Digging Deep, Taking Control

9 Farms — 9 Different Ways of Putting Soil Health in the Driver's Seat

By Brian DeVore

During the 2022 growing season, farmers, agronomists, economists, and market analysts agreed on one thing: the cost of planting a crop like corn was the highest it had been in decades, perhaps ever. And 2023 isn't looking much better. A lot of the blame for this pricey crop lies with the high cost of supplying fertility to plants these days. Natural gas is used to make fertilizers such as nitrogen, and the war in Ukraine, along with other factors, has disrupted the production and transportation of this fossil fuel. By September, fertilizer costs were running between $240 and $270 per acre — the previous high had been $140, according to Jason Ward, a commodities analyst with Northstar Commodity. "Anybody who makes fertilizer is seeing profitability," Ward told the *Star Tribune* newspaper in September.

Unfortunately, for most farmers, "making fertilizer" is not considered part of their job description. Crop producers usually purchase their source of fertility from manufacturers and distributors. As a result, the University of Illinois estimates that the "break-even" price — the price farmers need to cover their costs of raising a crop — will be near $5 per bushel for corn and $11 per bushel for soybeans in 2023. Headed into the 2022 harvest, the price being paid for both commodities was high enough to cover that break-even and produce a nice profit. But, as any farmer knows, commodity prices can be extremely volatile. Between 2001 and 2021, the price paid for corn on the Chicago Mercantile Exchange at harvest ranged from $2.08 to $5.37 per bushel, with an overall average of around $3.82.

The stranglehold purchased fertilizer has on the ability of farmers to make a profit was a prime topic of conversation during the Land Stewardship Project's 2022 field day season. Farmers shared various methods they have for taking more control over their soil's productivity and not being at the mercy of geopolitical upheavals or decisions made in corporate boardrooms. Some are using cover-cropping and no-till to build the kind of soil biome that is not as reliant on outside inputs of fertility and that keeps those nutrients from leaking off the land as waste products; others are stepping off the row-cropping treadmill completely and transitioning corn and soybeans into perennial grazing lands, relying on four-legged bioreactors to complete the nutrient cycle. Still others are combining enterprises that at first blush may appear to have little in common — rotational grazing and vegetable production, for example — to increase their return on investment and reduce risk. Finally, a lot of excitement is being generated by the idea of utilizing a cutting edge composting system to jump-start the soil's own ability to cook up fertility.

Scott Holthaus (*background, center*)**: "I'm just trying to get the nutrient cycle and the water cycle working on a daily basis, rather than on a three-month annual basis."** (*LSP Photo*)

Whatever the approach or the circumstances, it was clear this growing season that many farmers are determined to challenge the narrative that in fact "making fertilizer" is not part of their business model. The next few pages provide a summary of nine field days that prove healthy soil can be the ultimate input. ❍

Transitioning Crop Ground
The Basic Elements

On a stormy evening in mid-May, Scott Holthaus stood in a newly planted soybean field staring at a six-inch steel ring that had been pounded into the ground and filled with water as part of a soil infiltration test. After some 25 minutes, the water showed little sign it was going to soak into the hard, crusted soil. Holthaus gave up watching and looked over across the driveway at a 25-head cow-calf herd grazing a diverse stand of cover crops in a 12-acre field. During an earlier infiltration test in that field, water took just a few minutes to soak in.

"That's why I'm doing what I'm doing," said Holthaus as he walked away. "I want to be able to capture the sunlight and infiltrate the water."

And as he explained during an LSP pasture walk he was hosting that day, capturing those resources and turning them into protein is a key way he's transtitioning his family's northeastern Iowa farm from row- crops to perennial pastures. That 12-acres had been growing only corn and soybeans for the past 40 years, and this focus on limited diversity had taken its toll in the form of compacted, erosive soil.

In the fall of 2021, Scott and his wife, Amanda, seeded a four-way mix of rye, triticale, barley, and hairy vetch on that land. The mix overwintered and the Holthauses started grazing it in mid-May. The bright green of that verdant mix of covered land popped in contrast to the drab browns of all the bare fields in the neighborhood that had been tilled up for the planting of corn and soybeans. "Nowhere in nature do you have bare soil," said Scott as he led the pasture walk participants through the cover-cropped field while the cattle grazed nearby.

They are using no added inputs to fertilize the soils, and at one point Scott pulled up a hairy vetch plant and counted eight nitrogen nodules on the roots, a sign that one form of fertility was being grabbed for free out of the air.

The plan was to graze the cover crop mix a couple more times during the summer and then plant more grazing covers for use later in the growing season. The goal is to not only provide cheap forage for the cattle herd, but to build the soil's biology to the point where it will make a good home for perennial pasture. While Scott concedes he's just getting started building that field's soil health, he's excited to already see reduced erosion and better water infiltration on those acres. Grazing covers also takes pressure off the permanent pastures that are present on the farm.

