Colorado Master Gardener[sm] Program
Colorado Gardener Certificate Training
Colorado State University Extension

GardenNotes #211

Introduction to Soil

Outline:

Soil attributes

What is soil? Gardeners know that soil is more than simply broken up rocks. Rather than being an inert unchanging material, soil is a dynamic substance in which complex chemical and biological reactions are constantly occurring.

According to the Soil Science Society of America, soil is defined as, "…the unconsolidated mineral or organic material on the immediate surface of the earth that that serves as a natural medium for the growth of land plants." **Unconsolidated** materials are loose materials composed of multiple units (e.g. sand, gravel, etc.) unlike hard, massive materials like rock. Effective gardeners manage soils to produce healthy and resilient plants.

Soil contains a variety of substances. In a well-managed western soil, usually around 50% percent of the soil's volume is composed of solid particles, while the other 50% is empty space (Figure 1). Soil scientists refer to these empty spaces as "pores."

Most of the solid particles are derived from mineral sources such as decomposed rocks or sediments. Roughly 5% of the soil's volume is organic matter—plant and animal residues in various stages of decomposition.

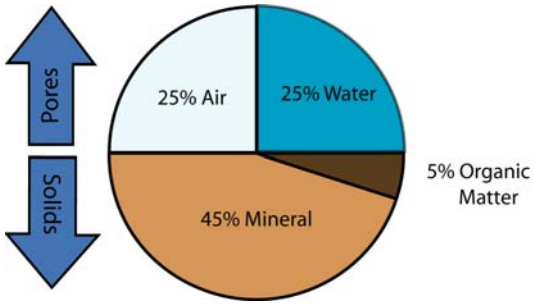

Figure 1: A Well-Managed Western Soil

The empty space between the solid particles can be occupied by water, air, or a combination of both. In a well-managed soil, about 25% of the soil's volume is air, while the remaining 25% is occupied by water. This

combination of components provides a healthy environment for roots to grow.

Soil-forming factors

Soils vary across the landscape. A Colorado gardener may have noticed substantial differences between the soil in his or her yard compared to their neighbor's soil. In Colorado, there are many different types of soils ranging from heavy clays to sandy soils to decomposed granite.

The factors that cause variation in the soils in different locations are referred to as soil-forming factors. Soil scientists recognize 5 soil-forming factors, including:

- Parent material
- Climate (precipitation, temperature, wind)
- Topography
- Biological organisms
- Time

These factors differ in subtle and complex ways over the surface of the earth to create an infinite array of soils. Climatic factors influence soil formation in several ways. First, precipitation and temperature cause weathering of rocks. In dry climates like Colorado (unlike warm, moist climates), wind is perhaps more important than water in weathering rocks and transporting parent materials. Together, these factors act over thousands of years to form soil.

The term **parent material** refers to the starting material for a soil. It consists of specific minerals (or organic materials) from which a soil is formed. The mineralogy of the parent material has a great effect on the mineralogy and properties of the soil.

Second, climatic factors often transport parent materials over long distances. Sometimes the parent material for a soil is **residual**, meaning it disintegrate in place to form soil. In other cases, the parent material is **transported** by water (rivers and streams), wind, gravity, or glaciers. Just like with weathering, wind is the primary means of transport in Colorado. Once the parent materials land on a stable surface, the process of soil formation can begin. The characteristics of the resulting soil will depend on the interaction of the remaining 4 soil forming factors on the parent material.

Soil variation

Soils are three-dimensional entities. Soil not only varies across the landscape, but also varies vertically with depth. Gardeners will notice changes in soil color, physical properties, and chemical properties as they

dig deeper. Over time, the soil-forming factors change the undifferentiated parent material into a vertically differentiated soil. Soil scientists recognize **horizons**, or horizontal layers within a soil. Horizons are identified by letter codes. They may blend together gradually or have abrupt borders between layers.

A Horizon (also referred to as "topsoil")

The A horizon is usually the surface horizon. This is an area of high biological activity with the greatest organic matter content. It is also a zone of leaching. As precipitation enters the A horizon, it dissolves soluble soil organic compounds and minerals. These dissolved compounds are then moved downward through the soil profile. Most plant roots are found in the A horizon.

B Horizon (also referred to as "subsoil")

The B horizon lies underneath the A horizon. This layer usually contains less organic matter than the surface layer, but accumulates the dissolved materials leached from the A horizon (clays, iron oxides, aluminum, and dissolved organic compounds). For this reason, the B horizon typically contains more clay than the surface layer. The accumulated products in the B horizon increase over time as the soil forms.

C Horizon

The C horizon contains unconsolidated parent material that has not been affected by the soil forming factors. It lies beneath the B horizon.

Landscape soils

Landscape soils differ significantly from agricultural or native soils. **Landscape soils** are soils that are found in a typical neighborhood community around homes, parks, schools, offices, parking lots, and buildings.

During the construction process, soils in communities are often graded by moving large volumes of soil. This process often removes the A horizon, taking with it the vast majority of organic matter. Furthermore, when construction workers drive large pieces of equipment over soil it becomes compacted.

Sometimes construction debris, such as wood, trash, drywall, bricks, asphalt, or concrete, is buried in the soil during construction. Other possible landscape soil changes include increased variability, increased surface crusting, increased pH, decreased drainage, decreased soil microbial

activity, and increased soil temperature. All of these factors can cause problems when managing soils around buildings.

In summary, soils are important to gardeners because they strongly influence plant growth. In Colorado, soils vary substantially horizontally across the landscape and vertically with depth. In addition, landscape soils may vary considerably from agricultural or native soils. Landscapers and gardeners must take these changes into account when developing a soil management plan.

Additional Information – *CMG GardenNotes* on Soils, Fertilizers and Soil Amendments:

#211	Introduction to Soils	#222	Soil pH
#212	The Living Soil	#223	Iron Chlorosis
#213	Managing Soil Tilth	#224	Saline Soils
#214	Estimating Soil Texture	#231	Plant Nutrition
#215	Soil Compaction	#232	Understanding Fertilizers
#216	Mulching with Wood/Bark Chips Grass Clippings and Rock	#233	Calculating Fertilizer Rates
		#234	Organic Fertilizers
#217	Asking Effective Questions about Soils	#241	Soil Amendments
#218	Earthworms	#242	Using Manure
#219	Soil Drainage	#243	Using Compost
#221	Soil Tests	#244	Cover Crops and Green Manure Crops

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