Plant Systematics and Evolution 170: 257-263. (The purpose of the research was to elucidate the relationship between Striga and Buchnera. Seven Striga species were examined but only one of Buchnera).


Machado, M. A. and K. Zetsche. 1990. A structural, functional and molecular analysis of plastids of the holoparasites Cuscuta reflexa and C. europaea. Planta 181: 31-96. (In this important paper, it was found that C. reflexa has normal chloroplast structure while the chloroplasts of C. europaea, a 'smaller dodder, lacked typical thalikyoids).


Parker, C. and T. I. Polniaszek. 1990. Par tition of cowpea by Striga gesnerioides: vi ation in virulence and discovery of a new source of host resistance. Annals of Applied Botany 116: 305-311. (Samples cowpea from West Africa exhibit different degrees of virulence. A cowpea line from Botswana was resistant to all parasites to which it was exposed).

Pate, J. S., J. Kuo and N. J. Davidson. 1990 Morphology and anatomy of the haustori of the root parasite Olax phyllanthi (Olacaceae), with special reference to the haustorial interface. Annals of Botany 65: 425-436. (This is one of the most detailed descriptions of the haustorial interface).


Schneider, M. J. and F. R. Stermitz. 1990. Uptake of host plant alkaloids by root pa sitic Pedicularis species. Phytochemistry 29(6): 1811-1814. (Concludes that alkaloid uptake by Pedicularis species is widespread. This is significant in light of the use of several Pedicularis species as herbal ideas).


Sprich, H., J. Sauerborn and W. Koch. 1990. (The solarizing effect of sprayable films.) Zeitschrift für Planzenkrankheit und Pflanzeneschutz 12: 455-461. (None of 12 films tested were as effective as polyethylene. Eight significantly reduced O. crenata, only one reduced S. asiatica).

Uotila, P. 1990. Orobanche crenata in Helsinki Botanical Garden. Lutukka 6: 125-126. (Orobanche crenata is seldom found as far north as Finland so it was surprising to discover it in September on broadbeans, apparently introduced with its host).


HAUSTORIUM
Parasitic Plants Newsletter
Official Organ of the International Parasitic Seed Plant Research Group

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- 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.
• **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

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• **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 Scarf 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 Emecheve gave a report on the very encouraging progress in development of cowpea lines with combined resistance to *Striga, Alecrta* 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 Kleinfeld 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 mycorrhizal 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. virginiana*. 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 canaden-
sis* 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 *Buck-
leya* 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 more reliable difference but not especially easy to use. For 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

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**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.

A. M. Suleiman, C. R. Riches and P. J. Terry, Long Ashton Research Station, University of Bristol

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**LITERATURE**


Cairns, R. I. and J. D. Lea. 1990. An agricultural survey of the subsistence farmers in the Nkandla District of KwaZulu. Development Southern Africa 7: 77-104. (Limiting constraints to maize yield include poor soil fertility and related presence of *Striga asiatica*).


Elliot, S. 1990. The distribution, status and ecology of *Sapria himalayana* Griff. (Rafflesiaceae) in Thailand. Bulletin of the British Ecological Society 11(4):246-249. (It is one of the more "modest" members of this bizarre family but similar in its habit to other Rafflesiaceae. *Sapria* is considered to be endangered due to habitat destruction. A helpful diagram of the complex flower is included).

Fate, G., M. Chang and D. G. Lynn. 1990. Control of germination in *Striga asiatica*: chemistry of spatial definition. Plant Physiology 93: 201-207. (Shows how germination in an agar medium can be correlated with the distribution of sorgeolone type compounds, exuded throughout the length of sorghum roots).


Fujsaka, S. and the FOFIGA team. 1990. Rice research priorities for Madagascar's Middle West. IRRI Research Paper Series 144: 15 pp. (*Striga asiatica* identified as a major research priority in both upland rice and maize).


Gworgwor, N. A. and H. C. Weber. 1991. Studies on biology and control of *Striga*. II. Varietal response of *cowspea*. Beitrage zur Biologie der Pflanzen 65: 393-408. [*Vigna unguiculata* (L.) Walp.] to *Striga gesnerioides*. (In pot experiments no germination of *Striga* took place in the presence of B-301. Parasitism of this resistant variety under field conditions is attributed to the presence of *Merremia emarginata*, a common weedy host).


Hartman, G. L. and O. A. Tanimounire. 1991. Seed populations of *Striga* species in Nigeria. Plant Disease 75: 494-496. (Up to 92% recovery of *Striga* seed from soil was achieved using sucrose 2.5 M. Natural infestation were found to range up to 2 per g soil. Seed production by *S. gesnerioides* ranged up to 900 per capsule and 180,000 per plant).


Horvath, Z. and G. Bujaki. 1990. New data to the biology of Smicronyx jungermanniae Reich. (Col.: Curculionidae). Novevvedekem (Plant Protection) 26: 346-351, (in Hungarian). [S. jungermanniae is reported to be an effective control of Cuscuta campestris (= C. pentagona) in Hungary. This is especially interesting considering that the same genus is common on Striga in Africa].


Linke, K. H., C. Vorlaender and M. C. Saxena. 1990. Occurrence and impact of Phytomyza orobanchia (Diptera: Agromyzidae) on Orobanche crenata (Orobanchaceae) in Syria. Entomophaga 35(4): 633-639. (Seed production was reduced by 29% due to a mean seed destruction of 91% per broomrape capsule).


Molau, U. 1990. The genus Bartsia (Scrophulariaceae- Rhinanthoideae). Opera Botanica 102: 5-99. (The genus is revised to 49 spp, 45 endemic to the Andes, 2 Afromontane, 1 Circumboreal and 1 Mediterranean).


Olivier, A., K. V. Ramaiah and G. D. Leroux. 1991. Selection of sorghum [Sorghum bicolor (L.) Moench] varieties resistant to the parasitic weed Striga hermonthica (Del.) Benth. Weed Research 31: 219-225. (Variety IS-7777 has exceptionally high resistance, while several other varieties are identified with useful levels of partial resistance/tolerance).


Striga control in maize with dicamba. pp. 55-59 in Proceedings of 43rd Annual Meeting of the Southern Weed Science Society. (0.25-0.56 kg/ha 41-48 days after sowing greatly reduced Striga whether applied to foliage or to soil. No apparent damage to crop, but no yield increase either).

Ransom, J. K., R. E. Eplee and N. S. Norris. 1990. Striga control in maize with dicamba. pp. 55-59 in Proceedings of 43rd Annual Meeting of the Southern Weed Science Society. (0.25-0.56 kg/ha 41-48 days after sowing greatly reduced Striga whether applied to foliage or to soil. No apparent damage to crop, but no yield increase either).


Tupuet, 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(4): 574-582. (Chloroplasts had lower levels of chlorophyll and polar lipids but had other characteristics of C3 plants).

Tupuet, 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(4): 574-582. (Chloroplasts had lower levels of chlorophyll and polar lipids but had other characteristics of C3 plants).


Yan, Z. G. 1990. Host specificity of Lysiana exocarpi and other mistletoes in southern South Australia. Australian Journal of Botany 38: 475-486. (L. exocarpi attacked mainly 2 of the available 15 potential host trees. Five other species were each restricted to single hosts).

Yan, Z. G. 1990. Host specificity of Lysiana exocarpi and other mistletoes in southern South Australia. Australian Journal of Botany 38: 475-486. (L. exocarpi attacked mainly 2 of the available 15 potential host trees. Five other species were each restricted to single hosts).

Zaitoun, F. M. F. 1990. Studies on the resistance and susceptibility of broad bean (Vicia faba L.) to broomrape (Orobanche crenata Forsk.). Ph.D. Thesis, Faculty of Agriculture, University of Alexandria, Egypt.


HAUSTORIUM
Parasitic Plants Newsletter
Official Organ of the International Parasitic Seed Plant Research Group

October 1992 ................................................................. Number 27

- **IPSPRG NEWS/PUBLICATIONS**

  - **New HAUSTORIUM Mailing List**

    We have completely redone our mailing list. Please bring any errors to our attention. It cost about one dollar for postage for each issue of HAUSTORIUM so it is important to keep our mailing list accurate.

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    To order copies of this volume contact: Professor K Wegmann, Institute for Chemical Plant Physiology, Eberhard-Karls University, Corrensstrasse 41, 7400 Tubingen, GERMANY. Fax: 7071-295246. (See Literature section in this copy of HAUSTORIUM for complete title).

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    Copies of a complete set of HAUSTORIUM (issues 1-27, ca 175 pages) are available at a cost of $25/set including postage. Payment must be to Old Dominion University Research Foundation and drawn on an American bank.

  - **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 greenhouse, 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 greenhouse 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 under-
ground 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 uninfeeted 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 infected with broomrape had 74 to 90% efficacy of the above substrates of inoculum, in controlling O. cumanana on sunflower, during 1991. In the laboratory and under natural field conditions the fungus survives for at least 420 days.

J. Bedi, Plant Pathology, Punjab Agricultural University, Ludhiana 141004, India

**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 occurring in close proximity with other mistletoe bearing plants. During the study period, seeds of the two mistletoe species were inoculated 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. Haustorian 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 inoculation, 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.

Z. Yan, Ecosystem Management, University of New England, Armidale, NSW 2351, Australia

**LITERATURE**


Americanos, P. G. and D. N. Droushiotis. 1991. New Orobanche hosts in Cyprus. Near East Working Group for Improved Weed Management Newsletter 11:5. [ Orobanche crenata found on Craspedia globosa (Asteraceae) and Hibiscus rosasinensis (Malvaceae)].

Anonymous. 1991. Second General Workshop of the Pan-African Striga Control Network (PASCON). Food and Agriculture Organization of the United Nations, Regional Office for Africa: Accra, Ghana. (This is a summary of the PASCON meeting held with the Fifth International Symposium on Parasite Weeds in Nairobi, Kenya in 1991. It includes summaries of national programs and surveys, recommendations for control, and standardization of research and survey techniques).


ron induces germination, possibly via ethylene, and also haustorial initiation, in *S. hermonthica* but not *S. gesnerioides*.


Graves, J. D., M. C. Press, S. Smith and G. R. Stewart. 1992. The carbon canopy economy of the association between cowpea and the parasitic angiosperm *S. gesnerioides*. Plant. Cell and Environment 15: 283-288. (*Striga gesnerioides* is highly dependent on the cowpea for carbon and transfer to the parasite accounts for 70% of 75% growth reduction in the host, though photosynthesis in the host may also be reduced by 50%).


Hauk, C., S. Muller and H. Schilknecht. 1992. A germination stimulant for parasite flowering plants from *Sorghum bicolor*, a genuine host plant. Journal of Plant Physiology 139: 474-478. (Work initiated by the late Johann Visser has succeeded in identifying the natural stimulant from sorghum, 'sorogolactone', as a close analogue of strigol, differing only in the replacement of one CH$_3$ group and one OH group, each by H. Activity on *S. asiatica* is even higher than that of strigol and is also shown on *S. hermonthica*, *S. gesnerioides*, *Orobanche aegyptiaca* and *Alectra vogelii*).

Hawksworth, F. G., R. F. Scharpf and M. Marosy. 1991. European mistletoe continues to spread in Sonoma County. California Agriculture 45: 39-40. (Rate of spread increased to 0.22 mile per annum since 1986).


tative biosynthetic trait that confers resistance to *Striga*. Phytochemistry 31(2): 493-497. (All sorghums produce sorgoleone but highly resistant varieties produce minute quantities of an as yet unidentified stimulant. A simple agar assay is described for rapid testing of sorghum lines).

Hood, M. E. 1991. Attachment and penetration characteristics of *Striga asiatica* on host and non-host species. Master's Thesis, University of Virginia, Charlottesville. [In what could prove a useful model for further research, the author used marigold (*Tagetes* sp.) and lettuce (*Lactuca sativa*) both Asteraceae as hosts for *Striga asiatica* and traced germination, attachment, and penetration attempts. Marigold stimulated germination of parasite seed but penetration was terminated in the cortex as it was in lettuce].

Igbinnosa, I. and S. N. C. Okonkwo. 1991. Screening of tropical legumes for the production of active germination stimulants and for resistance to Nigerian cowpea witchweed (*Striga gesnerioides*). Nigerian Journal of Weed Science 4: 1-9. (Besides cowpea, only *Indigofera spicata* and *I. tinctoria* were parasitized but many caused high germination, especially soybean, pigeon pea, *Pueraria, Mucuna, Calapogonium* and *Psophocarpus*).

Igbinnosa, I. and S. N. C. Okonkwo. 1992. Stimulation of seeds of cowpea witchweed (*Striga gesnerioides*) by sodium hypochlorite and some growth regulators. Weed Science 40: 25-28. (Germination stimulated by conditioning in NaOCl 0.001% w/v, also by kinetin, zeatin and ethylene after conditioning in water but not by GR-7 or GR-24).


Le Blanc, C. M. 1991. Report on the status of *Tomanthera auriculata* (Earleaf Foxglove) in Indiana. Department of Natural Resources Division of Nature Preserves, Indianapolis, IN. Endangered Species Program Project: E-1-5, Study No.: 14


Linke, K. H. 1992. Biology and control of *Orobanche* in legume crops. PLITS 10 (2). (A helpful summary of the *Orobanche* collaborative project between the University of Hohenheim and ICARDA. Different means of control, aspects of biology, and a list of publications are included).

Linke, K. H., J. Sauerborn and M. C. Saxena. 1991. Host-parasite relationships: Effect of *Orobanche crenata* seed banks on development of the parasite and yield of fava bean. Angewandte Botanik 65: 229-238. (The number of parasite shoots was positively correlated with seed density both in pot and field studies. The numbers of broomrape shoots decreased as broomrape seed density increased).


Lyshede, O. B. 1992. Studies on mature seeds of Cuscuta pedicellata and C. campestris by electron microscopy. Annals of Botany 69: 365-371. [Differences in seed morphology is due to C. pedicellata subgenus Cuscuta being endospermous while C. campestris subgenus Grammica (=C. pentagona) lacks endosperm. It is suggested that this may be a feature of different subgenera of dodders].


Matthies, D. 1991. Die Populationsbiologie der Annuellen Hemiparasiten Melampyrum arvense, Melampyrum cristatum und Melampyrum nemanorum (Serpophulariaceae). PhD Dissertation. University Bochum, Germany. (Melampyrum arvense when grown with Medicago sativa had a higher biomass the longer it grew on the host with a correspondingly smaller biomass allocated to roots. It would be interesting to know the energy trade off of producing haustoria versus normal roots).


Punter, D. and J. Gilbert. 1991. Explosive discharge of jack pine dwarf mistletoe (Arceuthobium americanum) seed in Manitoba. Canadian Journal of Forest Research 21: 434-438. (Seeds may be thrown 18 m but release occurs only during daylight, on declining humidity).


Wegmann, K. and L. J. Musselman, editors. 1991. Progress in Orobanche Research. Tuebingen, Germany: Eberhard-Karls University. 362 pages + x. (This volume contains the papers presented at the second Orobanche workshop in Germany in 1989. It includes recent research on both basic and applied aspects of broomrape biology and control. To order a copy, see announcement on page 1 of this issue of HAUSTORIUM).


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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 LJMJ00F at ODUVRM.CC.ODU.EDU, telex 823428 OLD DOM NK, fax 804-683-5283 or 5155 and C. Parker, C/O Long Ashton Research Station, University of Bristol, Bristol, BS18 9AF, ENGLAND, fax (0275) 391007 and typed by S. Musselman. It is 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 and requests for copies to L. Musselman.

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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

Striga 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 heated." 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.

Chris K. H. Teo, School of Biological Sciences, Universiti Sains Malaysia, 11800 Penang, Malaysia.

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.
R. P. Maharishi, Agriculture Research Station, Mandoor-Jodhpur 342 304, India

LITERATURE


Bock, F. de and A. Fer. 1992. Effects of abscissic acid on the transfer of sucrose from host, Pelargonium zonale (L.) Aiton, to a phanerogamic parasite Cuscuta reflexa Roxb. Australian Journal of Plant Physiology 19: 679-691. (High levels of ABA in the haustorium are thought to increase transfer of sucrose from host to parasite).


Gworgwor, N. A. 1993. Studies on the Biology and Control of Striga Species (Scrophulariaceae). PhD Dissertation, Philipps University, Marburg, Germany.


tralia No 190, 34 pp. (Including observations on the control of *Cuscuta campestris* in California).


Hipkin, C. R. 1992. Host range and specificity of *Orobanche minor* Sm. on Cynymul Burrows. Watsonia 19: 113-120. (One population could attack 15 host species. Some individuals were attached to three different species. Seed from parasites on *Eryngium* could attack *Hypochaeris* and *Trifolium* spp.).


Johnson, J. M. and J. S. Choinski Jr. 1993. Photosynthesis in the *Tapinanthus-Diporhynchus* mistletoe-host relationship. Annals of Botany 72: 117-122. (Chlorophyll was higher in *T. vitatus* than in the host *D. condylocarpum* but CO₂ assimilation was substantially lower. Host photosynthesis was also somewhat reduced by infection).


Kharrat, M., M. M. Halila, K. H. Linke and T. Had- dar. 1992. First report of *Orobanche foetida* on faba bean in Tunisia. FABIS Newsletter 30: 46-47. (Reporting damage from this red-flowered species on faba bean, including varieties resistant to O. crenata, around Beja. Also on chickpea).


Krishnamurty, G. V. G. 1992. Two new methods to control *Orobanche* in tobacco. Indian Farming 42. 7-8. (Repeating previous description of spear and vegetable oil techniques).


Lopez-Granados, F. and L. Garcia-Torres. 1993. Seed bank and other demographic parameters of broomrape (*Orobanche crenata* Forsk.) populations in faba bean (*Vicia faba* L.) Weed Research 33: 319-327. (A detailed study over 8 years records the build-up of seed bank to over 4 M seed per M². From the seed bank about 0.03% attached to root systems and less than 10% of these emerged).


activity and a simple analogue derived from gamma-phenyl-gamma-butyrolactone was almost as active as GR24).


Mitich, L. W. 1993. Intriguing world of weeds • Orobanche - the broomrapes. Weed technology 7: 532-535. (A curiously inaccurate and out-dated review, quoting no significant references later than 1969 and suggesting the existence of giant Orobanche up to 3.3 m high and with seed weight varying from 3 to 3,000 mg!)


Muller, S., A. van der Merve, H. Schidknecht and J. H. Visser. 1993. An automated system for large-scale recovery of germination stimulants and other root exudates. Weed Science 41: 138-143. (Stimulants active on S. asiatica, S. gesnerioides and Alectra vogelii were separated by desorption on to macroreticular polymer resin XAD-4 and desorption with methanol).

Muller, S., C. Hauck and H. Schidknecht. 1992. Germination stimulants produced by Vigna unguiculata Walp. cv Saunders Upright. Journal of Plant Growth Regulation 11: 77-84. (The stimulant 'alectrol' is shown to be very close to strigol in structure and to be highly active on both A. vogelii and S. gesnerioides).


Nassib, A. M., A. H. A. Hussein and M. A. El-Deeb. 1993. Faba bean pilot demonstration plots on Orobanche control in Middle Egypt. Proceedings 18th International Conference for Statistics, Computer Science, Scientific and Social Applications, Cairo, 1993, pp. 133-142. (Applications of glyphosate 64 g/ha, or 32 g/ha plus fertilizers, to 32 farmer demonstration plots reduced O. cre- nata by about 50% and increased bean yields by 56-75%).


Norris, R. S., M. Langston, T. English and R. E. Eplee. 1992. Basamid • a granular fumigant for control of witchweed and other weed seeds. Pages 308-312. Proceedings Southern Weed Science Society. Champaign, IL: Southern Weed Science Society. (Best results with daxomet at about 300 kg/ha were with surface application followed by
at least 0.5 cm irrigation, applied in March/April).


