

UI Extension Forestry Information Series

Forest Soils versus Agricultural Soils

Randy Brooks

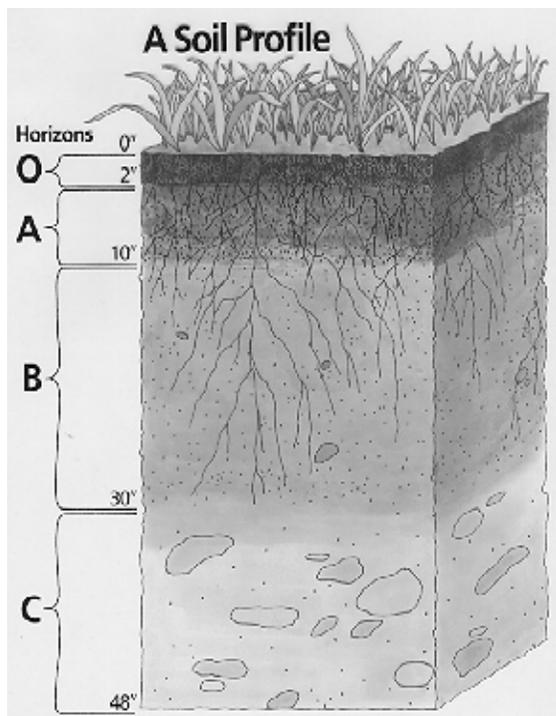
Soil or dirt? What's the difference? My college professor would get discombobulated when we called it dirt. So we posed the same question to him – what's the difference? He said that soil is what plants grow in and dirt is what you get under your fingernails! Big deal, we thought.

As a medium for plant growth, soil can best be described as a complex natural material derived from disintegrated and decomposed rocks and organic materials, which provides nutrients, moisture, and anchorage for land plants. A soil can be considered a product of its environment. Soils are formed from parent material (rocks, volcanic ash, etc.), by the action of living organisms (plants, animals, and man), climate, and topography over time. Soils consist of four basic components: mineral materials, organic (living or once living) matter, water, and air. These are

combined in widely varying amounts in different kinds of soil, and at different moisture levels, and can change as the environment changes or is modified.

Forest soils differ from agricultural soils in many respects. Agricultural soils were selected because of desirable chemical and physical properties. Foresters may regard the physical properties of soils as one of the more important factors. In agriculture soils chemical properties may be most important. In most areas of America, forest soils are those that were relatively undesirable for agriculture. Historically, the better soils have been cultivated while the poorer remained in native vegetation. Certain soil properties, such as rock content, prevent or restrict agricultural activities. Forest soils tend to be shallower with more rock than agricultural soils have. Since most forest soils occur on sloped terrain (especially in the west), they tend to be younger with more variability. Even so, some of these soil types can be very productive from a foresters perspective.

Fully developed forest soils are natural bodies with vertical layers. At the top is an organic surface layer or "forest floor" (O horizon) with subdivisions of fresh, undecomposed plant debris (Oi horizon, formerly called L); semi-decomposed, fragmented organic matter (Oe horizon, formerly called F) and humus; and amorphous organic matter without mineral material (Oa horizon, formerly called H). Below this surface layer is a mineral surface horizon (A); a subsurface mineral horizon often leached (E); a subsurface mineral horizon with features of accumulation (B horizon); a mineral horizon penetrable by roots (C); and locally hard bedrock (R). The E, B, C, and R horizon may be lacking, or the B horizon may be modified by groundwater or stagnant water. Forest soils usually are more



CONTINUED ON PAGE 2

shallow and rockier than agriculture soils. As a result, they tend to be more variable in their physical and chemical properties when compared to agricultural soils. The O horizon is usually more important in forest soil, as it is a primary source of nutrients.

Agricultural soils associated with rangelands and grasslands often have horizons similar to forested soils. However, if they are being cultivated, or have been in the past, they usually lack the organic (O horizon) layer. The A horizon usually has been mixed with parts of the E and even the B horizon, resulting in an artificial plow layer (Ap horizon). The B and/or C horizons may have been broken up by deep cultivation or ripping. The soils may have been so degraded by past human actions that they are no longer arable, as was the case in the southern United States before the large-scale commercial production of fertilizers. Such soils may still be classified as agricultural soils and used, for example, for grazing or non-cropping production. Agricultural soils are typically more uniform than their forested counterpart due to cultivation.

Recall that soils are formed from parent material. The nature of the parent material is of more importance in forest soils than in agriculture soils. As discussed by Ron Mahoney in *Good Rocks/Bad Rocks, the Latest Piece of the Puzzle of Natural Forest Fertility* (Woodland Notes, Vol. 8, No. 2, Winter, 1997), natural forest fertility can be traced to parent materials. More specifically, sedimentary rocks appear to be lower in nutrient values compared to soils formed from granites. In agriculture, fertilizers are added to amend any nutrient deficiencies. Thus, differences between the two soils are enhanced by the addition of agrichemicals and fertilizers.

Considering the natural landscape, you might wonder how native prairies and forests function in the absence of tillage and fertilizers. These soils are tilled by soil organisms, not machinery. They are fertilized too, but the “fertilizers” are used again and again, and never leave the site. Native soils are covered with a plant litter (the “O” horizon) and/or growing plants throughout the year. Beneath the surface litter layer, a rich complex of soil organisms decompose plant residue and dead roots, then release their stored nutrients

slowly over time. In fact, topsoil is the most biologically diverse part of the earth. Soil dwelling organisms release bound up minerals, converting them into plant available forms that are then taken up by plants growing on the site. The organisms recycle nutrients again and again from the death and decay of each new generation of plants.

There are many different types of organisms that live in the topsoil, each contributing in some form or fashion to soil fertility and health. An acre of living topsoil typically contains approximately 900 pounds of earthworms, 2,400 pounds of fungi, 1,500 pounds of bacteria, 133 pounds of protozoans, 890 pounds of arthropods and algae, and even small animals, in some cases. Therefore, the soil can be viewed as a living community rather than an inert body. These numbers, especially for earthworms, can be reduced by farm tillage practices.

In conclusion, forest soils differ from agricultural soils in many respects. Vegetation, rock content, well defined profiles, chemical and physical properties, nature of parent materials, and location/topography are just some of the factors that separates these two types of soils. In either case, the soil can be managed to remain sustainable, but that is another topic for another issue!

For more information on soil and soil organisms, browse the following websites:

http://www.soilfoodweb.com/sfi_html/index.html

<http://www.attra.org/attra-pub/soilmgmt.html>

<http://www.id.blm.gov/publications/crust/index.htm>

<http://www.liverpool.k12.ny.us/standards/lstandards/curriculum/sci/g3sci/soillayers.html>

This article first appeared in Woodland NOTES, Vol. 16, No. 1.

About the Author: *Dr. Randy Brooks* is an Area Extension Educator - Forestry and Associate Professor at the University of Idaho.