



Farming in the 21st Century

a practical approach to improve **Soil Health**

What is Soil Health? Why Should I Care?

Soil health is *the capacity of a soil to function*. How well is your soil functioning to infiltrate water and cycle nutrients to water and feed growing plants?

Soil is a living factory of macroscopic and microscopic workers who need food to eat and places to live to do their work.

There are more individual organisms in a teaspoon of soil than there are people on earth; thus, the soil is controlled by these organisms.

Tillage, fertilizer, livestock, pesticides, and other management tools can be used to improve soil health, or they can significantly damage soil health if not applied correctly.

Managing for soil health (improved soil function) is mostly a matter of maintaining suitable habitat for the myriad of creatures that comprise the soil food web.

Managing for soil health can be accomplished by disturbing the soil as little as possible, growing as many different species of plants as practical, keeping living plants in the soil as often as possible, and keeping the soil covered all the time.

Manage More by Disturbing Soil Less

Tilling the soil is the equivalent of an earthquake, hurricane, tornado, and forest fire occurring simultaneously to the world of soil organisms. Simply stated, tillage is bad for the soil.

Physical soil disturbance, such as tillage with a plow, disk, or chisel plow, that results in bare or compacted soil is destructive and disruptive to soil microbes and creates a

hostile, instead of hospitable, place for them to live and work.

The soil may also be disturbed chemically or biologically through the misuse of inputs, such as fertilizers and pesticides. This disrupts the symbiotic relationship between fungi, microorganisms and crop roots.

By reducing nutrient inputs, we can take advantage of the nutrient cycles in the soil to supply crop nutrients and allow plants to make essential associations with soil organisms.

Diversify with Crop Diversity

Sugars made by plants are released from their roots into the soil and traded to soil microbes for nutrients to support plant growth.

The key to improving soil health is assuring that the food and energy chains and webs includes as many different plants or animals as practical.

Biodiversity is ultimately the key to success of any agricultural system. Lack of biodiversity severely limits the potential of any cropping system and disease and pest problems are increased.

A diverse and fully functioning soil food web provides for nutrient, energy, and water cycling that allows a soil to express its full potential.

Above ground diversity = Below ground diversity
(plants) (soil food web)





Grow Living Roots Throughout the Year

There are many sources of food in the soil that feed the soil food web, but there is no better food than the sugars exuded by living roots.

Soil organisms feed on sugar from living plant roots first. Next, they feed on dead plant roots, followed by above-ground crop residues, such as straw, chaff, husks, stalks, flowers, and leaves. Lastly, they feed on the humic organic matter in the soil.

Healthy soil is dependent upon how well the soil food web is fed. Providing plenty of easily accessible food to soil microbes helps them cycle nutrients that plants need to grow.

Keep the Soil Covered as Much as Possible

Soil should always be covered by growing plants and/or their residues, and soil should rarely be visible from above. This is true regardless of land use (cropland, hayland, pasture, or range).

Soil cover protects soil aggregates from 'taking a beating' from the force of falling raindrops. Even a healthy soil with water-stable aggregates (held together by biological glues) that can withstand wetting by the rain may not be able to withstand a 'pounding' from raindrops.

A mulch of crop residues on the soil surface suppresses weeds early in the growing season giving the intended crop an advantage. They also keep the soil cool and moist which provides favorable habitat for many organisms that begin residue decomposition by shredding residues into smaller pieces.

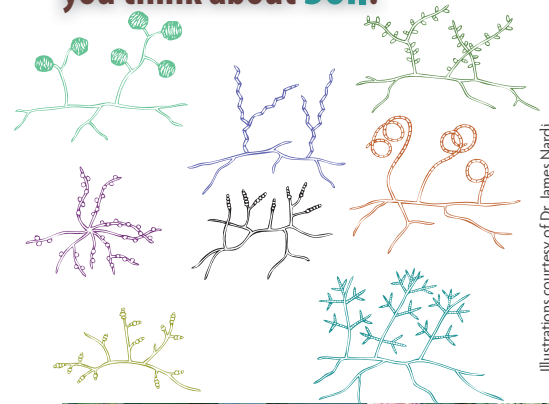
Soil Health for Your Farm, Ranch... for You!

Soil health is improved by disturbing the soil less, growing the greatest diversity of crops (in rotation and as diverse mixtures of cover crops), maintaining living roots in the soil as much as possible (with crops and cover crops), and keeping the soil covered with residue at all times.

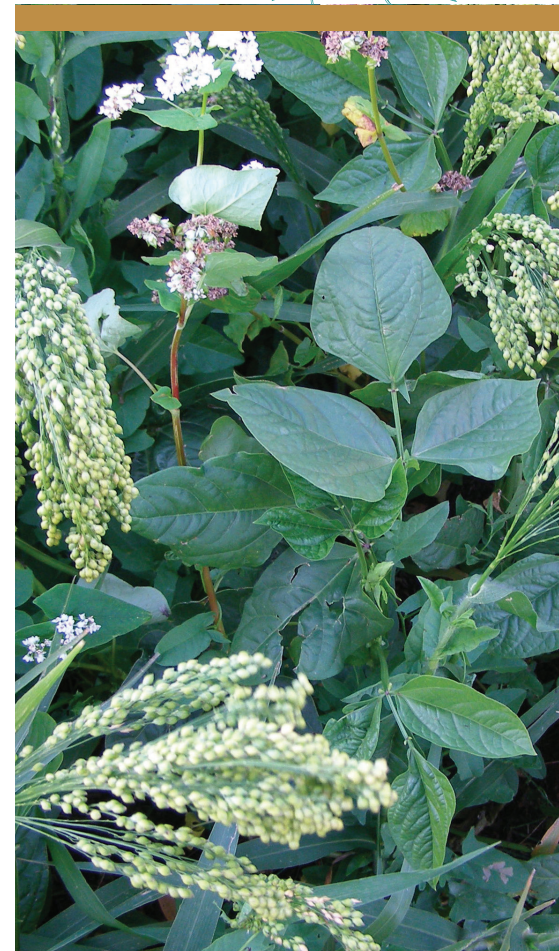
Drills, planters, seed, fertilizer, pesticides, livestock, fences, water, farm implements, etc. are all tools that can be used to manage the soil habitat for the benefit of living members of the soil food web.

Many soils have a water infiltration problem that causes a water runoff problem. If soil health is improved, the structure of the soil results in greater water infiltration, less runoff, less or no erosion, and reduced incidence of flooding and sedimentation.

Managing for Soil Health must begin by changing the way you think about Soil.



Illustrations courtesy of Dr. James Nardi, University of Illinois at Urbana-Champaign.



diversify with crop diversity

"The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, sex, religion, age, disability, political beliefs, sexual orientation, or marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410 or call (202) 720-5964 (voice and TDD). USDA is an equal opportunity provider and employer."

September 2010

Developed by the Soil Quality National Technology Development Team with contributions from North Dakota NRCS