The Holthauses, who operate their Oak

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Creek Pastures enterprise on Scott's family's land, hope to eventually start a similar transition process on the 19-acres of soybean ground across the driveway that's having problems soaking up moisture. It's part of their overall plan to create a livestock production enterprise based on perennial, grass-based systems that build healthy soil and cycle water efficiently. They are already direct-marketing beef, pork, broilers, and eggs raised using adaptive rotational grazing and other regenerative methods.

That may sound like a complicated process, given the long-term cropping history of the land and that the soil biome is one of the most diverse ecosystems on the planet, but Scott says what makes it manageable for him is to focus on two basic processes.

"I'm just trying to get the nutrient cycle and the water cycle working on a daily basis, rather than on a three-month annual basis." ❍

Mixing Enterprises
Optimal vs. Maximum

"This is our mess of a tomato patch," said Zach Knutson as he led a group of pasture walk participants into a tangle of knee-high grass on a warm evening in mid-July. As people parted the vegetation with their hands, they saw that yes, indeed, there were tomatoes growing there — lots of tomatoes. Knutson added that although the tomatoes aren't producing the kind of king-size fruit that wins blue ribbons at the fair, this method of production is proving to be economically viable. "If you can get over how ugly it looks," he said with a laugh.

Knutson and Brooke Calaway think a lot about optimal production versus maximum production. The couple, who are in their mid-20s, make it clear that they don't see corn and soybean production as the optimal use of the 177 acres they farm near Zumbrota in southeastern Minnesota. During the past few years, they have been transitioning row-crop acres to perennial pasture utilizing the grazing of cover crops to build soil health and break up pest cycles. They are also establishing a variety of trees in their grazing areas to create a silvopasturing system for their herd of Registered Shorthorns, which consist of 30 cow-calf pairs, along with yearlings.

But perhaps the most striking example of getting optimal productivity out of their land is that tangled tomato patch. During the tour, Knutson and Calaway led participants through five fenced-off, bright green patches that exist in one of their permanent pastures, and in one case, in their barnyard. As the tour participants parted the grasses that had grown up in areas that had been bale grazed the previous winter, a riot of peppers, tomatoes cabbages, beets, and broccoli revealed themselves. These vegetable plots are a low-labor, relatively pest-free way to get double the productivity out of parcels of land that normally would only be used for grazing.

Zach Knutson (*left*) **shows off a vegetable patch that had been planted into a bale grazed paddock. "Our opportunity cost for producing those vegetables is zero," he said.** (*LSP Photo*)

While many see stepping off the conventional corn-soybean path and mixing grazing, vegetables, and silvopasturing as a gamble, Knutson, who works in agricultural risk management, considers this system a safer way to start a farm business. That's particularly true at a time when sky-high input costs, fluctuating markets, and extreme weather are making commodity crop production akin to taking a spin on the agricultural roulette wheel.

"Going back to your Ag Econ 101 — optimal production versus maximum production — just because you can produce 300-bushel-an-acre corn doesn't mean that's the most productive point to be at," said Knutson. "You can produce more, but all of a sudden you're putting in too many inputs and you're not maximizing profit."

And it's at that point the couple bring up another economic term: "opportunity cost" — what one gives up when choosing one alternative over another.

In this case, those vegetables were planted in soil that was already fertile as a result of the nutrients the cattle stomped into the ground during bale grazing. Once they were planted, no time was spent weeding, spraying, or even trellising.

Calaway said that those vegetables are producing at a time — mid-summer — when that ground would be pretty much unproductive otherwise. "And in the fall, the cows will be out there harvesting those plants," she said.

"Our opportunity cost for producing those vegetables is zero," added Knutson. "We're not taking anything out of production."

They planted 256 trees representing over half-a-dozen species in 2022. It will be years before those trees produce shade for the livestock, as well as marketable products like nuts. But the young couple see playing the long game a much better bet than gambling on planting annual seeds in a volatile climate and market environment.

"On one of the calls I was on last week we talked about the struggles of the cash grain operations," said Knutson. "The spring's too wet, too dry. It's too cold. Those Goldilocks years are just getting harder and harder to come by. With the volatility comes higher highs and lower lows. It's great if you can catch those highs…but we're building for stability, not just for us, but future generations." ❍

No-till Organic
A Living Lab

Sometimes an experiment is just an experiment — and the results generate more questions than answers. That's the case with a foray into combining organic cropping with a form of minimum tillage that Mike and Holly Hunnicutt, along with James Koziolek, undertook recently on farmland near Hartland, in southern Minnesota.

