Metallothioneins: New insights into Zn storage in barley grains

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Why study metal homeostasis in plants

Nutrient availability in cereals affects human health

- Growing population
- Increasing food demand
- Micronutrient deficiencies
- Improve knowledge to develop micronutrient efficient crops

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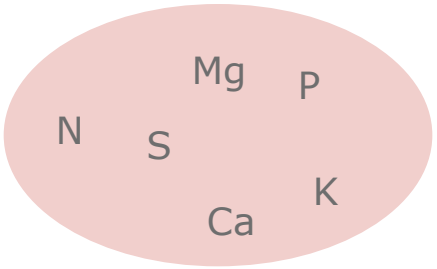
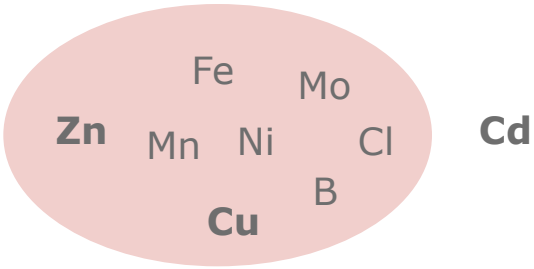
Metal toxicity in the environment

- Entry of toxic heavy metals into the food chain
- Knowledge to help crops to discriminate against toxic elements





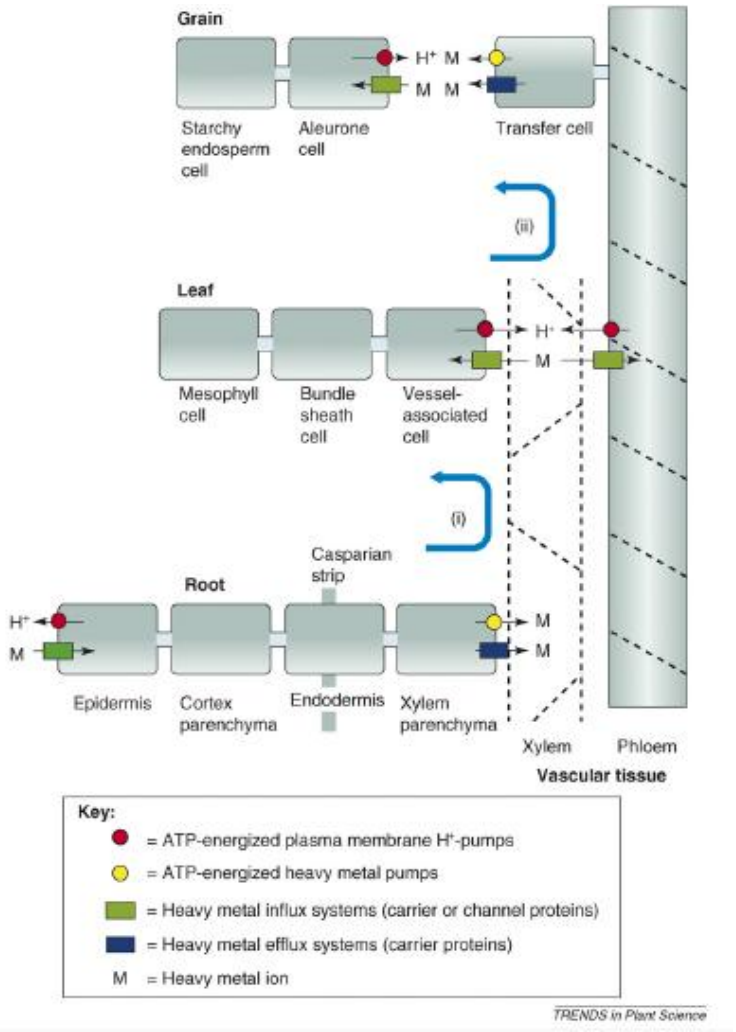
Factors influencing metal uptake and distribution