Pare, J. 1993. Aspects de la Dynamique de la Forma- tion de la Grains chez le Striga (Scrophularia-ceae) Parasite des Cereals Tropicicales. Doctoral Thesis, Univerisite Pierre et Marie Curie, Paris, 208 pp. (Concerned especially with embryology and seed development in a range of Striga species but also evaluating the effects of herbicide on seed formation and viability).


Polhill, R., Coordinator. The Golden Bough. A News-letter to Foster the Biosystematics of Loranthaceae and Viscaceae. Number 12. (This is the first appearance of this valuable newsletter for some time. The issue is dedicated to Frank Hawksworth and contains a description of HyperPara-site', a computer system for storing, retrieving and manipulating information on parasites; numerous notes and current literature. Golden Bough is available from Polhill at Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE England).


Ramirez-Ortega, R. and L. Garcia-Torres. 1993. Imazapyr for broomrape (Orobanche crenata Forsk.) control in faba bean. FABIS 31: 33-36. (Post-emergence applications of 2.5-5 g ai/ha give results comparable to glyphosate at 60 g ai/ha).


Teryokhin, E. S., G. V. Schibakina, N. B. Szaphimovich, N. B. and T. J. Kravtsova. 1993. Determinator of Broomrapes of the USSR Flora. NAUKA: St Petersburg. 124 pages. In Russian with English summary. (The USSR flora is exceptionally rich in the Orobanchaceae and the family has been the subject of studies by these authors for many years. The book deals mainly
with morphology and includes helpful SEM pictures of seed and epidermal surfaces as well as fruit shape. A detailed taxonomic treatment is also included).


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.
HAUSTORIUM
Parasitic Plants Newsletter
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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:

Dr Maria Teresa Moreno
Centro de Investigacion y Desarrollo Agrario
Apartado 4240
14080 Cordoba
SPAIN
Fax: (country code 34) 57 202721, Telex: 76686

● THIRD INTERNATIONAL WORKSHOP ON OROBLANCHE

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 (Zwanenburg; 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.joetida 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 (Bozukov; Bedi); also a report of successful biocontrol of Striga hermonthica by F. nygamaia (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. hermonthica 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 sulphonl urea and imidazoline 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 Orobanchew 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, Mau-ritskade 63, 1092 ED, Amsterdam, The Netherlands.

**PYRULARIA PUBERA AS A PATHOGEN OF CHRISTMAS TREES IN WEST VIRGINIA; THESION 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.

S. Clark Haynes, West Virginia Department of Agriculture, Charleston, West Virginia 25305-0170 and L. J. Musselman.
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 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.

Kamal I. Mohamed, Old Dominion University, Norfolk, Virginia.

STRIGA IN COTE D'IVOIRE 1992 AND 1994

A reconnaissance 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 vogelli, on the other hand, is common on peanut in the Korhogo areas with noticeable damage at several sites. The Natural Resources Institute (NRI) is collaborating 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

LITERATURE


Barlow, B. A. and R. Schodde. Bird dispersal of Loranthaceous mistletoes to remote Pacific islands: Symbiosis in default. Eeaufortia 124: 124-129. (Suggests that once distance dispersal by birds of mistletoes to remote islands occurs, the species may be freed from constraints imposed by avian dispersal so range extension may be increased. There may be a self generated distance dispersal syndrome for the Pacific which has arisen by default).


Carson, A. G. 1993. Studies on bio and chemical control of Striga hermonthica (Del.) Benth. in the Gambia. Nuisibles-Pests-Pragas 1:71-81. (Reporting 80-90% suppression of Striga by Cassia obtusifolia and a small increase in maize yield when removed after 10 days).


Clark, L. J., K. G. Shawe, G. Hoffman and G. R. Stewart. 1994. The effect of Striga hennonica (Del.) Benth. infection on gas-exchange characteristics and yield of a sorghum host, measured in the field in Mali. Journal of Experimental Botany 45: 281-283. (This study failed to confirm any specific reduction of host photosynthesis by Striga infection, suggesting that previous reports of reduced photosynthesis could be due to an artifact of pot experimentation).


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Doyle, G. J. 1993. Cuscuta epithymum (L.) (Convolvulaceae), its hosts and associated vegetation in a limestone pavement habitat in the Burren Lowlands in County Clare (H9), Western Ireland. Biology and Environment, Proceedings of the Royal Irish Academy, Section B 93B: 61-67. (Although attacking a wide range of hosts, C. epithymum may depend on a narrow range of primary hosts for initial establishment).

Fahmy, G. M. 1993. Transpiration and dry matter allocation in the angiosperm root parasite Cynomorium cocineum L. and two of its halophytic hosts. Biologia Plantarum 35: 603-608. [Transpiration of C. cocineum was lower than that of its hosts (as in Ouf, 1993). Infection reduced transpiration of the hosts.]


Garcia Torres, L. 1993. Biologia y Control de Especies Parasitas. Editorial Agricola Espanola, 94 pages. (This well illustrated booklet contains a great deal of information on the biology and control of all major parasitic plants. It is different from numerous other books and booklets on the topic which have appeared in the past few years in that it contains many helpful graphs. The booklet is in Spanish but deserves translation into English for a wider distribution).


Heide-Jorgensen and J. Kuitj. 1993. Epidermal derivatives as xylem elements and transfer cells: a study of the host-parasite interface in two species of Triphysaria (Scrophulariaceae). Protoplasma 174: 173-183. (Further contributions to understanding the remarkable versatility of the haustorium. In these species of Triphysaria, formerly Orthocarpus, the epidermal cells develop into xylem elements and transfer cells).


Hezewijk, M. J. van, A. P. van Beem and J. A. C. Verkleij. 1993. Germination of Orobanche crenata seeds as influenced by conditioning temperature and period. Canadian Journal of Botany 71: 786-792. (Optimum temperature for germination was 15-20 °C and optimum length of conditioning at 20 °C was 18 days. Conditioning for more than 4 weeks can lead to secondary dormancy).


Murphy, S. R., N. Reid, Z. Yan and W. N. Venables. 1993. Differential passage time of mistletoe fruits through the gut of honeyeaters and flower-
peckers: effects on seedling establishment. Oecologia 93: 171-176. [Seeds of Amyema quandang germinated over 80% after passage through both birds but establishment after 5 months was better after shorter passage through mistletoe-birds (12 m) v. honeyeaters (40 m)].


Wiesner, E. 1993. Baeume und blumen in zentralen Alborz gebirge (Nord-Iran). Der Palmengarten (Munich) 2/93: 82-88. [Figure 11 is a full color picture of *Phelypaea coccinea* (Orobanchaceae)].
SIXTH INTERNATIONAL PARASITIC WEED SYMPOSIUM
CORDOBA, SPAIN 16-18 APRIL 1996

Plan to attend the symposium in beautiful 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:

Secretaria de "6th Parasitic Weed Symposium"
Centro de Investigacion y Desarrollo Agrario
Apartado 4240
14080 Cordoba
SPAIN
Fax: (country code 34) 57 202721

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 sor-
golactone on the filter paper. In the control experiments, preconditioned (10-12 days at 25 °C) *Striga hennonothica* 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 attach-
ments 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 viewpoint, 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.

Hamid Ahmed Dirar, Faculty of Agriculture, Omar Mukhtar University, Al Beida, Libya

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 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 europaeus 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.

Pavol Elias, Institute of Botany, Slovak Academy of Sciences, Dubravská 14, SK-842 23 Bratislava, Slovakia

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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**Striga hermonthzca.** Journal of Experimental Botany 45: 925-930. (Photosynthesis reduced by 30 and 44% at high and low N respectively.)


Fer, A., J. C. Painset and L. Rey. 1992. [Characteristics of mineral nutrition in some types of parasitic plants (*Cuscuta, Orobanche, Thesium*) and their development on crops.] Bulletin de la Societe Botanique de France, Actualites Botaniques 139: 111-121. (Observations on K levels in host and parasite suggest that *Cuscuta* and *Orobanche* obtain nutrients mainly from the host phloem, while *Thesium* obtains them from host xylem.)


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Suzuki, Y., Yun-Hui Zhang, N. Murofushi and Y. Takeduchi. 1994. Endogenous gibberellins in clover broomrape, a parasitic plant and its host, clover: dependency of the parasite on the host for gibberellin production. Journal of Plant Growth Regulation 13: 63-67. (The range of gibberellins in *O. minor* is similar to those in the host, sug-
gesting the host as the main source; however, some are found only in the parasite suggesting some ability for gibberellin synthesis in the parasite.


**HAUSTORIUM** is edited by L. J. Musselman, Parasitic Plant Laboratory, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia 23529-0266 USA, electronic mail LJM100E 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 (1275) 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. To receive your copies of HAUSTORIUM or the bibliographies via electronic mail, send a message to the email address above. Issues 21-30 are available electronically.

**Haustorium 29 was mailed 2 June 1994**
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:

Secretaria de "6th Parasitic Weed Symposium"
Centro de Investigacion y Desarrollo Agrario
Apartado 4240
14080 Cordoba
SPAIN
Fax: (country code 34) 57 202721
Electronic mail: geouusa@uco.es

BOOK REVIEW: EUROPEAN BROOMRAPES


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 fababean. 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 Gézira 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 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 germination 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 (Koya-
ma, 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


Atokple, I. D. K., B. B. Singh and A. M. Emechebe. 1995. Genetics of resistance to Striga and Alpectra in cowpea. Journal of Heredity 86: 45-49. (Confirming that the Striga-resistant genes in B301 and IT82D-849 are allelic or very closely linked, while that in Suvita-2 is at a different locus. Alpectra-resistance is associated with two non-allelic dominant genes in B301 and with a further non-allelic gene in IT81D-994.)


Calvin, C. L. and C. A. Wilson. 1995. Relationship of the mistletoe Phoradendron macrophyllum (Visaceae) 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.)


Diana, G. and F. Castelli. 1994. (Adversities to the tobacco crop: plants.) (In Italian) Informatore Fitopatologico 44(6): 11-17. (Orobanche and Cuscuta noted as damaging weeds of tobacco in Italy.)


Gomez, J. M. 1994. Importance of direct and indirect effects in the interaction between a parasitic angiosperm (Cuscuta epithymum) and its host plant (Hormathophysa spinosa). Ökos: 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. Offerdinger, L. Swiatek and A. Guven. 1994. (The physiological and biochemical basis of growth and development of parasitic angiosperms.) (In Turkish) Ege Univertesi Ziraat Fakultesi Dergisi 31: 1489-1491. (Mentions incidentally that L. squamaria is used in Poland to treat epilepsy.)


Hibberd, J. M., W. P. Quick, M. C. Press and J. D. Scholes. 1995. Photosynthetic regulation in cowpea parasitised by Striga gesnerioides. Abstract. Journal of Experimental Botany 46: 55. (Initial increase in photosynthesis in infected cowpea tentatively attributed to reduced sink restriction, while the later reduction may be due to loss of N to the parasite.)


Kelly, C. K. 1994. On the economics of plant growth: stolon length and ramet initiation in the parasitic clonal plant Cuscuta europaea. Evolutionary Ecology 8: 459-470. (Stolon diameter negatively correlated with ramet initiation which was in turn greater under resource-poor conditions.)


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.)


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%).


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-aminoacyclopropene-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.)


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.)


Olaniyi, G. O. and G. A. Iwo. 1993. Field evaluation of sorghum varieties for reactions to witchweed *Striga hermonthica* (Del.) Benth. in Nigeria. Agricuutra 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.)


Proctor, G. 1993. IIRB weed control study group - Italy. British Sugar Beet Review 61: 12-14. (*Cuscuta campestris* recorded as a weed of sugar-beet 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.)


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.)


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 viscosotoxins. Plant Physiology 101: 745-749. (Recording the disappearance of the mRNA for viscostoxin and breakdown of this one protein during senescence. Other proteins are lost at abscission.)


Seel, W. E. and M. C. Press. 1994. Influence of the host on three sub-arctic annual facultative root hemiparasites. II. 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.)


Taylor, A. and W. E. Seel. 1995. Physiology of the parasitic association between maize and witchweed (Striga hermonthisica). Abstract. Journal of Experimental Botany 46: 54. (ABA shown to be higher in infected than uninfected host leaves. Levels much higher still in Striga shoots.)


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.)


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 homepage. 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: ljml100f@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 pro-
ceedings from the review is being prepared for publication by ICRISAT in 1997.

J. Lenne, ICRISAT, Patancheru, India

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**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 horticulturists.

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 *Strobilanthes* 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

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**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 symposium at fax number (359) 058 26364.

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**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 Prospopanche (Hydnoraceae) in Argentina. Other papers touched upon Rhamphicarpa, Thesium, Santalum and Arnyma, trichomes in Striga, tuberisa-
tion 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 Malcome 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). Other 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 agroforestry 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
c/Juan de Lara Nieto 1
41013 Sevilla
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 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. 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)


"...an attempt to provide a baseline of information to fill the gap since Kuijt's [1968] text" is the raison d'âtre 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 Flowering 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 initiative. 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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**LITERATURE**


Americanos, P. G. and N. A. Vouzounis. 1995. Control of *Orobanche* in cabbage. Technical Bulletin 170. 7 pp. Agricultural Research Institute, Ministry of Agriculture, Natural Resources and the Environment, Nicosia, Cyprus. (Four plants of *O. aegyptiaca* per host can cause total crop failure. Two applications of glyphosate 60-100 g/ha or imazaquin 5-10 g/ha successful some years but not reliable?)


Antonova, T. S. and S. J. ter Borg. 1996. The role of peroxidase in the resistance of sunflower against *Orobanche cumana* in Russia. Weed Research 36: 113-121. (Distinguishing races C and D on the basis of extra-cellular excretion of peroxidase from seedlings of C - resulting in reaction with host phenolics and the creation of a lignin barrier and resistance - but not from D - hence no host reaction, and a consequent virulence.)


Barker, E. R., M. C. Press, J. D. Scholes and W. P. Quick. 1996. Interaction between the parasitic angiosperm Orobanche aegyptiaca and its tomato host: growth and biomass allocation. The New Phytologist 133: 637-642. (Damage noted from the lowest infection rate and up to 80% reduction in biomass at high levels. Stem and fruit reduced but not leaves and roots.)


Bennetts, R.E., G.C. White, F.G. Hawksworth and S.E. Severs. 1996. The influence of dwarf mistletoe on bird communities in Colorado ponderosa pine forests. Ecological Applications 6: 899-909. (24 of 28 bird species positively correlated with levels of Arceuthobium vuginatum, perhaps due to more death of branches, snags, nesting sites, etc.: hence control of dwarf mistletoe can damage wildlife habitat.)


Berner, D., R. Carsky, K. Dashiell, J. Kling and V. Manyong. 1996. A land management based approach to integrated Striga hermonthica control in sub-Saharan Africa. Outlook on Agriculture 25: 157-164. (An outline of possible control measures, with emphasis on rotation with soyabean, clean crop seed, enhancing soil suppressiveness, varietal resistance and seed treatment with herbicide.)


Boukar, I., D.E. Hess and W.A. Payne. 1996. Dynamics of moisture, nitrogen and Striga infestation on pearl millet transpiration and growth. Agronomy Journal 88: 545-549. (Infestation and damage from S. hermonthica in pots higher under reduced moisture; also higher with added N but this associated with much increased root length. Attachments per m of root reduced by N.)

News 72: 42. (Noting a conference in Germany at which medical uses of *Viscum album* were discussed, products Iscador, Helixor and Abnoba being used in cancer treatment.)


Carsky, R. J., R. Ndikawa, R. Kenga, L. Singh, M. Fobasso and M. Kamuanga. 1996. Effect of sorghum varieties on *Striga hermonthica* parasitism and development. Plant Varieties and Seeds 9: 111-118. (Moderately resistant varieties S-35 and CS-54 supported less *S. hermonthica* emergence and seed production, and significantly lower seed numbers in the soil, than local varieties Djigani and Damongari.)


Cheng-Zhong Zhang. 1996. Fructosides from *Cynomorium songaricum*. Phytochemistry 41: 975-976. (*Cynomorium songaricum* grows in NW China and is used traditionally for kidney disorders.)


Debrah, S. K., D. Sanogo and F. O. Boadu. 1996. On-farm experiments with sorghum to assess the acceptability of new varieties and herbicide treatments. Experimental Agriculture 32: 219-223. [A survey studying farmers’ criteria for using herbicide (2,4-D) for control of S.
hermonthica and adopting new sorghum varieties.]


Dhanapal, G.N. and P.C. Struik. 1996. Broomrape (Orobanche cernua) control before attachment to host through chemically or biologically manipulating seed germination. Netherlands Journal of Agricultural Science 44: 279-291. (In lab and pot experiments, O. cernua stimulated moderately by GR 24 and ethephon, and by exudates from Vigna radiata, V. mungo, sunflower and sesame; less well by pea, pigeonpea and soybean.)


Dominguez, J. 1996. R-41, a sunflower restorer inbred line, carrying two genes for resistance against highly virulent Spanish population of Orobanche cernua. Plant Breeding 115: 203-204. (Identifying two dominant genes for resistance to O. cernua population EC94.)


Fan ZhiWei, Dong XingGuo, Zhou YuFang and Shen YiDe. 1995. Chemical control of Chinese taxillus on rubber trees. Planter 71: 459,468. (Taxillus chinensis reportedly controlled 80% by injection of 'Miesangling 3'.)


Alectra sessiliflora plus 4 newly described - A. hildebrandtii, A. humber-tii, A. ibityensis and Pseudomelasma pedicularioides.


Fischl, G. 1996. [A leaf-spot disease of mistletoe (Viscum album L.).] (In Hungarian) Novenyvedelem 32(4): 181-183. (Refers to 'control by’....Botryophaeostoma visci (Sphaeropsis visci)” and to 'a new pathogen of V. album, Plectophomella visci...’)


Gbehounou, G., A.H. Pieterse and J.C. Verkleij. 1996. The decrease in seed germination of Striga hermonthica in Benin in the course of the rainy season is due to dying off process. Experientia 52: 264-267. (At a site 70 km N. of Parakou, viability of seeds declined rapidly during wet season and prevention of new seeding for 2 seasons should result in dramatic decrease of the problem.)


Gurney, A. L., M. C. Press and J. K. Ransom. 1995. The parasitic angiosperm Striga hermonthica can reduce photosynthesis of its sorghum and maize hosts in the field. Journal of Experimental Botany 46: 1817-1823. (Photosynthesis in infested CK60 sorghum and H511 maize reduced by 46% and 31% respectively by 63 days after planting: Ochuti sorghum parasitized but photosynthesis unaffected.)


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 *Orobanchaceae* 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 *Orobanchaceae* *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.)


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.)


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.)


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.)


Ladley, J. J. and D. Kelly. 1995. Explosive New Zealand mistletoe. Nature 378: 766. (Suggesting a solution to Küjt'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.)


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.)


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.)

area basis is low-15 and 23% of that in the host (*Capsella bursa-pastoris*) before and after attachment respectively. Chlo-
rophyll and carotenoids are low; respi-
ration high - X1.8 and 2.6 before and after.

Lechowski, Z. 1997. Stomatal 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 stomatal aperture: after attachment, parasite insensitive to additional cytoki-

Lehtila, K. and K. Syrjanen. 1995. Com-

Leu, 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. phelypea*; deli-
mation from *C. tubulosa* and 2 other spp. outlined.)

Lock, G. M. and M.C. Press. 1995. Effects of elevated CO2 on *Agrostis capillaris* infected with the hemiparasite *Rhina-

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 host region, was not influenced by the host on which they were growing.)


