Plant Nutrients Other Than N, P and K_1

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Since carbon, hydrogen and oxygen are supplied by the atmosphere and water, they will not be a part of this discussion. Nitrogen, phosphorus and potassium are considered as the three major plant food elements and have been discussed previously. Calcium, magnesium and sulfur are usually considered as intermediate and secondary elements since they are required in lesser amounts than the major elements but in greater amounts than the micronutrients. Sometimes iron may be considered as a secondary nutrient although it can be classed as a micronutrient as well. Since there are 16 elements required for plants to achieve full maturity and reproduce, this discussion will be concerned with 10 of them.

BALANCE AND INTENSITY

Most turfgrass managers are aware that there is a specific balance of nutrients that is best for optimum growth of any plant. Therefore, intensity comes into play. As we increase the level of one nutrient, other nutrients can become out of balance and can limit the growth or performance of the plant. Therefore, we must carefully consider both balance and intensity in turfgrass nutritional programs. I am afraid that for golf courses in particular too much emphasis has been placed upon speed of the green and has resulted in starvation of the grass. Not only has this resulted in nutrient imbalances, but also insufficient quantities of nutrients available to keep the plant healthy and vigorous to compete with weeds, mosses, plant diseases and insects.

Let us consider some of these nutrients and their functions and a little of what we know about their balance and intensity.

MICRONUTRIENTS

Micronutrients or trace elements are requried in very small amounts and frequently the margin between deficiency and toxicity is quite narrow especially with such elements as boron and molybdenum. Toxicities or deficiencies of micronutrients can be induced when the pH is rapidly changing up or down, applied irrigation water high in the element, application of fertilizer compounds which form soluble toxic substances, and leached or accumulated spray materials. Guessing as to what is needed and applying a shotgun mixture is a very dangerous practice.

On the practical side of management, the use of micronutrients places a burden of responsibility of the turfgrass manager. The cost of micronutrient analysis is not cheap. Both tissue and soil micronutrient analyses can be misleading and need a great deal of improvement. Most normally developed soils are usually adequately supplied with micronutrients although deficiencies of one or more are common in most regions. In the turfgrass sciences, the advent of greater usage of sand rooting profiles in putting greens, bowling greens and sportsfields, micronutrient deficiencies are becoming more common and must be carefully considered.

Let us consider some of the micronutrients and a few of the factors that may affect deficiencies.

Boron. Factors favoring deficiency include high soil pH, unfavorable calcium:boron relationship, low organic matter, low moisture, and highly leached soils. Boron is extremely important in nitrogen and carbohydrate metabolism and in water relations in the plant.

When high levels of nitrogen are used or phosphate levels are low, more boron will be required. If the level of available boron is low, high levels of potassium application can induce boron deficiency. In general, some soil testing specialists consider that values of 1.3 to 2.00 ppm present high soils whereas tissue levels of 9 to 10 ppm are adequate. Visual deficiency symptoms for boron include greenish yellow color, dying prematurely, and abnormal tillering.

Copper. Copper deficiencies can be induced by high soil pH, high organic matter content, high concentrations of iron and manganese and highly leached soils. Copper plays an important role in plant growth as an enzyme activator and as a part of certain enzymes which function in respiration. Copper usually does not move from the older parts of the plant to the younger leaves, and this is why lack of copper shows up on younger growth. Copper will leach readily from sandy soils, but is tightly held by soils with high clay content. Soils high in organic matter maintain a tight hold on copper and the availability is decreased. Soils high in organic matter are, therefore, more likely to respond in additions of copper. Turfgrass deficiency symptoms include a withering and graying of the leaf tips, turning backward of the leaves, and dying of tips and newly emerging leaves. In general, high soils levels would register approximately 1.5 to 3 ppm, depending upon methods of extraction, while tissue levels of 17 to 20 ppm would be considered normal.

Iron. Iron deficiencies can occur with high soil pH, high soil phosphates, excessive copper, zinc and manganese, excessive soil moisture, and excessive lime. Iron is very essential for the formation of chlorophyll and for photosynthesis. It is also an activating element in several enzyme systems. Lime chlorosis is common in soils with excessive amounts of calcium carbonate (lime). In general, soluble applications of ferrous sulfate or ferrous ammonium sulfate will restore green color at least temporarily under these conditions. Usually soil levels of 25 to 50 ppm are considered high, depending upon the method of extraction. Tissue levels, however, are much more highly concentrated and can run as high as 280 ppm or higher.

Manganese. Deficiency symptoms can be induced by high soil pH, low organic matter content, high soil moisture, and nutrient interaction. Manganese plays a vital role with enzyme systems usually involved in the breakdown of carbohydrates and nitrogen metabolism. Deficiency symptoms on grasses include chlorotic leaves and often characterized by lesions and small brown or gray specks near the base of older leaf blades.

Zinc. Conditions favoring deficiency include high pH soils, high phosphate, low organic matter, exposed subsoils, high base exchange capacity and particulary very high organic matter soils such as those described as muck. Zinc is essential for transformation of carbohydrates and regulation of the consumption of sugar in the plant. The availability of zinc at pH values of 6.0 is low, and as the pH increases, the availability of zinc decreases. Therefore, heavy applications of lime can significantly reduce the availability of zinc. Although deficiency symptoms for zinc

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are not common, older leaves can appear grayish in color while part of the leaf may be gray to bronze-green. Soil test values of 3 to 8 ppm are considered high for zinc while tissue analysis may reveal 40 ppm as being adequate levels.

Molybdenum. This is one of the only micronutrients where availability is reduced by decreasing pH value. Values below a pH of 5.5 coupled with low phosphate levels can induce deficiency symptoms. Molybdenum is very important for the reduction of nitrates in the synthesis of protein by all plants, and, therefore, nitrogen cannot be properly metabolized in the presence of molybdenum deficiency. Molybdenum deficiency symptoms are not easy to detect in grasses which exhibit generally a pale green color. Soil test values for molybdenum range from 0.2 to 0.4 ppm in the high range, whereas tissue levels may run approximately 5 ppm.

Chlorine. Although many physiologists consider chlorine as being an essential element for plant growth and reproduction; deficiency symptoms are rare. Many fertilizer materials contain chlorine and it would be unusual to develop chlorine deficiencies in most of our turfgrasses.

In conclusion, highly leached sandy soils and especially with high pH values could develop micronutrient deficiencies. Rather than to guess or to use the shotgun approach for micronutrient applications, it is much best to conduct soil or tissue tests to determine micronutrient needs. Use caution in tissue tests!

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MAGCS Seeks 1990 Monthly Meeting Sites

The Midwest Association of Golf Course Superintendents, through its Arrangements Committee, is in the process of establishing a tentative monthly meeting schedule for the next year, 1990. It is, once again, our goal to arrange a geographically balanced schedule with a variety of golf courses for all MAGCS members to enjoy. If you are interested in offering your time and your club or facility for such an event: complete, clip and return the form below to:

Mike Bavier
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I am interested in hosting a 1990 MAGCS monthly meeting:

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