Availability in soil

Translocation

Storage

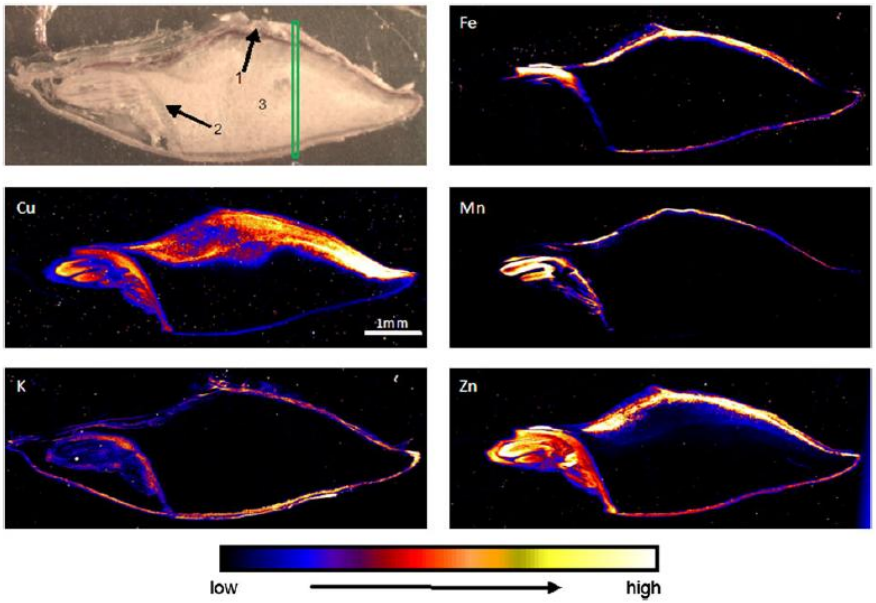
Speciation



Palmgren et al (2008) Trends in Plant Science 13(9), 464-473

Micronutrient distribution in barley grains

High definition synchrotron X-ray fluorescence of mature barley grains



Lombi *et al*. (2011) JXB 62, 273-282

Speciation of Fe and Zn in grains

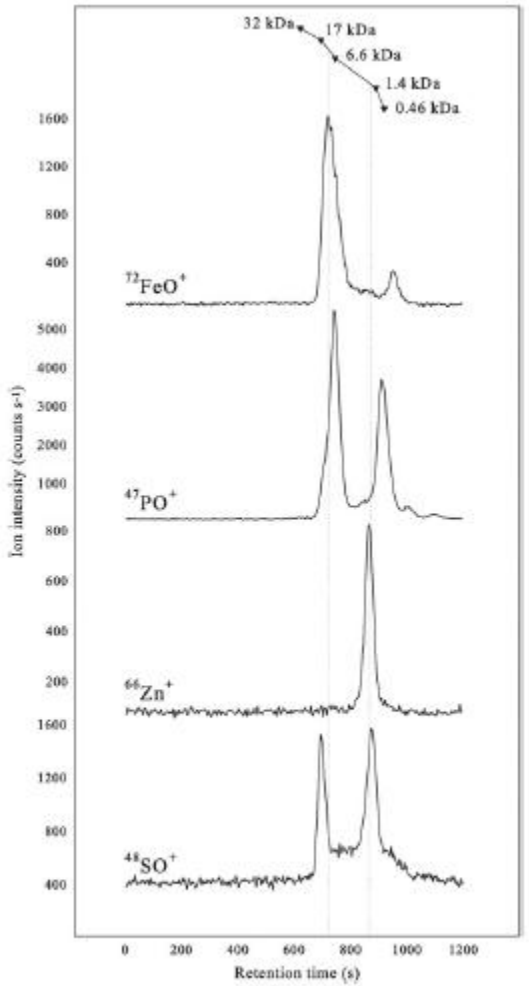


Fig. 3 SEC-ICP-MS speciation of Fe, P, Zn and S in an embryo sample, run in O_2 mode. The column was mass-calibrated with reference compounds as indicated at the top of the figure.

Persson et al (2009) Metallomics 1(5), 418-26

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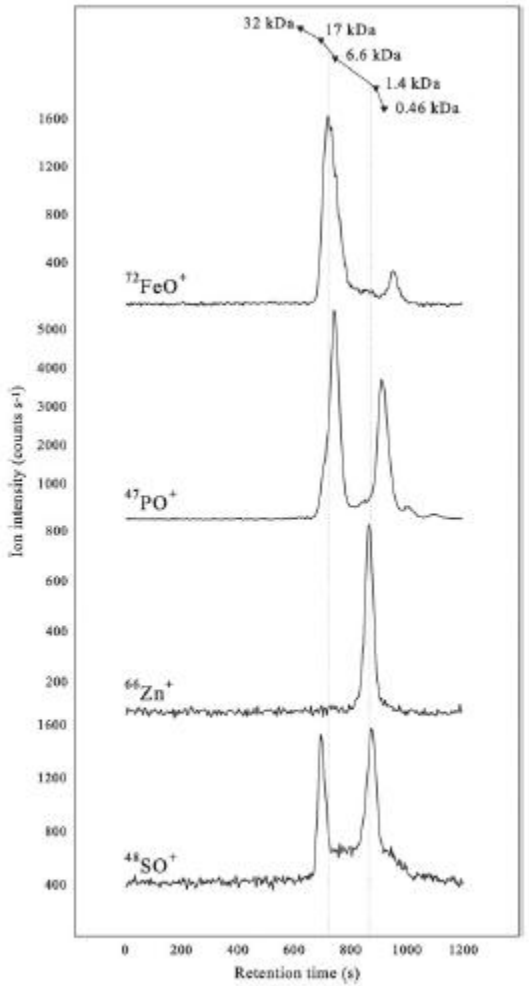