Marshall, J. D., T. E. Dawson and J. R. Ehleringer. 1994. Integrated nitrogen, carbon, and water relations of a xylem-
tapping mistletoe following nitrogen fer-

Marvier, M. A. 1996. Parasitic plant host interactions: plant performance and indirect effects on parasite-feeding her-

Martinez, del Rio, C., M. Hourdequin, A. Silva and R. Medel. 1995. The influence of cactus size and previous infec-


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Martinez, del Rio, C., M. Hourdequin, A. Silva and R. Medel. 1995. The influence of cactus size and previous infec-

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., 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 larcis on Larix lyallii are erroneous, the host being re-identified as L. occidentalis.)


Mertzig, C. and S. Prien. 1996. (Occurrence of pine mistletoe in forest stands in Niederlausitz.) (in German) AFZ/Der Walt, Allgemeine Forst Zeitsschrift 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.)


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.)


Nimbal, C., 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.)


Odasz, A.M. and O. Savolainen. 1996. Genetic variation in populations of the arctic perennial Pedicularis dasyantha (Scrophulariaceae) on Svalbard, 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.)


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.)


Popovic, S. and M. Stjepanovic. 1995. (Production of alfalfa seed is limited by presence of \textit{Cuscuta} spp.) (in Croatian) \textit{Sjemenarstvo} 12: 135-149. (Propyzamide as Kerb, 3-4 kg/ha gave best control.)


Pundir, Y. P. S. 1995. Host range of \textit{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.)


Ramlan, M. F. and J. D. Graves. 1996. Estimation of the sensitivity to photoinhibition in \textit{Striga} hermonthica-infected sorghum. Journal of Experimental Botany 47: 71-78. (Results indicate that Striga-infested plants suffered from photoinhibition due to damage to electron-transport/photophosphorylation processes.)


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 Portuguese) 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*.)


Ruso, J., S. Sukno, J. Dominguez-Gimenez, J. M. Melero-Vara and J. Fernandez-Martinez. 1996. Screening of wild *Helianthus* species and derived lines for resistance to several populations of *Orobanchaceae cernua*. Plant Disease 80: 1165-1169. (All 26 perennial spp. and some of 18 annuals resistant to 'highly virulent' races of *O. cernua*.)


Salonen, V. and S. Puustinen. 1996. Success of a root hemiparasitic plant is influenced by soil quality and by defoliation of its host. Ecology 77: 1290-1293. [Growth of *Rhinanthus serotinus* on *Agrostis capillaris* (in Finland) is reduced in sandy soil, and by partial defoliation of the host.]


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. *dasyarpa* allows only low infestation.)


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*.)


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, 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.)

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, 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.)
teristics 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%.)


Stockey, R.A., H. Kō and P. Waltz. 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.)


Striga Newsletters Number 6 (March 1996) and Number 7 (September 1996). FAO/PASCON. (Two further issues of this valuable newsletter, with an abundance of news items on the latest activities of research groups around Africa and elsewhere and extended summaries of selected literature items.)


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.)


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. (Studies 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.)

Teryokhin, E. S. 1996. Weed Broomrapes. Systematics, Ontogenesis, Biology, Evolution. Afsteig-Verlag, Beyreuth Germany*


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: Cucur- lionidae) on Striga hermonthica (Soro- phulariaceae). 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 (Tapinanthes dodoneifolius) areas. Plant Physiology and Biochemistry 34: 283-292.


Wiens, D., D.L. Nickrent, C.G. Shaw III, F.G. Haskworth, 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.)


Xi Qian. 1996. (Studies of the biological characteristics and control of Cuscuta chinensis in soybean 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 miqueli 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.)


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*.)


HAUSTORIUM
Parasitic Plants Newsletter

Official Organ of the International Parasitic Seed Plant Research Group

July 1998                  Number 33

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 Research, 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. Sauerkorn, 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 the 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 control 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 Nütingen, Germany), and on “Chemical control” (Dr. Garcia-Torres, Institute for Sustainable Agriculture, Spain).

An excursion to the Sai's 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**

*Rhampicarpa 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 Casamance, 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 problem.
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, IACR-Long Ashton Research Station, Bristol, UK; M. Camara, PV1, 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.


**LITERATURE**


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.)

Aigbokhan, E.I., D.K. Berner and L.J. Musselman. 1998. Reproductive ability of hybrids of *Striga aspera* and *Striga hermonthica*. Phytopathology 88: 563-567. (Hybrids were all virulent on maize and mostly fertile. Chromosome numbers of 2n=36 and 38 for *S. aspera* and *S. hermonthica* respectively are lower, and closer, than previously reported.)

Aflakpui, G.K.S., P.J. Gregory and R.J. Froud-Williams. 1998. Uptake and partitioning of nitrogen by maize infected by *Striga hermonthica*. Annals of Botany 81: 287-294. (*S. hermonthica* reduced shoot growth of maize by about 50% but did not affect root growth. N concentration was higher in infected maize and in *S. hermonthica* than in uninfected maize but concentrations and partitioning not significantly affected by a single N application at 9 days after sowing.)


Berner, D.K., F.O. Ikie and J.M. Green. 1997. ALS-inhibiting herbicide seed treatments control Striga hermonthica in ALS-modified corn (Zea mays). Weed Technology 11: 704-707. (Treatments with nicosulfuron and imazaquin on seeds of P31801R maize with the XA-17 gene gave selective control of S. hermonthica whose seeds had been placed in the planting hole.)

Bernhard, R.H., J.E. Jensen and C. Andreasen. 1998. Prediction of yield loss caused by Orobanche spp. in carrot and pea crops based on the soil seedbank. Weed Research 38: 191-197. (In Israel, losses due to O. crenata in peas and carrot, and O. aegyptiaca in carrot only, are related to parasite seedbank; a method of predicting losses is proposed.)


restoration of species-rich grasslands. Biological Conservation 82: 87-93. (Studies show suppression of productivity of 8-73% by Rhinanthus and reduced proportion of grasses in the sward.)

van Delft, G-J., J.D. Graves, A.H. Fitter and M.A. Pruksma. 1997. Spatial distribution and population dynamics of Striga hermonthica in naturally infested farm soils. Plant and Soil 195: 1-15. (Seeds of S. hermonthica in soil declined 62% after 1 year of fallow. Numbers emerged tended to decline at seed densities over 100 seeds per kg soil. Total seed production tended to decline at shoot densities over 40/m². And many other valuable observations.)


Dhanapal, G.N. and P.C. Struik. 1996. Broomrape (Orobanche cernua) control before attachment to host through chemically or biologically manipulating seed germination. Netherlands Journal of Agricultural Science. 44: 279-291. (Germination of O. cernua increased by Vigna radiata and Crotalaria juncea even in the presence of GR24.)


English, T.J., R.S. Norris and A.E. Miller. 1997. Control of clover broomrape (Orobanche minor Sm.) in southwest Georgia pecan groves. Proceedings Southern Weed Science Society 50: 81-82. (O. minor is common in poorly managed pecan groves, though the host is usually herbaceous. Controlled by destruction of weed growth with glyphosate.)


Esilaba, A., Tilahun M., Fasil Reda, J.K. Ransom, Gebremedhin W., Adane T., Ibrahim F. and Gobena A. 1998. Diagnostic survey on Striga in the northern Ethiopian highlands. Arem 4: 13-27. (90% of farmers in the surveyed area identified Striga as a major constraint and 87% believed it to be increasing. Control methods include hand-pulling, ploughing and farmyard manure.)


Faghir, A. and V. Narimani. 1998. Investigation efficacy of propyzamid and imazethapyr for the control of dodder (Cuscuta spp.) and other weeds in East Azarbaijan – Iran. Sixth EWRS Mediterranean Symposium, Montpellier, 1998, pp. 156-157. (Best treatment for Cuscuta sp. in lucerne was propyzamide 2.5 kg/ha early post-emergence.)


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 prehaustoria formation, stimulated by zeatin, was synergised by far red light and inhibited by IAA, suggesting phytochrome involvement; ethylene had no effect.)


Hayashi, S., E. Miyamoto, K. Kudo, K. Kameoka and H. Hanafi. 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.)


Hershenhorn, J.D. Plakhine, Y. Goldwasser, J.H. Westwood, C.L. Foy and Y. Kleinfeld. 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 chlorosulfuron 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. Kleinfeld. 1998. Effect of sulfonylurea herbicides on Egyptian broomrape (Orobanche aegyptiaca) in tomato (Lycopersicon esculentum) under greenhouse conditions. Weed Technology 12: 108-114. (Comparing the effects of chlorosulfuron and 6 other sulfonylurea herbicides applied to O. aegyptiaca at various stages in petri dish and polybag.)

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.)


Hoffman, G., C. Diarra, I. Ba and D. Dembele. 1997. (The use of herbicides to control Striga hermonthica.) (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.)


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.)


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.)


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 PR-B-11 promoter fused to the GUS reporter gene) suggest that the host is not a compatible partner, even though showing normal susceptibility.)


Jost, A. 1997. Intergrifer Getreideanbau in Nord-Ghana unter besonder Berücksichtigung der Striga-problematik. PLITIS 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 distinguished by fruit and seed features.)


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, 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., 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. Krop. 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.)


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.)


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 *Capsella bursa-pastoris*, but remained constant in *M. arvense*, at a lower level before attachment, at a higher level after.)

Lechowski, Z. and J. Bialczky. 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*.)


Ma YongQing, A.G.T. Babiker, L.A. Ali, Y. Sugimoto and S. Inanga. 1996. *Striga hermonthica* (Del.) Benth. germination stimulant(s) from *Menispermum dauricum* (DC.) root cultures. 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.)

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.)


Matthies, D. 1997. Parasite-host interaction in Castilleja and Orthocarpus. Canadian Journal of Botany 75: 1252-1260. (C. integra, C. miniatia, 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.)


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.(unspecific) on lentil.)


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.)


Portnoy, V.H., N. Katzir and D.M. Joel. 1997. Use of sequence characterized amplified DNA regions (SCAR) for species identification of soil-borne Orobanche seeds by DNA fingerprinting. Pesticide Biochemistry and Physiology 58: 49-54. (Describing a technique by which 4 Orobanche species can be identified from single seeds, alive or dead – amazing!)


Rugutt, J.K. and K.J. Rugutt. 1997. Stimulation of


dihydropaphenol. Journal of Agricultural and Food Chemistry 45: 4845-4849. (A sesquiterpene lactone extracted from Ambrosia artemisifolia apparently as active as strigol.)


Salimi, H. 1998. Possibility of dodder control (Cuscuta planiflora) on alfalfa with glyphosate in Iran. Sixth EWRSS Mediterranean Symposium, Montpellier, 1998, p. 161. (Glyphosate 150g/ha twice at 1 week interval gave over 90% control and increased lucerne yield.)

Sandler, H.A., M.J. Else and M. Sutherland. 1997. Application of sand for inhibition of swamp dodder (Cuscuta gronovii) seedling emergence and survival on cranberry (Vaccinium macrocarpon) bogs. Weed Technology 11: 318-323. (At least 2.5 cm of sand needed to reduce infestation.)


Spiller, H.A., D.B. Williams, S.E. Gorman and J. Sanfilben. Retrospective study of mistletoe ingestion. Journal of Toxicology, Clinical Toxicology 34: 405-408. (Study of 92 cases of accidental poisoning by Phoradendron flavescens (=P. serotinum), used in traditional medicine as an abortifacient.)


Surov, T., D. Aviv, R. Aly, D.M. Joel, T. Goldman-Guez and J. Gressel. 1998. Generation of transgenic asulam-resistant potatoes to facilitate eradication of parasitic broomrapes (Orobanche spp.), with the sul gene as the selectable marker. Theoretical and Applied Genetics 96: 132-137. (Potatoes with target-site herbicide resistance were sprayed with asulam post-emergence to give complete selective control of Orobanche.)

Taylor, A. and W.E. Seel. 1998. Do Striga hermonthica-induced changes in soil matrix potential cause the reduction in stomatal conductance and growth of infected maize plants? New Physiologist 138: 67-73. (Results suggest that the symptoms induced by the parasite are not primarily due to soil water deficit.)


Tennakoon, K.U., J.S. Pate and D. Arthur. 1997. Ecophysiological aspects of the woody root hemiparasite Santalum acuminatum (R.Br.) A.DC. and its common hosts in south Western Australia. Annals of Botany 80: 245-256. (N-fixing legumes (e.g Acacia rostellifera) and Allocasuarina were principal hosts. Interface with the host xylem was largely parenchymatous tissue.)

Tennakoon, K.U., J.S. Pate and G.R. Stewart. 1997. Haustorium-related uptake and metabolism of host xylem solutes by the root hemiparasitic shrub Santalum acuminatum (R.Br.) A.D.C. (Santalaceae). Annals of Botany 80: 257-264. (Estimated that at least 70% of N and one third of C requirements obtained from host xylem. The haustorium apparently important in the conversion of N to proline.)

Teryokhin, E. 1997. Weed broomrapes - systematics, ontogenesis, biology and evolution. Aufstieg-Verlag, Germany. (Review to follow in next issue.)


Orobanche crenata. Journal of Agricultural and Food Chemistry 45: 2284-2290. (Concluding that the correct structure of the D ring is essential for full stimulatory activity.)


Vildeyev, N., D. Bakhariel and S. Masheva. 1995. (Possibilities for the use of chemicals in the control of Orobancheaeae (Orobanche ramosea) in tomato stand.) (in Bulgarian.) Rasteniev’dni Na?i 32(7-8): 62-64. (Glyphosate 150 g/ha controlled O. ramosea and increased yield in spite of phytotoxicity.)

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: imazquin in both crops.)

Vouzounis, N.A. and P.G. Americanos. 1997. Control of the parasitic weed Cuscuta monogyna in grapevines. Agricultural Research Institute, Nicosia Cyprus, Technical Bulletin 182: 5 pp. (C. monogyna damaging to grapevines and not controlled by direct application of glyphosate or imazquin; but successfully controlled indirectly by destruction of weed growth with residual herbicides plus glyphosate or paraquat+diquat.)


Watling, J.R. and M.C. Press. 1997. How is the relationship between the C4 cereal Sorghum bicolor and the C3 root hemiparasites Striga hermonthica and Striga asiatica affected by elevated CO2? Plant, Cell and Environment 29: 1292-1300. (Double the normal carbon dioxide concentration resulted in lower Striga biomass but little or no impact on the damaging effect on the host.)

at 10-25°C led to secondary dormancy and, at 30°C, to loss of viability.


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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.)

**HAUSTORIUM 33** 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 development of the new website have been assisted by John Terry, Tropical Weeds Group, Michail Semenov and others at Long Ashton Research Station, Bristol.
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Thanks to arrangements with the Institute of Arable Crops Research, Long Ashton Research Station, Bristol, Haustorium 34 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 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 Ermiyas Kebrab'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, 1985, 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.
Lytton John Musselman

Lewis John Musselman

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 listserv 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 listserv@). 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 listserv, 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 here 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 systematist, 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:

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., Tilia spp., Quercus robur, Corylus avellana, 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-colporate, spheroidal, 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-Sáez, Laboratorio de Arqueobotánico 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 address is: sauerbn@uni-hohenheim.de

OBITUARY - LARRY BUTLER


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 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.


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 Broomrpes 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


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 Engelrema 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) discusses 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.


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 collection 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


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 Trichosurus vulpecula 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 sulphonylurea 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, Assuit 104 and Cairo 241.)

Aflakpui, G.K.S., Gregory, P.J. and Froud-Williams, R.J. 1998. Effect of temperature on seed germination rate of Striga hermonthica (Del.) Benth. Crop Protection 17: 129-133. (Base, optimum and ceiling temperatures were 23, 40 and 43oC after conditioning at 20 oC, and 19, 32-35 and 43 oC after conditioning at 30 oC.)


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.)


Bayaa, B., Kumari, S.G., Akkaya, A., Erskine, W., Makkouk, K.M., Turk, Z. and õ Özerk, I. 1998. Survey of major biotic stresses of lentil in South-East Anatolia, Turkey. Phytopathologia Mediterranea 37: 88-95. (Orobanche aegyptiaca was prevalent in some production regions, and in Sanliurfa some fields were totally devastated.)


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. gesnerioides, and of potential value as trap crops include other Vigna spp. and some selections of sorghum, pigeon pea, Lablab purpureus and Sphenostylis stenocarpa.)


Calder, M. (ed.) 1997. (Sixteen papers on mistletoe ecology and management) The Victorian Naturalist 114(3). (see e.g. Reid, 1997 below)

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 significantly better than the local variety: the Striga-resistant synthetic STR Syn-W was no better than the local.)


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 Loliun 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 increased 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.)

Debrab, 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.)


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.)


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.)

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.)


Hagenah, W., Dörges, I., Gafumbgete, 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.)


Hartmann, T. 1997. (Pine mistletoe contrary to ecological silviculture?) (in German) AFZ/Der Wald, Allgemeine 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.)


Hershenhorn, J., Goldwasser, Y., Plakhine, D., Lavan, Y., Herzlinger, G., Golan, S., Chilf, T. and Kleifeld, Y. 1998. Effect of sulfonyleurea herbicides on Egyptian 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.)


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.)


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 flameing suggest that browsing and periodic fires are natural control
agents.)


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.)


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.)


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'.)


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 acquired 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.)

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.)


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.)


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.)


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.)


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.)


Pazy, B. 1998. Diploidization failure and apomixis in Orobancheaceae. 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.)


Press, M.C. 1998. Dracula or Robin Hood? A functional role for hemiparasites 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.)


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.)


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.)


Schmuttere, H. 1998. Some arthropod pests and a semi-parasitic plant attacking neem (Azadirachta indica) in Kenya. Anzeiger für Schädlingskunde, Pflanzenschutz 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.)


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.)


Thomas, H. 1998. Das Potentil von Pilzwen zur Kontrolle von Orobanche spp. unter Beröcksichtigung 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.)

Thomson, A.J., Muir, J.A. and Lewis, K.J. 1997. Variability in sub-regional impact of dwarf mistletoe on mature lodgepole pine. Forestry Chronicle 73: 371-375. (Survey in British Colombia, Canada suggests that replacing large scale clear felling with smaller scale or selective felling may increase problems from Arceuthobium americanum in Pinus contorta.)

Tinin, R.O. 1998. An alternative to the 6-class dwarf mistletoe rating system. Western Journal of Applied Forestry 13(2): 64-65. (Proposing a system based on broom volume, with advantages of speed and ease of use.)

Touré, M. Olivier, A., Ntare, D.R., Lane, J.A. and St-Pierre, C-A. 1998. Reaction of cowpea (Vigna unguiculata) cultivars to Striga gesnerioides races from Mali and Niger. Canadian Journal of Plant Science 78: 477-480. (IT82D-849 resistant to Mali and Niger races; IT81D-994 resistant to Mali but not to Niger race. B301 resistant to both but the low quality of the seeds 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. But see item above - 'Striga-resistant cowpeas'.)


Watling, J.R. and Press, M.C. 1998. How does the C4 grass Eragrostis pilosa respond to elevated carbon dioxide and infection with the parasitic angiosperm Striga hermonthica. New Phytologist 140: 667-675. (Growth of E. pilosa reduced 50% by Striga at normal and double CO2 levels.)


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.)


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.

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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. Intercropping 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 worthwhile.

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 *Striga* 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.

C.R. Riches and R. Lamboll, Natural Resources Institute, University of Greenwich
E-mail: charlie.riches@bbsrc.ac.uk

A.M. Mbwaga, Ilonga Agricultural Research and Training Institute, PO Kilosa, Tanzania.

**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.

M. Koyama. John Innes Centre, Colney Lane, Norwich, NR4 7UH, UK.
Email: miki.koyama@bbsrc.ac.uk

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**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.
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.

Daniel M. Joel, Ad-hoc Secretary,
International Parasitic Plant Society,
Newe-Ya’ar Research Center, ARO, Haifa 31900, Israel.
Email: dmjoel@netvision.net.il

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.

