**pH and Nutrient Availability**

*PH can have a profound affect on nutrient availability*

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The pH of soils can have a profound affect on nutrient availability. Figure 1 is a representation of the relationship between pH of soils and nutrient availability. As the height of the horizontal bars decreases, so does nutrient availability. In alkaline soils with a pH of 8.5, the availability of phosphorus, iron, manganese, boron, copper and zinc can limit plant uptake. Plants growing in alkaline soils often have deficiencies of these nutrients. In relatively acidic soils (pH of 5.0), phosphorus, potassium, sulfur, calcium, magnesium and molybdenum can become limiting for plant growth. In soils with a pH of 5.0, plants may actually pick up so much of these elements that they become toxic. The optimum pH range for nutrient availability in soils would be from about 6.0 to 7.5.

The pH scale actually ranges from 0 to 14. The more acid (less alkaline) the soil, the lower the number. The more alkaline (less acidic) the soil, the higher the number. Battery acid would have a pH close to 0 and Drain cleaner (lye) would be close to pH 14. The pH scale is a logarithmic scale. Each whole pH value is ten times more or ten times less than the next nearest whole number. For example, pH 6 is ten times more acidic (10 times less alkaline) than pH 7 and 100 times (10 X 10) more acidic than pH 8. The same holds true for alkaline pH values. A pH of 9 is 10 times more alkaline (10 times less acidic) than pH 8.0 and a hundred times more alkaline than pH 7.0. A pH of 8.5 is 50 times more alkaline than pH of 7.0: 7 to 8 (10 times), 8.0 to 8.5 (5 times): 10 X 5=50. The pH range in Figure 1 extends from 4.0 to 10.0, rather than 0 to 14. Plant growth is severely limited outside this range of 4.0 to 10.0.

**Modifying Alkaline Soils**

In an effort to increase nutrient availability in alkaline soils, acidifying materials are often added. The material most often applied to reduce the pH of soils (acidify) is sulfur. Bacteria in soil will convert sulfur to sulfuric acid which makes the soil more acidic. Sulfuric acid, urea sulfuric acid (N-phuric) or sulfurous acid (generated by a "sulfur burner") may be applied through the irrigation system to lower pH. Sulfurous acid generated when sulfur dioxide (SO₂) reacts with water is converted to sulfuric acid.

Injection of anhydrous ammonia into soil and any fertilizer materials containing ammonium or urea will lower soil pH through the nitrification process. The nitrification process preformed by bacteria in the soil converts ammonium to nitrate and generates nitrous acid. Addition of organic matter will also lower soil pH.
MODIFYING ACID SOILS

Once pH of soils gets too low (too acidic) liming materials are often applied to raise the pH and increase nutrient availability. The most common liming materials are Agricultural lime (calcium carbonate) and dolomitic lime (mixture of calcium and magnesium carbonate).

AMOUNTS OF MATERIAL TO ADD

Amounts of material needed to affect the pH of soils varies tremendously. Purity of products influences rates needed. Soil texture influences how easy it is to change the pH of soil. The sandier the soil, the easier it is to affect the pH: the less material it takes. Silty clay loam soils will take more material to effectively modify the pH than sandy loam soils. Size of the particle (fineness) also has an influence. The smaller the particle size, the faster the materials react. Many products are pelletized to facilitate spreading. The particle size after the pellet “melts” can be very important. For example pelletized sulfur products are made from sulfur which has been ground finely then made into pellets. The finer the sulfur particle the “hotter” the material: be careful of burn. If amendments for pH modification can be incorporated into the soil, this greatly aids in affecting pH to a greater depth in soil. In alkaline soils, the amounts of acidifying agents needed will be dictated by the amount of lime present. If there is a lot of free lime (caliche) present, it will take more material than if only small amounts of lime are present.