II. Primary Nutrients and Fertilizers

Nitrogen, phosphorus, and potassium are considered most important because soils typically are deficient in these elements and they must be applied regularly. Because these elements are required in the greatest amounts, they are referred to as the *primary* or *essential* nutrients or elements. The numerical sequence on a fertilizer bag refers to the percentages of nitrogen, phosphate (P_2O_5), and potash (K_2O) the fertilizer contains. Thus a bag of 10-10-10 would contain 10% nitrogen, 10% available phosphate, and 10% potash.

The *secondary* elements are calcium, magnesium, and sulfur. Dolomitic limestone provides deficient soils with calcium and magnesium, while sulfur is added by sulfur-containing fertilizers. Sulfur also may be provided by acidifying materials such as elemental sulfur, which lowers soil pH, by desalinization materials such as gypsum, by rainwater containing the air pollutant sulfur dioxide, or by salts of nitrogen, magnesium, potassium, and various micronutrients. Table 9 shows the effects of increasing the levels of five essential nutrients on turfgrasses.

While *micronutrients* are essential elements, plants require them only in small amounts. Florida's flatwood soils, for example, may not contain ample micronutrients to sustain optimum plant growth. Due to the high sand content of many golf greens and extremes in soil pH levels (Figure 1), micronutrient management is somewhat more important for superintendents. Iron and manganese deficiencies often occur at high pH levels (>7.0) and are sometimes mistaken for nitrogen deficiency. Since a number of turfgrass specialty fertilizers contain some, or all, of these micronutrients, users should check product labels carefully before purchasing.

a. Nitrogen

Turf managers consider nitrogen a key element because of its influence on color, growth rate, density, and stress tolerance. Turfgrasses contain between 20 and 60 g N per kg; the element constitutes 2% to 6% of the total dry matter. The most often applied element, it is required in larger quantities than any other element except carbon, hydrogen, and oxygen. However, excessive nitrogen use creates problems. Excessive amounts of nitrogen increase shoot growth and susceptibility to selective diseases as well as lowering tolerance to heat, cold, drought, and traffic. Most important, inordinate use of nitrogen reduces root and lateral shoot growth. Root growth suppression results in decreased turf tolerance to heat and lessened resistance to nematode damage. In addition, excessive nitrogen fertilization may adversely affect the environment by contaminating groundwater.

Origins and Losses

Turfgrasses may obtain nitrogen through the decomposition of organic matter and to a limited extent from the air as nitrogen oxidized by lightning and dispersed by rainfall. In soil, ammonium (NH_4^+), nitrate (NO_3^-), and nitrite (NO_2^-) are the most important forms of nitrate, originating either from the aerobic decomposition of organic matter or from the addition of commercial fertilizers. Ammonium and nitrate are the only forms of nitrogen used by turf plants. No matter what the source of applied nitrogen (e.g., manure, crop residues, organic matter, or commercial fertilizer), it must be converted to one of these forms for plant use.