Gareth Davies, 40 Burleigh Park, Cobham, Surrey, KT11 2DU, UK.

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 (Capsicum annuum) was completely destroyed
after severe infestation. The parasite has also been observed on \textit{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: \url{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: \url{http://veghome.ucdavis.edu/Yoder/YoderLab/index.html}

\url{http://www.idrc.ca/nayudamma/striga_e.html} gives information on IDRC-funded work on biocontrol of \textit{Striga} with \textit{Fusarium oxysporum}.

\url{http://pest.cabweb.org/cpc/report.htm} uses the data sheet for \textit{Striga hermonthica} as a sample to illustrate the new CAB International Crop Protection Compendium, Global Module CD Rom.

PROCEEDINGS OF MEETINGS


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 \textit{S. asiatica} and improved yields.)

Ransom, J.K. \textit{et al.} An update on \textit{Striga} control research in Africa. (pp. 215-219)

Esilaba, A.O. \textit{et al.} Factors affecting the incidence of \textit{Striga} and its control in northern Ethiopia: results of a survey. (pp. 221-229)

Abayo, G.O. \textit{et al.} Stimulation of \textit{Striga hermonthica} germination by plant species indigenous to Eastern Africa. (pp. 231-239)

Chanyowedza, R.M. \textit{et al.} Effect of sorghum variety and leaf extracts from multipurpose trees on the germination and emergence of \textit{Striga asiatica}. (pp. 241-246)

Ariga, E.S. \textit{et al.} Potential of using cotton and other trap crops for \textit{Striga hermonthica} management in cereals in Kenya. (pp. 247-253) (Response of \textit{S. hermonthica} to cotton shown to be complex, depending on cotton variety, \textit{Striga} seed source, and other factors.)

Kanampui, F.K. \textit{et al.} Advantages of seed-primed imazapyr for \textit{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 \textit{Striga} (added artificially to seed hole) and good yield.)

Oswald, A. \textit{et al.} Intercropping – an option for \textit{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.)


Contents:


Kim, S.K. Horizontal resistance in maize.
The main purpose of this workshop was to review past research on managing horizontal resistance in maize. The examples given in Dr Kim's paper are not referenced and no proof is lacking for such an international workshop. 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 misunderstandings 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.

Jill Lenné, NR International Ltd., Chatham, UK.


Contents (with some abbreviation):

**Introductory:**

Wegmann, K. Progress in *Orobanche* research during the past decade.

**Session 1. Germination, physiology and biochemistry:**

Wegmann, K. The *Orobanche* problem in tobacco.

Zwanenburg, B and Wigchert, S.M. The molecular inception of *Striga* and *Orobanche* seed germination.

Shomer-Ilan, A. Proteolytic activity as a possible control mechanism of the germinating *O. aegyptiaca* Pers. seeds against self-destruction for minimising host root damage.


Kebrab, E. and Murdoch, A.J. Thermal time models for rate of germination of five *Orobanche* species.

Abu-Irmaileh, B.E. Salinity effect on *Orobanche* germination and establishment.

Christeva, T. and Naumova, S. Stimulation of broomrape seed germination by soil microorganisms.

Shindrova, P. et al. Effect of broomrape (*O. cumana* Wallr.) degree of attack on some
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:
Boelhouwer, G.J. and Verkleij, A.C. A study of the interaction between O. aegyptiaca and Brassica napus.
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?
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.
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.
Alvarado-Aldea, J. et al. Interactions of host genotype and planting time in the infection of sunflower by O. cernua.
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:

To obtain copies, please contact: Institute of Wheat and Sunflower, General Toshevo, 9520, Bulgaria. Tel: 359(058)27454: fax 359(05731) 4448: email iws@eos.dobrich.acad.bg


List of Contents:

Advances in Parasitic Weed Control at On-Farm Level. Volume 2. Joint Action to Control Orobanche in the WANA Region. 1999. Edited by Kroschel, J., Abderabhi, M. and Betz, H. GTZ/University of Hohenheim. 347 pp. (Selected papers from a Regional Workshop held in Morocco, April, 1998.)

List of Contents:

Ait Abdallah, F. et al. Le problème de l’Orobanche en Algérie.
Hassenine, 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.
Kleinfeld, 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.
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 orobanchiae Kult., a review.
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 orobanchiae and rot fungi.
Norambuena, H. et al. Introduction of Phytomyza orobanchiae 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.
Kleinfeld, 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 intégrée 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.
Loudie, N. et al. Développement du matériel didactique pour le contrôle de l’Orobanche au Maroc (Bloc d’images).
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.

Abstracts of papers presented at this meeting are included in Phytoparasitica 1999. Vol. 27. Relevant papers (pp. 109-115) are:


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.


Weinberg, T. et al. Effects of herbicide inhibitors of carotenoid biosynthesis on field dodder (Cuscuta campestris).


LITERATURE


Albrecht, H., Yoder, J.L. and Philips, D.A. 1999. Flavonoids promote haustoria formation in the root parasite Triphysaria versicolor Plant Physiology 119: 585-591. (Haustoria were induced by phenolic acids, flavonoids and the quinone DMBQ: most active were DMBQ and the anthocyanidin, peonin. Washings from maize seeds shown to be a source of active compounds.)


Aukema, B. and Stigter, H. 1998. (Discoveries of Pinalitus viscicola and Hyseloecus visci in Limburg (Heteroptera: Miridae).) (in
Dutch) Entomologische Berichten 58: 244. (Refound on Viscum album in Netherlands after lapse of 20-30 years.)


Bright, E.O. and Okusanya, B.A. 1998. Infestation of economic plants in Badeggi by Taginanthus dodonaeifolius (DC.) Danser and T. globiferus (A.Rich.) van Tiegh. Nigerian Journal of Weed Science: 11: 51-56. (Both species widespread, on shea butternut (Vitellaria paradoxa = Butyrospermum paradoxum), neem, citrus, Parkia globosa and Nerium oleander, frequency over 30% on the first 2 named. The main bird responsible for dispersal was the tinker bird Pogonias chrysoconus; others included the bulbul Pyconotus barbatus, weaver Ploceus cucullatus and plantain-eater Crinifer piscator.)


Bright, E.O. and Okusanya, B.A. 1998. Infestation of economic plants in Badeggi by Taginanthus dodonaeifolius (DC.) Danser and T. globiferus (A.Rich.) van Tiegh. Nigerian Journal of Weed Science: 11: 51-56. (Both species widespread, on shea butternut (Vitellaria paradoxa = Butyrospermum paradoxum), neem, citrus, Parkia globosa and Nerium oleander, frequency over 30% on the first 2 named. The main bird responsible for dispersal was the tinker bird Pogonias chrysoconus; others included the bulbul Pyconotus barbatus, weaver Ploceus cucullatus and plantain-eater Crinifer piscator.)


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.)


Annales Botanici Fennici 35: 171-174. (A species with pedicillate flowers in subgenus Cuscuta, occurring on Karpathos island.)


Goldwasser, Y., Hershenhorn, J., Plakhine, D., Kleinfeld, 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 phenyproponoid pathway upon infection, leading to 4-fold higher elenolic 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, Dloppement 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.)

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.)


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 sesame 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 of 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.)


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. cerina more rapid at higher temperatures (25-30°C) but induction of secondary (‘wet’) dormancy generally more rapid at low temperatures (10°C); the processes independent of each other. Also data on loss of viability when continuously imbibed at 30°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.)


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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.)

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López-Granados, F. and Garca-Torres, L. 1999. Longevity of crenate broomrapes (*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.)

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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.)

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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 engelmannii* 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 *Arceuthobium douglasii* and *Abies bifolia* as an occasional host.)


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.)


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.)


Pronier, I., Par, J., Traoré, 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.)


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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.)

and wild relatives screened, of which about 50 showed low infection.)


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.)


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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.)


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Vouzounis, N.A. and Americanos, P.G. 1998. Control of Orobanche (broomrape) in tomato and eggplant. Technical Bulletin, Cyprus Agricultural Research Institute No. 196: 1-7. (Useful treatments for O. aegyptiaca/ramosa were black polythene at time of transplanting in both crops, and rimsulfuron at 10 or 20 g/ha in tomato only.)


Westwood, J.H. and Foy, C.L. 1999. Influence of nitrogen on germination and early development of broomrape (Orobanche spp.). Weed Science 47: 2-7. (Effects of 5 mM ammonium greatest on O. minor, least on O. aegyptiaca, with O. crenata, O. ramosa and O. cernua intermediate: damage can occur within 4-8 hours during conditioning or germination and takes the form of inhibition of germ tube elongation. Host species much less sensitive. Useful clarification.)

Wigchert, S.C.M., Kuiper, E., Boelhouwer, G.J., Nefkens, G.H.L., Verkleij, J.A.C. and Zwanenburg, B. 1999. Dose-response of seeds of the parasitic weeds *Striga* and *Orobanche* toward the synthetic germination stimulants GR 24 and Nijmegen 1. Journal of Agricultural and Food Chemistry 47: 1705-1710. (Confirming high activity of GR 24 at $10^{-9}$ - $10^{-8} \text{M}$ on *S. hermonthica* and *S. asiatica* and at higher concentrations on *O. crenata*, but not on *S. aspera*. Activities of Nijmegen 1 about 3 orders of magnitude lower. Proposing further practical testing of both in the field.)

Wigchert, S.C.M. and Zwanenburg, B. 1999. A critical account on the inception of *Striga* seed germination. Journal of Agricultural and Food Chemistry 47: 1320-1325. (Proposing that *Striga* germination is induced by strigolactones via a receptor-mediated mechanism and is quite distinct from that resulting from sorgholeone.)


Yoder, J. 1999. Parasitic plant responses to host plant signals: a model for subterranean plant-plant interactions. Current Opinion in Plant Biology 2(1): 65-70. (A brief but perceptive review of recent developments in understanding the evolution of Scrophulariaceae and Orobanchaceae, and the mechanisms involved in host recognition and penetration, with intriguing conclusions on the potential for e.g. transferring parasitic genes into crops!)


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Zonno, M.C. and Vurro, M. 1999. Effect of fungal toxins on germination of *Striga hermonthica* seeds. Weed Research 39: 15-20. (Toxin T-2, most active, at $10^{-5} \text{M}$; deoxinivalenol active at $10^{4} \text{M}$; both from *Fusarium* spp. Discussion of potential as natural herbicides and possible role of biotechnological techniques in their production.)
HAUSTORIUM 35 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.

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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.

PARASITIC WEED PROJECTS FUNDED BY DFID/CPP

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 assessment 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 Kilosa, 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.

Malcolm Press, Anita Gurney and Julie Scholes, Department of Animal and Plant Sciences, University of Sheffield, S10 2TN, UK.

**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 avocado, 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.

Charlie Riches, Natural Resources Institute, IACR-Long Ashton Research Station, Bristol, UK; Duncan Overfield, Natural Resources Institute, University of Greenwich, Chatham, UK.

**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.

Charlie Riches and David Johnson, Natural Resources Institute, IACR-Long Ashton Research Station, Bristol, UK; Monty Jones, West Africa Rice Research Association, Bouake, Cote d’Ivoire.

*Alectra vogellii* resistance in common bean and cowpea in Malawi

*A. vogellii* 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. vogelli* 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. vogellii* 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. vogellii* 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 ochroleuca*) and fish bean (*Tephrosia vogelii*) are potent sources of *Alectra* germination stimulant. There is considerable interest in Malawi, and other *Alectra* 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.

Chrissie Mainjeni, Farming Systems IPM Project, Bvumbwe Research Station, Malawi. Charlie Riches, Natural Resources Institute, IACR-Long Ashton Research Station, Bristol, UK. E-mail: charlie.riches@bbsrc.ac.uk

(This study was supported through the DFID funded Farming Systems IPM project).

**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 was 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 of Striga biology, and ensure that any new techniques are fully acceptable to them. There was strong pressure 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 Orobanche 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:

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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.

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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.

Daniel M. Joel, Newe-Ya’ar Research Center, Israel (I); Patrick Thalouarn, University of Nantes, France (F); Andrew Bishop, Department of Primary Industry and Fisheries, Tasmania, Australia; Hocine Benharrat (F); Vitaly H. Portnoy (I) and Stephen Welsh (A).

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, ICRI SAT, 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 IITA, ICRI SAT, 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 P₂O₅; 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, Phaseolus beans, cassava, sorghum, millet, maize, Styllosanthes, 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, Phaseolus 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 STRIGNA 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 with TAC-TICs; ‘Transposons with Armed Cassettes for Targeted Insect Control’. They suggested transforming insects with a gene which, if activated 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 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:


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, Neve-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**


An overview of the *Striga* control sector review.


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:

Mayer, A.M. et al. Involvement of pectinases in plant infection by parasitic weeds.
Kleifeld, Y. et al. Control of Orobanche in tomatoes with sulfonyleurea herbicides.
Kleifeld, Y. et al. Selective Orobanche control with imidazolinones 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.
Weinberg, T. et al. Effects of herbicide inhibitors of carotenoid biosynthesis on field dodder (Cuscuta campestris).


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.
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. 1999. Bericht 1999 Verein f
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 propinquu.)


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.)


Buen, L.L. de and Ornelas, J.F. 1999. Frugiforous birds, host selection and the mistletoe Psittacanthus schiedeanaus, in central Veracruz, Mexico. Journal of Tropical Ecology 15: 329-340. (Liquidamer styraciflua was main host species, apparently because most visited by the three bird species responsible for spread. Other hosts included Persea americana and Crataegus mexicana.)


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.


Gurney, A.L., Press, M.C. and Scholes, J.D. 1999. Infection time and density influence 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.)


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.)


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.)


recommandations et liste de publications.
Projet suprarregional 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.,
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.)

Integration of socio-economically
appropriate management strategies for
Striga hermonthica in The Gambia. The
575-576. (Tethering livestock on infested
fields shown to be especially helpful.)

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
Dicaeinur hirundineum.)

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
taxonomical 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-Bisset, 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.)

preliminary census on the host-plants of
Cuscuta reflexa Roxb. in Gangtok, Sikkim.
(Host plants included 53 species in 27
families, including some young woody
species but no fully grown trees.)

Matiays 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 CO2 depends on
host type and soil nutrients. Oecologia 120:
156-161. (Complex interactions recorded
between Rhinanthus electrolophus, Lolium
perenne and Medicago sativa, grown in all
combinations and at different levels of
nutrient and CO2. The presence of the
parasite reduced the total productivity of
the system, regardless of CO2 level: growth
of all components, especially the parasite,
increased by high CO2 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. acutum.)

Ecological studies on the forests of
Midnapore district, West Bengal:
assessment of angiospermic parasites.
(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 flava*, *Peraxilla colensoi* and *P. tetrapetala* (mainly on *Notothofagus* spp.) widest for *Tuceia antarctica* (on a wide range of hosts), intermediate for *Ileostylus micrantha*. Degrees of host specificity discussed in relation to relative host availability.)


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.)


Pundir, Y.P.S. and Dhan Singh. 1998 More unrecorded hosts of *Scirrula pulverulenta* (Wallr.) G.Don (Loranthaceae) from Doon Valley and adjacent areas. World Weeds 5(2): 147-148. (*S. pulverulenta* recorded vigorous on *Colebrookea oppositifolia* but weak on *Bauhinia retusa*.)


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.)


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 Lyton 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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Those interested in membership of a new International Parasitic Plant Society please send the following form to:

Email: dmjoel@netvision.net.il

or: Dr Jos A.C. Verkleij
    Free University
    De Boelelaan 1087
    1081 HV Amsterdam
    The Netherlands

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Fields of interest
HAUSTORIUM
Parasitic Plants Newsletter
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August 2000                      Number 37

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 Striga infestation was not significantly different from the maize monoculture, as with soya bean, or the Striga 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 Striga 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 Striga 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 Striga 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 Striga 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 chlamydomspores 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**


Contents:

Gurney A.L. *et al.* Physiological processes during striga infestation in maize and sorghum. pp. 3-17.


DeVries, J. The inheritance of striga reactions in maize. pp. 73-81.


Odongo O.M. *et al.* Screening of teosinte-derived maize lines for resistance to *Striga hermonthica* in Western Kenya. 127-137.

Johnson D.E. *et al.* The potential for host resistance to striga on rice in West Africa. pp. 139-145.

Wilson, J.P. *et al.* Resistance to *Striga hermonthica* in the primary gene pool of *Pennisetum glaucum*. pp. 147-156.


Bennetzen, J.L. *et al.* The study and engineering of resistance to the parasitic
weed striga in rice, sorghum and maize. pp. 197-205.

Gressel J. and Levy, A. Giving Striga hermonthica the DT’s. pp. 207-224.


Singh, B.B. Breeding cowpea varieties with combined resistance to different strains of Striga gesnerioides. pp. 261-270.


Nour Eldin, I. Screening for striga resistance in sorghum in Sudan. p. 337.


Ouedraogo, O. et al. Striga research activities in Burkina Faso. p. 341.


Future striga research

Application of molecular marker technologies by NARS

List of participants

Group photograph

List of abbreviations

Glossary of genetic terms

(see Haustorium 36, pp. 6-8, for a detailed report of this meeting.)


Contents:

Kirway, M.T. Opening address. pp. 1-2.


Massawe, C.R.S. Results of sorghum variety screening for Striga resistance. p. 47.

Riches, C.R. Stimulant production by potential trap crops. p. 52.
Mbwaga, A.M. On-farm evaluation on the use of animal manure to control Striga. pp. 56-57.
Lamboll, R. Options for Striga control in rice cropping systems in Kyela. pp. 61-64.
Kaswende, J. Development of Striga control options in maize. pp. 69-74.


Relevant abstracts include:
Joel, D.M. Long-term approach for parasitic weeds control: manipulation of specific developmental mechanisms of the parasite. (p. 44)
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.

Edited by Anne Lgère. 301 pp.

Relevant abstracts include:
Watson, A.K. et al. Striga biocontrol - obstacles overcome. (371). pp. 176-177. (NB. see full abstract above.)


Eplee, R.E. and Norris, R. Eradication of *Striga asiatica* from the United States. (442). p. 212.


Saghir, A.R. New possibilities for *Cuscuta* management in some vegetable crops. (545). p. 263.


**LITERATURE**


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.)


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.)


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.)


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*.)


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* (Convulvulaceae) and *Ancistroclads 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 *Naytsia 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 *Naytsia floribunda* (Labill.) 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., Owewole, 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.)


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.)


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.)


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.)


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.)


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
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.

Garcia, 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., Kleinfeld, 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*. )


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.)


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.)


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*.)


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.)


Janssen, T. and Wulf, A. 1999. (On the significance of mistletoes for forest protection.) (in German) Mitteilungen aus der Biologischen Bundesanstalt für 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.)


Juan, R., Pastor, J. and Fernández, 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*.)
Ochrana Rolin 44(12): 15, 33.

(Summarising interception of notifiable weeds including Cuscuta, Orobanche spp.)


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°C at high water potential, somewhat lower, 17-20°C with a decrease in water potential.)


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 ‘Isacor’ 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 flava, Illeostylus micranthus, Peraxilla colensoi, P. tetrapetala and Tupeia antarctica, are described.)


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. and Read, D.J. 2000. Symbiotic germination and development of myco-heterotrophic plants in nature: transfer of carbon from ectomycorrhizal *Salix repens* and *Betula pendula* to the orchid *Corallorrhiza 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 transferring carbon from the indirect hosts *S. repens* and *B. pendula* via ectomycorrhizal fungi. Should we be treating them as parasitic plants?)


Mathiasen, R., Parks, C., Beatty, J and Sesnie, S. 2000. First report of *Psittacanthus angustifolius* on pines in Mexico and Guatemala. Plant Disease 84: 808. (*P. angustifolius* recorded on *Pinus maximinoi*, *P. oocarpa* and possibly *P. tecunumanii*, but no damage observed.)


