









Long-term organic matter application reduces cadmium but not zinc in wheat

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1 Background

- Zinc (Zn) deficiency in human populations is a global nutritional problem
- Zn deficiency is caused by imbalanced diets, especially if cereals are the main source of calories and Zn
- Wheat is a major contributor of both Zn and cadmium (Cd), which are chemically similar, to humans
- Increasing Zn concentrations of wheat grains (biofortification) is an important agricultural challenge
- Accumulation of the toxic heavy metal (Cd) must be prevented

2.1 DOK long-term field trial

- Farming system comparison
- Est. 1978, Basel, Switzerland
- Treatments (replicated in 4 blocks)
 - o NOFERT: unfertilized control
 - CONMIN: mineral fertilization only
 - CONFYM: mineral fertilization+ farmyard manure
 - o **BIODYN**: composted farmyard

manure



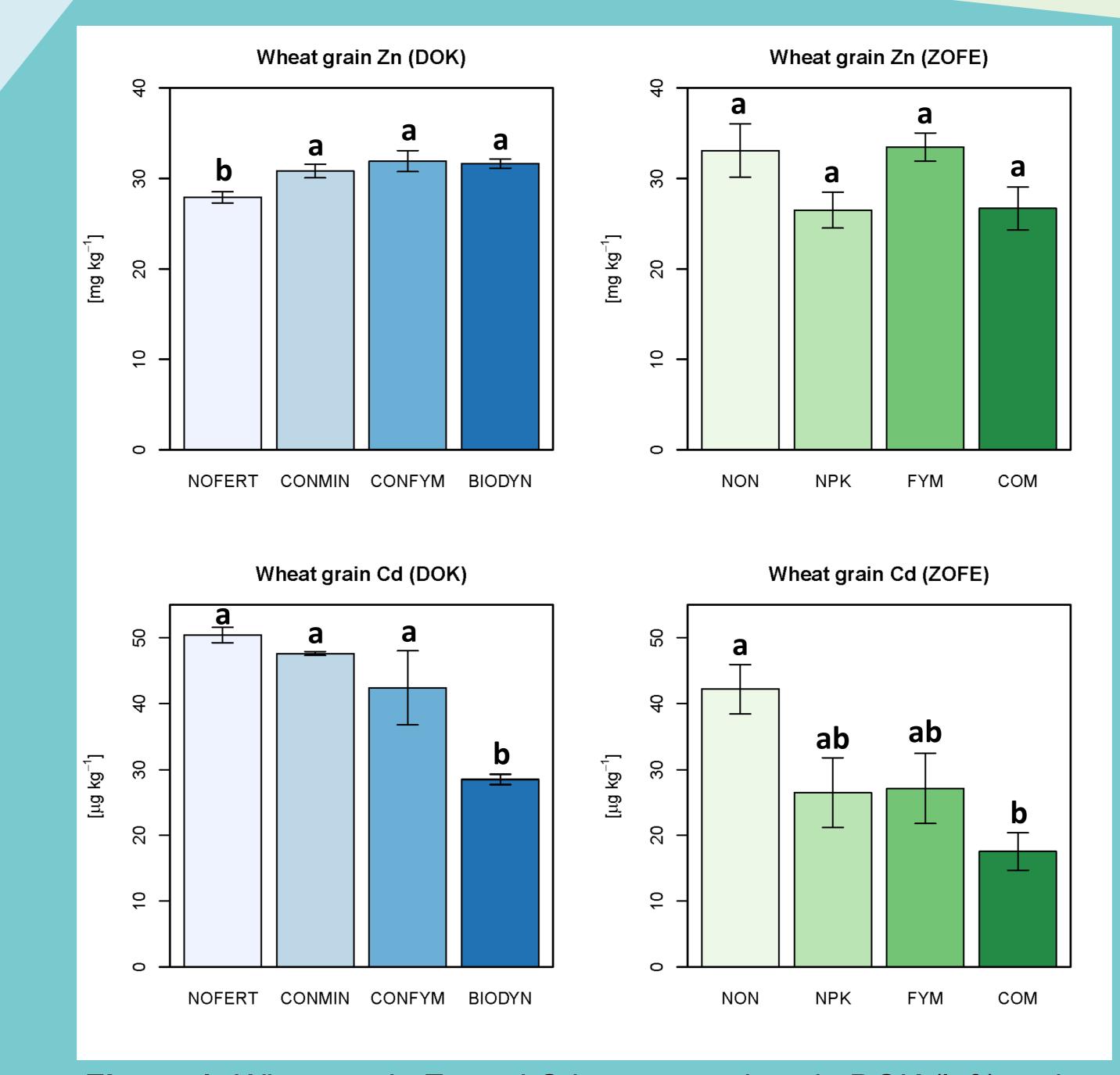
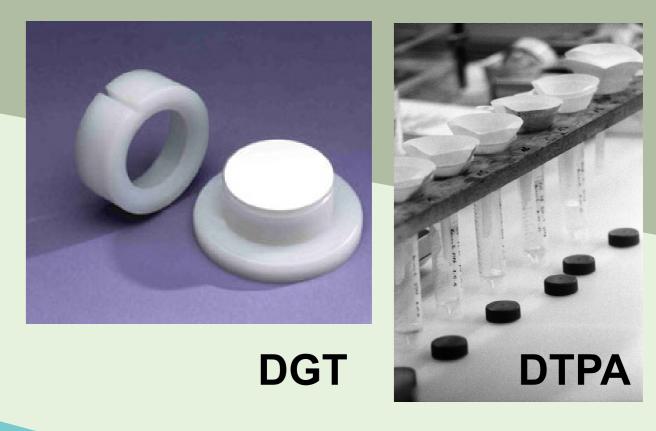


Figure 1: Wheat grain Zn and Cd concentrations in DOK (left) and ZOFE (right) field trials.

2.3 Zn & Cd phytoavailability

- Assessment methods:
 - DGT method: diffusive gradients in thin films
 →mimics a plant root
 - o DTPA extraction: diethylene-triamine-pentaacetic acid
 → classical chemical extraction



3.1 Results

- Organic fertilizer application increased both soil pH and soil organic carbon, which were strongly correlated (DOK: R² = 0.43***, ZOFE: R² = 0.92***)
- DGT-available soil Zn and Cd showed a strong negative correlation with soil organic carbon (Figure 2), pH and cation exchange capacity
- Wheat shoots and grains accumulated less Cd when more organic matter was applied (Figures 1 and 2)
- Wheat shoot and grain Zn concentrations (Figure 1) did not correlate with DGT but were related to total and DTPAextractable soil Zn

2.2 ZOFE long-term field trial

- Fertilization comparison
- Est. 1949, Zurich, Switzerland
- Treatments (replicated in 5 blocks)
 - o NON: unfertilized control
 - NPK: mineral fertilizers
 - FYM: farmyard manure
 - o COM: compost



DOK ZOFE R2=0.60*** R2=0.80*** R2=0.57*** Soil organic carbon [g kg⁻¹] Soil organic carbon [g kg⁻¹]

Figure 2: Negative correlations between soil organic carbon and DGT-available Zn (left) and Cd (middle) and positive correlations between DGT-available Cd and wheat grain Cd (right).

4 Conclusions

- Long-term organic matter inputs decreased available soil Zn and Cd through increasing soil pH and metal binding capacity
- There is a potential of long-term compost application to reduce Cd phytoavailability
- As desired for human nutrition, long-term organic fertilizer addition increased Zn/Cd ratios of wheat grains

