EXTENSION
SERVICE

eral particles into aggregates that are largely responsible for the loose, easily managed condition of productive soils and increases the soil's water-holding capacity.

Soil organic matter contains nutrients that can be used by plants. ese nutrients are released through a process called mineralization, which converts organic forms of nitrogen (N), phosphorus (P) and boron (B) into plant-available forms. Soil organic matter can also bind a variety of metal forms of plant nutrients such as copper (Cu), zinc (Zn) and iron (Fe). If the bond is strong and not soluble in water, plants may not able to use them; however, if the bond is not strong and those nutrients can be released in water, then they are available for plant uptake.

Soil organic matter posse24.2 (t)-8 (i)JETEMC pp 7ti ing nutrients to growing plants. An important property of the soil solution is its acidity or alkalinity, i.e., the amount of hydrogen ions (H^+) or hydroxide ions (OH^-) in the soil solution. Soil solution acidity, or pH, influences the solubility and availability of several essential nutrient elements, such as iron (Fe), manganese (Mn), P, Zn, Cu and Mo, to plants.

The force that holds soil pore water is referred to as soil moisture tension. Small pores possess more power to hold water and vice versa. Soil water held strongly by pores is not available for the plant to use and is referred to as unavailable water. The wilting point occurs when there is not enough water in the soil for the plant to use. The maximum amount of water a soil can hold after gravitational drainage is referred to as field capacity. During and immediately following a heavy rain or irrigation, pores in the upper soil zones are often entirely filled with water. When soil has been saturated, moisture will continue to drain away for 24 to 48 hours, after which the soil is at field capacity. The amount of water in soil that can be used by plant is the plant-available water in soil. To calculate the amount of water available (grams of water per cubic centimeter soil), you need to subtract the water content at wilting point from the soil water content at field capacity. One unit of expression for pore force or tension is the atmosphere (normal atmospheric pressure at sea level), 14.696 lb in^2. The metric term "bar" is also used; 1 bar is equal to 14.5 lb in^2. Since bar and atmosphere are essentially the same, they can be used interchangeably for most purposes. The greater the amount of water in a given soil, the lower the soil moisture tension. At the same soil moisture tension, a clay soil holds more water than a sandy soil.

Water in excess of the field capacity is termed "gravitational." Gravitational water is of limited use to plants because it is present in the soil for only a short time. While in the soil, it occupies the larger pores, thereby reducing soil aeration. Removing gravitational water f.4 (l wa)14 (t12 T r)14 (ed)18.6 (u)12 c-43-2.8 (.)55 (" G)ien-U49.5 313.616 (r)-rcaucn thilt1.7 (. A

Figure 1. Soil textural triangle (from Brady, N. C. 1990. e Nature and Properties of Soils. *New York: MacMillan).*

withstand careful handling without breaking; however, a ribbon won't form.

Loam

An ideal loam is a mixture of sand, silt and clay particles that exhibits the properties of those soil separates in about equal proportions. Neither

acidic conditions, Mg is very soluble and may be lost due to leaching. If an acidic soil is limed with a material that contains little or no Mg, a de ciency of this nutrient may result. When liming a very acid soil (below pH 5.2), it is a good practice to use a liming material that contains Mg or to monitor soil Mg levels closely.

Magno Mg12tc2yum cadded to fertilizers as well as when acidic, low-lying sandy soils are limed to pH levels above 6.5, or when wet, sandy soils are drained.

Zinc (Zn)

Soil acidity is the primary factor affecting Zn availability. Zinc deficiency occurs in moderate- to high-pH soils and may be more pronounced if soil P levels are high. Zinc deficiency may occur in soils with a pH of 6.0 to 7.0 if they are overfertilized with P. Zinc deficiency is most likely to be found in sandy or high-organic matter soils.

Iron (Fe)

Iron deficiencies occur only in high-pH soils. In soils with high pH, most of the Fe is insoluble and therefore unavailable to plants. Reducing the pH with elemental S or some other acidifying agent will correct the problem by solubilizing the Fe in the soil.

Copper (Cu)

Copper solubility also decreases as pH levels increase. Therefore, Cu deficiency can occur in soils with pH levels above 7.5. In contrast to Mn, Zn and Fe, Cu is tightly bound by soil organic matter. As soil organic matter content increases, Cu availability decreases. In some soils with large amounts of organic matter, Cu can be deficient when soil pH is 5.5 or below.

Molybdenum (Mo)

Higher plants require Mo in extremely small amounts. Molybdenum behaves very differently from most other micronutrients. The most common form of soil Mo is anionic, which can be easily leached from sandy soils. Molybdenum is most soluble at high pH levels and is most likely to be deficient in acidic sandy soils. However, Mo deficiencies are sometimes found in moderate-pH, fine-textured soils. This generally occurs where the parent material is low in Mo. Molybdenum is essential to N fixation by legumes, which are very sensitive to Mo deficiencies. The crucifers (broccoli, Brussels sprouts, cauliflower, canola and the forage rapes) all have a high Mo requirement. These plants are sensitive to low Mo levels and also remove substantial quantities of Mo from the soil when harvested.

Boron

is publication replaces the following Extension publications: Soil Fundamentals *by C. L. Johnson, former Extension Assistant, Palmer Research Station, University of Alaska Fairbanks and* Soil Fertility Basics *and* Soil Sampling and Analysis *by J.L. Walworth, former Soil Scientist, Agricultural and Forestry Experiment Station, Palmer Research Center, University of Alaska Fairbanks.*