soil health matters:
MAKE YOUR SOIL HEALTHIER

Natural Resources Conservation Service

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If you want a more productive, self-sustaining soil that will improve rather than degrade with time, take a few lessons from Mother Nature. That's the advice from soil health experts who have worked with farmers to regenerate degraded soils.

Take lessons from Mother Nature, soil health experts say

"The diverse plants of the prairies cycled carbon back to the soil," says Dwayne Beck, manager of South Dakota State University's Dakota Lakes Research Farm near Pierre, South Dakota. "That slow, steady return of carbon to the soil boosted soil organic matter which continuously fed billions of microbes," Beck says. "Those microbes, in turn, broke down organic matter, making nutrients available to plants. This cycle produced the high levels of active organic matter in virgin prairie soils that accounted for the astounding yields sodbusters enjoyed in past generations."

But constant cultivation of farmland has taken its toll on organic matter and the topsoil itself. On average, most sloping agricultural land in the Midwest has only about half the organic matter and half of the topsoil that it had before it was first cultivated.

Tillage is the culprit

The latest research shows the less you till, the more carbon you keep in the soil to build organic matter—living and dead plant roots, microorganisms, insects and earthworms. "In tillage-based systems, mineralization is 'boom and bust.' Booms occur after tillage with busts following shortly after. In contrast, mineralization in no-till soils is more evenly spread over the season," Beck says.

Beck, who has researched no-till and used no-till farming methods on his own farm for more than 30 years, says no-till more closely mimics nature.

Using a no-till process retains organic matter in soil.

Create fields with soil like fence rows

All you have to do to be convinced of the soil-building power of nature is to look at the soil in a fence row, says Jim Hoorman, an assistant professor and Extension educator at Ohio State University.

"Any farmer can tell you his or her fence rows have the best soil on the farm," Hoorman says. "The organic matter there, where the soil was built naturally, may be 5 to 6 percent or higher, but on the soils being tilled, organic matter levels have been cut in half. And the critical part of what's missing is the active organic matter that comes from live roots." To create farm fields with soil like the fence rows, he says, tillage needs to be eliminated and continuous living cover needs to be growing as long as practical.

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No-till and cover crops emulate natural prairies

"Using no-till and cover crops, we can try to emulate the ecosystem functions of natural prairies," says David Lamm of the USDA Natural Resources Conservation Service (NRCS). "Prairies and prairie soils flourished with a diversity of plants, a minimum amount of disturbance, and living roots that grew throughout most of the year."

"Some of the most innovative cover crop users have continued to experiment with as many as eight to 15 different cover crops in mixtures on their farms, to see what each contributes to their system," says Lamm, the leader for the NRCS National Soil Health and Sustainability Team in Greensboro, North Carolina. "These farmers are breathing new life into their soils with no-till and cover crop mixes, and they're telling us they're getting all kinds of benefits."

No one species can deliver all the advantages multiple cover crops deliver in combination, he says. Some fix nitrogen, some are very good at scavenging leftover nitrogen in the soil, and some have deep roots that extend benefits deeper into the soil profile. Still others help control specific weeds or attract beneficial insects, etc.

Misconceptions about multiple species

Jay Fuhrer, NRCS district conservationist in Bismarck, North Dakota, agrees. Fuhrer has been studying, observing, practicing and recommending soil health measures for 20 years.

"Most farmers don't have enough crop types in their operation," Fuhrer says.

Having grown up on a small grain and livestock farm before he started his conservation career, Fuhrer knows the misconceptions well. "I used to think multiple crops would compete with each other, but I've learned they help each other grow if you follow the model of native rangeland diversity," he says. "You get some benefits from using two or three cover crops together, but the benefits are exponential with the synergy you create to feed the soil biology with a dozen species together."

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"First-time cover crop users tend to use only one or two species because they think that's simplest," Fuhrer says. "I think using one or two species is a step in the right direction, but using 10 or 12 species can actually accelerate biological time."

A multiple-species planting is actually easier and safer to manage than a single species cover crop, Fuhrer maintains. "The more diversity you have, the more plant balance you have above ground, and with that plant balance comes a more balanced soil biology below ground," he says.

Jump-start microbes with cover crops

Most farmers with experience in improving soil health have converted from conventional tillage to no-till farming. Then over time they added cover crops into their farm operations.

But there's no need to master no-till before you use cover crops with no-till, says Hoorman. In fact, he says farmers may be able to shorten or eliminate the short-term yield drop that often comes with no-till if they use cover crops from the beginning. "Those microbes in the soil need food year round, like any living organism," he says. "You can speed up microbial activity significantly with cover crops. The literature says there are 1,000 to 2,000 times more microbes associated with living roots than in soil without live roots."

Taken together with intensive rotations, no-till becomes a comprehensive program. "There's no need to fall back on occasional tillage," Beck says. "You don't

Forage legumes like alfalfa are a good option for crop rotations that do not deplete nitrogen from soil.

want to till occasionally, because one year of tillage destroys that environment for microorganisms you've been building for years."

"Cover crops are considered old-fashioned by some people in modern agriculture, but cover crop pioneers have figured out how to make them work on their farms, with some impressive results," says Joel Gruver, Western Illinois University's go-to guy in cover crops. "It's going to take home-grown innovation by farmers who haven't used cover crops to really ramp up their use. I say that because everyone's situation is different—cover crops aren't an 'off the shelf' practice that can be done the same way on every farm."

Gruver, an assistant professor of soil science and sustainable agriculture at WIU, points out that before World War II, when cheap nitrogen fertilizer wasn't readily available, most farmers included forage legumes like alfalfa and red clover in crop rotations ahead of nitrogen-demanding crops like corn. Forage grasses and small grains were also commonly used to curb soil erosion.

Low on the learning curve

"We're still relatively low on the learning curve of figuring out how to get millions of acres of cover crops planted and managed effectively," Gruver says. To make cover crop use mainstream, he believes many more farmers will have to adapt the practice to their farms, not just adopt the practice.

"Fortunately, many of the farmers trying cover crops now are experienced no-tillers or strip-tillers who have a track record of doing the type of trouble shooting necessary to make cover crops work consistently," Gruver says.

The principles of building healthy soils are the same everywhere, soil health experts agree. Key actions are to stop tilling the soil and to switch from a monoculture crop to a diversity of crops and rotations that provide a living cover on the soil throughout the year. Sounds a lot like Mother Nature!

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