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Considerations for zinc (Zn) applications

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Zinc (Zn) is considered both a micronutrient and a heavy metal in soil systems. As a micronutrient and enzyme constituent, it plays an important role in plant production. It is an essential element for cellular processes of protein, carbohydrate and chlorophyll synthesis and is required for membrane integrity and activation of enzymes. But do you need to apply Zn to produce a healthy crop? To answer this question use the SPEC philosophy: first consider your Soil, then your Crop, then your Experiences, then your Corrective options.

1) Soil factors

a. Soil pH. Plant-availability of Zn is controlled by soil pH, soil texture, soil temperature and soil phosphorus. The solubility of Zn (i.e. the ability of Zn to exist in soil solution rather than bound to soil particles) decreases when pH increases. Thus, as a guideline, Zn deficiency rarely occurs below a soil pH of 6.5. Zn deficiencies are not uncommon in sensitive plants in calcareous soils of the western U.S.

b. Soil texture. Zn exists in soil solution as a divalent cation (Zn2+). Sands and loamy sands are commonly deficient in Zn because these coarse-textured soils provide little in terms of supply. Organic soils also contain relatively low levels of Zn. Zinc also exists as soluble or insoluble complexes with organic matter. Soluble complexes are a supply of Zn in the plant/soil system, while insoluble complexes, like those that form in organic soils (e.g. muck soils, peat soils) reduce Zn availability.

c. Soil temperature. Lower soil temperatures reduce Zn availability. The interaction between slow root development and Zn availability during seasonally cool periods can cause visual deficiency symptoms to occur.

d. Soil phosphorus. High levels of phosphorus in soil cause greater amounts of phosphorus to be taken up by the plant, which in turn, interferes with Zn movement in the plant. Under these conditions, Zn accumulates in the root and is not translocated into the above ground biomass.

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2) Crop factors

a. High demand crops: Field corn, sweet corn, onion, spinach

b. Medium demand crops: Apple, barley, kidney bean, navy bean, lima bean, table beet, canola, cucumber, lettuce, lupine, potato, sorghum, soybean, tobacco, tomato

c. Low demand crops: Most everything else

3) Experiences

a. Soil conditions. Early wet growing season conditions reduce the plants ability to uptake Zn. Plants typically grow out of deficiency symptoms as soil moisture returns to adequate levels.

b. Plant symptoms. Are you observing Zn deficiency? Zinc deficiency is often expressed as a yellowing or whitening of leaf area between leaf veins (interveinal chlorosis). Zn2+ is not mobile in plants and deficiency symptoms will occur on newer leaves. On corn, a classic symptom is a broad band of bleached tissues on either side of the midrib. In soybean and snap bean, Zn deficiency is expressed as shortening of leaf internodes and production of small, narrow and malformed leaves. Interveinal chlorosis may also be present. Photos of Zn deficiencies can be found at http://www.agronext.iastate.edu/soilfertility/nutrienttopics/deficiencies.html

c. Soil test. Our current UWEX guidelines rely on a measure of available soil Zn extracted using 1M hydrochloric acid and analyzed using atomic absorption. The optimum range for soil test Zn is 3.1 to 20 ppm. In soils testing in the optimum range or greater, response to Zn is unlikely. Zinc should never be applied to soils testing “excessively high” (<40 ppm). Soils testing “very low”, <1.5 ppm, will require Zn and soils testing “low”, 1.6 to 3.0 ppm, may require Zn for high demand crops and some bean crops. Do not collect soil in buckets that contain Zn such as rubber or galvanized steel.

d. Plant tissue test. Interpretation of Zn concentrations in plant tissue is specific to each crop and timing of sampling. Detailed information can be found at http:tinyurl.com/plantsampling. Always submit a soil sample when submitting a plant tissue sample for analysis.

4) Corrective options

a. Reduce P inputs or couple P and Zn applications. Reduction in P application may improve Zn uptake. A simple effective solution if P is the cause of Zn deficiency. Low Zn soils in Kansas have shown a benefit to applying Zn along with P in starter or in broadcast applications (Ruiz-Diaz, January 29, 2010, K-State

Extension Agronomy Updates). These studies on low Zn soils also show application of P without Zn can reduce yields compared to application of Zn without P.

b. Apply manure. Although manure contains large amounts of P, it also contains enough Zn to overcome the potential negative effect of P application. If you were planning on applying manure regardless, you will be applying sufficient levels of Zn. Consider testing your manure if you are interested in knowing the exact nutrient content.

c. Apply inorganic Zn. Zinc sulfate (36% Zn) and zinc oxide (78% Zn) are two common forms of inorganic zinc fertilizer. Zinc sulfate is typically less expensive and has greater solubility. Typical applications are 2 to 4 lb/A of Zn if band applied and 4 to 8 lb/A of Zn if broadcast applied. Zinc is not very mobile in soils and thus requires greater additions if only applied to the soil surface to ensure adequate plant uptake.

d. Apply chelated Zn. Zinc chelate products typically use EDTA to create a highly soluble Zn compound. Thus, less product is required (0.5 to 1 lb/A of Zn if band applied, 1 to 2 lbs of Zn if broadcast).

e. Foliar apply. Suggested for rescue treatments only. Apply 1 lb/A of Zn if using zinc sulfate and 0.15 lb/A of Zn if using Zn chelate. Zn chelate will be a more effective source of Zn for foliar application. This option may require more than one application and chance of success is not guaranteed.