SL267

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Soils and Fertlilizers for Master Gardeners: Soil Fertility[1]

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This article is part of a series entitled *Soils and Fertilizers for Master Gardeners*. The rest of the series can be found at http://edis.ifas.ufl.edu/topic_series_soils_and_fertilizers_for_master_gardeners. A glossary can also be found at http://edis.ifas.ufl.edu/MG457.

Introduction and Purpose

Soils supply the 14 essential mineral nutrients needed to support plant growth. These nutrients must be dissolved in the soil solution (the water films that surround soil particles) in order to be taken up by plant roots. For the most part, soil minerals and/or soil organic matter supply these nutrients to the soil solution. Rainfall, irrigation water or fertilizers also contain nutrients, which enter the soil solution and then can be taken up by plants. Soil fertility is the natural ability of a soil to provide the required plant nutrients. The fertility status of soils is variable and is related to the chemical composition and physical properties of the soil, and inputs of fertilizers and organic soil amendments. This publication explains the important chemical properties of the soil that influence soil fertility. A specific discussion of the fertility of Florida's soils is also included.

Soil Chemical Composition and Fertility

Soils are composed of solids (mineral materials and organic matter), air, and water. The soil clay particles and organic matter are the smallest and most chemically reactive materials in the soil because of their large surface area per unit weight and chemical nature. This allows them to hold more nutrients for plant uptake. (See EDIS publication *Soils and Fertilizers for Master Gardeners: Soil Physical Properties*, http://www.edis.ufl.edu/MG451, for a discussion of surface area.) In contrast, the large sand particles are less reactive due to low surface area and a non-reactive chemical nature. As a result, sandy-textured soils have low natural fertility, while soils with higher clay and organic matter contents have higher natural fertility. In addition, soil pH can influence the ability of soil clays and organic matter to hold nutrients (see EDIS publication *Soil pH in the Home Landscape*, http:edis.ifas.ufl.edu/SS480, for more discussion about nutrient availability and soil pH).

When dissolved in the soil solution, most of the essential plant nutrients are positively charged (e.g., calcium [Ca^{2+}], potassium [K^{+}], magnesium [Mg^{+}],

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etc.). The exceptions are nitrate (NO_3-), phosphate (PO_4-), sulfate, (SO_4^{2-}), and chloride (Cl-). The positively charged nutrients are called cations and the negatively charged nutrients are called anions. The soil clays and organic matter have a negative charge so they strongly attract cations, just as the negative and positive poles of a magnet are attracted to each other. These cations can be removed from the surface of clays and organic matter and put back into solution where they are available for uptake by plants. In contrast, anions are repelled away from the soil clays and organic matter. This is why nitrate is considered to be a mobile plant nutrient and can move downward through the soil profile and pollute the groundwater. Some anions, such as phosphate, are relatively immobile despite their negative charge. This is because under normal conditions, iron (Fe) and aluminum (Al) minerals in the soil have a positive charge and they strongly hold phosphate on their surfaces.

The Natural Fertility of Florida Soils

The natural fertility of Florida's soils is low due to their sandy nature and low organic matter content, but the small amount (often less than 2%) of organic matter in Florida's mineral soils is responsible for most of the soil fertility (i.e., 95% of the nutrient holding capacity is due to the <2% of soil organic matter present in Florida s sandy soils). As a result, Florida soils usually cannot provide a sufficient amount of nutrients to growing plants. Consequently, homeowners may have to apply fertilizers to the soil in order to correct or prevent nutrient deficiencies. However, fertilizers must be used with care to prevent pollution of water resources. The only notable exception is the organic soils, which contain thick layers of organic matter and are extremely fertile when drained.

References

Obreza, T.A. 2002. Plant Nutrient Educational Modules for Horticulture. Module 3: Soil Chemical Properties. University of Florida, Gainesville, FL.