Mauromicale, G., Restuccia, G. and Marchese, M. 2000. Germination response and viability of *Orobanchus crenata* Forks seeds subjected to temperature treatment. Australian Journal of Agricultural Research 51: 579-585. (Freshly imbibed seeds exposed to high temperatures – over 40°C – for 12 or 24 hours suffered large reductions in subsequent germination: tetrazolium tests suggested they were mainly dormant up to 65°C but dead above 70°C.)

Mbwa, A.M., Kaswende, J. and Shayo, E. 2000. A Reference Manual on *Striga* Distribution and Control in Zimbabwe. SIDA/FAO – FARMESA Programme, P.O. Box Ilonga, Kilosa, Tanzania. 26 pp. (A very sound, well-illustrated booklet, summarising information on biology and control in clear terms, suitable for other researchers, extension personnel and the more literate farmers.)

Medel, R. 2000. Assessment of parasite mediated selection in a host-parasite system in plants. Ecology 81: 1554-1564. (Spine length shown to be important in susceptibility of individuals of cacti, *Echinopsis chilensis* and *Eulychnia acida* to the mistletoe *Tristerix aphyllus*. The study suggests a possible role for mistletoe attack in selection for spine length in *E. chilensis* but not in *E. acida.*)

Michi, L. Bouillant, M-L., Rohr, R., Sall, G. and Bally, R. Physiological and cytological studies on the inhibition of *Striga* seed germination by the plant growth-promoting bacterium *Azospirillum brasilense*. European Jopurnal of Plant Pathology 106: 347-351.

Morozev, I.V., Foy, C.L. and Westwood, J.H. 2000. Small broomrape (Orobanche minor) and Egyptian broomrape (Orobanche
aegeyptiaca) parasitization of red clover (Trifolium pratense). Weed Technology 14: 312-320. (Inoculation of T. pratense roots with rhizobacteria increased germination and attachment of O. minor but not of O. aegyptiaca.)


Musselman, L.J. and Vorster, P. 2000. Finding furtive flowers. Plant Talk 21: 38-39. (Describing members of Hydnoraceae – Hydnora spp. in Africa and Psospanche spp. in tropical America – with especially interesting observations on H. triceps seen in Namaqualand for only the second time this century, on its host Euphorbia dregiana.)


Norton, D. A. and Ladley, J. J. 1998. Establishment and early growth of Alepis flavida in relation to Nothofagus solandri branch size. New Zealand Journal of Botany 36: 213-217. (Establishment of Alepis flavida seedlings was found to be better on smaller diameter branches, about 3mm.)


Pate, J.S. and Bell, T.L. 2000. Host association of the introduced annual root hemiparasite Parentucellia viscosa in agricultural and bushland settings in Western Australia. Annals of Botany 85: 203-213. (P. viscosa shown to parasite, and to benefit from, attachment to 10 native taxa as well as 17 introduced taxa; also to be able to continue growth in the absence of a host. Data also provided on carbon isotope discrimination and N metabolism – amino acids in parasite not always comparable to those in the host.)


Puustinen, S. and Salonen, V. 1999. The effect of host defoliation on hemiparasitic-host interactions between Rhinanthus serotinus and two Poa species. Canadian Journal of Botany 77: 523-530. (R. serotinus was somewhat reduced when the host P. annua was 100% defoliated but not when the host was P. pratensis. Biomass of undefoliated P. annua was reduced 4 times as much as P. pratensis by R. serotinus infection.)

to the number of parasites per host and the length of time attached, over a 2 year period.)

Pywell, R.F., Nowakowski, M., Walker, K.J. and Barrett, D. 1999. A preliminary study of the introduction of *Rhinanthus minor* into a field margin to control productivity. Aspects of Applied Biology No. 54: 315-320. (Introduction of *R. minor* reduced productivity of most other species but failed to reduce the total community productivity when *R. minor* itself was included.)


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.)


Rich, T.C.G. 2000. A reanalysis of the mistletoe (*Viscum album* L.; Loranthaceae) survey data from the 1970s and 1990s. Watsonia 23: 338-339. (Further to the report by Briggs, 1999 (see above), the author concludes that there is 'no evidence for a decline at a national level for tetrad frequency data'.)


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*.)


Schmidt, K. and Jensen, K. 2000. Genetic structure and AFLP variation of remnant populations in the rare plant *Pedicularis palustris* (Scrophulariaceae) and its relation to population size and reproductive components. American Journal of Botany 87: 678-689. (Reporting studies in Germany.)


Silleró, J.C., Rubiales, D. and Moreno, M.T. 1999. (Broomrape (*Orobanche crenata*) resistance in faba bean (*Vicia faba*). (in Spanish) In: SEMh Congreso Sociedad Española de Malherbología, Actas, Logroño, Spain 1999: 395-399. (Faba bean lines studied for stability of resistance over a range of sites.)

Stein, G.M., Schaller, G., Pflüger, U., Schnietzel, M. and Bssing, A. 1999. Thionins from *Viscum album* L.: influence of the viscotoxins on the activation of granulocytes. Anticancer Research 19: 1037-1042. (Viscotoxins exerted immunomodulatory effects on human granulocytes which might be of benefit to tumour patients, in addition to their cytotoxic properties.)

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.)

Taylor, J.E. and Marsden, M.A. 1997. Permanent plots for studying the spread and intensification of larch dwarf mistletoe and the effects of the parasite on growth of infected western larch on the Flathead Indian Reservation, Montana. Results from the 5-year re-measurement. Forest Health Protection Report – Northern Region, USDA Forest Service No. 92-5. 5 pp. (Reporting effects of overstorey removal and pre-commercial thinning on *Arceuthobium laricis* and *Larix occidentalis*.)


Young, N.D., Steiner, K.E. and de Pamphilis, C.W. 1999. The evolution of parasitism in Scrophulariaceae/ Orobancheaceae: 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 holoparasitic Orobancheaceae but arose independently. At the broader level it is suggested that the Orobancheaceae, the parasitic Scrophulariaceae, and *Lindenbergia* be defined as Orobancheaceae.)

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: Email: dmjoel@netvision.net.il

or to Dr Jos A.C.Verkleij at:

16
Free University
De Boelelaan 1087
1081 HV Amsterdam
The Netherlands

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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 coordinated, 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 substrate 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 1 Project 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.

References:


Kushan U. Tennakoon Department of Botany, University of Peradeniya, Peradeniya, SRI LANKA. Email: kushan@botany.pdn.ac.lk

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/


LITERATURE

infested with *S. hermonthica*. Best hybrid, 9012-12, suffered 25% reduction in dry matter v. 60% in susceptible, 8338-1.)


Bayaa, B., El-Hossein, N. and Erskine, W. 2000. Attractive but deadly. ICARDA Caravan 21: 16. (Noting that *Orobanchaceae 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.)


Chikoye, D., Manyopng, V.M. and Ekelleme, 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.)


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.)

Dozet, B., Dzerefos, C.M., Shackleton, C.M. and Fineran, B.A. and Calvin, C.L. 2000. Transfer 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.* (Convulvulaceae) 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 douglasi* are more likely to break – of concern in public access areas, such as campsites, etc.)


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, 11<sup>th</sup> 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.)


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.)


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°C for *C. trifolii* and 16-32°C for *C. campestris*.)


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.)


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.)


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.)


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.)


**HAUSTORIUM 38**

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.

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Those interested in membership of the new International Parasitic Plant Society please send the following form to Danny Joel at:

Email: dmjoel@netvision.net.il

or to Dr Jos A.C. Verkleij at:

Free University

De Boelelaan 1087

1081 HV Amsterdam

The Netherlands

Name

Postal address
Email
Fields of interest
HAUSTORIUM
Parasitic Plants Newsletter
Official Organ of the International Parasitic Seed Plant Research Group

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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. 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. Griffits *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 Wangou-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 Kenya (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.
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 Verkleij (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 soyabeans 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 OROBNACHE 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 (Zermame, 1997; Zermame 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. crenata 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:

Zermame, 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

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/](http://www.belspo.be/cost/)

Diego Rubiales, CSIC, Cordoba, Spain
Email: ge2ruozd@uco.es

A NEW TECHNICAL MANUAL


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**


(Email Patrick.Thalouarn@svt.univ-nantes.fr)

Price: Euro 40.00 or $US 40.00.

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**AVAILABILITY OF PREVIOUS SYMPOSIUM PROCEEDINGS**


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.

**WEBITIES**

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.si.edu/parasitic-plants/index.html

**LITERATURE**


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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. rigens from Corsica should be given specific status as O. rigens Loisel.)

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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.)

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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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Oswald, A., Ransom, J.K., Kroschel, J. and Sauerborn, J. 2001. Transplanting maize and sorghum reduces Striga hermonthica damage. Weed Science 49: 346-353. (In Kenya, transplanting sorghum failed to show any benefit but transplanting maize at 17 days old reduced Striga attack and doubled yields. Earlier transplanting was less effective.)


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Sonk, B., Kenfack, D. and Tindo, M. 2000. (Parasitism of avocado trees (Persea americana, Lauraceae) with Loranthaceae in the area of Yaoundé (Cameroon)) (in French) Fruits 55: 325-331. (Three species of mistletoe are a ‘limiting factor’ in avocado culture, affecting from 43 to 69% of trees across 5 zones.)


protein during haustorial formation in the seedlings of a holoparasitic plant, *Cuscuta japonica*. Plant and Cell Physiology 41: 1373-1380. (Observations suggest the involvement of down-regulation of heat-shock protein CJHSP17 in haustorial development of *C. japonica.*)

Teryokhin, E.S., Romanova, V.O. and Wegmann, K. 2001. (Method of biotests for intraspecific taxonomy of *Orobanche cernua* (Orobanchaceae).) (in Russian) Botanicheskii Zhurnal 86(1): 157-167. (Sub-species *cernua* and *rajahmundrica* were distinguished by their host-related germination behaviour.)

Tinnin, R.O. 2001. Effect of dwarf mistletoe on bole taper and volume in young Douglas-fir. Western Journal of Applied Forestry 16(1): 5-8. (Results suggest that *Arceuthobium douglasii* increases bole taper and affects the volume of younger *Pseudotsuga menziesii* by affecting tree diameter and height but not by a substantive change in bole profile.)


van Ast, A., Bastiaans, L. and Kropff, M.J. 2000. A comparative study on *Striga hermonthica* interaction with a sensitive and a tolerant sorghum cultivar. Weed Research 40: 479-493. (Concluding that the greater sensitivity of CK60-B, compared with the relatively tolerant land-race Tiemarifing was associated with differences in root architecture, together with earlier infection and higher *Striga* numbers.)


Westwood, J.H. 2000. Characterization of the *Orobanche-Arabidopsis* system for studying parasite-host interactions. Weed Science 48: 742-748. (*A. thaliana* stimulates germination of *O. ramosa* and *O. aegyptiaca* but not of *O. crenata*, *O. cernua* or *O. minor*; but it can support the development of all these species. Mutant *A. thaliana* deficient in flavonoid biosynthesis was equally susceptible.)

Wollenweber, E., Wieland, A. and Haas, K. 2000. Epicuticular waxes and flavonol aglycones of the European mistletoe, *Viscum album* L. Zeitschrift fUr Naturforschung. Section C. Biosciences 55: 314-317. (Oleanolic acid found to be the main component, but a number of other components identified, all varying somewhat according to season.)


Yoneyama, K., Takeuchi, Y. and Yokota, T. 2001. Production of clover broomrape seed germination stimulants by red clover root requires nitrate but is inhibited by phosphate and ammonium. Physiologia Plantarum 112: 25-30. (Poorly described experiments involved seedlings of *Trifolium pratense* grown for 4 weeks with zero nutrient, then fed at 4 and 5 weeks and root exudates extracted with solvent at 6 weeks. Nitrate in the nutrient at 2-50 mg N/l increased stimulant activity but only in the absence of phosphate above 5 mg P/l. K had no effect, urea comparable with nitrate, while ammonium tended to be inhibitory.)

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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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. Rusted 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

<table>
<thead>
<tr>
<th>Planting season</th>
<th>Crops</th>
<th><em>Striga</em> situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Season 1</td>
<td>Maize, sorghum, green beans, groundnuts</td>
<td>Season wet. Lot of <em>Striga</em> every year</td>
</tr>
<tr>
<td>December – January</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Season 2</td>
<td>Maize and green beans if rain. No sorghum.</td>
<td>Lot of <em>Striga</em> when rains good. Poor rains little or no <em>Striga</em></td>
</tr>
<tr>
<td>March - April</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Season 3</td>
<td>Maize only</td>
<td>Little rain, hot and dry. No <em>Striga</em></td>
</tr>
<tr>
<td>July – August Planting</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 coup 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 agricultural 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:


Derek Laycock, Jl. Pahlawan Revoulusi A-11, Pondok Bambu, Jakarta 13430, Indonesia.
e-mail laycock@attglobal.net

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 December 2001

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**


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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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Adler, L.S. and Wink, M. 2001. Transfer of quinolizidine alkaloids from hosts to hemiparasites in two Castilleja-Lupinus associations: analysis of floral and vegetative tissues. Biochemical Systematics and Ecology 29: 551-561. (Castilleja miniata and C. indivisa have reduced herbivory but no reduced pollination when absorbing alkaloids from host Lupinus spp., apparently because the alkaloids do not reach the nectar.)

Ahmed, N.E., Sugimoto, Y. and Inanaga, S. 2000. Inhibition of Striga hermonthica seed germination using Fusarium solani extracts. Proceedings Twenty-seventh Annual Meeting, Plant Growth Regulation Society of America, August, 2000, p. 246. (Mycotoxins isolated from F. solani, SUD96, found to be active v. S. hermonthica at time of germination but not later.)


Chivinge, O.A., Kasembe, E. and Mariga, I.K. 2001. The effect of different cowpea cultivars on witchweed and maize yield under dryland conditions. Proceedings The BCPC Conference - Weeds 2001: 163-168. (Six cowpea varieties inter-planted within the maize row reduced Striga asiatica numbers and significantly increased maize yield compared with sole-crop maize, while stover yields were similar or somewhat lower. There were no significant differences between cowpea varieties.)

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Canadian Journal of Botany 79: 1225-1240. (A thorough and generally informative review of *S. gesnerioides* in cowpea, but regrettably repeating inaccurate observations concerning inheritance of undesirable characters from resistant line B.301, refuted by B.B. Singh in Haustorium 34.)


Gworgwor, N.A., Ndahi, W.B. and Weber, H-Chr. 2001. Parasitic weeds of North-eastern Nigeria: a new potential threat to crop production. Proceedings The BCPC Conference - Weeds 2001: 181-186. (Surveys suggest that in addition to the widespread *Striga hermonthica* on cereals, *S. gesnerioides* on cowpea, *Alectra vogelii* on cowpea and groundnut, and *Tapinanthus oleifolius* on shea butter-nut, there is significant occurrence of *S. aspera*, *S. densiflora* (?), *Rhamphicarpa fistulosa* and *Buchnera hispida* on cereals. *Cuscuta campestris* is increasingly common but so far only on weeds.)


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floribunda and Santalum acuminatum in Australia, their haustorial anatomy, nitrogen metabolism and transfer from hosts, and more.)


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(Results suggest H3 is a highly branched heteropolysaccharide.)


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HAUSTORIUM

Parasitic Plants Newsletter

Official Organ of the International Parasitic Plant Society

July 2002 Number 41

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 the President

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 mechanisms 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 *Eucalyptus 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. Amongst 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.


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.

<table>
<thead>
<tr>
<th>Entry</th>
<th>CW 11 weeks</th>
<th>Grain yield kg/ha</th>
<th>AC m$^{-2}$</th>
</tr>
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V. Kabambe, H.N. Soko and T. Kapewa,
Chitedze Research Station, P.O. Box 158,
Lilongwe, Malawi.
email: maizeagronomy@malawi.net

### IDENTIFICATION OF OROBLANCHE SPECIES OCCURRING IN NEPAL


There has been controversy and misinterpretation of *Orobanchae* species occurring in Nepal (Rao et al. 1988). Hence, an effort has been made to ascertain and update the taxonomy of *Orobanchae* 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 *Orobanchae* 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...
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*
2. Bracteoles absent, stem unbranched, calyx divided in 2 segments ..................2
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*

1. Bracteoles absent, stem unbranched, calyx divided in 2 segments ...............2
2. Calyx segments equal, each bifid ....*O. cernua*
3. Calyx segments unequal, one 3-lobed, the other 2-lobed ..........................3

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.

References

G.B. Khattri, Dept. of Botany, Tribhuvan University, P.O.Box 102, Thamel, Kathmandu, Nepal. gkhattri@wlink.com.np
Suresh C. Srivastava, Dept. of Botany, B.R.B. Bihar University, Muzaffarpur, Bihar, India
R. Jacobsohn, A.R.O., The Volcani Center, Bet Dagan, Israel. vcarie@volcanic.agri.gov.il

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)

Lethbridge, B. 2001. Grafting compatibility of quandong, Santalum acuminatum. (12: 2)
Jones, P. 2001. Sandalwood re-visited in Western Australia. (12: 3-4)
Vernes, T. Preliminary results from Santalum macgregori in ex situ conservation planting. (13:6-7.)
Moretta, P. et al. 2001. Longitudinal variation in the yield and composition of sandalwood oil from Santalum spicatum. (14:5-7)
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 TESIS

K. Pageau (PhD, Université 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, Université 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, Université 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 interspecies 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. Radiolabeled (\(^{14}C\)) 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 intercropping 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.)

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Hess, D.E. Achieving Striga control on-farm: recommendations of working groups. pp. 84-86.


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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
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/mistletoe/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 listserv’ see:  
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


(Including methods for management of mistletoes.)


Amsellem, Z., Kleinfeld, Y., Kerenyi, Z., Hornik, L., Goldwasser, Y. and Gressel, J. 2001. Isolation, identification, and activity of mycoherbicidal pathogens from juvenile broomrape plants. Biological Control 21: 274-284. (Two strains of Fusarium, F. arthrosporoides strain E4a (CNM 1-64) and F. oxysporum strain Eld (CNM 1 1622), isolated from diseased Orobanche stems, prove to be distinct from any strains previously used in biocontrol studies and to show promise for the control of O. aegyptiaca, O. cernua, and O. cumana.)


Bannister, P. and Strong, G.L. 2001. Carbon and nitrogen isotope ratios, nitrogen content and heterotrophy in New Zealand mistletoes. Oecologia 126: 10-20. (In a study of 7 spp. of Loranthaceae and Viscaceae, and their hosts, differences in carbon ratio between host and parasite were relatively small, while nitrogen content and N isotope ratios in parasites were strongly correlated with those of the hosts. It is proposed that the smaller differences in this study, compared with previous ones, are due to the temperate conditions in which the study was conducted, with little water stress.)


(Loranthaceae) and Euphrasia formosissima (Scrophulariaceae).


de Buen, López L. and Ornelas, J.F. 2001. Seed dispersal of the mistletoe Psittacanthus schiedeianus by birds in Central Veracruz, Mexico. Biotropica 33: 487-494. (Fruiting of P. schiedeianus in January/February coincides with the local abundance of the generalist flycatchers Pitlogyns cinererus and Myzetetes similis at a time of relative food shortage, but not with that of the more mistletoe-specialised cedar waxwings (Bombycilla cedrorum).)

de Buen, López L. and Ornelas, J.F. 2002. Host compatibility of the cloud forest mistletoe Psittacanthus schiedeianus (Loranthaceae) in Central Veracruz, Mexico. American Journal of Botany 89: 95-102. (Differences in distribution of P. schiedeianus on Quercus germama, Q. leiophylla, Liquidambar stryaciflua, Acacia penntaula and Platanus mexicana attributed to differences in bird foraging and territorial behaviour, host abundance and host species compatibility.)

