The DIRT Society

Introduction to Soil Science

Agriculture wouldn't be possible without soil, and yet it is often treated to one of two extremes; complete disregard or active abuse. Neither approach has ever yielded a healthy balance between consumer and resources. By studying the basics of soil science, you will not only learn to grow healthier and more productive crops; you will learn to be a better steward to your local ecosystem.

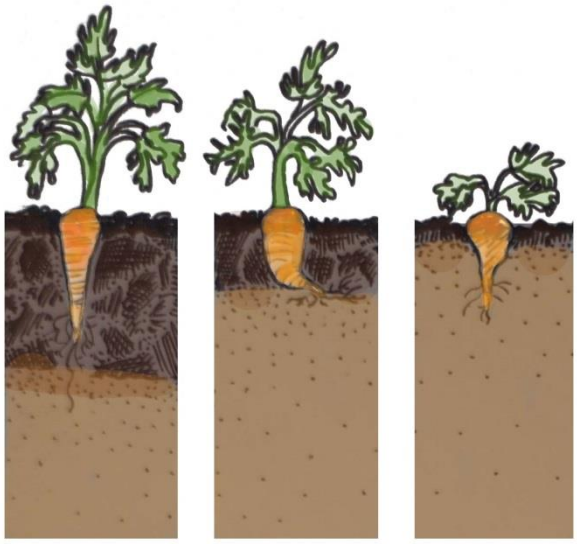
The very first thing to understand about soil science is this: **While we can improve a soil with amendments and simple structural changes, we can more easily damage the soil by interfering in natural processes without care.** While improvements are limited, the possible damage is seemingly infinite. With that in mind, the below information is to be treated like a soil science primer; sound, fundamental information that could **prevent** damage done to an ancient and irreplaceable natural resource.

Similarly to people, soils will range in character. Different soils will have widely varied histories, nutrient inputs, functions, relationships, etc. To better understand the soil you're living with, you can look for a few clues that will reveal its personality.

Before requesting any tests on your soil, appraise its appearance and structure yourself. As a farmer or gardener, your interaction with the soil will be limited to the uppermost layers of earth. Most plant roots are relatively shallow, so you will not need to dig deeply to find a good representative soil sample. By digging two or three feet deep, you will expose a large enough area to view key soil horizons.

Soil horizons are layers of noticeably different earth material. The uppermost layers are A, which is commonly known as **topsoil**, and B, the **subsoil**. Above these will likely be a moveable, light layer of organic matter; sometimes called O.

Most cultivated food crops depend on the topsoil for nutrient uptake. It should be well aerated, moisture balanced, and rich with microbial life. Depending on your location, this horizon should be a dark, porous layer. (The average depth in the United States is between 6 to 12 inches.) Its identity is swiftly changed, however. Walking on it, digging around or within it, adding or subtracting from it, temperature changes, pollutants, drought and flood, heavy wind; all of these can alter topsoil's potential. It is, therefore, both critical and delicate material.



Topsoil can be enriched over time. Adding organic compost, natural slow-release minerals, and missing soil matter can all greatly improve topsoil quality. What may be more important than adding positives, however, is removing negatives. By this, it is meant that refraining from a few detrimental practices will allow your topsoil to be better maintained over time. Some negatives that should be avoided are:

- Walking among crops or in plant beds
- Driving or operating heavy machinery on topsoil
- Tilling
- Constant removal of whole plants
- Preventing or discouraging cover-crop development
- Preventing or discouraging beneficial microbial and animal presence

In some cases, no topsoil will be evident. Below the loose, organic matter will be a thick, dense layer of subsoil. Unfortunately, this condition is not only difficult to remedy, but may be a clear sign that the local ecosystem is unhealthy. Topsoil can be stripped away after abuse; as toxic runoff when moved by water, or as dust during wind erosion. Great pains are now taken to ensure minimal topsoil loss, but a historical lack of understanding and appreciation for soil and ecology have meant great reductions in topsoil depth around the world. The amount lost could take hundreds of years to replace.