As they explained during a field day in late July, the experiment involved utilizing a method called "strip-tillage" to grow organic soybeans. A form of minimum, or conservation tillage, strip-tillage involves clearing strips that are approximately six-inches wide in a field that otherwise might have residue from a previous year's crop covering the soil. The row areas between the strips are left undisturbed.

Strip-tillage provides many of the advantages of a pure no-till system: it saves soil, builds organic matter, and preserves moisture, for example. Because it exposes the seed bed to the open air, strip-tillage can help soil warm up faster during cold,

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wet springs, speeding up germination. It's a compromise between using the moldboard plow and leaving the soil completely untouched in a 100% no-till system.

But when Mike Hunnicutt started considering strip-tilling organic soybeans, he was told by other farmers it would be a disaster. Exposing even that narrow strip of bare ground would provide an open door for weeds, it was predicted. Since the field is organic, the farmers couldn't spray. And since it was in a minimum-till system, controlling weeds with a cultivator during the growing season was not an option.

"You're going to have a mess," Mike recalls being told. But he said he was looking for ways to reduce the number of times he ran equipment across his fields while protecting and building the soil. One problem with organic production systems is that they can be heavily reliant on tillage and other forms of soil disturbance in order to control weed pests, and that can result in erosion.

But innovative farming is full of ignored advice and contrariness. So, during the 2022 growing season, the farmers set up a side-by-side experiment on 120 organic acres. Part of the field was planted in a full, conventionally tilled system with no cover crops, while another was planted to a rye cover crop in the fall of 2021 and then, in the spring of 2022, seeded to soybeans. The standing rye was then "roller crimped"—a system where the plants are flattened with a drum or other device, crimping and killing it without herbicides. Finally, the third treatment involved strip-tilling soybeans into another section that had a light seeding of rye cover crop from the previous fall growing in it. That cover crop was killed off using a modified version of roller-crimping — the Hunnicutts and Koziolek jury-rigged a rolling barrel stock chopper to make their crimper.

In the end, the farmers were the happiest with how the strip-tilled soybeans turned out. "The soil health was just phenomenal, it was like crumbled cake. I mean there was no compaction or seed-to-soil issues," Mike explained at the field day. The rye sheltered the soybeans and helped them emerge without competition from weeds.

The farmers, who are planning on doing an analysis of what it cost to raise a crop under each treatment, say it's already clear they've garnered savings when it comes to time on the tractor cultivating and undertaking other practices to control weeds.

"Everybody's time is worth something," said Mike. "Whether you're doing one pass across the field, or 10 passes, you've got to get paid for something."

During a tour of the 120-acre plot, field day participants could see the strip-tilled soybeans were thriving, especially after a recent rain. They were also relatively free of weeds, and the dead rye was providing a nice cover between the strips. The part of the field that had been fully tilled and lacked cover-cropping was parched and crusty. The soybeans that were planted into rye and then fully roller crimped were a little behind in growth for late July, but Léa Vereecke, an organic crop consultant for the Rodale Institute who has done extensive research on this system of weed control, said roller crimped crops can start out slow, but catch up by August. However, the strip-tilled organic soybeans obviously had her flummoxed.

"So strip-tilling in organic? Hmm," she said with a laugh. "This is crazy, because bare ground that's not going to be tilled, it just seems like one of those things that's never going to work — there will be weeds everywhere. It has to be scientific somewhere. It seems like I need to do more research on this."

The Hunnicutts and Koziolek have enough farming under their belts to know that one successful growing season can't be relied on to determine how to produce crops far into the future. But this experience has taught them that not listening to the experts can have its payoffs, even when they are tattooed with question marks. There are plans to possibly repeat the experiment on corn ground in 2023, but there are no guarantees.

As Mike fielded questions about timing of cover crop termination, seeding rates, seed varieties, and pest issues, he made it clear that perhaps the biggest lesson to take away from this experience is to be willing to challenge conventional wisdom — and to not be surprised when things go differently the following season.

"Now next year could be a completely different story," said the farmer. ❍

"Now next year could be a completely different story," said Mike Hunnicutt (*left*) **of his experiment with strip-tilling organic soybeans. He's shown here with organic cropping expert Léa Vereecke** (*white shirt*) **of the Rodale Institute and Margaret Smith, an agronomist with Albert Lea Seed.** (*LSP Photo*)

Monitoring Success

Unearthing the Truth

After taking a mid-morning hike through a recently planted stand of cover crops on the Luke and Holly Bergler farm, some 40 field day participants gathered in a circle and provided a report on what they observed: earthworm middens, too many insects to count, some compaction, a few bare spots, birds, weeds, and, in a word, diversity.

