USDA United States Department of Agriculture

Your Soil is Alive!

Understanding the soil food web on your land

More South Dakota farmers and ranchers are using soil health practices every year. Once they fully understand their soil is alive and they need to feed soil microbes to improve their soil, crops, and grasses, using the practices makes a lot more sense. Microbial activity in nature's soil food web is part of that understanding.

The soil food web

The soil food web is the community of organisms living all or part of their lives in the soil. This complex living system in the soil is a food web, not a food supply chain. The more diversity in the soil food web, the more resilient the soil. Understanding the soil is alive and how the food web functions has everything to do with how you farm or ranch.

How the soil food web works

When plants access solar energy, they use photosynthesis to capture and convert carbon dioxide from the atmosphere to simple sugars and then more complex carbohydrates and other compounds to help the plant grow. Importantly, a good amount of the carbon captured by the plants is "leaked" out through root exudates into what is known as the rhizosphere. These exudates—compounds like glucose, very simple sugars, organic acids, and amino acids—are really small, and easy for a soil microbe to digest. Along with decomposing plant materials, the root exudates are the energy that drives the soil food web. Without carbon (associated with organic matter) in the system, there would be no energy, no life.

The all-important rhizosphere

It's a big word, but a small space. The rhizosphere is the part of the soil that immediately surrounds living plant roots, not much wider than 1/8th of an inch. This is where root exudates are at their highest concentration and where bacteria and fungi are most active, and where protozoans and nematodes graze and prey on the bacteria and fungi. This is also the area of the soil where actively growing plant roots get their nutrients—keep in mind that there are far more beneficial bacteria, fungi, protozoans, and nematodes (good guys) than there are harmful ones in a healthy soil system.

Organic matter matters

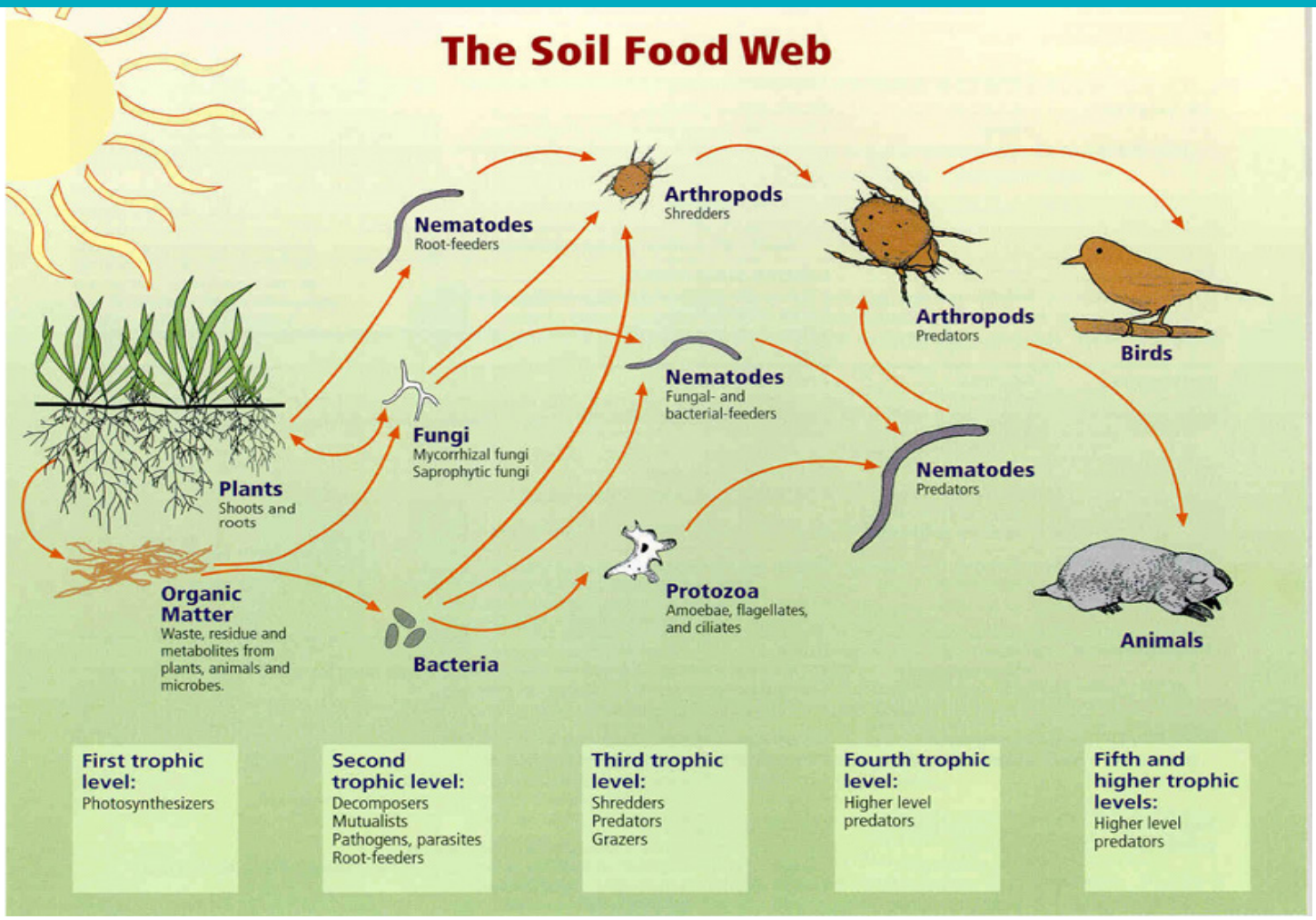
As with all of nature, organic matter is diverse. Larger particles, which include fragments of leaves and roots, are called particulate organic matter. It's not fully incorporated into the soil but is an important pool of available nutrients as it decomposes. As root exudates in the bodies of microbes and larger particulate organic matter are broken down to small particles, they become mineral-associated in tiny clay particles, where up to 80 or 90 percent of your carbon and nitrogen are stored. Particulate organic matter responds fastest to soil health practices, but both types are important.

Increasing carbon capture, diversity

While scientists are still figuring out exactly how root exudates, organic matter and other parts of the soil food web work together, we do know that climate-smart practices like cover crops and crop rotation and sound grazing practices work to increase carbon capture and aboveground diversity—and that in turn fuels all the complex interactions in the soil, including higher populations of soil microbes. We know that healthy soils are more nutrient efficient (think lower inputs) and more water efficient (think more able to withstand weather extremes) and, bottom line, more resilient.

This fact sheet was produced using information from an interview in December, 2022, with Dr. Andrea Jilling, soil organic matter researcher and assistant professor of environmental soil chemistry at Oklahoma State University.

GROWING RESILIENCE THROUGH OUR SOILS



The whole soil food web system is driven by solar energy that plants harvest through photosynthesis. The energy moves one way, as materials in the system are recycled and transformed.

There is much scientists don't know about the soil food web, but scientists and producers are finding more diversity and higher populations of soil organisms is key to healthy, productive soil..