Soil Health Trial Update 2014

Healthy Soil is Resilient Soil

We are now in the fifth year of our soil health experiment on the Woodson Ranch. The intent of this project is to gather and disperse information on the applicability of no-till farming and cover crops for building soil organic matter and soil structure in our arid environment.

Since we started this effort "soil health" has become common agricultural terminology nationwide. Look for it on Google or YouTube and you will find dozens of inspiring articles and videos about farmers, ranchers and agencies working hard to improve soils for a better bottom line and a healthier environment. Even the big agricultural companies are acknowledging the importance of healthy soils in trade publications and advertisements. Hopefully we are witnessing a lasting change in our attitude towards soil as a living resource.

Since the advent of synthetic fertilizers and pesticides following World War II, soil has been treated like a sterile medium that simply holds up plants, and requires regular destruction and supplementation to produce a crop. We are now re-learning that soil is actually a thriving biological system that can meet many of our demands without these inputs if cared for properly. In other words, healthy soils are resilient soils that can continue to produce a crop despite fluctuations in weather patterns, pests, and input costs.

Unfortunately, this shift in management mentality cannot come fast enough. Studies from around the world indicate that current farming practices will only afford us enough soil to feed people for decades, not generations. It is easy to think this doesn't apply to us here in SW Montana, but we have all seen the soil blowing off fields this winter, and know deep down this resource can only last for so long.

Soil is the foundation of everything we do and care about in this community, and therefore must be considered with every management decision we make. Healthy soils provide food, habitat, clean water and clean air. It is our sincere hope that this project will help encourage the adoption of practices that not only conserve our soil, but restore and build it as well.

Carbon is the Key

Soil Organic Matter is the foundation for a functioning soil ecosystem. SOM fuels the microbes that carry out critical belowground activities. It contains important nutrients that, when mineralized over time, provide a lasting food source for plants. SOM also helps the soil matrix hold more water, often the most limiting factor for growth in our environment.

So what is Soil Organic Matter? The entire answer is very complicated, and deserves a lot more of your time. However, in general, SOM is dead plant and animal matter that has been decomposed into simpler carbon compounds by soil microbes. The carbon originated in our atmosphere and was then "fixed" in a plant by photosynthesis. That plant eventually ended up in the soil to be eaten by critters.

The longer these carbon chains reside in the soil, the longer they grow. They also get harder and harder to eat, becoming more likely to stay in the soil as humus, the stuff that gives soil its beautiful dark color.

Future SOM waits on the surface of our no-till field, ready for critters to incorporate it into the soil.

Building soil means building Soil Organic Matter and ultimately the amount of carbon stored in a soil. To do so requires that we leave abundant plant residue on the soil surface as crop stubble, forage residue, and manure. These materials will be incorporated into the soil by critters and form the backbone of the soil ecosystem. We also need to encourage as much root growth as possible throughout the year, as roots are a critical source of carbon and other foods required by soil life.

Unfortunately, building SOM is much harder than destroying it. Microbes are always eating our OM, so we need to put more back than is consumed each year. Moreover, a couple passes with a plow, or years of careless overgrazing can rapidly undo decades of soil building.

There is a lot of talk these days about the effects of carbon in our atmosphere, and what to do about it. The answer is right under out feet. Given the chance, the soil will store all the carbon we can feed it. At the same time these carbon compounds provide a lasting food source for critters and plants alike and allow our soils to function at their full potential. Sure seems like a "no-brainer" to us.

Soil Organic Matter at the Woodson Ranch

SOM is measured annually on the Woodson Trial using conventional soil tests. Currently OM ranges from **3-4%.** Rapid change in OM as part of this study is unlikely for a few reasons. First, we started out with good SOM levels compared to 1-2% at neighboring properties and 5% in native plant communities. Secondly, this process takes time. Again, it's slow to build but easy to burn. And finally, our climate is cold and dry, while plants and microbes (the sources of SOM) like warm and wet.