"We need to re-teach ourselves the art and science of observation," said Allen Williams, a regenerative agriculture expert who does work on farms and ranches around the world with Understanding Ag, a consultancy company. Williams had been brought to this farm in southeastern Minnesota's Winona County by LSP on a day in mid-August to help teach some of those observational skills.

Luke Bergler conceded at the onset that what he observed on this land when they came here 17 years ago was that decades of tillage had taken its toll in the form of a hardpan at the plow layer, which was producing compacted soils and the inevi-

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table runoff and erosion that comes with it. They attempted to fix the problem with more intensive tillage, to no avail.

"We were just chasing our tail," he said.

The Berglers began building the soil's biology by planting cover crops, implementing no-till, and rotationally grazing their cow-calf herd. These efforts are beginning to show the tail-chasing days are over.

After tabulating what people had observed in the newly planted cover crop stand, Williams and Luke waded into a 20-way mix of cover crops that had been planted 60 days prior. It was a good five-feet high, and would provide prime grazing for the cow-calf herd. But Williams was more interested in what it looked like beneath the surface. He spaded up a clump of soil and showed it to the field day participants. The soil was dark, well-aggregated, cool to the touch, and moist on an 80-degree day. An adjacent cover-cropped stand had been baled up for winter feed after 30 days of growth. A sample grubbed up there showed soil that was crusted, paler, and drier. It was a good illustration of how keeping living roots in the soil for an extra few weeks has tremendous soil health benefits.

"The land does not lie," Williams said, paraphrasing famed soil conservationist Walter Lowdermilk. "The shovel does not lie."

Another thing that doesn't lie is water — its movement says a lot about how the land is being treated. Luke walked over to a stand of corn bisected by a grassed waterway, a sign that these fields are vulnerable to washing. The Berglers have been experimenting with 60-inch corn — a system where instead of planting corn every 30 inches, a gap is left every-other-row. The seed population was doubled in the existing corn rows to maintain overall productivity of the field.

In those un-corned gaps was planted a cover crop mix of brassicas, annual ryegrass, flax, and buckwheat. The extra solar energy reaching the cover-cropped rows increases the amount of forage available for cattle grazing after corn harvest — all while building soil health. Luke says such a system greatly boosts the potential income off the same patch of ground, although he concedes he hasn't found a way yet to put a direct dollar figure on the benefits of building soil health. That doesn't mean there aren't other ways to measure success.

"A few years ago this waterway, after a two-to-three-inch rain, would be full of silt," the farmer told the field day participants. "I cleaned thousands of tons of soil out of these low areas. Now it can take several inches of rain to see water running down that waterway, we're infiltrating so much." ❍

Converting to Pasture

Priming the Pump

A day after the Bergler event, Allen Williams was back out in the field, wielding his heavy-duty shovel. This time it was on a steep, Driftless Area hillside at the Rachelle and Jordan Meyer farm in far southeastern Minnesota, near the Iowa border. During the past few years, the young couple has converted hundreds of acres of highly erodible crop ground into perennial pastures, which they use to raise beef, goats, and chickens for their direct-to-consumer meat business.

"The shovel does not lie," said Allen Williams, shown holding a cover crop sample as farmer Luke Bergler (*blue shirt*) **looks on.** (*LSP Photo*)

Williams is a big believer in using annual cover crops as a biological primer — a two-to-three-year transition where the covers help serve as a link between an annual, monocultural system characterized by intense tillage and chemical use, and a deep-rooted, biodiverse, perennial pasture. Sometimes that transition period can be surprisingly fast when it taps into some of the hidden natural processes lurking beneath the soil. That appeared to be the case on one particular field featured at the Meyers' event.

As a steady downpour started to let up, the field day participants followed the young couple and Williams into the pasture, which had been idled for 25 years under a Conservation Reserve Program contract. In 2019, it was tilled and planted to corn. In 2020, after soybeans were taken off in the fall, the Meyers seeded rye. After the rye overwintered, they grazed it during the spring of 2021 and in mid-April seeded a pasture mix of perennial species like fescue, orchard grass, red and white clover, and birdsfoot trefoil. They used USDA Environmental Quality Incentives Program funding to set up a rotational fencing and watering system for their livestock.

By the time of the field day, they had been using adaptive grazing on the field for less than two years, carefully adjusting their stocking rates and rest periods. Jordan said when they first started grazing it, the field's soil was"lifeless" as a result of no animal activity for so many years. Cow pies routinely sat on the surface without being broken down — a sign of low biological activity. But he and Rachelle now feel it's come back to life, producing a good stand of forage for their animals while soaking in and managing water.