Deeks, S.J., Shamoun, S.F. and Punia, Z.K. 2001. In vitro germination and development of western hemlock dwarf mistletoe. Plant Cell, Tissue and Organ Culture 66: 97-105. (Optimum elongation of Arceuthobium tsugense ssp. tsugense seedlings was obtained with modified White’s Medium at 20 °C, in light, without plant growth regulators. Holdfast production was promoted with addition of 2.4-D at 1 mg/l.)


Galindo, J.C.G., de Luque, A.P., Jorrin, J. and Macías, F.A. 2002. SAR studies of sesquiterpene lactones as *Orobanche cumana* seed germination stimulants. Journal of Agriculture and Food Chemistry 50: 1911-1917. (Three naturally occurring sesquiterpene lactones, 2 from *Sussurea lappa*, and one parthenolide from *Magnolia grandiflora*, and 10 synthetic derivatives from these compounds were compared with known stimulants including orobanchol, GR 24 etc. Some showed equal or higher activities than GR 24. Structure-activity relationships are discussed.)


Haussman, B.I.G., Hess, D.E., Reddy, B.V.S., Mukuru, S.Z., Kayentao, M., Welz, H.G. and Geiger, H. 2001. Pattern analysis of genotype x environment interaction for Striga resistance and grain yield in African sorghum trials. Euphytica 122: 297-308. (Significant entry x country interactions when sorghum lines were tested across sites in Mali and Kenya support the hypothesis of sub-populations of Striga hermonthica differentially adapted to local sorghum hosts. F₂ populations from resistant Framida and tolerant Seredo tended to be superior to other combinations across sites in both Striga resistance and yield.)

Hidayati, S.N., Meijer, W., Baskin, J.M. and Walck, J.L. 2000. A contribution to the life history of the rare Indonesian holoparasite Rafflesia patma (Rafflesiaceae). Biotropica 32: 408-414. (About 50% of buds may be destroyed by birds and mammals: flowers remained open for 3-5 days and were visited by insects of the genera Lucilia and Sarcophaga.)


Jayusman. 2000. (The infestation intensity of Loranthus spp. in Styrax sp. plantations in North Tapanuli.) (in Indonesian) Bulletin Penelitian Kehutanan – Pematang Siantar 15(2): 73-90. (70-90% of trees in 2 Styrax sp. plantations in N. Sumatra were seriously infested by 4 mistletoe spp. including Loranthus atropurpureus, L. schultesii and L. pentandrus, which caused reduced incense gum production and wood quality and some tree deaths.)


Joel, D.M. and Eisenberg, H. 2001. Three Orobanche species newly found on crops in Israel. Phytoparasitica 30: 187-190. (O. pubescens found damaging parsley and Tropaeolum major; O. amethystea (cf. O. crenata) on vetch; and O. loricata on ornamental Pelargonium and Gazania spp. A key is included.)

Kanampiu, F.K., Ransom, J.K. and Gressel, J. 2001. Imazapyr dressings for Striga control on acetolactate synthase target-resistant maize. Crop Protection 20: 885-895. (Reporting a very thorough series of studies leading to excellent results with seed dressings of imazapyr on seeds of the mutation-derived ALS-resistant ‘3245 IR’ maize line, involving total application of 30 g a.i./ha. Seed priming was less satisfactory.)

Kebreab, K. and Murdoch, A.J. 2001. Simulation of integrated control strategies for Orobanche spp. based on a life cycle model. Experimental Agriculture 37: 37-51. (Concluding that there is need to reduce and maintain seed bank below 2000 seeds/m² and that integration of a range of control approaches are likely to be needed to achieve this.)


valuable review of the potential and techniques for exploiting *P. orobanchia.*

Koskela, T., Salonen, V. and Mutikainen, P. 2001. Interaction of a host plant and its holoparasite: effects of previous selection by the parasite. Journal of Evolutionary Biology 14: 910-917. (Results suggest that populations of *Urtica dioica* with a previous history of attack by *Cuscuta europaea* supported less vigorous growth of *C. europaea,* but were themselves more damaged by the attack, compared with *U. dioica* populations not previously exposed.)

Kumar, R.M. 2000. Effect of herbicides on the control of parasitic weed *Cuscuta* in blackgram (*Vigna mungo*). Journal of Research ANGRAU 28(3): 1-5. (Unidentified *Cuscuta* sp. caused almost 70% yield loss in blackgram. Best control achieved with fluchloralin and pendimethalin. Propyzamide was damaging.)

Kureh, I., Chiezey, U.F. and Tarfa, B.D. 2000. On-station verification of the use of soybean trap-crop for the control of *Striga* in maize. African Crop Science Journal 8: 295-300. (Growing maize in mixture with soybean resulted in lower *S. hermonthica* and higher maize yields.)


Li, J., Boufford, D.E. and Donoghue, M.J. 2001. Phylogenetics of *Buckleya* (Santalaceae) based on its sequences of nuclear ribosomal DNA. Rhodora 103(914): 137-150. (Discussing relationships between *Buckleya* spp. in China, Japan and USA.)

Loweys, B.R., Tyerman, S.D. and Loveys, B. 2002. Effect of different host plants on the growth of the root hemiparasite *Santalum acuminatum* (quandong). Australian Journal of Experimental Agriculture 42: 97-102. (*S. acuminatum* is an increasingly important crop. Pot experiments showed growth enhanced by the presence of a host, especially *Myoporum parviflorum* and *Atriplex nummularia.*)


Mathiasen, R.L. and Daugherty, C.M. 2001. Susceptibility of foxtail pine and western white pine to limber pine dwarf mistletoe in Northern California. Western Journal of Applied Forestry 16: 58-60. (Classifying *Pinus balfouriana* as an occasional host, and *P. montica* as a secondary host of *Arceuthobium cyanocarpum.*)


Medel, R. 2001. Assessment of correlational selection on tolerance and resistance traits in a host plant-parasite interaction. Evolutionary Ecology 15(1) 37-52. (A continuation of studies reported in Medel 2000 (see Haustorium 37) with the mistletoe *Tristerix aphyllus* on the spiny cactus *Echinopsis chilensis* and concluding that tolerance and resistance traits may coexist in *E. chilensis.*)


oil fatty acid profiles – mainly oleic acid in *O. cernua*, linoleic acid in *O. cumana*.)


Rödl, T. and Ward, D. 2002. Host recognition in a desert mistletoe: early stages of development are influenced by substrate and host origin. Functional Ecology 16: 128-134. (Studies with *Plicosepalus acaciae* on *Acacia raddiana* suggest the existence of chemical cues that affect seedling development and are host-specific at the level of populations.)

Sala, A., Carey, E.V. and Callaway, R.M. 2001. Dwarf mistletoe affects whole-tree water relations of Douglas fir and western larch primarily through changes in leaf to sapwood ratios. Oecologia 126: 45-52. (Studies with *Arceuthobium douglasii* on *Pseudotsuga menziesii* and *A. laricis* on *Larix occidentalis*.)

Salimi, H. and Shahraeen, N. 2000. A study on comparison of seed dormancy and germination in three species of dodder. Rostanîha 1(1-4): 33-35. (*Cuscuta monogyna*, *C. planiflora* and *C. campestris* all germinated in response to seed scarification: light improved germination of *C. monogyna*: dormancy was shortest in *C. monogyna* and longest in *C. campestris*.)

Salonen, V. and Lammi, A. 2001. Effects of root hemiparasitic infection on host performance: reduced flower size and increased asymmetry. Ecoscience 8: 185-190. (Showing that parasitisation of *Linum usitatissimum* and *Brassica rapa* by *Rhinanthus serotinus*, resulted in some deformity of host flowers and reduction of pollination and reproductive success, as well as reduced biomass.)


Sauerborn, J., Buschmann, H., Ghiasvand Ghiassi, K. and Kegel, K-H. 2002. Bezonthiadiazole activates resistance in sunflower (*Helianthus annuus*) to the root-parasitic weed *Orobanche cumana*. Phytopathology 92: 59-64. (Seed treatment with 40-60 ppm BTH greatly reduced infection of sunflower by *O. cumana*. This effect was associated with increased synthesis of scopoletin and hydrogen peroxide and accumulation of chitinase in the roots.)


Sinebo, W. and Drennan, D.S.H. 2001. Vegetative growth of sorghum and *Striga hermonthica* in response to nitrogen and the degree of host infection. European Journal of Plant Pathology 107: 849-860. (Results of pot experiments indicate an inverse relationship between the degree of host root infection and the level of resistance; and suggest that sorghum releases resistance-conferring substances to the infection point after sensing infection.)

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*.)


Timoshenko, A.V., Lan, Y., Gabius, H.J. and Lala, P.K. 2001. Immunotherapy of C3H/HeJ mammary adenocarcinoma with interleukin-2, mistletoe lectin, or their combination; effects on tumour growth, capillary leakage and nitric oxide (NO) production. European Journal of Cancer 37: 1910-1920. (A galactoside-specific lectin from *Viscum album* unexpectedly increased tumour growth, perhaps due to increased generation of nitric oxide (NO), suggesting caution in the use of this material.)

van Ommeren, R.J. and Whitham, T.G. 2002. Changes in interactions between juniper and mistletoe mediated by shared avian frugivores: parasitism to potential mutualism. Oecologia 130: 281-288. (Indicating a role for *Phoradendron juniperum* in enhanced dispersal of the host *Juniperus monosperma*, thanks to birds (*Myadestes townsendii*) being more attracted to mistletoe infested trees.)

Velasco, L., Gofman, F.D. and Pujadas Salvà, A.J. 2000. Fatty acids and tocopherol contents in seeds of *Orobanche*. Phytochemistry 54: 295-300. (Showing differences between section *Orobanche* and section *Trionychion*; and within section *Trionychion* - these latter differences in tocopherol contents paralleled by differences in fatty acid profiles.)

Watking, J.R. and Press, M.C. 2001. Impacts of infection by parasitic angiosperms on host photosynthesis. Plant Biology 3: 244-250. (Special issue : Photosynthesis) (A general review of the effects of *Striga* and *Orobanche* on host photosynthesis, including observations on the wide range of different direct and indirect effects.)


**HAUSTORIUM 41**

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.

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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 workload 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.

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**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.

A M Mbwaga, Agricultural Research Institute, Ilonga, Tanzania (ilonga@africaonline.co.tz)
C R Riches, Natural Resources Institute, UK (charlie.riches@bbsrc.ac.uk)

**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 Kallarakal 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 subfalculata, 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 brittienii 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](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](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.rmes.nau.edu/publications/ah_709/index.html](http://www.rmes.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.rmes.nau.edu/mistletoe](http://www.rmes.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.

Brian Geils, USDA Forest Service, Rocky Mountain Research Station, 240 W Prospect Road, Fort Collins, CO 80526. Email: bgeils@fs.fed.us

**WEBSITES**

For past and current issues of Haustorium see: [http://web.odu.edu/haustorium](http://web.odu.edu/haustorium)


For Lytton Musselman’s Plant site see: [http://web.odu.edu/plant](http://web.odu.edu/plant)

For Dan Nickrent’s ‘The Parasitic Plant Connection’ see: [http://www.science.siu.edu/parasitic-plants/index.html](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/mistletoe/welcome.html](http://www.rms.nau.edu/mistletoe/welcome.html)

For on-line access to USDA Forest Service Agriculture Handbook 709 ‘Dwarf Mistletoes: Biology, Pathology and Systematics’ see: [http://www.rmes.nau.edu/publications/ah_709/](http://www.rmes.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 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](http://www2.labs.agilent.com/bot/pp_home)

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%.)


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.)

Ahonsi, M.O., Berner, D.K., Emechebe, A.M. and Lagoke, S.T. 2002. Selection of rhizobacterial strains for suppression of germination of Striga hermonthica (Del.) Benth. seeds. Biological Control 24: 143-152. (Screening of 460 fluorescent pseudomonad isolates from naturally suppressive soils resulted in the identification of 15 Pseudomonas fluorescens/P. putida isolates that significantly inhibited germination of S. hermonthica. Six of these applied as seed dressings in maize reduced Striga infection and improved crop growth.)


Alford, J. D. and L. C. Anderson. 2002. The taxonomy and morphology of Macranthera flammia (Orobanchaceae). Sida: 20(10): 189-204. (This beautiful, humming bird pollinated root parasite is a federally endangered species and is endemic to the pine flatwoods of the lower coastal plain of the southeastern United States. The authors conclude that recognition of more than one taxon in the genus is not warranted because calyx features are due to the replacement of flower units in the architecture of individual plants.)


Aukema, J.E. and Martinez del Rio, C. 2002. Variation in mistletoe seed deposition: effects of intra- and interspecific host characteristics. Ecography 25(2): 139-144. (Studying the abundance of Phoradendron californicum on hosts Olneya tesota, Cercidium microphyllum, Prosopis velutina, Acacia constricta, and Acacia greggii, as affected by host frequency, bird distribution, etc.)

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(Resistance to race F in the lines studied, is apparently a recessive character.)

Alford, J. D. and L. C. Anderson. 2002. The taxonomy and morphology of Macranthera flammia (Orobanchaceae). Sida: 20(10): 189-204. (This beautiful, humming bird pollinated root parasite is a federally endangered species and is endemic to the pine flatwoods of the lower coastal plain of the southeastern United States. The authors conclude that recognition of more than one taxon in the genus is not warranted because calyx features are due to the replacement of flower units in the architecture of individual plants.)


Aukema, J.E. and Martinez del Rio, C. 2002. Variation in mistletoe seed deposition: effects of intra- and interspecific host characteristics. Ecography 25(2): 139-144. (Studying the abundance of Phoradendron californicum on hosts Olneya tesota, Cercidium microphyllum, Prosopis velutina, Acacia constricta, and Acacia greggii, as affected by host frequency, bird distribution, etc.)

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Barros, M.G., Rico-Gray, V. and Diaz-Castelazo, C. 2001. (Flowering synchrony between Lantana camara L. (Verbenaceae) and Psittacanthus calyculatus (DC.) G. Don (Loranthaceae) found in dunes in la Mancha, Veracruz, Mexico.) (in Spanish) Botanica Mexicana 57: 1-14. (While L. camara is mainly pollinated by insects, and P. calyculatus by humming birds, data from floral convergence, floral colour similarities and pollination syndromes suggest that these species are involved in a floral association in which both derive equal benefit.)


Benharrat, H., Delavault, P. and Thalouarn, P. 2000. (The genomes of parasitic angiosperms: characterization and applied interest.) (in French) Comptes rendus de l’Academie d’Agriculture de France 86(8): 97-110. (Comparing the plastid genome size in Lathraea and Orobanche species. The rebl sequences from both genera recorded a 92% identity.)

Borsics, T. and Lados, M. 2002. Dodder infection induces the expression of a pathogenesis-related gene of the family PR-10 in alfalfa. Journal of Experimental Agriculture 53: 1831-1832. (A full-length cDNA, PPRG2, representing a gene highly expressed in alfalfa infested by Cuscuta trfolii, is induced not only by dodder attack but also by bacterial infections and other environmental stresses.)


Cohen, B.A., Amsellem, Z., Lev-Yadun, S. and Gressel, J. 2002. Infection of tubercles of the parasitic weed Orobanche aegyptiaca by mycoherbicidal Fusarium spp. Annals of Botany 90: 567-570. (Pot experiments with O. aegyptiaca on tomato roots showed that the Fusarium oxysporum and F. arthrosporioides strains used were not virulent enough for field use but might be enhanced transgenically, or other isolates sought.)

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.)


Gurney, A.L., Press, M.C. and Scoles, J.D. 2002. Can wild relatives of sorghum provide new sources of resistance or tolerance against Striga species? Weed Research 42: 317-324. (Sorghum arundinaceum was susceptible to both S. asiatica and S. hermonthica but...
demonstrated striking tolerance to *S. asiatica.*

Gurney, A.L., Taylor, A., Mbwaga, A., Scholes, J.D. and Press, M.C. 2002. Do maize cultivars demonstrate tolerance to the parasitic weed *Striga asiatica?* Weed Research 42: 299-306. (Variety Staha supported emergence of *S. asiatica* comparable to that on vars Katumani and TMV-1 but yield was reduced by only 5% instead of 20-25%, apparently due to the maintenance of high photosynthesis and less photoinhibition.)


Ishizu, T., Winarno, H., Tsujino, E., Morita, T. and Shibuya, H. 2002. Indonesian medicinal plants. XXIV. Stereochemical structure of perseitol·K+ complex isolated from the leaves of *Scurrula fusca* (Loranthaceae). Chemical & Pharmaceutical Bulletin 50: 489-492. (Tending to confirm the anti-tumour activity of extracts from *S. fusca.*)

Ivanauskas, N.M., Monteiro, R. and Rodrigues, R.R. 2001. (Floristic survey of Atlantic Forest at Pariquera-Acu, Sao Paulo, Brazil.) (in Portuguese) Naturalia (Sao Paulo) 26: 97-129. (11.7% of species were epiphytes, hemi-epiphytes or parasitics.)


Jayusman. 2000. (The infestation intensity of *Loranthus* spp. in *Styrax* sp. plantations in North Tapanuli.) (in Indonesian) Buletin Penelitian Kehutanan - Pematang Siantar 15(2): 73-90. (Species involved included *L. pentandrus*, *L. atropurpureus* and *L. schultesii*. Up to 90% of trees were seriously affected, suffering degradation of incense gum production and wood quality, or death.)


Jiang ZhiHong, Hirose, Y., Iwata, H., Sakamoto, S., Tanaka, T. and Kouno, I. 2001. Caffeoyl, coumaroyl, galloyl, and hexahydroxydiphenoyl glucoses from *Balanophora japonica.* Chemical & Pharmaceutical Bulletin 49: 887-892. (Results showed that caffeoyl ellagitannins were the major phenolic constituents of *B. japonica.*)


Kanampiu, F.K., Ransom, J.K., Friesen, D. and Gressel, J. 2002. Imazapyr and pyrithiobac movement in soil and from maize seed coats to control *Striga* in legume intercropping. Crop Protection 21: 611-619. (*Phaseolus* beans, cowpea, and *Vigna radiata* were unaffected when planted over 15 cm. from maize coated with pyrithiobac or imazapyr, but were severely inhibited when planted within 12 cm.)

Kawakita, A. and Kato, M. 2002. Floral biology and unique pollination system of root holoparasites, *Balanophora kuroiwai* and *B. tobiracola*. American Journal of Botany 89: 1164-1170. (Studies of the two species in the forests of S. Japan suggest that geitonogamy (pollination within the monoecious inflorescence) was most likely achieved by ants or flightless cockroaches, and occasional cross-pollination by pyralid moths.)


Kim ChangSeok, Chung YoungJae and Oh SeMun 2000. Taxonomic evaluation of selected *Cuscuta* species (Cuscutaceae) based on seed morphology. Korean Journal of Weed Science 20(4) 255-263. (Giving keys to the sub-genera Monogyna, Cuscuta and Grammica, and some species.)


Koskela, T., Puustinen, S., Salonen, V. and Mutikainen, P. 2002. Resistance and tolerance in a host plant-holoparasitic plant interaction: genetic variation and costs. Evolution 56: 899-908. (Studies with *Cuscuta europaea* on *Urtica dioica* indicate that host tolerance and resistance can evolve as a response to infection by a parasitic plant and that costs of resistance and tolerance may be one factor maintaining genetic variation in these traits.)


Leebens-Mack, J. and de Pamphilis, C. 2002. Power analysis of tests for loss of selective constraint in cave crayfish and nonphotosynthetic plant lineages. Molecular Biology and Evolution 19: 1292-1302. (Concluding that rbcL has been retained in holoparasitic genera either because these taxa are photosynthetic for at least a part of their life or rbcL may have an unknown function other than photosynthesis.)