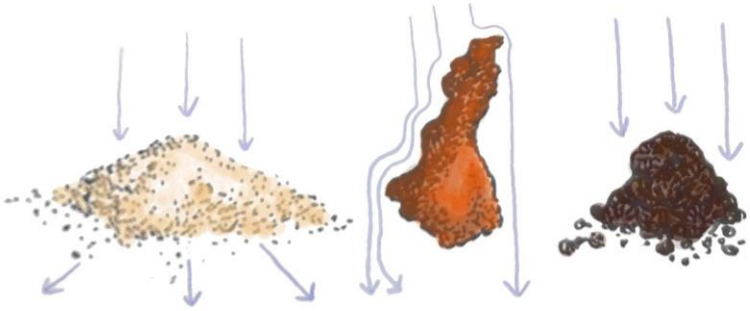
If the topsoil is present, the subsoil should be easy to distinguish. It is usually rich with absorbed minerals that will give it a brighter, lighter color. It will also be dense; obviously less porous. If too much compaction has occurred, or if water is not moving freely, root systems may divert laterally when they fail to break through the subsoil.

An unhealthy subsoil horizon will indicate greater problems with the whole soil structure. Ideally, the layer will be sturdy, but workable.

There are three general features that define your soil as a whole; color, texture, and structure.

Color will indicate mineral and biological content. A bright color typically means oxidized minerals. A dull, splotchy color indicates an excess of moisture. The best soil is usually dark brown or black; rich with balanced organic matter.

Determining overall texture is simple, but diagnosing the precise components that contribute to the texture is an exact science. There are three particles that make up the solid portion of soil; sand, silt and clay. Healthy earth is a mixture of these. If your soil is too sandy, it will fall apart in your hand and retain very little water as a foundation for crops. If soil contains a high percentage of clay particles, it will hold its shape in your hand. Clay soil can block water movement and compact easily. Silt particles are larger than clay, and smaller than sand. A good proportion of silt usually results in soil that, when squeezed in your hand, makes a solid shape that is moderately easy to crumble up again. The most fertile soil is loam; a mixture of these particles that will drain well, hold its shape, but remain porous and aerated.



Structure can be evaluated by analyzing the aggregates (sometimes called “peds”) within the soil body. A well-structured soil is one with spacious channels for air and water to move quickly, and smaller channels that will retain moisture for uptake by plants. These are macropores and micropores, respectively. When these channels are present, soil will break off into smaller chunks that reveal underlying characteristics. In general, however, moderately firm and porous structures are best; allowing for nutrient and microbial movement as well as consistently good drainage. To maintain an excellent soil structure, reduce compaction and exposure while gently applying organic material; the “glue” that gives the soil aggregates their shape.

Imagine a soil that has been vitiated by improper use or neglect. Because it drains poorly and contributes little, additional topsoil is added so that agricultural crops may thrive. The following scenarios are then possible:

Scenario 1: In the event that excessive rainfall occurs, the poor soil below will not be able to rapidly collect water and divert the flow gravitationally. As a result, the micropores will be overwhelmed, and flooding could occur above the root systems. This pooled water will then move across the terrain, pulling much of the costly topsoil with it. The result is infertile, wasted agricultural land and a water supply tainted with a heavy dose of minerals and microbes.

Scenario 2: An alternative to rain would be drought; another serious event that could cripple agricultural operations built on unhealthy, bolstered soil. This exact phenomenon occurred in North America during the 1930s; colloquially known as the “Dust Bowl”. During this time, soil was readily picked up by wind storms and blown across the entire continent; damaging 100 million acres of land.

Both of these scenarios are preventable. By reducing the damage we do to local soil structures, and by replacing nutrients removed in the agricultural process, we can maintain a healthy network of topsoil and subsoil that will support gardens and farms for generations to come. The first step, as always, is educating ourselves.