Understanding Soil Microbes Could Help Agriculture, Environment

Rhae Drijber, a soil microbiologist at the University of Nebraska-Lincoln, removes a sample from a soil probe amid native grasses. Drijber studies the microbial communities that dwell in soil and how management practices such as tillage or fertilization affect them. Better understanding these microbes could help enhance crop production and the environment.

LINCOLN, Neb. — There's a whole other world beneath your feet. While the soil's ecosystem gets little thought, understanding the secret life of soil microbes could enhance crop production and the environment.

These invisible soil denizens are workhorses in complex processes integral to healthy plants and soils. Microbes perform all sorts of beneficial tasks such as converting plant residue to rich, stable humus, improving crop nutrient and water use, and enhancing soil structure.

A University of Nebraska-Lincoln scientist thinks microbes could help make agriculture more profitable and sustainable if we get to know them better.

Soil Microbiologist Rhae Drijber studies microbial communities and the influence of agricultural practices such as tillage or fertilization. Better understanding someday might lead to management schemes that enhance beneficial microbes.

"If we are ever going to manage agricultural systems from a biological perspective, we need to understand how management affects microbial function," the Institute of Agriculture and Natural Resources scientist said.

Drijber examines microbial communities under diverse conditions — from golf greens and crop fields to native grasslands and forests.

"Rather than isolate a particular bacteria from the soil and work with it in the lab, I'm trying to understand how the community functions together in soil," she said.

There's much to learn. An average teaspoon of soil contains up to 1 billion cells from 4,000 or more different species of microbes.

Drijber pulls soil samples from several depths. While the root zone – the top 8 to 12 inches – is the biological hot spot, she also samples the region 12 to 24 inches below the surface to collect historical information. There she finds more stable microbes that survived the high-carbon feeding frenzy and have been in the soil for years.

To identify different communities, Drijber's team uses lipid fingerprinting, a biochemical technique. This produces a distinct profile representative of the entire microbial population in a soil sample.

Fingerprints are unique to a specific microbial community. Drijber uses them to compare microbial communities, gather historical information and chart changes over time.

"When I look at a microbial lipid profile, it will tell me aspects of historical management as well as the more recently active groups of organisms," she explained. "I can dissect that fingerprint to get at specific groups of organisms but I can't tell individuals or functions."

In a study of a dryland wheat-fallow system in western Nebraska, Drijber compared microbial fingerprints under fallow and growing wheat fields that were plowed or no-tilled. She found significant differences that suggest a relationship between tillage and microbial communities' long-term resiliency.

"You need to know what's there and whether it has changed," she said. "If you don't know whether it has changed, how can you say anything about it?"

Drijber is especially interested in microbes' role in stabilizing organic matter in sandy soils because of these soils' importance to Nebraska and their vulnerability worldwide.

"If we understand how to manage organisms and organic matter in these systems, I think we can improve or maintain productivity in developing countries," she said.

Sand is common ground for her studies of golf greens, Sandhills range and native Minnesota prairie. Greens provide a highly managed model to contrast with more natural systems and cropland. Such comparisons provide clues about how management might influence important variables such as microbial biomass and organic matter.

A golf green study illustrated microbes' vital role in converting plant residue into humus. She found that organic matter under greens increases from near zero to 2 percent in 25 years.

"That's amazing. That humus is all produced by the microbes," Drijber said.

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