Li ShiSheng, Gullbo, J., Lindholm, P., Larsson, R., Thunberg, E., Samuelsson, G., Bohlin, L. and Claeson, P. 2002. Ligatoxin B, a new cytotoxic protein with a novel helix-turn-helix DNA-binding domain from the mistletoe *Phoradendron ligatum*. Biochemical Journal 366: 405-413. (Ligatoxin B shares a three-dimensional structure with the viscotoxins and purothionins and so may have the same mode of cytotoxic action.)


Lin JerHuei, Chiou YiNing and Lin YunLian 2002. Phenolic glycosides from *Viscum angulatum*. Journal of Natural Products 65: 638-640. (Three new glycosides identified from *F. angulatum* in Taiwan.)

Lopez de Buen, L., Ornelas, J.F. and Guadalupe Garcia-Franco, J. 2002. Mistletoe infection of...
trees located at fragmented forest edges in the cloud forests of Central Veracruz, Mexico. Forest Ecology and Management 164(1/3): 293-302. (Studies with **Psittacanthus schiedeana**us on its preferred host tree *Liquidambar styryciflua*.)


Maloney, S.E. and Rizzo, D.M. 2002. Dwarf-mistletoe-host interaction in mixed-conifer forests in the Sierra Nevada. Phytopathology 92: 597-602. (No significant relationship of *Arceuthobium abietinum* and *A. campylpodium* on white fir (*Abies concolor*) and Jeffrey pine (*P. lambertiana*) respectively, with associated bark beetles. But degree of infection and stand history appear to be important in the spatial dynamics of these two species.)

Maloney, P.E., Rizzo, D.M. 2002. Pathogens and insects in a pristine forest ecosystem: the Sierra San Pedro Martir, Baja, Mexico. Canadian Journal of Forest Research 32: 448-457. (*Phoradendron pauciflorum* was one of the two commonest pests in mixed forest including *P. Jeffreyi, P. lambertiana* and *Abies concolor*.)


Marambe, B., Wijesundara, S., Tennakoon, K., Penideniya, D. and Jayasinghe, C. 2002. Growth and development of *Cuscuta chinensis* Lam. and its impact on selected crops. Weed Biology and Management 2(2): 79-83. (*C. chinensis* grew best on, and caused severe damage on, tomato, was less vigorous and caused less damage on chilli, and failed to develop on rice.)


Nickrent, D.L., Blarer, A., Qiu, Y.-L., Soltis, D.E., Soltis, P.S., and Zanis, M. 2002. Molecular data place Hydnoraceae with Aristolochiaceae. American Journal of Botany 89: 1809-1817. (Genes from the nucleus, chloroplast and mitochondrion were analyzed separately and in combination and the results support the monophyly of Hydnoraceae and the association of that clade with Aristolochiaceae sensu lato (s.l.). Despite over 11 kb of sequence data, relationships within Aristolochiaceae s.l. remain unresolved, thus it cannot yet be determined whether Aristolochiaceae, Hydnoraceae, and Lactoridaceae should be classified as distinct families. In contrast to most traditional classifications, molecular phylogenetic analyses do not suggest a close relationship between Hydnoraceae and Rafflesiaceae.)


Oswald, A. and Ransom, J.K. 2002. Response of maize varieties to transplanting in Striga-infested fields. Weed Science 50: 392-396. (Transplanting greatly reduced emergence of Striga hermonthica and greatly improved grain yields of 3 Striga-susceptible maize varieties but not that of the early maturing Morogoro.)

Oswald, A., Ransom, J.K., Kroschel, J. and Sauerborn, J. 2002. Intercropping controls Striga in maize based farming systems. Crop Protection 21: 367-374. (Eight legumes tested as in-row or between-row-planted, simultaneous or relay-planted intercrops. Yellow gram (Vigna radiata) and cowpea most effective in reducing Striga: groundnut, Phaseolus bean, V. radiata and bambara, simultaneously planted, gave greatest, 40-120%, increases in total crop production: mechanism of Striga suppression assumed to be a combination of shading, humidity and temperature. The technique needs to be combined with hand-pulling for long-term benefit.)

Ouedraogo, J.T., Gowda, B.S., Jean, M., Close, T.J., Ehlers, J.D., Hall, A.E., Gillaspie, A.G., Roberts, P.A., Ismail, A.M., Bruening, G., Gepts, P., Timko, M.P. and Belzile, F.J. 2002. An improved genetic linkage map for cowpea (Vigna unguiculata L.) Combining AFLP, RFLP, RAPD, biochemical markers, and biological resistance traits. Genome 45(1): 175-188. (In addition to the construction of a new map, molecular markers associated with various resistance genes, and RGAs were also placed on the map, including markers for resistance to Striga gesnerioides races 1 and 3.)


Pae HyunOck, Oh GiSu, Seo WonGil, Shin Minkyo, Hong SungGak, Lee HoSub and Chung HunTaeg. 2001. Misteltoe lectin synergizes with paclitaxel in human SK-Hep1 hepatocarcinoma cells. Immunopharmacology and Immunotoxicology 23: 531-540. (Results indicate the potential clinical usefulness of ML-I combination therapy with paclitaxel.)


Piszker, Z. 2001. (Studies on pathogenicity of broomrape (*Orobanche cernua* Loefl.) populations of sunflower.) (in Hungarian) Novenyvedelem 37(4): 173-182. (Line P-1380A was resistant to race E of *O. cernua* and to some other local virulent populations.)


Rapparini, G. 2002. (Weed control in beet.) (in Italian) Informatore Agrario Supplemento 58(2): 66-75. (Mention of herbicide treatments failing to control heavy infestations of *Cuscuta* sp.)


Rugutt, J.K., Rugutt, K.J. and Berner, D.K. 2001. Limonoids from Nigerian *Harrisonia abyssinica* and their stimulatory activity against *Striga hermonthica* seeds. Journal of Natural Products 64: 1434-1438. (A new limonoid, deoxybacunone, was isolated from root bark of *H. abyssinica* and compared with several others for their structure/activity as germination stimulants for *S. hermonthica*. They were active at $10^{-3}$ - $10^{-5}$ M.)

Ruhlman, B.M. and Calvin, C.L. 2001. Morphological aspects of seedling establishment in four temperate region *Phoradendron* (Viscaceae) species. Madrono 48(2): 79-89. (Differences between *P. densum*, *P. villosum*, *P. juniperinum* and *P. californicum* are discussed in terms of morphological, ecological and evolutionary implications.)


of Entomology 41: 164-169. (Apparently occurring on 'mistletoe trees'.)


Smestad, B.T., Tiessen, H. and Buresh, R.J. 2002. Short fallows of Tithonia diversifolia and Crotalaria grahamiana for soil fertility improvement in western Kenya. Agroforestry Systems 55: 181-194. (31-week managed fallows raised soil fertility and organic matter, and post-fallow maize yields were improved, but there was an indication that T. diversifolia may have stimulated infestation of Striga hermonthica.)

Sofletea, N. and Stanescu, V. 2000. (Directions and implications of ecological genetics in siliviculture.) (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. cyaneus were frequent while f. monoclonos and f. albiflora were rare.)

Soto-Gamboa, M. and Bozinovic, F. 2002. Fruit-disperser interaction in a mistletoe-bird system: a comparison of two mechanisms of fruits processing on seed germination. Plant Ecology 159: 171-174. (In studies with Tristerix aphyllus on cacti, regurgitation by bird seed vectors was more frequent than defaecation but the latter resulted in longer radicles.)


Stefanović, S., Krueger, L. and Olmstead, R.G. 2002. Monophyly of the Convolvulaceae and circumscription of their major lineages based on DNA sequences of multiple chloroplast loci. American Journal of Botany 89: 1510-1522. (‘Results indicate that Convolvulaceae are monophyletic and sister to Solanaceae. Two of the 3 groups that have been proposed previously as separate families, Cuscuta and Dichondraeae, are nested within Convolvulaceae in this analysis. The exact position of Cuscuta could not be ascertained.’)


album increase natural killer (NK) cell-mediated killing of tumour cells.)


Tue Man Luong 2002. Competitive effects within and between Santalum album and pot host Alternanthera dentata. Sandalwood Research Newsletter 16: 4-6. (Optimal density for growth of S. album found to be one S. album per 2 plants of the host.)

Vaughn, K.C. 2002. Attachment of the parasitic weed dodder to the host. Protoplasma 219: 227-237. (Studies with Cucuta pentagona show that attachment to the host involves differentiation of epidermal cells in the parasite into trichomes which secrete a cementing layer of pectin.)


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.)
IPPSE 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:


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.


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 (IPPC)

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:

Lytton Musselman  lmusselm@odu.edu

COVER CROPS AND ORGANIC RESIDUES FROM TREES FOR REDUCING STRIGA HERMONTICA 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.


For more information, please contact:
A. Létourneau, M.-P. Dubé and A. Olivier : Département de phytologie, Université Laval, Québec, G1K 7P4, Canada. Alain.Olivier@plg.ulaval.ca
K. Coulibaly, Institut d'économie rurale, B.P. 186, Sikasso, Mali.

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 purpureum (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.

Braima James, SP-IPM Coordinator, IITA, Cotonou, Benin. B.James@cgiar.org

On behalf of the nucleus of SIPWEMA partners: PASCON (pascon1@yahoo.com), AU/SAFGRAD (ouattaram.safer@cenatrin.bf), FAORAF (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 *Orobanche* 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.

B E Abu Irmaileh
Faculty of Agriculture, Amman, Jordan
barakat@ju.edu.jo

**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"-isoprenylfuranono-(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 dependent 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 Annapurna 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 Viscaceae 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 host’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.
Jorrin 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.
Slavov, S.B. and Batchvarova, R.B. Chemical mutagenesis of tobacco for broomrape resistance.
Rubiales, D. et al. Resistance to *Orobanche crenata* in grain legumes.
Hausmann, 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.
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.
Kanampiu, F.K. et al. *Striga* control in maize using herbicide seed coating.
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.
Stalov, 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](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**


**WEB SITES**


For past and current issues of Haustorium see: [http://web.odu.edu/haustorium](http://web.odu.edu/haustorium)

For Lytton Musselman’s Plant site see: [http://web.odu.edu/plant](http://web.odu.edu/plant)

For Dan Nickrent’s ‘The Parasitic Plant Connection’ see: [http://www.science.siu.edu/parasitic-plants/index.html](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.htm!](http://www.rmrs.nau.edu/misteltoe/welcome.htm!)

For information on activities and publications of the parasitic weed group at the University of
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.)


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 agramatoploidy and symplody in the genus.)


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., Thodet, 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. amatystica, and among O. cernua and O. cumana. Analysis also showed...
polymorphism among geographically separate populations of O. hederae.


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, Rotboellia 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.)


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.)


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.). Beitrag 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.)

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*.)


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°C but increasingly resistant at higher temperatures, while the susceptible variety Adi shows increasing susceptibility at higher temperatures.)

Eizenberg, H., Plakhine, D., Herschenhorn, 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.)


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.)

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.)


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.)


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.)


(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.)


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.)


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.)


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)


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.)


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.)


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.)


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 to Viscaceae. 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.)


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.)

Ouédraogo, J.T., Tignegre, J.B., Timko, M.P. and Belzile, F.J. 2002. AFLP markers linked to resistance against Striga gesnerioides race 1 in cowpea (Vigna unguiculata). Genome 45: 787-793. (Genetic mapping of Striga resistance in two cowpea varieties found markers that are linked to both traits. The implication is that resistance genes may be either clustered together or are alleles of a single gene.)
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 parasitic plant Scurrula atropurpurea (Loranthaceae). Chemical & Pharmaceutical Bulletin 51: 343-345. (The most inhibitory compound isolated from S. atropurpurea, parasitic on tea, was an alkylic fatty acid octadeca-8,10,12-triynoic acid.)
Olupot, J.R., Osiru, D.S.O., Oryokot, J. and Gebrekidan, B. 2003. The effectiveness of Celosia argenta (Striga "chaser") to control Striga on sorghum in Uganda. Crop Protection 22: 463-468. (C. argenta was shown to cause suicidal germination of S. hermonthica; inter-planting in the field reduced Striga emergence over 50% and increased sorghum yield by 35%.)
Pageau, K., Simier, P., Bizec, B. le, Robins, R.J. and Fer, A. 2003. Characterization of nitrogen relationships between Sorghum bicolor and the root-hemiparasitic angiosperm Striga hermonthica (Del.) Benth. using K15NO3 as isotopic tracer. Journal of Experimental Botany 54: 789-799. (Concluding that nitrogen nutrition in S. hermonthica is based on a supply of both nitrate and amino acids from the host, implying a non-specific transfer in the transpiration stream. Nitrate reduction probably occurs mainly in the leaves of the parasite. Excess nitrogen in S. hermonthica is stored as asparagine.)
Parnell, J. 2001. A revision of Orobanchezaceae in Thailand. Thai Forest Bulletin (Botany) 29: 72-80. (Three species occur – Aeginetia...
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Pierce, S., Mbwaga, A.M., Press, M.C. and Scholes, J.D. 2002. Growth and photosynthetic response of *Sorghum bicolor* cultivars Pato, P9405, P9406 and Macia to nitrogen availability and infection by the hemiparasitic weed *Striga hermonthica*. Working Paper, University of Sheffield, Sheffield, UK. 29 pp. (In pot experiments under a controlled environment, Pato showed greatest susceptibility to *S. hermonthica* at all levels of N; P9406 was the least affected at high N levels, while P9405 showed greatest tolerance over a range of N levels. Photosynthesis was little affected.)

Pilittmann, U. 2002. Agamospermy is much more common than conceived: a hypothesis. Israel Journal of Plant Sciences 50 (Supplement): S111-S117. (The evolutionary implications of casual or facultative agamospermy in opportunistic plants, including Cuscutaceae and Orobanchaceae, are briefly discussed.)

Procopovici, E. 2001. (Behaviour of some sunflower hybrids to *Orobanche cumana* attack under conditions of Dobrogea.) (in Romanian) Probleme de Protectia Plantelor 29: 209-214. (Varieties Favorit, Turbo, Melody, Arena, and Pixel are recommended for cultivation in areas infested with *O. cumana*.)


Román, B., Satovic, Z., Rubiales, D., Torres, A.M., Cubero, J.I., Katzir, N. and Joel, D.M. 2002. Variation among and within populations of the parasitic weed *Orobanche crenata* from Spain and Israel revealed by inter simple sequence repeat markers. Phytophology 92: 1262-1266. (ISSR marker analysis clusters Spanish populations apart from Israeli populations. The Spanish populations have a high degree of similarity to each other, while Israeli populations show more variation.)

Román, B., Torres, A.M., Rubiales, D., Cubero, J.I. and Satovic, Z. 2002. Mapping of quantitative trait loci controlling broomrape (*Orobanche crenata* Forsk.) resistance in faba bean (*Vicia faba* L.). Genome 45: 1057-1063. (Isozyme, RAPD, seed protein gene, and micro-satellite markers were used to identify three QTLs for broomrape resistance. One of the three explained more than 35% of the phenotypic variance, whereas the others accounted for 11.2 and 25.5%, respectively.)

(Overall, the germination data suggested a hormonal mode of action by ACC, which involves indirect stimulation of biosynthesis of ethylene that then triggers seed germination.)


Shabana, Y.M., Muller-Stover, D. and Sauerborn, J. 2003. Granular Pesta formulation of *Fusarium oxysporum* f. sp. *orthoceras* for biological control of sunflower broomrape: efficacy and shelf-life. Biological Control 26: 189-201. (Yeast extract, glycerol, sucrose, and sodium alginate all proved useful additives to the basic wheat-gluten matrix. Several of the formulations provided excellent control and highly significant yield increases.)

Sutiak, V., Sutiakova, I., Korenek, M., Cellarova, E., Conkova, E. and Neuschl, J. 2002. There is a possibility to protect the environment of Kosice against the menaces of mistletoe, vermin birds, and emissions. Folia Veterinaria 46(2)Supplementum: 61-62. (Referring to the problem of *Viscum album* in city trees.)


Sirma, M., Kadioglu, I. and Yanar, Y. 2001. (Study on the distribution and density of weed species in tomato fields in the vicinity of Tokat.) (in Turkish) *Turkiye Herboloji Dergisi* 4(1): 39-47. (*Orobanche* spp. were among the most common weed species.)


Subhash Kumar. 2002. Preliminary studies on the control of broomrape (*Orobanche aegyptiaca*) in mustard. Indian Journal of Weed Science 34: 303-304. (Glyphosate at 82 g/ha 60 days after sowing was apparently selective. A range of other herbicides and oils were less effective.)

Sutiak, V., Sutiakova, I., Korenek, M., Cellarova, E., Conkova, E. and Neuschl, J. 2002. There is a possibility to protect the environment of Kosice against the menaces of mistletoe, vermin birds, and emissions. Folia Veterinaria 46(2)Supplementum: 61-62. (Referring to the problem of *Viscum album* in city trees.)

Tanji, A. 2001. (Weeds in rainfed lentil fields in the Settat province.) (in French) Al Awamia 104: 49-59. (Orobanche crenata and O. ramosa were found in 40% of the fields in this district of Morocco.)

Tanji, A. 2001. (Weeds of the rainfed spring chickpea crop in the Settat province.) (in French) Al Awamia 104: 61-71. (Noting that Orobanche crenata was NOT found.)

Tanji, A. 2001. (Weeds in rainfed faba bean fields in the Settat province.) (in French) Al Awamia 103: 71-81. (Orobanche crenata was ‘the most noxious’ weed.)


Werner, K. 2002. (Comments to the revised edition of "Exkursionsflora von Deutschland, Band 4 (Kritischer Band)". 3. To the nomenclature of some species and subspecies.) (in German) Schlechtendalia 8: 1-13. (Including deliberation on the genus Rhinanthus.)


Woodall, G.S. and Robinson, C.J. 2002. Direct seedling Acacias of different form and function as hosts for Sandalwood (Santalum spicatum). Conservation Science Western Australia 4(3) 130-134. (Proposing the use of a mixture of host species.)

Yang HyunOk, Park ShinYoung, Hong KyungHee, Kang LinWoo, Choe KwangHoon and Kim YoungKyooon. 2002. Bleeding time prolongation effect of


Zehhar, N., Ingouff, M., Bouya, D. and Fer, A. 2002. Possible involvement of gibberellins and ethylene in *Orobanche ramosa* germination. Weed Research 42: 464-469. (Exogenous ethylene failed to stimulate germination of *O. ramosa* but ethephon (2-chloroethylphosphonic acid) did so, while inhibitors of ethylene synthesis or action reduced germination by GR24, suggesting that ethylene is in some way involved.)

Zehhar, N., Labrousse, P., Arnaud, M.C., Boulet, C., Bouya, D. and Fer, A. 2003. Study of resistance to *Orobanche ramosa* in host (oilseed rape and carrot) and non-host (maize) plants. European Journal of Plant Pathology 109: 75-82. (None of 15 oilseed rape varieties showed any resistance. Carrot varieties Palaiseau and Buror showed resistance after germination and attachment, preventing penetration into the vascular tissues, and resulting in necrosis of the parasite. Maize also prevented effective penetration.)

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 caloricas* var. *fargesii* but also on *Scarruda 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.)


**HAUSTORIUM 43**

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.
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 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).

**IPPS Workshop** - *Striga* management in various cropping systems.

**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](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](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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Danny Joel, IPPS Secretary
dmjoel@volcani.agri.gov.il

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

References:

Bikash Ranjan Ray,
Sugarcane Research Station, Bethuadahari 741126, Nadia, West Bengal, India,
bray@sancharnet.in
and MrinaiKanti Dasgupta,
Institute of Agriculture, Sriniketan, Birbhum, West Bengal, India.