"How bad have we been lying?" Rachelle asked with a laugh after Williams' gave his "the shovel doesn't lie" talk and began grubbing up a soil sample. Actually, Williams said, he counted 17 different species of perennial forages in the short walk through the paddock; he guessed there were 30 or more in total. The Meyers didn't plant anywhere near 30 species, but they did prime the biological pump via their management, allowing the latent seed bank of perennials to get activated.

"Nature also played a role here, but you had to create the conditions through management for the latent seed bank to respond, and it did," said Williams. "This is the power of biology. This is an exponential effect, not a linear one."

While holding the soil sample, Williams pointed out the diversity of roots, lack of surface crusting, lots of bugs, and the soil's dark, carbon-rich color.

"I really, really like what I'm seeing here," he said as he gave the sample a sniff. Williams, who has a doctorate in animal science, said he was particularly impressed with the quick progression this soil has made, given that when he was in academia he used to teach students that soil improvements like this would take 100 years or more. "Less than two years is radically fast progress," he added as the farmers gathered around applauded.

However, there was room for improvement, Williams pointed out. Further down in the soil profile there were signs of compac-

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tion caused by years of moldboard plowing, and the color got lighter at depth, a sign that carbon had not yet been built deeper in the ground.

"So, good job," Williams said with a laugh as he pointed at the part of the profile where the soil's quality was dropping off, "to here."

"Give me another year," said Jordan. ❍

New Wave Composting
Working the Microbes

When dairy farmer Dale Pangrac first heard microbiologist Elaine Ingham speak about what she calls the "soil food web," he got extremely excited about the message she conveyed: soil has the ability to generate its own fertility and resistance to pests. That message resonated with Pangrac so strongly that he didn't buy fertilizer for the next growing season.

"That was a disaster," he said during a field day in late August on his family's organic farm near Lewiston, in southeastern Minnesota. "But I've learned a lot since."

What Pangrac has learned — from Ingham and others — is that in order for soil to become self-sufficient, a whole lot of damage has to be undone, biologically and structurally. Over a century of tillage alone has decimated soil's aggregate structure, and the post-World War II agri-chemical revolution nuked its natural processes.

"Give me another year," said Jordan Meyer (*red shirt*) **of efforts to bring a field back to life.** (*LSP Photo*)

"Our soil has basically lost its biological functionality," molecular biologist David Johnson told the more than 60 farmers, natural resource professionals, and others who gathered in the Pangrac family's cavernous machine shed. The good news is that the focus of the field day was how that biological functionality can be restored. Johnson, along with his wife, Hui-Chun Su Johnson, described how a cutting-edge composting system they've developed can jump-start soil's biological activity and, indeed, help it generate its own fertility.

"Your farm is an ecosystem — you have to adjust in each case," said Hui-Chun Su Johnson, shown here with her husband, David. (*LSP Photo*)

Their method is called BEAM (Biologically Enhanced Agricultural Management) and centers around the fungal dominant biome created using the Johnson-Su Bioreactor. Invented by the Johnsons, the bioreactor system represents a radical departure from the traditional way of taking organic material and breaking it down into a source of fertility via composting. Rather, the inoculant created by the bioreactor system activates the soil's innate biological functions — akin to a baker introducing yeast to bread dough — giving rise to a chain reaction of ecological activity that eventually results in more nutrients for growing plants.

Traditional composting relies on frequent turning of the waste material to keep oxygen flowing and thus prevent the material from becoming anaerobic. This greatly reduces the timetable for producing a finished product, which can be an excellent source of fertility for soil. The disadvantage to such a system is that it demands lots of labor during the breakdown process, and, if done on farm scale, can be infrastructure intensive, requiring turning equipment and lots of room for windrows. One big advantage to the Johnson-Su system is that it's scalable. A bioreactor stack can be set up for less than $50 using locally available materials like wire mesh and landscape fabric.

According to research by the Johnsons, the bioreactor system shows great promise for triggering healthy soil functions in a variety of farming situations, producing greater crop yields and more carbon sequestration, for example. However, most of that success has occurred in climates similar to that found in New Mexico, where the couple lives and works.

Since the summer of 2021, LSP has been working with the Pangracs and four other farmers — four in southeastern Minnesota and one in Wisconsin — to study if the Johnson-Su system will work in the Upper Midwest. Through this project, which is being funded by a grant from the Minnesota Department of Agriculture's Agricultural Growth, Research, and Innovation Program, farmers are experimenting with ingredients that can be found on local farms, such as livestock manure, forage material, forest soil, and wood chips.

David Johnson made it clear during the field day that the bioreactor system is not creating a direct source of fertility. Rather, it's setting the stage for the soil's microbes to build natural productivity.

"What we're doing is creating a feedback loop," he said. "This planet is what it is because of microbes."

