

Soil Health Principles

Living on
The Land

There is a whole world right under your feet! The soil is alive, and it should be treated that way. Farmers and gardeners use soil in several ways, focusing on its support of plants. But soil also stores and filters water, recycles nutrients, and provides habitat for animals. **Soil health** is the capacity of soil to function in these ways. It depends on a balance of soil's physical, chemical, and biological components.

Soil Biology

Soil is much more than a collection of minerals; every teaspoon of soil contains **billions** of living organisms. Each of these organisms has a job to do in soil.

Bacteria are soil decomposers. They decompose dead organisms and minerals. They also convert chemical compounds. For example, they transform nitrogen (N_2) from air into ammonium (NH_4), a form of nitrogen that plants can use. This process is called fixation.

Fungi are soil explorers. They seek out water and nutrients and exchange them with plants for food such as sugars.

Protozoa and **nematodes** are soil hunters. They consume other organisms and produce microbial "manure," an excellent plant fertilizer.

Earthworms are soil engineers. They work the soil and break down organic matter, making soil stronger and more fertile.

Feed the Soil

Each acre of soil contains enough organisms to equal the weight of two cows. So, you can be sure soil is hungry! Like humans, the soil requires nutrition, such as carbohydrates, proteins, and vitamins. The source of this nutrition is the sun's energy.

As they use photosynthesis to harvest sunlight, plants leak substances, including sugars and acids (called exudate), out their roots to feed soil microbiology (bacteria and fungi). In exchange, these "soil microbes" provide plants with minerals from their waste, including nitrogen, phosphorus, and potassium. This beneficial relationship encourages microbes to live in soil near plant roots. The root exudates and microbial manures are sticky and cause soil to clump into aggregates (Figure 1). Stable aggregates create good soil structure with pores for sufficient aeration and water infiltration.

The living and dead plants and organisms found in soil are collectively called **soil organic matter**. Although it makes up a small percentage of soil by volume (generally 1 to 5 percent), organic matter is essential for healthy soil.

The Five Soil Health Principles

#1 Keep the soil covered

Healthy soils have a protective surface layer of plant residue to control soil temperature and reduce evaporation. This maintains a favorable environment for soil biology.

You can preserve residue to keep soil covered by leaving crop residues in the field, reducing tillage, and adding organic mulch. For more information, see "[Under Cover Farmers](#)" (YouTube.com).



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Figure 1. Soil aggregates on cover crop roots.

#2 Do not disturb the soil

Soil, like people, can sustain stress. But chronic stress can have devastating health effects. Management practices that stress the soil include tillage, overgrazing, and pesticide use. These often destroy soil biology and stimulate rapid decomposition of valuable organic matter.

It takes years to lose organic matter and years to gain it back. Minimize your soil disturbance to minimize organic matter loss. To learn more, see “Soil Health Principles—Ray Archuleta” (YouTube.com).

Table 1. How do I know if my soil is healthy?

Healthy Soil	Unhealthy Soil
<ul style="list-style-type: none">• Feels spongy, cool, and loose	<ul style="list-style-type: none">• Feels hard, warm, and chunky
<ul style="list-style-type: none">• Looks dark, with signs of life	<ul style="list-style-type: none">• Looks pale and devoid of life
<ul style="list-style-type: none">• Smells sweet and earthy	<ul style="list-style-type: none">• Smells metallic or sour

#3 Keep living roots growing

To maximize soil improvement, harvest as much sunlight as possible. Do this by keeping plants and their roots growing. This feeds soil organisms and adds vital organic matter to soil.

You can plant cover crops between cash crops to cover soil, add organic matter, reduce erosion, add diversity, and suppress weeds. Try to plant several different species that work cooperatively and fit your budget and management needs. To learn more about cover crops, see *Managing Cover Crops Profitably, 3rd Edition* (SARE)

#4 Maximize diversity

The power of diversity is phenomenal. Each plant uniquely supports soil and its own “herd” of microbes. To gain the most benefit, grow different plants each season and across the farm to diversify plant cover.

You can use crop rotation and intercropping to introduce more diversity. Try to include in your cropping system as many of the functional plant groups from Table 2 as you can. For more information, see, *Crop Rotation on Organic Farms* (SARE).

Table 2. Functional plant groups and examples

Cool season grass wheat ryegrass	Warm season grass corn millet
Cool season broadleaf peas radish	Warm season broadleaf soybean sunflower

#5 Integrate managed livestock

Ruminant animals, such as cattle and deer, shelter microbes in their digestive systems. They increase nutrient cycling by helping with decomposition of plant residues all year, even when it is too hot, dry, or cold for soil biology. Grass then responds with vigorous growth that feeds soil.

You can care for soil by using a grazing management system. If livestock are not an option for you, then mowing can mimic many benefits of grazing. Find out more about managed grazing in *Pasture Principles for Smaller Acreages* (University of Idaho Extension).

Information presented in this article comes from the USDA Natural Resources Conservation Service (NRCS) in association with its soil health campaign, and the Oregon State University Extension Service. For more information on soil health, contact your local OSU Extension agent, Soil & Water Conservation District, or Natural Resources Conservation Service. Technical and financial assistance is available for landowners wishing to address resource concerns on their property.

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