

Student of the Soil

Cade Bushnell, Stillman Valley, Ill.

Look, scout, troubleshoot and learn: Cade Bushnell, who farms 1,200 acres of strip-till corn and no-till soybeans in Stillman Valley, Ill., has been learning from his soils ever since he was “old enough to push in the clutch on the tractor.”

His dad, Fred, now 85, began farming in the early 1960s, when conservation farming was barely a concept. Concerned about erosion, he was the first in the area to buy a chisel plow, “which really made the neighbors talk,” Bushnell says.

By the 1980s, their tinkering with no-till turned into a serious endeavor. “We worked at it, made mistakes and learned a lot,” Bushnell says. In the early 1990s, they sold all of their tillage equipment.

On straight ground, which is about 1/3 of the acres he farms, Bushnell strip-tills continuous corn with a non-shank Dawn Pluribus unit. The remaining ground, which is hillier and/or terraced, is in a no-till, corn-soy rotation. Nearly all his ground is cover cropped, and all acres are enrolled in the Conservation Stewardship Program. Their approach is paying off: “This year was the best crop we’ve ever harvested,” he says.

Bushnell is married to Mari Lyn, an engineer. Their son, Ross, is studying agriculture at Iowa State. Their daughter, Grace, is earning a PhD in Biomedical Engineering at the University of Michigan.

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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 provided the foundation for your current practices?

A: My dad is responsible for the vast majority of what we are doing now. He has always liked experimenting and tinkering. For example, he was one of the first in our area to do soil testing. If he could see an advantage, he didn’t mind making a change; but he also knew that with change comes risk.

Q: What led to your decision to no-till and strip-till?

A: My dad has always been concerned about erosion. In the early 1970s he experimented with no-till, which was pretty early; back then the saying was, “no tillage, no corn.” In the early 1990s we went completely no till. Initially, we were trying to reduce costs.

The big thing I have learned over the years is that if you just take away tillage and don’t apply the necessary management skills required for no-till, it’s a recipe for disaster. Rotational tillage is not no-till either. Even if you till once every 20 years, you still lose some of the benefits of no-till.

I’ve gone to a more intensive corn-after-corn rotation to grow more organic matter (OM), so strip-till provides two chances to move residue away from the corn seedlings. I will make the strips in fall if I can; otherwise, in spring. I want all seedlings to emerge within 24 hours of each other. Strip tillage also allows me to warm up the soil.

Q: Do you have a personal philosophy or set of principals for your farming approach?

A: My personal philosophy is maximum gain (yield and profit) for minimum environmental cost, including soil health. I think I raise a better crop by putting my money in places other than iron.

The long-term effects of tillage have always concerned me. As a kid, it was always interesting to observe the soil profile while we were laying tile – the black dirt was 12” down and the grayer dirt was on top. This is because the intensive tillage in the 1950s and 1960s washed the soil off the hills and buried the better-quality soils downhill.

And I’m not an expert, just a farmer, but I try to be a good student of the soil.

Q: What mistakes have you made and how have you learned from them?

A: My biggest disaster in the last 25 years was in the only field I've ever tilled. In the early 1990s, we had to distribute up to 1 ft. of fine sand from floods across a very productive creek-bottom field. My mistake was in using same management decisions I would use in a no-till field, such as using the same no-till planter. As a result, I had a much-reduced population due to shallowly planted seed and herbicide damage.

Other than that, there haven't been any huge mistakes – just several poor management decisions on my part that compounded to a bigger problem. For example, we've tried to no-till without residue movers. I also wish I had laid more tile. On the hillsides, the water infiltration rate has gone through the roof and the seeps have gotten bigger.

Farmers have a fear of making mistakes. There is also a fear from their banker, who isn't sure they know how to manage a new program. There is a fear of what their dad is going to say. Sons would like to try new things, but dads or grandparents won't let them. The older generation is thinking about how few crop years they have left, while the younger generation is thinking about how many resources are going to be left in 40 years. It's just a different view of the same page.

