

Microbial MYSTERIES

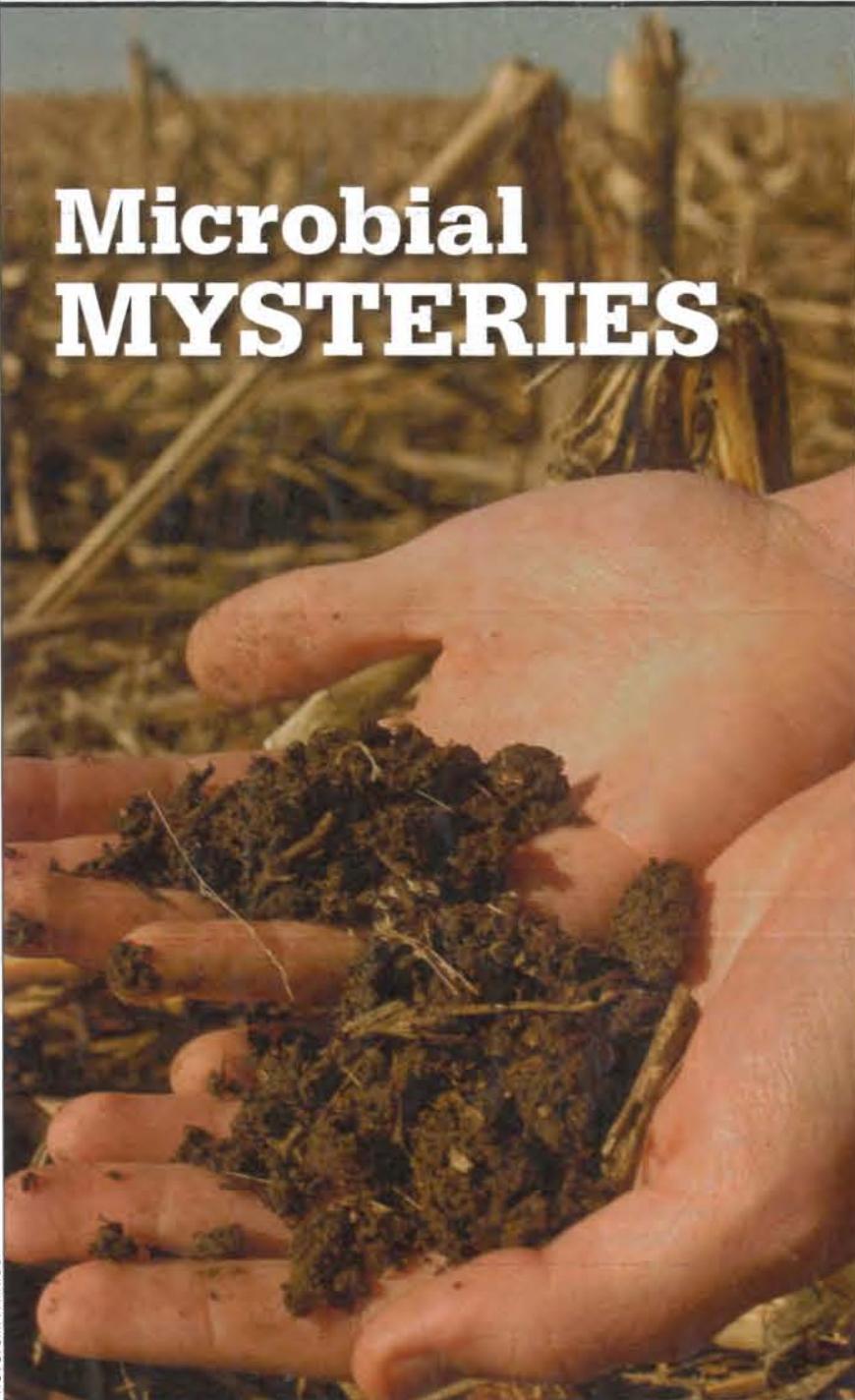


PHOTO: JIM PATRICO

Scientists work to unravel the role microorganisms play in building healthy and productive soils.

