FARMER TO FARMER SUCCESS STORIES

# Start at the Top

## *Steve and Julie Berger, Wellman, Iowa*

*Washington County, Iowa, was an early leader in conservation agriculture. Steve Berger and his late father, Dennis, were two of its enthusiastic pioneers when they began to no-till in the spring of 1979, when Steve was just in the eighth grade.*

*With no-till and cereal rye now on 100% of their 2,200 acres of corn and beans, Steve and his wife, Julie, are continuing that legacy. They also own a 15,000-head hog finishing operation, which is an important part of their manure application program. They round out this source with turkey manure from a local farm.*

*Steve is a sought-after speaker on cover crops and no-till systems at conferences and on-farm programs in eight states, and is the recipient of numerous awards and recognitions for his conservation farming innovations. The farm participates in the Soil Health Partnership (SHP), an initiative of the National Corn Growers Association that seeks to identify and test various soil health practices.*

*The Bergers have made tremendous strides since their initial leap into no-till nearly four decades ago, but their original motivations continue to move them forward. "The most important things in our lives are our families; the next thing is the soil. That's the biggest number on your balance sheet you have to protect," Steve says. "You have millions of dollars tied up in the land. Why would you not want to protect that asset?"*

**Vol. 3, No. 5**
Farmer to Farmer Success Stories are a series of interviews of farmers sharing how they have found success in incorporating conservation into their operation. To follow this series, visit: *www.HarvestingThePotential.org*

**Q: What formed the background of your efforts in conservation farming?**

**A:** We were part of the early push for conservation in our area in the late 1970s, when our county Extension director, Jim Frier, held meetings for farmers to learn about no-till. Back then we didn't have the equipment, so we figured out everything by trial and a lot of error. Many farmers had train wrecks and would quit, but we stuck with it. Dad was a strong conservationist very early on. Retailers, the soil conservation service and other growers were actively supporting the effort. Back then, nobody knew anything about soil biology; we were simply trying to stop erosion.

We gradually increased our no-till acreage until we were 100% no-till by the mid-1980s. As we stuck with long-term, continuous no-till, we began to see benefits. No-till introduces a different soil environment in which microbes flourish. I seeded my first cover crop as a 4-H project in 1978, but because soil health wasn't on the radar back then, we didn't continue with cover crops until over 20 years later.

When we started no-till, it was a safe practice from a conservation point of view. The soil was not eroding off the hills, winding up at the bottom of the hill or washing into the river.

**Q: You stress five steps for boosting soil health and crop yield. How do you employ them?**

**A:** If you really want to improve soil health, you must start at the top. To reach step number five, which is feeding your cash crop, you have to go through steps one through four first.

Number one is to stop tilling the soil, and number two is to establish a cover crop. That leads to step three, which is increased microbial processes in the soil. That leads to step four, which is improvements in soil health. Finally, in step five, your healthier soil feeds your cash crops, which is where you get paid. That's how I think about the whole process.

**Step one: Stop tilling the soil.** The most active part of your soil profile is in the top few inches, where billions of microbes are living off the surface residue. Tillage breaks up the hyphae made by arbuscular mycorrhizae fungi (AMF) and also destroys all the channels made by earthworms coming up and feeding

"Most growers would say they're applying nitrogen [N] to feed their corn plant," says Steve Berger. "But I apply N so I can feed the microbial beast." Microbes need N to help them digest the abundant residue from crop stalks and terminated cover crops; they then cycle the nutrients back into the soil to make them available for the growing crop. One of the most important soil organisms is the arbuscular mycorrhizal fungus, which has a symbiotic relationship with crop roots.

on the residue. From the soil life's perspective, having your environment destroyed is like being in bed on the coldest month of the year and having a fire hose turned on you. As far as organic matter, it's already difficult to increase it; but I guarantee if you stir that soil, all bets are off – there's almost no way you can gain organic matter then because you're oxidizing carbon.

**Step two: Establish a cover crop.** As you stop tillage, it is imperative to start growing a cover crop. Twenty years into our continuous no-till program, we thought it couldn't get any better. However, we still had soil erosion on our hilly soybean ground and had problems keeping residue on the soil surface. In the late 1990s and early 2000s, we kind of plateaued and knew we needed to do more to keep the soil covered.