But it's not a mistake unless you do it twice or more. You just have to be smart enough to learn from it. If you are thinking of doing this, fiddle with it. Make some small mistakes. Don't try to no-till a 500-acre field; try a 5-acre field and be a good student of what you did or didn't do. That means taking a shovel between the corn rows, not driving by in your truck.

Be honest and critique yourself. Probably the biggest thing that needs fixing on my farm isn't a new corn hybrid or a new fertilizer; it's the nut between the steering wheel and the seat – me.

Q: What is your residue management strategy?

A: I don't want to destroy the residue – I want to manage it.

As my soil health has improved, keeping enough residue on the soil surface, especially after beans, is becoming more of a challenge. I'm in my sixth year of corn-after-corn, and by the time I get to fall, the only corn stalks left from the previous crop are the ones that are standing. Usually the residue is gone after July.

Nutrient recycling is the hardest concept to prove, but this is what I think happens: After harvest, everything



Cade Bushnell examines a spadeful of soil in his 20-acre, no-till cover crop test plot, which is seeded to purple top turnips, spring oats and winter oats. He regularly tests and experiments with cover crops and other strategies, studying the soil closely as a student would a textbook.

that is water soluble in a plant – most of the nutrients – leach back into the soil. A cover crop then picks up those nutrients and sequesters them in organic form. When the cover crop is killed in the spring, it releases nutrients and micronutrients back into the soil when the corn is growing. Without a cover crop, if these nutrients haven't washed out of the soil, they have to go back into the soil and re-weather out of the soil chemistry. That takes time, and they may or may not be available for the crop in the following year.

Q: When did you start using cover crops, and what benefits have you seen?

A: I started planting cover crops about nine years ago. When you dig in sod, you can see what perfect soil looks like. Cover crops are a way to mimic that effect.

Cover crops also make a good strip-till and no-till system work much better. If you are cover cropping with tillage, you are losing 70 to 80 percent of the benefit of cover crops.

One reason I started cover cropping was because the biological life was reducing residue so quickly, we were getting some soil movement on the steeper slopes. With the ramped-up biological activity, water infiltrates the soil instead of running off the surface.

The same long-term thinking that applies to liming your field also applies to cover crops. I may not get a three-year payback on applying lime, but I know it pays off in the long term. Cover crops have also helped me increase my management focus on soil health in addition to crop yields.

Q: How do you determine your cover crop strategy?

A: The crescent wrench in my cover-crop toolbox is now cereal rye. It's versatile and really hard to goof up. It can be planted late, early, on top of the ground and in the ground. It's also very easy to kill in the spring with glyphosate.

It can be managed two different ways: kill it when it's short, and the carbon-to-nitrogen ratio is narrower; or let it get long to create biomass. Some of our best beans were planted in tall cereal rye, which seems counterintuitive.

I plant about 1,160 acres to cereal rye, saving some for seed to keep costs low. I have a 20-acre experimental cover-crop plot where I've tested things such as purple top turnips, spring oats, winter oats, Winfred brassica, radishes, crimson clover, sunflower, Ethiopian kale and fava beans. One year we tried a section with 30 to 35 different seeds. I will also take a smaller field and purposely experiment, like letting cereal rye get 5 ft. tall.

Q: How have these strategies benefited soil health?

A: Our soil health has gone through the roof. On some farms, we started with all-clay bare spots due to erosion from previous tillage. They harvested at zero. There are still some small areas like that, but they

shrink every year.

OM has come up. In 1961, when Dad bought the farm I live on, some places tested at just 0.7% of OM; the ground had been intensively tilled, and the OM just burned up. Since that time, OM has come up to 3.5-4%.

With the increased OM, the worm population and everything else associated with them flourishes. After the first rain following soybean harvest, there is no residue left. The night crawlers will pull it into their midden pile. Using the concept of underground livestock, there are about two "cows" per acre worth of soil life. They need to be fed!

Our marginal soils have definitely paid off the best and most rapidly with no till. The worse they look, the easier it is to see improvement. In the better soils, the rate seems to level off; in the last 15 years, they've picked up 1% OM.

