AGRONOMY

# Zinc

Zinc (Zn) deficiency is one of the most common micronutrient deficiencies in the corn belt of the northern Midwest and Great Plains states. Because corn is the most sensitive crop, the causes of deficient nutrient supply must be understood and addressed.

## Role and Deficiency Symptoms

Zinc is an essential nutrient for plant growth. It is necessary for the activation of enzymes, chlorophyll formation, growth hormone regulation, cell growth, and seed formation. Zinc is taken up by the plant in the form of a cation, Zn++. Because zinc is immobile in the plant, the visible deficiency symptoms (interveinal yellowing) will be more prominent in newly emerged plant growth.

## Factors Affecting Zinc Availability

Soil pH – The solubility and availability of zinc is directly related to soil pH. In alkaline soil, solubility is low and increases as the soil becomes more acidic. The table below predicts zinc concentration at various soil pH levels. For every one pH unit change, the soil zinc changes one hundred-fold.

| pH | Soil Zinc (ppm) |
|---|---|
| 4.0 | 412 |
| 5.0 | 4.12 |
| 6.0 | 0.0412 |
| 7.0 | 0.000412 |
| 8.0 | 0.00000412 |

**Organic Matter –** Zinc deficiencies are frequently associated with low soil in organic matter content. Soil organic matter behaves much like a chelate as it binds with zinc in the soil. This chelating process protects zinc from reacting with other soil minerals that can make zinc unavailable to the plant. Zinc therefore accumulates in the topsoil with the soil organic matter because of the organic matter's strong attraction to zinc. Because of this, fields that have had the topsoil removed by leveling or erosion are often prone to zinc deficiency. This is further exaggerated when the newly exposed subsoil is alkaline.

**Total zinc content –** The original minerals present during soil formation determine the total zinc concentration in the soil. This total soil content (available plus unavailable) can range from 10 to 300 ppm with an average of 50 ppm. The total zinc content acts like a reservoir of potentially available zinc and the availability of this reservoir is dependent on the pH and organic matter as discussed above. Most zinc containing minerals occur in the silt and clay sized particles of the soil, therefore, sandy soils are more likely to be deficient in zinc than silty, loamy or clayey soils.

**Phosphorus –** Research has shown that phosphorus fertilizer can induce zinc deficiencies when the zinc soil test levels are low to marginal (< 1.0 ppm DTPA). If the soil test level is greater than 1.0 ppm, there is no need to worry about a phosphorus-induced zinc deficiency. High phosphorus applications will intensify a zinc problem only if there is a zinc problem to begin with.

**Soil temperature and moisture –** Cold, wet soil conditions, often found in the spring, reduce root growth, zinc uptake, zinc solubility, and zinc released from soil organic matter. This causes more severe zinc deficiencies in wet, poorly drained soil compared to warm, well-aerated soil. Plant uptake of most micronutrients is reduced in cold, wet soil.

## Diagnosing Deficiencies

The soil testing extractant most commonly used for zinc is DTPA, which is a chelating compound. The critical soil-test level for DTPA extractable zinc is 1.3 ppm. Soil testing less than 1.3 ppm would be considered deficient. The process of interpreting a zinc soil test can be improved when other factors that affect zinc availability, such as the factors previously mentioned, are taken into account. For example, a soil-test level of 1.0 ppm would probably be adequate for a neutral, medium-textured soil with more than 2% organic matter. However, a 1.0 ppm soil test level would result in zinc deficiency if the soil is an alkaline sand with less than 1% organic matter.

Since many factors can affect zinc availability, a plant tissue sample is a great diagnostic tool to add to your soil-fertility program. Plant tissue analysis is especially helpful in managing micronutrients since most of the visual symptoms of micronutrient deficiencies all look alike (e.g., interveinal yellowing of new plant growth). For most agronomic plants, the critical plant-tissue zinc level is 20 to 30 ppm.

## Recommendations

Total crop uptake (stalk, leaves, and grain) for most crops is usually somewhere close to one pound of zinc per acre, and zinc grain removal for many crops is 0.025 lbs. per 1,000 lbs. of grain. Therefore, a 180 bushel corn crop would remove about 0.24 lbs. per acre. Theoretically, based on these numbers, at least one pound of zinc per acre is required to meet crop uptake. Every four years, an additional one pound would be needed to replace crop removal. A suggested corrective zinc application would be 5 to 10 lbs./acre as a broadcast application or 1 to 2 lbs./acre applied in bands close to the seed. Zinc is an immobile nutrient, and soil test levels can be built up with zinc fertilizer (with the exception of some strongly alkaline soils). Therefore, the benefits of a one-time application can often be utilized for many years.

## Conclusion

Corn growers need to be on the lookout for zinc deficiencies. Soil pH, soil organic matter, total soil zinc content, phosphorus application rates, soil moisture, and temperature can all affect zinc availability. The DTPA zinc soil test is a very reliable and accurate indicator of zinc availability. Plant tissue analysis can also be a good tool to measure the effects that these other factors have on zinc availability. Zinc deficiencies can usually be corrected through fertilizer applications.