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 Orobanchacea. It had previously been pointed out (e.g. by U. Molau in ‘Parasitic Plants’ by Press and Graves, 1995) that the Orobanchacea 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 Orobanchacea’, 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 (Orobanchacea) 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. GA3 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 oxidoreductase subunits 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 hemiparastic 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 hypocotyl 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 cytotoxic 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:
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 antibiotics.
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.
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.
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 ramosa 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.
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/mistletoe/welcome.htm1

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


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.)


Ahonsi, M.O., Berner, D.K., Emechebe, A.M., Singinga, 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.)

pseudomonads in combination with effective N₂-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.)


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.)


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.)


Bar Nun, N. et al. – see Nun, N.B. et al.

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 luxophleba results in seedling death.)

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.)


Deng Xiong, Feng HuiLing, Ye WanHui, Yang QiiHe, 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.)


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.)


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.)


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 Betula vulgaris grown on varying levels of salt failed to give clear confirmation of this.)


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.)

Gbèhoungou, G., Pieterse, A.H. and Verkleij, J.A.C. 2003. Longevity of Siriga 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. (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.)


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.)


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.)

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.)


Maurer, W.D. 2003. (Dendroecological research on silver fir (Abies alba Mill.) stands damaged by mistletoe (Viscum album.).) (in German) Mitteilungen aus der Fororschungsanstalt für Waldkologie und Forstwirtschaft Rheinland-Pfalz 50(3) 161-170. (Analysing attack by mistletoe under varying climate, soil, stand structure, and atmospheric deposition.)


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 Dasypygus alternosquamella, a closely related phycitine, also feeding on Arceuthobium at this site.)


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.)

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 Scrophus – no such thing?’

Olupot, J.R., Osiru, D.S.O., Oryokot, J. and Gebrekidan, B. 2003. The effectiveness of Celsia 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 Christisomia siamensis.)


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.)


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.)


Roussel, 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.
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., Perez-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 discoloration, inhibition and death of the invading haustorium.)


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.)


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.)

discussion of the problem of Arceuthobium americanum in Pinus contorta.)

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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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Weinberg, T., Lalazar, A. and Rubin, B. 2003. Effects of bleaching herbicides on field dodder (Cuscuta campestris). Weed Science 51: 663-670. (Effects of xylem-mobile fluorochloridone in reducing β-carotene levels was much more short-lived than that of phloem-mobile sulcotrione and mesotrione but all three led to destruction of plastids, and reduction of starch. β-carotene appears to be important to the integrity of amyloplasts.)


HAUSTORIUM 44 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.
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 dmoel@volcani.agri.gov.il. The Executive Committee will select the suggestions, and the final decision will be taken by the General Assembly.
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; Gidon); 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). One paper suggested more consideration of *Smicronyx cyaneus* for control of *Orobanche* spp. (Zermame).

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. (Zermame).

More basic work on *Striga* and *Orobanche* spp. included studies of the analysis and production of strigolactones (Yoneyama; Watanabe); influence of fluridine 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
jonathanbriggs@mistletoe.org.uk

References:


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.

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.
Benvenuti 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 semi-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.*
Eijzenberg, H. et al. - Growing degree days - a predictive 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 mycorbicides - 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.*
Gbehoumou, G. and Asseigbe, P. - A study of germination of seeds of Rhampicarpus fistulosus (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 vogelli 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.*
Haidar, M.A. et al. - Blue light induced changes in inositol 1,4,5-trisphosphate in dodder (Cuscuta campestris) seedlings.*
Hausmann, B.I.G. - Genetic variability of Striga hermonthica (review).*
Hausmann, 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.*
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 Dzomak, 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.*

Yonezawa, A. 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 hemiparastic (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.


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 dendothauma R. R. Mill and D. J. Allard, sp. nov.

Brita Svensson (Uppsala, SE) - The hemiparasitic plant: friend or foe?

Siny ter Borg ( Wagningen, 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 (Wagningen, 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 (Wagningen, 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:


Schneeweiss, G.M. - Taxonomy and phylogeny in Orobanche.

Garcia, 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.
Joita-Pacureanu* et al.* - Races of broomrape in Romania.
Molina, L. and Melero-Vara, J.M. - Highly virulent populations of sunflower broomrape (*Orobanche cumana*).
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*.
Satoveč, 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.


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, Cyprus, 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.

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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*.

**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.
   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 mycorrhizal (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 inoculum 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.


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.si.edu/parasitic-plants/index.html

For The Mistletoe Center (including a comprehensive Annotated Bibliography on mistletoes) see:
http://www.rmrs.nau.edu/mistletoe/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://omnista.com/mailman/listinfo/pp_omnista.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.omnista.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 online 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.)


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.)


Arda, N., Önay, E., Koz, Ö. and Kirmızigül, 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.)

Aukema, J.E. 2004. Distribution and dispersal of desert mistletoe is scale-dependent, hierarchically nested. Ecography 27: 137-144. (Concluding that seed-dispersing birds are a significant factor in distribution of Phoradendron californicum in Arizona, USA.)


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.)


Brand, J.E., Robinson, N. and Archibald, R.D. 2003. Establishment and growth of sandalwood (Santalum album) in south-western Australia: Acacia host trials. Australian Forestry 66: 294-299. (S. bicupulata 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. hemitellis (11 mm).)


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 Bajio 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 viscosotoxins 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 viscosotoxins 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. epilimum 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.)


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.)


Encheva, J., Christov, M., Nenov, N., Tsvetkova, F., Ivanov, P., Shindrova, P. and Encheva, V. 2003. Developing generic 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., Hetscher, I. and Rennenberg, H. 2004. Seasonal and spatial variation of carbohydrates in mistletoes (Viscum album) and the xylem sap of its hosts (Populus x euramerica 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 euramerica.)


Gbéhounou, 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.)

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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.)

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Koch, A.M., Binder, C., Sanders, I.R. 2004. Does strong induction of $H_2O_2$ in tumor cells, leading to cell death.)


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Kuyper, T.W. 2002. (Deceit in mycorrhiza world, or how the mycorrhizal fungus proved to be a cheat. (in Dutch) Cuelinia 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.)

Liu Hui and Yuan ShiBin 2003. Biological characteristics of Glomerella cingulata (Penz.) Sacc. f.sp. cuscacae 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.)


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.)


Magda, D., Duru, M. and Theau, J-P. 2004. Defining management rules for grasslands using weed demographic characteristics. Weed Science 52: 339-345. (Studies on Rhinanthus minor in the French Pyrenees suggested longevity of only 2 to 3 years. Lack of mowing or grazing could lead to dominance but a single well-timed grazing could give eradication within a few years.)

diseases. Annual Review of Phytopathology 41: 41-52. (Noting von Tubeuf’s interest in the mistletoes.)

Marley, P.S., Aha, D.A., Shebyan, 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.)


Miller, A.C., Watling, J.R., Overton, I.C. and Sinclair, R. 2003. Does water status of Eucalyptus largiflorae (Myrtaceae) affect infection by the mistletoe Amyema miqueli (Loranthaceae)? Functional Plant Biology 30: 1239-1247. (Concluding that increasing water and/or salinity stress make E. largiflorae a less suitable host for A. miqueli.)

Mishra, J.S., Manish Bhan, Moorthy, B.T.S. and Yadav, N.T. 2003. Influence of seeding depth on emergence of Cuscuta with lineseed 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.)


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; lineseed 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.)


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.)


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 with 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).

Euphrasia frigida and Melamphyrum 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).


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 polyethylene bags but was attacked in the field.)


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.)


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. Gymnochaulis, Myzorrhiza, and Trionymon.)

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 Gymnochaulis, Myzorrhiza, and Trionymon) and, after dysploidisation, to x = 19 in Orobanche (section Orobanche) and Diphelypaea.)


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.)


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.)


(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 Rasteniĭ 11: 36. (Noting the infestation of over 40,000 ha with the quarantine weeds Cuscuta spp. in Rostov region.)


Vuorro, 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.)


Wiens, D. and Hawksworth, F. 2004. New species of Phoradendron (Viscaceae) from Mexico and Guatemala and a synopsis of species in section Pauciflorae. Aliso 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 Rasteniĭ, No. 6, 40 pp. (Referring to the use of varieties resistant to Orobanche cumana.)


Zuber, D. 2004. Biological flora of Central Europe: Viscum album L. Flora (Jena) 199: 181-203. (A general review on taxonomy, biology, physiology, etc.)
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

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 Cyprus!) 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 biogeographic 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

Jay F. Bolin
Old Dominion University
Norfolk VA 23529, USA
Jbolin@odu.edu

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.
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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 to 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@absafrica.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, Cyprus, 13-15 May, 2004. The corrected list of papers presented at this meeting is as follows:
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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 Youzounis - 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 sulfofuran.
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.
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 Macias *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 Tòth 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.
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.
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/](http://www.ppws.vt.edu/IPPS/)

For past and current issues of Haustorium see also: [http://web.odu.edu/haustorium](http://web.odu.edu/haustorium)

For the ODU parasite site see: [http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page](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](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](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](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


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.)


Ángeles Castillejo, M., Amiour, N., Dumas-Gaudot, E., Rubiales, D. and Jorrin, 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 flaviga. New Zealand Journal of Ecology 8: 93-103. (Birds prefer red fruit but orange fruit are also taken.)


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 promoters.)

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.)

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.)


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.)


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.)


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.)


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.)


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.)


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°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.)


roots in normal pea roots but were intensified at the junction between host root and the haustoria of *Orobanche crenata.*


Jayasinghe C., Wijesundara, D.S.A., Tennakoon, K.U. and Marambe, B. 2004. *Cuscuta* species in thelowlands 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.)


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., Evci, 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.)

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.)


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 verus 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.)


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.)


*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., Ogumbode, 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.)


Pérez-de-Luque, A., Siller, 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.)


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 pericinal 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.)

Penninsula.) (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.)


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.)


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.)


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.)


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.’)


Wilson, J.P., Hess, D.E., Hanna, W.W., Kumar, K.A. and Gupta, S.C. 2004. *Pennisetum glaucum* subsp. *monodii* accessions with *Striga* resistance in West Africa. Crop Protection 23: 865-870. (Out of 274 lines tested, 11 lines showed some consistent resistance to *S. hermonthica* and four (PS 202, PS 637, PS 639, and PS 727) were considered potentially useful. Among these PS202 also showed good downy mildew resistance.)

Yonli, D., Traoré, H., Hess, D.E., Abbasher, A.A. and Boussim, J.J. 2004. Effect of growth medium and method of application of *Fusarium oxysporum* on infestation of sorghum by *Striga hermonthica* in Burkina Faso. Biocontrol Science and Technology 14: 417-421. (Application of *F. oxysporum* isolate 4-3-B reduced numbers of *S. hermonthica* by 33 and 27% is successive years, and increased sorghum yield by up to 38%).
IPPS – RESULTS OF ELECTION

The newly elected Officers of the IPPS are:

Danny JOEL (Israel) President
dmjoel@volcani.agri.gov.il
Jim WESTWOOD (USA) Vice-President
westwood@vt.edu
Koichi YONEYAMA (Japan) Secretary
yoneyama@cc.utsunomiya-u.ac.jp
Phillippe DELAVAULT (France) Treasurer
philippe.delavault@univ-nantes.fr
Diego RUBIALES (Spain) Editor
diego.rubiales@uco.es
Grama DHANAPAL (India) Member
dhanapalgn@indiatimes.com
Fred KANAPIU (Kenya) Member
f.kanapiu@cgiar.org
Simon SHAMOUN (Canada) Member
SShamoun@pfc.cfs.nrcan.gc.ca

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
dmjoel@volcani.agri.gov.il

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. Orobranchol 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.africanecrops.net/striga)
HAUSTORIUM 47 July 2005

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-phosphatase (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 association; 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 parasitic 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, imidazoliones, 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, chlorsulfuron, 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 (AtSUC2) 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 sympatrically 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 *Striga 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 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](http://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.

### RECEIVING HAUSTORIUM BY EMAIL

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.

If you already receive by email, do please keep us informed of any change of address. And if you would prefer to have it ‘zipped’ as a smaller file, this option is now available.

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/](http://www.ppws.vt.edu/IPPS/)

For past and current issues of Haustorium see also: [http://web.odu.edu/haustorium](http://web.odu.edu/haustorium)

For the ODU parasite site see: [http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/parasitic_page](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](http://www.odu.edu/webroot/instr/sci/plant.nsf/pages/lecturesandarticles)

For Dan Nickrent’s ‘The Parasitic Plant Connection’ see: [http://www.science.si.edu/parasitic-plants/index.html](http://www.science.si.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](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](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](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.cnrl.it/](http://cost849.ba.cnrl.it/)

For the Parasitic Plants Database, including ‘4000 entries giving an exhaustive nomenclatural synopsis
of all parasitic plants’ the address is:
http://www.omnistrerra.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.

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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 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.
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
dmjoel@volcani.agri.gov.il
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 (Berghothsson 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 (Berghothsson 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.

References:


Jim Westwood, Virginia Tech, Blacksburg, USA. westwood@vt.edu
**Orobanchecrenata 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. Field pea were the two most susceptible hosts but the host range appeared to expand rapidly. After 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.

Fasil Reda
Ethiopian Agricultural Research Institute,
Melkassa Agricultural Research Center,
P.O. Box – 436,
Nazareth, Ethiopia
fasil_reda@hotmail.com or maku1987@yahoo.com

**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 circumcissile, 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’.

J.S. Mishra, National Research Centre for Weed Science, Maharajpur, Jabalpur (MP) - 482 004, INDIA. Email: jsmishra_nrcws@rediffmail.com

**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.

Gebisa Ejeta
Purdue University
Department of Agronomy
915 W. State St.
West Lafayette IN 47907
gejeta@purdue.edu

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 *Scymbium glaziowii* 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.

Leandro Cardoso  
Botanic Garden Research Institute  
Rua Pacheco Leão, 915, sala 106  
Rio de Janeiro CEP 22460-030, Brazil  
mailto:leandrocardoso@msn.com

**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 tabacum*), 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) Highly potential trap crops: radish, lentil, linseed, fennel and cumin; b) Moderately potential trap crops: barley, onion and chickpea; and c) Non-potential trap crop: garlic, chili, 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
Significant reduction in viability was found only under radish, lentil, chilli, fenugreek, 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 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. aegyptiaca 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.

Dr Acharya’s current address is: Department of Botany, Amrit Campus, Tribhuvan University, P.O.Box 102, Thamel Kathmandu, Nepal (amritcampus@ntc.net.np; mkchettri@ntc.net.np))

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

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 broomrape) 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 ssp. 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

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:

Radoslava Matušová 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 ramosa.

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 Joiţa 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. Jingga et al. - Control of Orobanche on sunflower and tobacco crops in România.
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. Vouzonis - 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. Herschenhorn et al. – Integrated broomrape management in tomato based on resistant varieties and chemical control.
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:


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 phytochomes 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 Omsgstead, 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 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/mistletoe/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 (ISICMAS) 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., Al-Sheety, 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 (Forsk. 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. (Host arrangement, structure and 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.)


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 branching 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.)


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.)

mitochondrial gene regions with similarity to mycotroph, is reported to have three Botrychium virginianum 272(1578): 2237-2242. (The rattlesnake fern, London. Series B, Biological Sciences

community, as influenced by abiotic factors resultant indirect effects on the plant major experiments to explore the direct effects of Geobotanica 40(2-3): 217-239. (Describing its hosts: from the cell to the ecosystem. Folia hemiparasitic angiosperm Seel, W.E. 2005. Interactions between the Bacillus subtilis, Trichoderma harzianum, methyl jasmonate and harpin protein 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 benzo thiadiazole (BTH) at 250 mg/l reduced O. cumana by 71% without reducing sunflower biomass. Foliar applications of salicylic acid and acetylsaliclyc 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 Rafflesia that appears to have come from the host Tetrastigma.) de Andrade, M.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).) Dembelé, B, Dembelé, 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.
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mistletoe extracts. Pharmazie 60: 448-454. (Detailed comparisons of pure viscotoxins and mistletoe lectins with commercial preparations Ascador(R)M, Ascador(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.)


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.)


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.)


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.)

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 noduleation 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°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 effective substitute. Covering moist soil with clear plastic for 2 months raised soil

Pérez de Luque, A., Jorrin, 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.)


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 efficacity 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*.)


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 trnK intron sequences. Annals of the Missouri Botanical Garden 92: 153-178. (Indicating that *Hypodaphnis* is sister to all other Lauraceae, *Neocinnamomum* is close to *Caryodaphnis*, 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 ashcalensis* 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 *Cinnyrincinus 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.)

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.)


Stefanovic, S. and Olmstead, R.G. 2005. Down the slippery slope: plastid genome evolution in Convolvulaceae. Journal of Molecular Evolution 61: 292-305. (Cuscuta plastid genomes were compared to those of tobacco and non-parasitic Convolvulaceae, providing clarification on which gene changes are associated with the family and which are associated with the evolution of parasitism.)


Tomilov, A.A., Tomilova, N.B., Abdallah, I. and Yoder, J.I. 2005. Localized hormone fluxes and early haustorium development in the hemiparasitic plant Triphysaria versicolor. Plant Physiology 138: 1469-1480. (Demonstrating that localized auxin and ethylene accumulation are early events in haustorium development, following up-regulation of auxin and ethylene-responsive promoters in T. versicolor, and that parasitic plants may thus recruit established plant developmental mechanisms to realize parasite-specific functions.)


Bioscience, Biotechnology and Biochemistry
69: 71-78. (Describing the cloning and characterization of the sole phytochrome A gene from O. minor. Accumulation and targeting of this transcript are light-dependent)

Üstüner, T. 2003. Identification and density of Viscum species in Nigde Province. Türkiye Herboloji Dergisi 6(2): 45-53. (V. album ssp. abietis occurred only (densely) in Abies cilicica: density of V. album ssp. album was highest in pear, almond, apricot and hawthorn (Crataegus monogyana).)

van Ast, A. and Bastaans, L. 2005. (Delay of the time of affixation of Striga hermonthica: an option for higher yields for sorghum?) (in Dutch) Gewasbescherming 36: 116-120. (Confirming that infection by S. hermonthica tends to be earlier on the susceptible variety CK-60B than on the tolerant Tiemarling, also that artificially delaying infection significantly reduces damage to the susceptible variety, and suggesting ways in which such a delay might be achieved in the field.)


Véronési, C., Bonnin, E., Benharrat, H., Fer, A. and Thalouarn, P. 2005. Are pectinolytic activities of Orobanche cumana seedlings related to virulence towards sunflower? Israel Journal of Plant Sciences 53: 19–27. (In studies with different races of O. cumana on a range of sunflower varieties, it was observed that, before attachment, the most virulent race F released more active cell-wall-degrading enzymes, pectin methylesterase and polygalacturonase than races D and E.)


Ward, M.J. 2005. Patterns of box mistletoe Amyema miquelii infection and pink gum Eucalyptus fasciculosa condition in the Mount Lofty Ranges, South Australia. Forest Ecology and Management 213: 1-14. (Frequency of A. miquelii was greater on E. fasciculosa (28% trees infected) than on other woodland species and was higher in less shaded situations, but extent of die-back did not appear to be correlated with level of infection.)


Yi JaeSeon, Song JaeMo and Kim ChulWoo. 2004. The vegetation structure analysis of mistletoe (Viscum album var. coloratum (Kom.) Ohwi) habitat. Journal of Research Forest of Kangwon National University No.24: 29-34. (V. album var. coloratum in Korea is found mainly in Quercus spp. and Betula schmidtii.)
Yoneyama, K. 2004. Chemical studies on growth regulators from plants in semi-arid regions. Regulation of Plant Growth & Development 39: 10-16. (Including a survey of germination stimulators of *Striga* and *Orobanche*.)