



**HEALTHY SOILS.** Soil organic matter at Reddick Farms in Bardwell, Ky., has increased from 1% to 3% over the past 8 years. The Reddicks have also seen a significant decline in soil erosion since going all in on no-till and cover crops in 2018.

## **Building Soil Biology Boosts No-Till Goals, Fights Drought**

By [Brian O'Connor](#) posted on November 2, 2022 | Posted in [No-Till Farming 101](#), [Cover Crops](#), [Soil Health](#)

Soil biology is here to stay, says soil consultant Wayne Volkl, co-owner of SWJ Consulting based in Alburnett, Iowa.

“Big agriculture is now looking at it. You can't open up a farm magazine without seeing something on soil fertility and soil biology,” he says. “It's finally come to the light. I'm elated because it's been so overlooked for so long and it's now being addressed. I also think it's the new big frontier in agriculture.”

### **Bacteria, Fungi Build Organic Matter**

Volkl divides soil biology into two groups — bacteria and fungi.

“The thumb rule is: bacteria typically degrades organic matter, but fungi builds organic matter,” he says. “Fungi are the side of the equation that we need to be looking at because it's the most efficient piece of the biological puzzle out there.”

Soil Regen founder Liz Haney says of the volume of carbon dioxide (CO<sub>2</sub>) taken out of the air by plants, about 50% goes directly into the soil. Another roughly 25% is part of the plant's root system. The remaining 25% is converted to plant root exudates, sugars and amino acids that feed biological actors. Both bacteria and fungi contribute to soil organic matter.

“When you build up that bacterial and fungal component, those fungi die, and the bacteria die, and those cells become a part of organic matter over time,” she says.

In small areas, for example, her backyard garden and chicken flock, can result in about an inch of additional soil per year. The results aren't as drastic on large-scale operations but are just as beneficial, Haney says.

Among the beneficial fungi found in the soil are mycorrhizal fungi, which serve as natural extensions of plants, Volkl says.

"Mycorrhizal fungi can extend your root network by a hundred times, if not more," he says. "If you grow 3 pounds of roots and if you've got high mycorrhizal fungi levels, you have 300 pounds of roots."

Mycorrhizal fungi can also hold up to 10 times their weight in water, acting as a reservoir when precipitation doesn't materialize, Volkl says.

Volkl cites research by David Johnson, a molecular biologist at New Mexico State University, that supports the more fungi, the better.

"When you see the pictures of his research, it's pretty obvious that plants which have higher fungal levels in the soil do extremely well," Volkl says. "He found 0.3-0.5 ratio of fungi, bacteria [in the soil]. Then he ramped up his ratio of fungi to bacteria from 1:1 up to 5:1, and the pictures from his research plot were phenomenal. You'll immediately see the benefit of increasing that fungal mass in your soil. That's why I teach and preach how to perpetuate the fungal mass in the soil."

Arbuscular mycorrhizal fungi produces a sticky substance called glomalin. The substance enhances soil formation by acting like a glue to stick soil aggregates together, which the fungi then transport to the plant roots.

"Think of it as like a sponge," Volkl says. "That's what we want the soil to become because when we have air pockets. That allows oxygen and water to permeate down, and it also induces an aerobic environment. An aerobic microbe environment is what we want because aerobic biology produces all the positive, beneficial plant-available nutrients to the plant."

## **Feeding the Bugs**

Cover crops are one essential component to enhancing soil biology. Corn and soybeans are present in fields about 6 months of the total year. Without additional carbon to maintain biology, planting season comes at an inopportune time for the microbes.

"Here we are saying 'Grow, seed, grow,'" he says. "But the biology says 'Hey, I haven't had anything to eat for 6 months, and you want me to go out and work really hard? I don't think so.' If you didn't eat for 6 months, you might feel a little bit lethargic, too."

Biological elements of soil can survive long periods without adequate nutrition, but Haney says they respond more quickly when food is available.

“We have taken soils that were dried 80 years ago and added water to try bringing them back to life,” she says. “There was still some remaining dead biology in there that came back to life, but nothing like a soil that’s had a living plant in it for a long amount of time.”

## **Essential Testing**

Traditional soil testing can tell you the total potential of your soil, but it sometimes neglects how much is available for plant growth and development.

“It tells you how much grain you got in the grain bin, but generally it’s locked up, tied up and unavailable,” Volkl says.

Haney says soil tests frequently show elevated levels of phosphorous (P) and calcium.

“That calcium and P are bound together,” she says. “The way to unlock that is through cover crops and increasing the microbial activity in the soil so that stuff becomes more biologically available.”

Volkl frequently received recommendations to add additional sulfur to his soils when he farmed. When he asked if that would be available for the next growing season, he was told it would become available 2-4 years after the recommendation. His training and research have since given him an explanation.

“Elemental sulfur has to be converted to plant-available sulfur, which is sulfate, and then the plant will take it up,” he says. “There’s a little critter called thiobacillus, and his job is to convert that.”

Thiobacillus are a group of microbes that can convert metal nutrients, like sulfur, P, iron and zinc into plant-available forms. The microbial role in converting elements to useable forms can’t be underestimated, Volkl says, although it’s a departure from how he was trained.

“I remember one of my agronomy professors talking about the virtues of organic matter,” he says. “I asked ‘Why don’t we just work on improving organic matter?’ He looked at me, pointed his finger and says ‘Not in your lifetime, son.’”

The professor told him that the best possible outcome involving organic matter in soil was to prevent it from degrading.

“I wish (he) was here today because we are now building organic matter 0.1-0.5% per year, and it all focuses on fungi,” he says.