Finally, at the National No-Tillage Conference in Cincinnati in 2001, one farmer stood up and announced, "Fellas, we're still losing organic matter. We're not getting the job done." It was a kick in the butt for us to go forward with cover crops the way Jim Frier had advised us to do way back in 1978.

After we started doing cereal rye cover crops – which is now our go-to because it is the most economical, abundant and easy-to-grow species – our fields began to stay intact. We didn't see the change overnight, but our fields would stay put even after a big rain that would normally have had us dreading to go out and check our hilly ground. The high rainfall amounts in Iowa the last 10 years would normally cause a lot of erosion. But even a 4" to 6" rain doesn't move our resilient soils now.

Cover crops also reduce nitrates in the tile lines and do a good job suppressing weeds when used with a residual herbicide. It's not realistic to expect to move completely away from herbicides, but heavier rates of cover crops and diversity will help control weeds through competition. And no soil disturbance means fewer weed seeds are planted.

When you establish continuous no-till with cover crops, the microbes love that environment. If you can take it a step further and diversify your cover crop species, your microbial base number might double or triple. Each new cover crop species gives you a whole new rooting complex and secretes different types of enzymes, which attract different species of microbes. While we can accomplish 90% of our cover-crop goals with cereal rye, we can improve the soil even more with diversity, so we are striving to make it work economically.

When you have a green root living in the soil year-round, your microbial environment in the soil changes. One of the most important elements is AMF.

**Step three: The microbial processes in your soil begin to increase.** While we originally added cover crops to protect the soil surface, our understanding of the microbial processes under the soil began to increase at the same time. In 1996, Agricultural Research Service soil scientist Sara Wright discovered glomalin, the distinct, sticky protein from the threadlike hyphae of AMF. Glomalin is also the substance that helps bind soil particles.

AMF has a symbiotic relationship with the crop root. Its hyphae, which extends 100 times longer than a corn root, pumps nitrogen (N), phosphorus and moisture into the corn root and creates a bigger root system.

As we began to understand this, all the things we were seeing in the field began to make sense. As it turns out, our continuous no-till had changed the microbial environment over time; therefore, the microbes were decomposing the residue much faster. When we started putting a living root in the soil year-round through cover crops, our microbial environment improved even more. No-till and cover-crop roots make AMF in particular more plentiful. Overall, microbial processes flourish and increase in this system, which we have proven through Solvita $CO_2$ soil respiration tests.

**Step four: Your soil health improves.** At this point, we began to have resilient soils capable of building organic matter. Over time, our infiltration rates have greatly improved because of the improved aggregate soil structure from cover crops and no-till. Our soil has more pore space, soaks up water and holds together better. We have good infiltration with our surface-applied hog and turkey manures, and our soil has enough stability to support the heavier weights from trips with the drag hose and applicators across the field.

Earthworm populations also flourish because they have a food source and an environment that is not being destroyed. In our fields, it's not unusual to see middens everywhere. When we're laying tile, we can see numerous earthworm channels. The roots of cover crops and corn go right down those channels. Earthworms also have an enzyme or sticky substance full of carbon, N and other beneficial nutrients.

It takes time for the soil to get in shape, just like people who are going to the gym. Stop tilling the soil and start growing cover crops, and the microbial processes are going to improve your soil – which is what actually feeds your crop in step five.

**Step five: Healthy soils feed your cash crop.** Most growers would say they're applying N to feed their corn plant because it takes up N in the form of ammonium and nitrate. But I apply N so I can feed the microbial beast, which breaks down residue and makes the ammonium and nitrate available to my crop.

However, if you don't realize how this microbial process works and manage accordingly, the microbes will steal N from your corn crop, resulting in a "carbon penalty" that is experienced by corn in the spring. In the soil food chain, the corn doesn't get to the N first – the microbes in the top couple inches of the soil do. They take N from the soil to decompose residue in the spring. We want microbes to do this so they release nutrients back into the soil, but we need to serve them their N source to do it. It's like they're sitting at a bar, needing some chips to munch on.

That is why I spoon-feed N with different sources five or six times per year instead of just putting on "weed and feed" in the spring and calling it good. I'm trying to feed those microbes and fire them up. We have a lot of flexibility with a smorgasbord of delivery options, but a typical five-step N program looks like this: In both spring and fall, 30 lb. of total N per acre with surface-applied ammonium sulfate (AMS, 21-0-0-24); around March, 3,500 gallons of surface-applied swine manure per acre; at planting, 30 lb. total N per acre with liquid 32% urea ammonium nitrate (UAN, 32-0-0) and 3 gallons per acre of pop-up (6-24-6); and at the V4 stage, 50 lb. of total N per acre with 32% UAN sidedressed.