These strategies have increased my efficiency, and I am seeing increased corn and soybean yields. We're able to cover a greater number of acres for fewer man hours by making *different* trips over the field. Pulling a chisel plow and field cultivator requires more man-hours than a sprayer and cover crops.

Q: Why is deep tillage detrimental to this strategy?

A: Tilling in corn stalks is like blowing air on hot coals. It oxidizes the OM as well as long-term humus, which make up the value in your soil. OM makes your soil more forgiving and more resilient. You need to preserve it.

Also, because the breakdown of residue is bacterial based, incorporating residue with tillage is like giving the soil microorganisms a huge Thanksgiving feast and then nothing to eat later, so they eventually die off. The fungal breakdown of residue in a no-till system takes more time. Beneficial fungi, which live for multiple years, are very sensitive to any kind of disturbance with tillage.

With no-till, you manage the residue on the surface. No-till also doesn't destroy the root structure of the harvested



This soil, which started at 1% organic matter (OM) in the 1960s, is now approaching 4% OM using no-till and cover crops. It has a high level of bioactivity and a granular structure.



The Bushnells enjoyed a record 220-bu average corn yield on their strip-tilled, continuous-corn ground in 2015. Multiple nitrogen (N) applications are used to increase yields as well reduce N-loss risk.



Soybean harvest was also excellent, with a low 60-bu average. On hillier ground, a no-till, corn-soy rotation is used. Bushnell's goal is to maximize corn and soybean yields, but not at the cost of soil health.

crop, which is a contributing factor to OM.

When you till 9" deep, you move the entire soil profile. Topsoil always moves downhill a couple of inches each time it's tilled. On my no-till ground, I can raise really good crops because all the dirt is where it belongs. I am not even comfortable with tillage in a high-traffic compaction situation. Instead, I've grown cover crops to try to alleviate that.

Some of my fields have never been tilled during my lifetime. In the last 24 years, I've conservatively saved 4 tons of soil per acre per year. You do the math.

Q: What are some management considerations you can share with your program?

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- Use a planter with some down force control, not a tillage planter.
 - Use residue movers with corn-after-corn.
 - Nitrogen management pays. Part of my risk reduction strategy in continuous corn includes 10 gallons of 32% on 2x2 placement with the corn planter, then sidedressing the balance.
 - Planting corn into a standing green cover crop can cause issues with shading and seed-slot closure. I like to kill cereal rye at boot-top height ahead of corn.
 - In beans, I've planted into 5-ft-tall cover crops very successfully; cereal rye can be terminated any time.
 - With cover crops, you need an excellent relationship with your spray operator or your own sprayer.

Q: Why is it important for more U.S. farmers to adopt these practices?

A: One of my concerns is the gradual degradation of our soils. Along Interstate 80, for example, the amount of erosion is pretty incredible. I-80 was built in the 1960s with all new fences, and now soil is washing over the fence posts in places where it began to be intensively tilled in the 1980s.

The biggest barrier is cultural; it takes effort to be introspective about why you do things the way you do. Landlords share some of the blame. If the landlord is just looking for the quickest return on their investment, then



Cade (right) and son Ross (left) carry on the conservation legacy begun by father Fred (center) in the late 1950s, when he began as an agronomist with Del Monte and bought his first farm in the 1960s.

it's hard to compete using no-till. The gap of understanding between farmers and nonfarmers will grow wider as we get two to three generations removed from the farm, too.

My gut tells me that if this country did cover crops on the majority of acres, a lot of the nutrient loading issues we are seeing in the Mississippi River and the Gulf of Mexico would disappear pretty quickly.

Q: Why is it important keep learning and not give up?

A: It goes back to that short-term gain versus long-term improvement. Some of the benefits aren't painfully obvious, but they make a difference. No-till is about working with the subtleties.

A lot of guys who give up are attempting half-heartedly, but the successful person is going to experiment and push their boundaries. This approach takes more management. The easiest thing to do is to make everything the same.

Dig, look at, smell and know your soils. Nothing is as educational as hand-probing soil samples again and again.

My goal is not to beat the soil into submission; I try to work with what I have been given. In reality, the soil is my teacher, and I am the student.