Soil: The Home for Plants

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Introduction

Despite soil being the foundation of our gardens, most people know little about it. First, we need to understand what soil is not. Soil does not necessarily equate to 'dirt.' As a soil science professor once stated, "Soil is what plants grow in; dirt is what you clean up off of the floor." This may be an over-simplification, but it holds a lot of truth. Soil is a dynamic, living system that enables plants to function properly. Dirt refers to a state or quality of uncleanliness.

Roles of Soil

Soil performs at least 4 roles in relation to plants. It:

- **Physically supports the plant.**
- **Provides the plant with water.**
- **Provides the plant with nutrients.**
- **Provides the plant roots with oxygen.**

Physical Support

The root system of most plants extends into the upper layers of the garden's soil. Depending on the plant species and the type of root system inherent to that plant, roots extend downward to about 8 to 12 inches in the soil. The roots provide structural anchorage for the plant.

Water Uptake

Most herbaceous plants are greater than 95% water. All of that water entered the plant through the root system. Water enters through the terminal half-inch or so of each root tip. The loss of water from the leaves by transpiration provides the force that drives water uptake into the root system. As water leaves the leaf surface, more water is taken into the root. An extensive root system allows sufficient water uptake to supply the need of the entire plant.

Nutrient Uptake

Soils act as a repository for the mineral nutrients that plants need. The nutrients are in solution in the soil water and are taken up by the plant as it takes up needed water.

Oxygen Supply

Roots are part of a living and respiring organism. As such, they have an absolute requirement for oxygen. The porous nature of soils allows oxygen uptake. One of the factors limiting how deep roots penetrate the soil is oxygen availability. Soil compaction can seriously limit oxygen supply.

Components of Soil

Soil is comprised of a mineral (inorganic, non-living) component and an organic (living or formerly living) component.

Mineral component

The mineral component of soil typically is broken down into subcategories based on the particle size of the inorganic matter rather than chemical composition. All come from the parent rock underlying the top layers of the soil. There are three general categories: sand, silt, and clay. Sand particles are the largest and range in size from 0.05 to 2.0 mm. Silt particles range from 0.002 to 0.05 mm and clay particles are those less than 0.002 mm

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(less than 7.8 hundred-thousandths of an inch). Sand and many silt particles are easily visible with the naked eye, but clay particles are best seen through a microscope. For perspective, consider that smooth-feeling talcum powder is a clay.

The percentage of sand, silt, and clay in a soil greatly impacts the water-holding capacity and air-holding capacity of a soil. A greater percentage of larger particles, i.e. sand, results in greater pore space because the particles cannot fit as tightly together. These soils can, at times, hold more water and allow more air penetration. They drain well, but also can dry out quickly.

Soils with larger percentages of smaller particles, i.e. fine silt and clay, tend to have greater density and cannot hold as much water or air. However, they do not tend to drain as rapidly as more sandy soils.

Organic component

The organic component in the soil is comprised of the living or formerly living matter. A teaspoon soil may contain billions of individual organisms. The majority of these are bacteria and fungi. However other living organisms may include insects, worms, and even plant roots. As these organisms die, they become part of the 'formerly living' organic matter. This organic component is a rich repository of nutrients which the plant will depend upon for future growth.

The average soil contains 2 to 5% organic matter. However, most Florida soils contain less than 0.5% organic matter. These soils have conditions which lead to rapid organic matter break down. High sand content means that the soils are well aerated and have higher oxygen content. The plentiful rains that Florida receives keeps the soil relatively moist, and the mild climate means that soils in Florida do not freeze. These conditions lead to high microorganism levels which increase the rate of organic matter decomposition.

Chemical Properties

Two chemical properties of soils especially are important when considering plant growth, pH and Cation Exchange Capacity, the ability to retain plant nutrients in the soil.

The pH is a measurement of the alkalinity or acidity of a soil. A pH of 7.0 is neutral, neither alkaline nor acid. Above pH 7 is considered alkaline and below is considered acidic. Plants typically grow best in soils with a pH that is slightly acidic (6.0 to 6.5), however, this is not an absolute. Soils in most of Florida (especially peninsular Florida) are alkaline due to the parent rock material from which the mineral components are formed. Florida's parent rock is comprised primarily of limestone and is very alkaline. The plants best able to grow in these alkaline soils are typically those native to high-pH soils. Organic soils tend to have lower, more acidic pH, however, as previously stated, Florida soils typically are low in organic matter.

Cation Exchange Capacity is a measure of the soil's ability to chemically bind plant nutrients. All plant nutrients are soluble in water to some extent. In their soluble form, most are ionic, that is, they have an electrical charge, either positive or negative. Positively charged particles are cations, and negatively charged particles are anions. The majority of plant nutrients are cations. Soil particles, sand, silt, clay and organic matter, typically have negative charges on their surfaces.

Opposites attract – positive to negative. The negative soil particles hold onto the positive ions much like magnets are attracted to each other. Of the inorganic components, sand has the least number of negative charges and clay the most. Organic matter has more negative charges than any of the inorganic components. The bottom line is that Florida's sand-rich soils with low organic matter do not have a great capacity to hold on to plant nutrients making nutrient management extremely important to successful gardening.

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