We started with cereal rye simply to prevent erosion, but since then we've learned that cover crops also play a role in nutrient cycling. Their deep roots – which in cereal rye grow up to 40" – pick up N and scores of other nutrients, sequestering them and preventing them from washing away until the rye is terminated in spring. As the cover crop lies dead and brown on the soil surface, the microbes digest the residue and cycle the nutrients back to the growing corn crop. However, this process is not automatic or predictable, so we're studying it further (see sidebar on last page). It's undoubtedly influenced by temperature and moisture: The warmer and wetter the conditions, the more N will be released back into the soil.

Overall, I think long-term no-till, cover crops and manure is an excellent system, and corn and beans thrive in healthier soil. Corn root systems increase, which is partially where I can attach a yield number. Our corn yield is about 20% higher than the county average, while our soybeans are about 13% higher. In 2016, we averaged 254 bu. per acre corn while beans averaged in the high 60s. That's with a corn suitability rating of 72, which is 10 points lower than the county average.

In 1979, the Bergers planted corn into a rye cover crop with their new Kinze planter for the first time. Now, their precision corn and soybean no-till equipment easily plants into cover crop growth higher than a man's head.

The Bergers' hog operation usually supplies enough manure to cover two-thirds of their acres; the rest comes from turkey farms. Eight to 10 samples from each hog barn are tested for nutrients before being surface applied.

"There is a huge difference between our soil and aggressively tilled soils from the same county," Steve Berger says. "It takes time to attain this kind of pore space, infiltration and aggregate stability."

**Q: In your opinion, how important is it to focus on organic matter?**

**A:** In Iowa, we've lost half our organic matter through 150 years of tillage. If you study organic matter long enough, it becomes a little depressing to find out how long it really takes to build it. I'm probably adding a tenth of a percent of organic matter per year through long-term cover crops, no-till and hog and turkey manures. Soil test numbers are highly variable on organic matter, too. The science is inexact.

**Q: What do you think is a reasonable pace of change for transitioning to this system?**

**A:** Environmentalists can be impatient; they want to see improvements right now, but making these changes is like steering a big ship in the harbor. You're just not going to turn it around in a hurry. According to researchers at the Ohio State University, it might take seven to nine years of no-till for the soil aggregate stability to change. If you add a cover crop, you could shorten that to two to four years.

Iowa farmers gave up the plow, but they didn't do it in one year. There is a learning curve, so slowly start to change on your farm, on your own time and with your own machinery. Start by no-tilling soybeans, which are easy. The next step is to no-till a few acres of corn in bean residue. Just take baby steps and learn.

Elbon cereal rye, planted on Sept. 27, 2016, is flourishing by Oct. 22. The Bergers increased cereal rye acres until they reached 100% coverage about 15 years ago. The success of a cover crop species is partially determined by climate; cereal rye is dependable in northern regions.

## Nitrogen Management Study

If farmers want to succeed with no-till and cover crops, "it is crucial to know how to manage nitrogen [N]," Steve Berger says. In coordination with the Soil Health Partnership (SHP), the farm set up a 16-acre test field with four plots replicated four times with variable rates of N: At 100% of their normal rate, 75%, 25% and 0% as a control.

They pull soil samples every week, using the Haney test to check levels of soil nitrates.

"The real need right now is N management, which is one of the limiting factors when working with cover crops," Berger says. "The million-dollar questions are when and how much N is being cycled to the crop. The mainstream farmer, me included, doesn't have the best handle on this, so we're trying to create a test that other growers can replicate."

The first set of harvest data this fall should offer a clue as to the most efficient rate. Berger is open to surprises.

"We don't think it will be the zero rate, but it may be one of the middle two rates," he says.

HARVESTING THE POTENTIAL
FARMING TO FEED THE WORLD

THE HOWARD G. BUFFETT

SOIL HEALTH PARTNERSHIP

The Howard G. Buffett Foundation is a private family foundation working to catalyze transformational change to improve the world and the lives of the most impoverished and marginalized populations. The Foundation has invested over $150 million in research to improve agriculture and an additional $350 million in agriculture-related programs globally.