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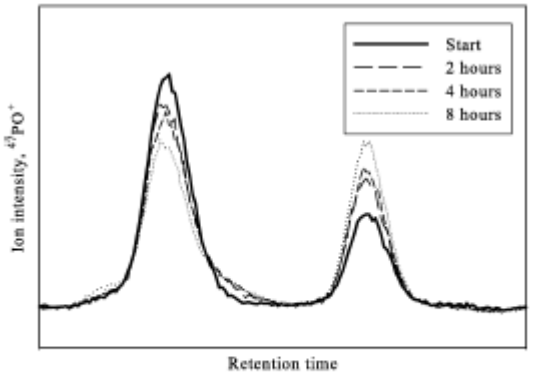

Fig. 4 Incubation of the extracted embryo sample using the IP_6-degrading enzyme phytase. The $^{47}PO^+$ signal at time zero is identical to the $^{47}PO^+$ signal in Fig. 3.

In embryos Fe is bound to phytate whereas Zn is bound to small peptides or proteins

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Metallothioneins in barley

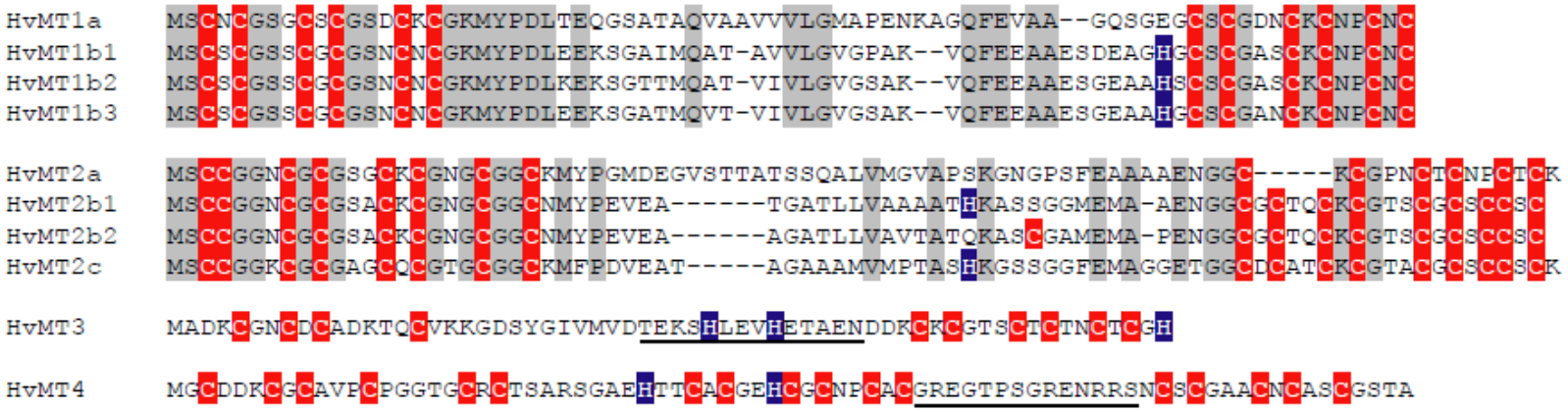
Metallothioneins are small sulfur rich proteins with high binding capacity for divalent metals

Reported metal-MT complexes are Zn-MT, Cd-MT in mammalian cells and Cu-MT, Cd-MT and Zn-MT complexes in plant cells

10 metallothionein (MT) genes have been cloned from Golden Promise.

3 MTs are expressed exclusively in the root – all others are expressed throughout the plant

Metallothioneins in barley



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Public Health Impact of long-term, low level Mixed element Exposure in susceptible population strata