Does addition of copper increase the macronutrient content of wheat?

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Introduction

- Recently, agronomists recommend that Cu (as well as other micronutrients) is applied in an effort to increase macronutrient uptake and in particular N uptake and subsequently high protein in the wheat seed.
- This premise is based on crops achieving “better health”.
- It is very well established that nitrogen is needed for protein synthesis and for chlorophyll synthesis, and symptoms appear as a result of the disruption of these processes.
- A number of nutrients, e.g., S, Mg, etc. play important role in protein formation in plants.
- However, one has to remember that producers are paid for crude protein, that is, organic (yield/fg/mg) N x 5.7.

Objective

- We tested this hypothesis by examining the impact of Cu on the protein levels (where measured) or the macronutrient tissue content in 47 field experiments.

Background

Due to the small amounts required micronutrients cannot serve as building blocks or major plant components.

1. Anion forming elements are part of enzyme molecules, e.g., Boron & Molybdenum
2. Cation forming elements serve as co-enzymes, e.g Cu
3. Others take part in oxidation/reduction reactions e.g. Fe, Mn and Cu
4. Several of the micronutrients are involved in chlorophyll production.

- Deficiency will be similar to that of nitrogen.
- Role of Cu
  - Within green tissues, copper is bound in plastocyanin and protein fractions. As much as 50% or more of plant copper localized in chloroplasts is bound to plastocyanin.
  - The highest concentrations of shoot copper usually occur during phases of intense growth and high copper supply.
  - Oxidation–reduction cycling between Cu(I) and Cu(II) oxidation states is required during single electron transfer reactions in copper-containing enzymes and proteins.

As early as 1948 (Lucas ¹) it was recognized that Cu deficient plants contained abnormally high Cu concentrations and that Cu does not aid in the formation of proteins.

Vinod et al.² observed that the plant exhibited a decline in growth, chlorophyll contents, protein and DNA, RNA content carbohydrate, where as proline, total phenol and H₂O₂ content increased at high concentration of Cu and Zn.

Alberta Agriculture Food and Rural Development³: Other indications of Cu deficiency include consistently low bushel weights, especially in barley, and high protein (>18%). A lack of Cu hinders the movement of carbohydrates to form starch in the maturing grain head. Hence, shriveled grain, low bushel weight and concentrated protein result since there is relatively little starch present.

References

3. Alberta Agriculture Food and Rural Development. 1999. Copper Deficiency: Diagnosis and Correction. Agdex 532-3