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VIEWPOINT

One Indiana farmer's response to weather variations

Dan DeSutter

Disclosure: I have been asked to provide a description of our farm's soil health philosophy, strategies, and progress, particularly in regard to adverse weather fluctuations. It is important to note that I was trained as a financial analyst, not as an agronomist. We always look for good data to base decisions on, but we don't always find meaningful data. In this case, the art of farming requires the use of "farmer's intuition" and the power of observation over time. The ideas that follow rely primarily on experiences of myself and others, history, and observation, with a little science thrown in to the best of my ability.

THE PROBLEM

In nature, manmade solutions tend to degrade resources over time. Natural solutions tend to improve resources over time. Let's be honest. American agriculture faces some serious challenges moving forward. We are responsible for the lion's share of nonpoint source pollution causing the dead zone in the Gulf of Mexico. Soil erosion is continuously depositing our topsoil and nutrients into our nation's waterways. Monocultures have increased our reliance on pesticides and genetically modified organisms, causing resistant weeds, diseases, and bugs to develop at an alarming rate. Water supplies that have fueled the productivity in vast areas of our country are becoming increasingly scarce. Perhaps most significantly, we have oxidized roughly half of the native organic matter of our soils into the atmosphere.

We have continuously migrated away from diversity toward monoculture. It is a testament to the ingenuity of man and mostly to the amazing ability of our natural systems to compensate in the face of environmental adversity that we have strayed this far and remained as productive as we have. But make no mistake, you can only short-circuit nature for a little while. In the long run, she always wins.

Dan DeSutter farms 4,400 acres of corn, soybeans, wheat, grassfed beef, and cover crops on mostly silty-clay loam soils near Attica, Indiana. With a finance degree from Indiana University, Dan worked as a financial analyst and commodity broker before returning to the farm in 1991. Dan and his wife Barbie have three sons in school and three full-time employees.

THE SOLUTION: MIMIC NATURE WHENEVER AND WHEREVER POSSIBLE

The good news is that nature provides us with a template that can solve and/or mitigate many of the problems we face. Our most productive soils were built under a prairie ecosystem over eons. Is it not logical that we look to this proven management construct for solutions to our problems?

As we contrast a native prairie system with our present agricultural practices, there are several obvious differences. First, in a prairie ecosystem, the soil is always covered. Just as we mulch our trees and flower beds, nature provides for soil cover 365 days a year. This cover protects the soil from erosion; helps maintain soil moisture levels that in turn foster biological activity; and insulates the soil from becoming too hot, which also helps maintain biological activity. We willingly spend money to buy mulch for our yards, yet we refer to field residue as trash.

Another lesson from the prairie is that there is always something growing throughout as much of the year as the climate allows. This means that there are actively growing roots nearly year round. We know that soil organic matter (SOM) is derived from rootmass. So to rebuild it, we must harness solar energy year round in the form of actively growing roots. These root systems also have another important function in that they are the primary food source of the rizosphere. Millions of soil flora and fauna depend on root exudates to thrive and in turn make abundant soil nutrients plant available.

A third lesson of the prairie is diversity. In some native prairie systems it is not uncommon to identify over 100 different species of plants within an acre. This diverse array of plant and root types results in a virtual soil symphony where complex symbiotic relationships develop to nurture soil microbial and fungal populations. These populations feed the plants and create robust health that results in plants that are much more impervious to insect, bacterial, and fungal attack.

This diversity also extends outside of the plant kingdom. Indeed, with multiple plant species come an array of insects, nematodes, and other soil "critters." We tend to think of these as pests that need to be wiped out. However, in nature, for every parasite there is almost always a predator. Through this diversity, balance is achieved. This concept extends to the fungal and bacterial communities as well. The balance created by increased diversity will result in a healthier ecosystem that will be much less dependent on man-made, Band-Aid solutions. Band-Aids can be necessary, but they are temporary and don't address the root problem.

OUR ADAPTATIONS AND EXPERIENCE: LEARNING TO THINK BIOLOGICALLY

Starting back in 1983, my father converted from conventional tillage to ridge tillage. When I came back to the farm in 1991, we converted to no-till. Our earliest inclinations toward reduced-tillage systems were driven by the need to control soil erosion. As we noticed the impact these practices had on soil productivity in general, and as our understanding of soil health has developed, we have incorporated a variety of practices. Phases or adaptations we have moved through since include strip-till, Nu-till, use of hog and chicken manure, cover crops, cover crop cocktails, and cover intercropping (figure 1). Currently, we are looking at perennial cover intercropping.

We have also become livestock farmers. Even though we do have a grass-fed beef business, I am not referring to our beef livestock. Rather, we now understand that in order to optimize production and maximize the environmental benefits of our cultural practices, we must evaluate all our management decisions within the context of our soil livestock. Understanding how our actions affect our underground workforce has become central to our management decision process.