However, there is always room for improvement. Simply maintaining existing conditions is not going to cut it with the ever increasing demand on limited resources. Our goal is to see continual increases in Organic Matter up to 5-7% or even more.
What is your goal?

How to Grow More Quackgrass and Canada Thistle

Two widespread crop invaders in the Ruby Valley are quackgrass and Canada thistle. Countless gallons of chemical and diesel have been used to "renovate" infested fields, but they are still as prevalent as ever, suggesting they like what we are doing.

Till It

Our trial plots make it pretty clear that these species love to be tilled. In fact, due to their rhizomotous (root-spreading) nature, tillage helps them to disperse and thrive throughout crop fields. Each pass of a disk or plow cuts the roots into tiny pieces that can grow into a new plant. The contrast between the tilled and no-tilled plots at the Woodson Ranch is quite striking. Over the 4 years Canada thistle patches have grown considerably in tilled plots and actually stop when they get to the plots that haven't been disturbed with a plow in recent years.

In addition to the impacts of tillage on soil structure and organic matter, this observation highlights another cost of tillage that might not justify the short-term bump in yields.

Fertilize It

Another eye opener has been how well synthetic nitrogen fertilizer stimulates quackgrass in grain and alfalfa plots. Side by side comparisons of fertilized vs. unfertilized plots clearly demonstrate how our management choices can have unintended consequences.

This makes perfect sense as abundant nitrogen benefits the grass more than the alfalfa (which can fix its own) and gives it the competitive advantage. This highlights the need to tailor nutrient applications to the desired crop and base inputs on soil test results rather than "the way we have always done it."

This Spring 2015 photograph clearly shows how last year's tillage and fertilizer have benefitted quackgrass on the conventionally tilled grain plot on the left, while weeds are nearly absent in the no-till grain plot on the right.

The Numbers Don't Lie

2015 Alfalfa Crops	Production in Tons	
	No Fertilizer	Fertilized
No-Till Alfalfa (following Barley)	1.0	2.9
No-Till Alfalfa (following Barley and Peas)	1.6	3.4
No-Till Alfalfa (following Cover Crop Cocktail)	2.1	2.6
Conventional (plowed) Alfalfa	1.9	2.7

2015 yields from the Soil Health Trials demonstrate that no-till farming is a viable alternative for converting old grass pasture into productive alfalfa fields without ever using a plow or destroying valuable organic matter and soil structure.

The Next Step, Limit the Inputs

Typically no-till farming uses glyphosate herbicide to kill weed competition before direct seeding. (This is how we have done it at the Woodson Ranch) It is relatively inexpensive and very effective. However, many consider this method a "necessary evil" for conserving soil. Others worry it is a pending catastrophe.

These concerns are justified. We know that glyphosate creates herbicide resistant super-weeds and it is now nearly ubiquitous in water supplies, vegetables, and even processed foods. Moreover, new research is suggesting this chemical needs to be listed as a carcinogen and has negative impacts on soil critters.

Therefore, the next step in creating safe, economically viable, soil building agriculture is to reduce the need for synthetic chemicals when possible in no-

Bring On the Livestock

Happy Cows Recycling Nutrients at the Woodson Ranch Soil Health Trial Plots.

For maximum soil improvement, livestock need to be incorporated into farming systems. Grazing animals (not those in a feedlot) are an incredibly efficient way to take sunlight and nutrients, and turn them into consumable protein. In the process of grazing forage, livestock return huge quantities of nutrients to the soil in the form of manure and urine. These products stimulate microbes and boost the mineralization process. Even cattle saliva has been shown to stimulate growth in plants and microbial activity in the soil!

If grazing standing forage is not an option for a given field, feeding hay right back on the spot it was grown is the next best option. This will keep nutrients in the system, rather than down the road to at the neighbor's or worse yet, in a feedlot.

It has been difficult to fully incorporate cattle into the Woodson Trials for several reasons, but as this project progresses livestock need to be a bigger component to close the nutrient loop, show real improvements in organic matter and reduce input requirements. Fortunately, we are blessed with many beautiful cows in the Ruby Valley who will work for food!