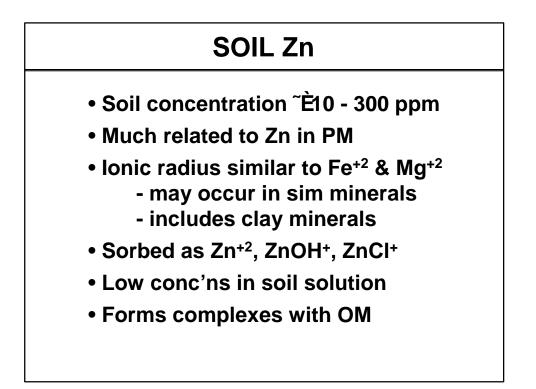
BIOL 695

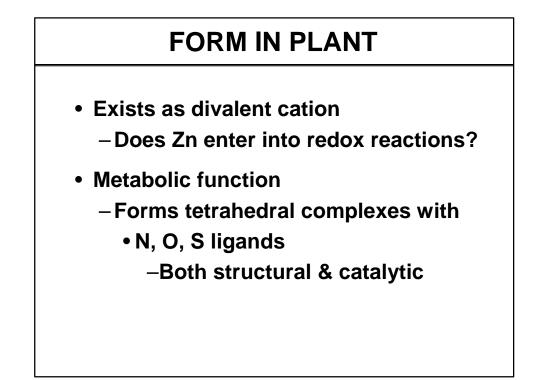
ZINC

Chapter 15 MENGEL et al, 5th Ed (Handout: Sec 9.4 Marschner, 1995)



UPTAKE

- Taken up as a divalent cation (Zn²⁺)
 At high pH taken up as ZnOH⁺
- Xylem transport
 - -bound to organic acids
 - -in free divalent form
- High conc in phloem sap
 - Complexed with low molecular organic solutes



ENZYMES WITH CATALYTIC FUNCTIONS

- Carbonic anhydrase, carboxypeptidase
- Example 4 points of ligand
 - -Water
 - -Histidine (most frequent)
 - -Glutamine
 - -Asparagine (Model I pp 348, Marschner)

ENZYMES WITH STRUCTURAL Zn FUNCTIONS

- Alcohol dehydrogenase & proteins involved in DNA replication & gene expression
 - Structural Zn atoms coordinated to S-groups of 4 cysteine residues
 - Highly stable tertiary structure
 - -Model II pp 348, Marschner

ALCOHOL DEHYDROGENASE

- 2 Zn atoms / molecule
 - -1 catalytic
 - -1 structural
 - pp 348, Marschner

CARBONIC ANHYDRASE

• Single Zn atom catalyzes – Hydration of CO₂

 $CO_2 + H_2O \Leftrightarrow HCO_3^- + H^+$

- Lack of relationship between PS & CA in C₃ plants.
- In C₄ plant, high CA activity needed in mesophyll chloroplasts to shift to HCO₃⁻ from CO₂ (Fig. 9.14 & 9.15, Marschner)

CuZn SUPEROXIDE DISMUTASE

- Cu is catalytic metal
- Zn structural metal
- SOD decreases with Zn deficiency
 - -Increase in O_2^- (Table 9.16, Marshner)
 - Causes peroxidation of membrane lipids
 - Increase in membrane permeability

REGULATION OF GENE EXPRESSION

- Zinc metalloproteins
 - Polypeptide chain forms a loop of
 - 11-13 amino acids which binds
 - -Specific DNA sequences
 - -Zn directly involved in translation step of gene expression (Fig. 9.16, Marschner)

PROTEIN SYNTHESIS

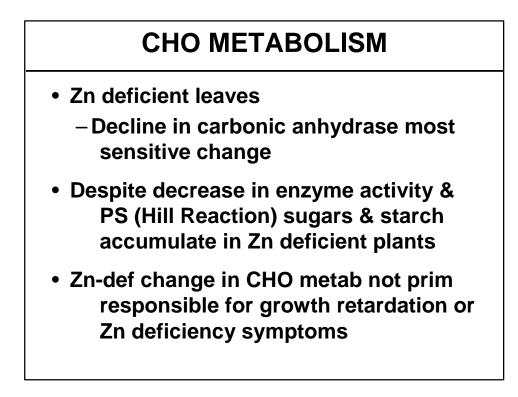
- Protein content of Zn-def plants
 - Decreases (Table 9.17, Marschner)
 - -Amino acids accumulate
- Resupply Zn & proteins increase
- Zn structural component of ribosomal RNA
 - -Zn defic ribosomes disintegrate

SHOOT MERISTEMS REQUIRE Zn

- Requires 100µg g⁻¹ for maintenance of protein synthesis
- Leaf blades require much less Zn
- Most root-supplied Zn preferentially translocated to apex to meet high req
- Increase in RNase activity observed before Zn def symptoms appear

CHO METABOLISM

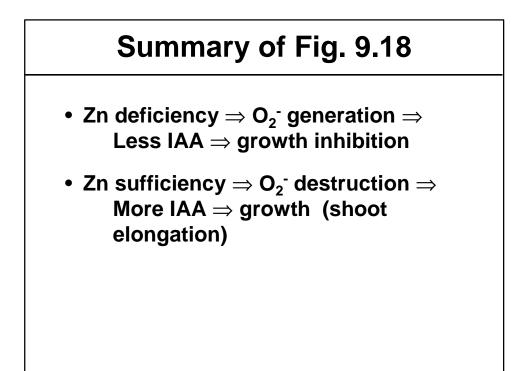
- Zn-dependent enzymes in CHO meta
 - Fructose 1,6-bisphophatase
 - Key in partitioning C₆ sugars
 - -<u>Aldolase</u> transfer of C₃ photosynth
 - from chlorop to glycolytic pathway
 - (Model pp 354, Marschner)
- Both located in chloroplasts & cytoplsm



TRYPTOPHAN & IAA SYNTHESIS

- Rosettes & Little Leaf are related to disturbances in IAA metabolism
- Model pp 355, Marschner
- $Zn \Rightarrow IAA \Rightarrow Growth$
- Lower IAA in Zn defic plants

 Could be result of oxidative degradation of IAA



Zn REQUIRED FOR MEMBRANE INTEGRITY

- Binds to phospholipids & sulfhydryl gps to form tetrahedral complexes with cysteine & polypeptide chains
 - Thus protects lipid membranes & proteins from oxidative damage
- Prevents oxidation of NADPH

AS A RESULT OF Zn DEF PLANTS

- Increase in PM permeability
- Decrease in phospholipids
- Decrease in degree of unsaturation of fatty acids.

P - Zn INTERACTIONS

- Large appl of P in soils low in available $Zn \Rightarrow Zn$ deficiency
- High P supply
 - -Reduces root growth
 - -Less infection with VA mycorrhizae
 - -Might reduce solubility of Zn
- Pecan Zn defic cleared up by alfalfa