Zinc

Zinc (Zn) deficiency is one of the most common micronutrient deficiencies in the corn belt, with corn being the most sensitive crop. A complete overview of zinc will be discussed, beginning with its role in plant nutrition, reactions in the soil, and fertilizer application parameters.

Role and Deficiency Symptoms

Zinc is an essential nutrient for plant growth. Zinc is taken up by the plant in the form of a cation, Zn++.
It is necessary for activation of enzymes, chlorophyll formation, growth hormone regulation, cell growth, and seed formation. Zinc is immobile in the plant; therefore, visual 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

Zinc – Zinc deficiencies are frequently associated with soil low in organic matter. Soil organic matter behaves much like a chelate in holding zinc in the soil. This chelating process of organic matter protects zinc from reacting with other soil minerals that contribute to zinc tie-up. Zinc accumulates in the topsoil with 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. The total zinc content of soil (available plus unavailable) can range from 10 to 300 ppm with an average of 50 ppm. The total zinc acts like a reservoir of potentially available zinc. The availability of this reservoir is dependent on the pH and organic matter as discussed above. Most zinc minerals are contained in the silt and clay fraction of the soil. Therefore, medium and fine-textured soil usually has a much higher zinc content and is less prone to zinc deficiency than sandy-textured soil.

Phosphorus – Research has shown that phosphorus fertilizer can induce zinc deficiencies when the 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 reduces 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 Symptoms

The extractant most commonly used for zinc is DTPA, which is a chelate. 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 complete 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 150-bushel corn crop would remove about 0.20 lbs. per acre. Theoretically, based on these numbers, at least one pound of zinc per acre is required to meet crop uptake. Every five years, an additional one pound would be needed to replace crop removal. A suggested corrective zinc application would be 5 to 10 lbs./acre broadcast-applied or 1 to 2 lbs./acre band-applied. Zinc is an immobile nutrient, and soil-test levels can be built up with soil-applied zinc (with the exception of some severely 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 test is a very reliable and accurate indicator of zinc availability. Plant tissue analysis can be a good tool to measure the effects that these other factors have on zinc availability. Zinc deficiencies can often be corrected through fertilizer applications.