BY CHARLES JOHNSON

Inspect a double handful of soil and you're looking into a mysterious microbial world scientists are only beginning to understand. The crops you grow

depend on the interactions of these microscopic creatures, which can number in the millions in a single gram of soil.

Researchers still puzzle over

exactly how the tiny dynamos do what they do, and just what they all are. However, scientists do know the soil-borne organisms fall into some basic groups:

- ▶ Bacteria and fungi supply nutrients to roots through symbiotic relationships.
- ▶ Protozoa interact with and stimulate bacteria.
- ▶ Herbivores feed on roots.
- ▶ Nematodes eat microbes in the soil and, sometimes, roots.
- ▶ Grazers eat fungi and release nutrients.
- ▶ Predators hunt down and eat whatever other microorganisms they can find.

Put them all together with earthworms and their underground skirmishes determine the organic matter and health of the soil. The trick for farmers is to encourage them to work as naturally as possible.

TILLAGE DEGRADES SOIL. One obvious step soil scientists recommend: reducing tillage. Early results from tests in Iowa show fewer tillage trips help improve degraded soil.

"Tillage can have a dramatic effect on soil," says Tom Sauer, USDA Agriculture Research Service soil scientist at the National Laboratory for Agriculture and the Environment located in Ames, Iowa. "How roots find their way is related to structure. By not destroying it with tillage, you're going to change structure. There is a positive feedback between roots and soil structure."

"We see that certain decisions in managing land can have long-lasting effects on soil. Tillage is one of those long-lasting things," says Jay Lennon, Michigan State University professor of microbiology and molecular studies working at the W.K. Kellogg Biological Station at Hickory Corners, Mich.

Healthy soil has a balance of all those microscopic creatures at work

within it, and no-till encourages that, says Kris Nichols, USDA-ARS soil microbiologist at the Northern Great Plains Research Laboratory in Mandan, N.D.

“Changing management of the soil environment with tillage results in some organisms going high in number and others to disappear from the system,” he continues. “Problems like diseases occur when the population of one organism gets out of control.

“Healthy soil has diversity and is healthy when all the microbes are working to keep the populations in check by competing for food sources. Every organism is trying to live and reproduce for its own sake,” Nichols points out.

EXTRA COVER BENEFITS. Cover crops can also boost soil health. Increasing numbers of farmers are putting them to work.

“We’ve seen a dramatic increase in interest in cover crops,” says Ellen Phillips, University of Illinois Extension crop systems educator.

“In southern Illinois particularly, farmers are utilizing cover crops aerial-seeded into corn a month or two before harvest. They can overwinter those cover crops or till them in,” Phillips says.

One popular system involves seeding red clover into wheat. “That adds nitrogen to the field, which can be an advantage,” he continues. “It’s very important to add materials with sugars and proteins soil bacteria need to grow and multiply. There’s certainly a benefit in conservation tillage like that.”

Scientists using new DNA techniques are identifying previously undiscovered soil microbes almost daily. Figuring out what they do is not so easy. “We’re even finding little organisms one micron in size. Some reproduce quickly, even a couple of times a day. We’re working on learning what they do in the soil,” Lennon says.

Soil likes TREES

For severely depleted soil, the best restoration effort might be to go natural. Tom Sauer, USDA Agriculture Research Service soil scientist at the National Laboratory for Agriculture and the Environment, Ames, Iowa, is testing how returning fields to forested land and prairiegrass cultures can rehabilitate soils.

“We’re seeing how fast we can make profound changes. Iowa was originally 18% forested,” Sauer says.

“What we’re really interested in are those degraded, eroded lands that have lost a lot of carbon and are not viable to use in modern agriculture. We think forestry can offer something with economic opportunity.”

Biofuel opportunities have researchers investigating short-rotation woody biomass crops like willow. “Some are even looking at things like ginseng grown under tree canopies in Wisconsin,” Sauer says.



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