The Pangracs are using it as part of an integrated system of building soil health that includes managed rotational grazing of their dairy cows. Other farmers who attended the event described utilizing it in conjunction with cover cropping and no-till systems.

That's important, said Hui-Chun Su. Adding a compost extract is not a silver bullet to bringing soil back to life — it works best if dovetailed with other soil health methods, she said. It also requires sharing information at events like this.

In fact, during the field day participants asked questions about everything from the

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equipment used to apply the compost extract, to the role of plant diversity and cover crops in building fungal life.

"This is a kick-starter," Hui-Chun Su said. "Your farm is an ecosystem — you have to adjust in each case." ❍

Cutting Tillage
Tractor Seat Economics

When Everett Rolfing realized 13 years ago that he needed a way to keep soil from washing off his southeastern Minnesota crop farm, he was absolutely certain of one thing.

"I knew no-till would not work for me," he told a group of two-dozen other farmers who were gathered in his immaculate machine shed for an LSP field day in early September. "I was full tillage — the soil had to be totally black."

Rolfing had heard all the knocks against no-till: it won't work on the kind of clay soils found in his part of Winona County, weed control and fertilizer incorporation are difficult, it would prevent the soil from warming up in the spring. But he was a bit desperate. When the farmer had sold his dairy cows as a result of bad knees, he knew that a major bovine feed, alfalfa, which at one point covered half his farm, would no longer be part of the rotation. That was a problem, because this perennial forage is very good at keeping soil in place, and Rolfing is mindful of soil loss on his farm, which is considered highly erodible.

"I'm on the township board and this May we had places where guys had to go out with loaders and scoop their dirt out of the road ditch," Rolfing recalled of the aftermath of an intense set of rainstorms in the area. "We had culverts that were plugged."

So, he gave no-till a try, and after a few hits and misses, his 550-acre corn-soybean operation is now 100% no-tilled, or, as Rolfing concedes, at least minimum till, since he does do some light tillage with a vertical tiller. And for the past three years, all of those acres have also been protected during the shoulder seasons by a rye cover crop. Each spring, he plants his cash crops straight into the standing rye — a method called "planting green." The rye is then terminated with herbicide, creating a thick mulch that protects and feeds the soil.

"When you terminate that rye, it takes it two to three months to disintegrate into the soil," he said. "I feel it's very well worth $14 an acre for that cover crop seed when I consider the benefits I'm getting out of that rye: erosion control, weed control, and soil biology build-up."

But Rolfing warned that increased soil biological activity does not come immediately. In fact, after years of conventional tillage, he found his soils were pretty much lifeless and unable to break down residue from previous year's crops. But he took the field day participants across the road to a stand of soybeans that was just a few weeks from harvest. The soil between the rows was absent of residue from last year's crop, as well as the rye cover crop — a good sign of active biology.

Rolfing recommended taking it slow, and not going 100% on no-till or cover crops. But once the soil's aggregate structure gets reclaimed, the payoffs can be significant, said the farmer. His erosion is next to non-existent, and in recent years it's been the soil health benefits that have impressed him the most. His fields work nicely during planting, weeds are under control, his yields are good, and he can see "15 to 18 earthworms per shovel full of dirt."

And that's money in the bank. Rolfing is a crack mechanic, and works on a lot of other area farmers' tractors. That makes him mindful of what it costs to run machinery on the land.

"When I was full tillage, I never made the money I'm making now. My diesel fuel use is approximately 40% of what it used to be, which means less hours on the tractor, less oil changes, less man hours," he said while sitting near a tractor he had been working on. "When the tractors aren't in the field, you're making money."

If Rolfing can be convinced of the efficacy of a practice like minimum tillage, then maybe a lot of people can have their eyes opened. Later in the day, Robb Miller, a dairy farmer just down the road from Rolfing, showed the field day participants a thriving stand of soybeans he planted after taking off a triticale cover crop for cow feed. He originally started planting cover crops 15 years ago to control erosion and scavenge excess nitrogen. Now it's providing good feed value for his herd.

"It is by far some of my most profitable acres," Miller said of the triticale-cash crop combination.

Miller reported that some of the area farms that had the worst erosion during the May rainstorms are now planting cover crops. Another reminder that erosion control can serve as a launching pad for a galaxy of other benefits — economical and ecological.

"So there's hope," said a farmer as he walked back to his pickup truck. ❍

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No-till farmer Everett Rolfing (*left*) **believes fewer trips across the field aren't just good for the soil. "When the tractors aren't in the field, you're making money," he said.** (*LSP Photo*)

Give it a Listen

Check out these *Ear to the Ground* podcasts to hear Land Stewardship Project field day hosts and presenters discuss the role soil health can play in profitable, resilient farming. Episodes can be found at landstewardshipproject.org/ear-dirt.

