TURF **TIPS**

Soil pH

Soil pH is one of the driving forces affecting overall soil fertility and the management of turf grass. It directly and indirectly affects the ability of plants to utilize soil nutrients. Understanding what causes soil acidity, and how to correct it, is essential to a successful nutrient management program.

Soil pH measures the relative amount of acidity or alkalinity in the soil by measuring the concentration of hydrogen ions (H+) in a suspension of soil in water. The alkalinity, or concentration of hydroxyl ions (OH-), is always in relative balance with the acidity. The pH scale ranges from 0 to 14. As diagramed in **Figure 1**, 0 is extremely acidic, and 14 is extremely alkaline. Soil with a pH of 7.0 is neutral.

It is interesting to note, each number on a pH scale represents 10 times the value of the previous number. For example, a pH of 6.0 is 10 times more acidic than a pH of 7.0. Thus, using the substances listed in **Figure 1**, battery acid is 10 million times more acidic than distilled water. Using this analogy, it is easy to understand why soil pH is so important.

In extreme soil situations, pH can be as low as 3.0 and as high as 9.5. Normally, it ranges between 5.0 and 8.5, and values below 5.0 or greater than 8.5 represent severe growing conditions.

Soil pH Effects on Nutrient Availability and Toxicity

Managing the soil pH maximizes the effectiveness of the nutrients in the soil. For example, availability of nutrients such as nitrogen, potassium, and phosphorus is optimum from 6.5 to 7.5. Conversely, phosphorus availability decreases at pH levels lower than 6.0, because of aluminum and iron tie-up, and at pH levels higher than 7.5, because of calcium tie-up.

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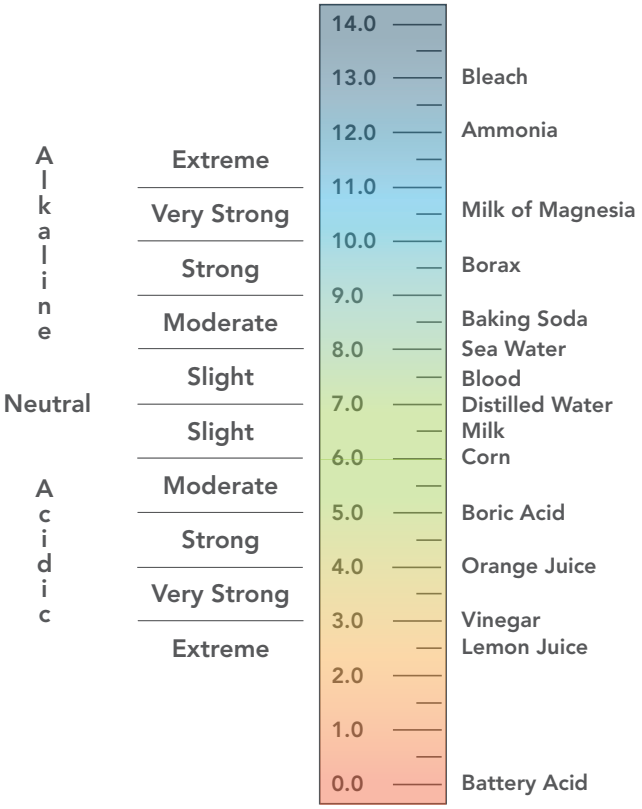
Figure 1. Examples of pH values for several common items.



At pH values lower than 5.0, aluminum and manganese become toxic to plants. When higher than 7.5, manganese, iron, zinc, and copper become insoluble and unavailable, possibly resulting in micro-nutrient deficiencies. These examples are further detailed in Figure 2.

Sources of Soil Acidity (low pH)

Soil acidity originates from rain, microbial activity, and nitrogen fertilizers. Therefore, soils naturally become acidic with time. Of these three factors, only the nitrogen fertilizer can be managed by the turf superintendent.

Three characteristics of rain can cause soil pH values to be less than 7.0. First, rain is intrinsically acidic. Rainfall carries with it a certain amount of nitric, sulfuric, and carbonic acid absorbed from the atmosphere. (Nitric and sulfuric acid are a result of burning fossil fuels. Carbonic acid, on the other hand, is the natural product of carbon dioxide and moisture, i.e., rain.) Second, geographic location makes a difference. Rainfall downwind of a metropolitan area can have a pH as low as 4.2 because there is more nitric and sulfuric acid in the atmosphere near a city. (Rain free of nitric and sulfuric acid has a pH of 5.6 because of carbonic acid.) Third, when an area receives more than 25 inches of rain per year, the primary minerals and nutrients are leached from the topsoil, creating acidic conditions in the soil.

Microbial activity also reduces soil pH levels. As the nutrients are removed from the soil by plant uptake the micro-organisms in the soil utilize organic matter or plant residue for their nutrient needs. This process of decomposing organic residues and releasing available nutrients produces carbon dioxide. While the air we breathe contains 0.04 percent carbon dioxide, soil air can contain levels between 3 to 5 percent CO2. This elevated CO2 then further reacts with the soil moisture to form carbonic acid, resulting in increased acidity.

Nitrogen fertilizers containing ammonium also lower the soil pH. Ammonium creates acidity during the nitrification process. On average, 1.8 pounds of limestone is needed to neutralize the acidity from one pound of ammonium nitrogen.

Conclusion

Soil pH is the cornerstone of a good soil fertility program. A soil pH between 5.8 and 6.5 is ideal for turf grass; a soil pH greater or less than this affects nutrient availability and toxicity. Fortunately, it is possible to manipulate soil pH levels with lime or sulfur applications.

Figure 2. Soil pH levels affect micronutrient availability