We find that in order to make an extremely complicated biological system manageable, it helps to break it down into an admittedly over-simplified mindset. First, our livestock need to breathe. We need to make sure that our soil livestock are not spending extended amounts of time in an anaerobic condition because our "workers" are primarily aerobic. There are two parts to this equation. Chemically, we want to make sure that we have the proper calcium (Ca) to magnesium (Mg) ratios so that the soil can "breathe." Physically, we want to use roots to break up compacted layers and build a sort of deep, Swiss cheese system of macropores and micropores so that roots can follow these decayed root channels to water and allow oxygen (O_2) into the soil.

On many of the soil types we farm, we find it is necessary to add tile drainage in order to allow plants the opportunity to live in an aerobic environment consistently enough to put down extensive root systems and build the system of root channels that allow the soil to breathe and function best. We use real time kinematic technology to design and install all our drainage systems on the contour. This allows us to variable-space our tile lines, optimizing drainage and cost. It also sets the stage on flatter fields to introduce drainage-water management. Presently, we feel we can minimize tile runoff through judicious, just-in-time fertilizer management and by keeping a growing plant in the field at all times in order to absorb, or "sink," any free nitrates (NO_3) or phosphates (PO_4).

The second important practice to maintain our "herd" in peak condition is water management. A soil covered by mulch at the surface and containing root- and earthworm-induced macropores is able to absorb water at rates far higher than conventionally managed soils. We can't control torrential downpours, but we can increase the likelihood of keeping rainwater on our farm and in our soil by keeping it healthy.

Also, by increasing SOM, we increase a soil's ability to store or hold moisture. For every 1% of SOM in just the top 30 cm (12 in) of soil, we can store 154,275 L water ha^{-1} (16,500 gal water ac^{-1}). Where we have practiced systemic no-till and added cover crops and manure, we have seen SOM on many farms increase over 2%. In other words, a 2% increase in SOM in just the top 30 cm is the equivalent of 3.18 cm (1.25 in) of rain.

Anyone that has ever experienced teenagers knows that air to breathe and water to drink is not enough. Indeed, our soil livestock also have a voracious appetite. In contrast to conventional soils that are typically fallow nine months of the year, we endeavor to have live growing plant roots throughout as much of the year as is climactically possible. The resulting active rizosphere provides the soil food web necessary to foster maximum microbial activity. It is these same root systems that are essential to rebuilding our SOM.

Finally, our soil livestock need cover from the elements in order to thrive. While some contend that our desired soil blanket can insulate the soil and prevent it from warming up quickly in the spring, this is actually an advantage 95% of the time. The most crucial time for yield determination in corn (*Zea mays* L.) and soybeans (*Glycine max* L.) occurs during reproduction, typically in July and August. Bare soil this time of year means much higher temperatures in the root zone, which can slow or halt biological activity and thus lead to loss of yield.

By successfully providing a layer of mulch over the soil surface in our cash crop, we maintain soil moisture and temperature at levels much more conducive to maintaining peak biological activity. This activity is responsible for making nutrients available to the reproducing plant at a critical time. We feel that fostering peak mineralization during ear and pod set is the most efficient and effective way to feed our cash crops and maximize yields.

CONCLUSIONS: WHERE THERE IS A WILL, THERE IS A WAY

I have purposefully refrained from discussing the specific equipment and how-tos of our system. These are not unimportant details. However, they can and will vary from soil to soil, climate to climate, and farmer to farmer.

Instead, I've attempted to impart the most important aspect of our system: the mentality. When confronted with challenges and obstacles in an agronomic system, look first to nature for the solution. In almost every case, she has already figured out a solution that will be far more potent than the best laboratories can conceive. It is my hope that in the future, scientific resources will be utilized to increase our understanding of natural systems and provide technology that will help us to mimic and use them to our advantage whenever possible as opposed to the current system, which is focused more on how to fix the problems our agronomic short-sightedness has caused.

Another important mindset comes in the form of trying to simplify our mental paradigms. We are just beginning to understand and appreciate an extremely complex soil biological system. The interactions that occur below the soil surface are no less complicated or powerful than the systems which function beneath our own skin. In the face of such complexity, we farm-

Figure 1

Dalton DeSutter pictured in the growth of a 12-way cover crop cocktail mixture after wheat.

ers must strive to keep the main thing, the main thing, namely, providing O_2, water, food, and protection from the elements to our crops and soil livestock while maintaining and improving the environment and soil resource that we have been given.

There is no single system that will apply to every farm. Hopefully, as understanding increases, both in academia and at the farm level, increased adoption of good soil health practices will occur. This will in turn lead to an agricultural system which is more robust and able to function at a high level even in an era of increasing climactic variability.

In our own case, the movement toward better soil health has had a tremendous positive impact on our bottom line at the farm level. Healthier soils have increased yield while simultaneously reducing our costs. I am also confident that this improvement in our profitability has been achieved while improving our soil resource and our environment. We are not afraid to use inputs and pesticides where they are warranted, but we have learned to better identify the circumstances requiring their use.