- ✔ **Episode 255: Embracing the Weed**
- ✔ **Episode 274: From Dirt to Diversity**
- ✔ **Episode 276: Why Regenerative Ag?**
- ✔ **Episode 277: 3 Regenerative Rules**
- ✔ **Episode 278: It Can Happen Anywhere**
- ✔ **Episode 279: We Are What We Eat**
- ✔ **Episode 280: Maximum vs. Optimal**
- ✔ **Episode 286: Tractor Seat Economics**
- ✔ **Episode 287: Opportunity Knocks**
- ✔ **Episode 288: More with Less**
- ✔ **Episode 289: Reflections on a Revolution**
- ✔ **Episode 290: Silt Suppression**
- ✔ **Episode 291: Shovel Doesn't Lie**
- ✔ **Episode 292: Working the Microbes**

Farmer-to-Farmer

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Blending Ecology & Economics
Opportunity Knocks

Joe Lawler is an accountant by trade, so, like Zach Knutson and Brooke Calaway, he thinks a lot about the concept of "opportunity cost." But his passion is farming in a way that leaves the land better for future generations. "The accountant side is on one shoulder, and the spiritual side of taking care of the land is on the other," he said on a recent afternoon in late September. But, he adds, "We can find a happy medium in-between."

On that particular day, he showed participants in an LSP field day being held on his family's farm near Rochester, Minn., a perfect example of that balance being struck. It was in the form of a 40-acre patch of prime pollinator habitat growing between stands of corn and soybeans. Lawler explained that this was part of a program he enrolled in through the USDA's Natural Resources Conservation Service.

Through the program, he was given an annual payment of roughly $330 an acre for two years to grow a mix of species that benefit bees and other pollinators: buckwheat, sunflower, red clover, dwarf essex rapeseed, and multiple clover species. As part of the deal, Lawler has been monitoring the patch of ground and noting how many bees are using what plants.

"It's been just blooming with bees — and pheasants and deer," he said.

But it's also been providing something else for the farmer: healthier soil and the build-up of fertility via the nitrogen-fixing clovers. And that's where the practical side shoulders in. The two-year contract expired in 2022, so next spring he will plant the field to a crop of corn that will be eligible to be certified organic.

Lawler calls using a program like this a "game changer," given that transitioning to organic can come with a lot of overhead expenses. "I'm not trying to garner profit during these two years, I'm just trying to cover expenses," he said of the transition. "We may miss out on opportunity cost those two years the 40-acres is in bee habitat, but in the long term what the farm gains from the pollinator habitat soil health-wise more than makes up for it."

The Lawler farm is full of these kinds of calculations. Part of the reason is that Joe, along with his father, Steve, and uncle, Tim, are farming in the Silver Creek watershed, and any runoff from that area impacts drinking water quality in Rochester.

"We take what comes off the farm very seriously," said Joe. "We'd rather it go into the soil."

That's why they utilize methods that build soil health as much as possible, such as no-till and cover-cropping. They have also devoted 30 acres of the around 600 acres they farm to University of Minnesota research. During the field day, U of M researchers showed plots devoted to studying cover crop seeding rates and termination methods, as well as corn silage production and small grains. A long-term nitrate study, which has significant water quality implications, has also been done here.

Joe Lawler (*left*) **thinks a lot about how to strike a balance between environmental and economic sustainability. "The accountant side is on one shoulder, and the spiritual side of taking care of the land is on the other," he said.** (*LSP Photo*)

The Lawlers — Steve is a resource specialist with the Mower County Soil and Water Conservation District — like to experiment on their own as well. For example, they showed a stand of corn that just a few weeks before had been interseeded with a cereal rye cover crop. The seeding had taken well, and the rows were bright green, just as the corn was starting to lose its color as harvest approached. Joe applied the seed with a "high-boy rig" — a machine with tall wheels that had, in a previous life, been used to detassel corn in Canada.

After he bought it, Joe modified it in a "Frankenstein manner," as he puts it, to seed cover crops before harvest. Because of weather and timing issues, farmers in the Upper Midwest often have a hard time getting cover crops established after harvest.

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Survey: Soil Building by the Numbers

According to the 215 Soil Builders' Network farmers and landowners who responded to the Land Stewardship Project's 2022 acreage survey:

- ✔ 13,200 acres moved into reduced or no-till practices since January 2020.
- ✔ 11,200 acres moved into cover crop practices since January 2020.
- ✔ 5,200 acres moved into rotational grazing since January 2020.
- ✔ 14,000 acres have seen a reduction in the use of synthetic fertilizer and chemical use since January 2020.

