Zinc in Turf Grass

Zinc is a plant essential nutrient, necessary for plant growth and is taken up by the plant in the form of a cation, Zn++. It is utilized in the following processes; activation of enzymes, chlorophyll formation, growth hormone regulation, cell growth and seed formation. Since zinc is immobile in the plant, visual deficiency symptoms (interveinal yellowing) will be most prominent in newly emerged tissue.

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 pH levels. For every one pH unit change, the soil zinc changes one-hundredfold.

Soil pH	Soil Zn ppm
4.0	4.12
5.0	4.12
6.0	0.0412
7.0	0.000412
8.0	0.00000412

Organic Matter—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. The 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, areas with a high degree of dirt work (cutting and filling) or heavy erosion are most prone to zinc deficiencies. This is further exaggerated when the newly exposed subsoil is alkaline.

Constructed sand based soils, are by design, low in organic matter. Generally, the organic material used in an 80:20 mix is organic residue not fully decomposed organic matter. Meaning, that the reactivity is very low without continued applications of this organic residue, short lived (depending on geography, to 3 years) in the soil.

Total zinc contest—The original minerals present during soil formation determine the total zinc concentration in the soil. The total zinc content of the 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 the reservoir is dependent on the pH and organic matter. Most zinc minerals are contained in the silt and clay fraction of the soil. Therefore, medium and fine textured soil usually has higher levels of zinc and less prone to zinc deficiency then sandy-textured or sand constructed soil.

Phosphorus—Research has shown that phosphorus fertilizer can induce zinc deficiencies. Although, only when soil test levels are low to marginal (< 1.0 ppm Zn). With these low levels high phosphorus applications will intensify a zinc deficiency. If the soil test zinc is > the 1.0 ppm, then phosphorus induced zinc deficiency will not occur.

Soil temperature and moisture—Cold, wet soil reduces root growth, zinc uptake, zinc solubility and zinc released from soil organic matter. As a result, the most severe zinc deficiencies occur in cold, wet and poorly drained soil.

Diagnosing Deficiencies

Soil Analysis—The extract most commonly used for zinc is DTPA, which is a chelate. The critical level for DTPA extractable zinc is approximately 1.5 to 2.5 ppm. A value less than 1.5 would be considered deficient. The process of interpreting a zinc soil test can be improved when other factors that affect zinc availability (factors above mentioned). For example, a soil-test level of 1.5 ppm would be an adequate form of a slightly acid medium textured soil, with an organic matter level of 2%. However, a 1.5 ppm zinc level would definitely be deficient on an alkaline sand soil with organic matter less than 1%.

Application rates of zinc, will be regulated by the types and grades of fertilizer materials used. If needed, buy a fertilizer material containing zinc and follow the label for the correct rate. As noted above, zinc should be applied with the first application of the growing season, when soil temperatures are cool.

Plant Analysis—Since many factors can affect zinc availability, a plant tissue sample is an excellent diagnostic tool to complete a fertility monitoring program. This tool allows the user to observe the actual zinc concentration in the plant. You can better evaluate whether the plant is getting enough zinc or if too much zinc is present in the soil. Critical zinc levels for some turf grasses; Bermudagrass, 50 –

80 ppm, Bluegrass 40 – 60 ppm, Bentgrass 80 – 120 ppm. As a result of the equilibrium, phosphate anion concentrations in the soil solutions are created. Phosphorus is absorbed by the plant directly from the soil solution, in the forms of H_2PO_4, HPO_4 or PO_4. Thus, soil solution phosphorus is actually the source of phosphorus for plants even though the bulk of the reserve is found in the soil organic matter and mineral forms. The concentration of the soil solution increases if there is more released than removed. Conversely, the concentration decreases if there is more removal than release.

Toxicities

Toxicities of zinc have not been document in turf grasses. Research studies included application rates of up to 1000 pounds/acre, with no negative affect. However, very high levels of zinc are common, particularly in areas of intensive turf management (golf greens). Laboratory levels of 50 to 100 ppm are common in older golf courses (older than 10 years) have been reported. Even though an agronomic toxicity may not occur it is important to identify where the zinc is coming from (fertilizers, irrigation water, top dress materials; sand or organic compost or from fungicide applications) and eliminate the source. These high levels may or may not decline over the years, but it is important to keep zinc from getting higher.

Conclusion

Zinc deficiencies in turf grass are quite common through out the U.S. This is particularly true with constructed sand soils. Correction can be accomplished with zinc fertilizer applications and in some circumstances acidifying the soil itself will be helpful. Remember zinc is a metal and leaches little over time. In addition, plant uptake of zinc is approximately 0.1 to 0.2 pounds per acre. So systematic monitoring is needed to determine when to stop applying zinc.