Altogether, 800 participants, primarily farmers and landowners from across southern/central Minnesota, northeastern Iowa, and western Wisconsin, were reached through LSP's soil health programming and partnering efforts during the spring, summer, and fall of 2022.

Join LSP's Soil Builders' Network

Interested in profitable ways to build soil health? Join hundreds of other like-minded farmers, natural resource professionals, and others in the Upper Midwest by becoming a member of the Land Stewardship Project's Soil Builders' Network. Members get regular updates on workshops, field days, and on-farm demonstrations, as well as the latest soil health and cover crop research.

For more information on joining, see the web page at landstewardshipproject.org/soil-health or call 507-523-3366.

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Interseeding before harvest can take the pressure off come October and November.

Two-and-a-half miles of new perimeter fencing was another example of balancing water quality protection with practical farming. The Minnesota Department of Agriculture's Water Quality Certification Program covered three-quarters of the cost of the fencing. The Lawlers were able to successfully make the argument that the fencing would improve water quality by allowing them to integrate Steve's beef herd into more acres on the farm via rotational grazing. The careful animal impact can build soil health, while providing an economic incentive to raise cover crops and perennial forages that can be grazed.

"It really brings life back to the soil," said Joe of the animal impact.

And life in the soil is long-term opportunity gained. ❍

Return on Investment

Compounded Interest

"Yield used to be king. Quit looking at yields." That was one of the first things Tom Cotter said during the opening session of a field day on his Mower County, Minn., farm in mid-September. That may as well have been the title of the entire event, which was sponsored by LSP, the Minnesota Soil Health Coalition, Superior Cannabis Company, Albert Lea Seed, and the Nature Conservancy. Cotter, along with guest speaker and soil health pioneer Gabe Brown, spent the rest of the day persuading the 150 farmers and others who attended the event to focus less on gross profit generated by bin-busting yields, and more on net return. And such an approach to accounting should be fueled by a close examination of just how much it's costing to produce each bushel of corn or pound of beef.

"As farmers, our profits are based on our ability to cycle solar energy," said Brown, whose North Dakota crop and livestock operation has become a showcase for profitable, regenerative agriculture. "Farmers and ranchers aren't deficient in nutrients — they're deficient in biology."

That message — a myopic, reductionist focus on yields while ignoring soil's innate potential to generate food and profits — was driven home again and again during the field day. It was made clear during an opening presentation in Cotter's machine shed, and again while looking at soil samples in a stand of sweet corn or checking how bale grazing had set the groundwork for a thriving stand of sunflowers.

Cotter raises organic and conventional crops, along with grass-finished beef, on 795 acres. He started planting cover crops in 1998, and half-a-dozen years ago adopted no-till. He says rotationally grazing livestock on cover-cropped and pastured acres is what really got his soil biology activated.

And that has resulted in what the farmer calls "lots of less." Cotter's low-lying farm is in the Cedar River watershed, and he's noticing less water ponding, fewer weeds, reduced erosion, and lower fuel and chemical bills since practices that build healthy soil were integrated into the operation.

"Human consumption is about more, more, more," he said. "Just give nature a chance, and the less I put on, the more chance nature has to do its thing."

But at the last stop of the day, Cotter showed a field that is actually characterized by "more," as in more diversity. He had participants wade into a waist-high, 19-way mix of cover crops he seeded in late July. They were sent on a kind of scavenger hunt to see how many species could be identified. It was a bit overwhelming — it turns out sun hemp stumped almost everyone. Cotter's goal was to graze it in the fall, providing economic value via the cow-calf herd. But the immense diversity of the mix, both below and above ground, will also help supercharge the soil's biology, putting the field in good shape to grow future cash crops.

In a sense, the farmer is "advancing biological time" with all this diversity and cutting years off what it normally takes to see significant soil health benefits, said Brown as he examined the stand. The compounding power of diversity — something that's long been shown in prairie ecosystems, for example — is gaining traction amongst farmers who are frustrated with the lack of resiliency in monocropped regimes.

"It would take Tom 19 years to advance soil health on this field with a monoculture of rye," said Brown.

And it turns out that more of something else is needed if regenerative farming practices are to become widespread.

"I talk about community a lot," Cotter said after the field day. "It's great to have Gabe Brown here, he does a great job. But realistically you need to find your core group within 20 miles and someone you can talk to five-times-a-week and really bounce ideas off of. And instead of learning one thing a year, I'm learning from 20 different people, so I'm learning twice as fast. It just keeps compounding." ❒

"I talk about community a lot," said Tom Cotter, shown in the middle holding red flags. "And instead of learning one thing a year, I'm learning from 20 different people, so I'm learning twice as fast. It just keeps compounding." (*LSP Photo*)