



May 2017 Issue:

# Soil Visions

## Dates to Remeber

**June 7-9** – Youth Range Camp,  
South Dakota Professionals Range  
Camp, Sturgis, SD

**June 9-10** – Birds at Home on the  
Range Tour, Anderson Ranch,  
Meadow, SD

**June 20-21** - Rangeland Days and  
Soil Days Wall, SD

**2017 South Dakota Soil Health School Set for September  
5-7, 2017 at Aberdeen and Ipswich, SD.**

We have an exciting lineup of speakers again this year, and look forward to having an exciting, information-packed agenda. Space is limited to the first 30 participants, so early registration is advised! Cost is again \$150 for the first participant, \$75 for one additional participant from the same operation. Meals, materials, and on-site transportation are included, but participants will be responsible for their own travel to the conference space and lodging.



## Soil Story



### Infiltration Through Soil Profiles Under Three Different Farming Systems.

(Dr. Tom Schumacher – Part 2)



Dr. Tom Schumacher, SDSU, (Retired) walks us through the experimental setup he used with large [rainfall simulators](#), the type developed for the Universal Soil Loss Equation (USLE), on three different tillage systems. The data Dr. Tom discusses is based on experimental runs conducted four years after this land was taken out of CRP and then continuously treated under three different farming systems: moldboard plow, a chisel plow and no-till. With the use of TDR probes that sense moisture at 10 cm (4inches) and 40 cm (16 inches). In this video, Dr. Tom discusses how much quicker water infiltrates into the no-till system and explains why that is. The chisel plw treatment discussed at the end is somewhat in between the no-till and moldboard plow treatments – notice the chisel plow surface still gets saturated and water has a tough time getting into the soil profile at 16” showing a 50-minute delay.

A new “Soil Story” has been released by the Natural Resources Conservation Service (NRCS) South Dakota in conjunction with South Dakota’s Conservation Districts.

This “Soil Story” features JP and Holly Heber, Zell, SD, who have a farming and cow/calf operation. “We’re moving towards using more cover crops annually,” says JP Heber. “We are trying to figure out a way to expand out and to keep some money in our pocket too. One way we did was by growing our own cover crop seed.”

“We believe in it,” says Holly Heber, “But with our farming operation, we have business partners – landlords. As we learn about cover crops, we had to figure out how to bring other people with us on our journey... it’s a complete paradigm shift of how we’re going to manage the land.”

In their Soil Story, the Hebers talk about the relationships with people like agronomists and landlords, some of the challenges they’ve had in seeing eye-to-eye with those they rent from, and ways that they’ve resolved some of those issues. They have been encouraged by the progress that they have already made, and they are determined to find the best ways possible to move forward with their land and their relationships.

One of many Soil Stories, this series from the USDA-NRCS covers topics such as no-till methods, crop rotation, and grazing.

NRCS has been committed to helping farmers and ranchers voluntarily help their natural resources for more than 80 years.

This collaboration with South Dakota’s Conservation Districts is one of many over the years, explains Angela Ehlers, Executive Secretary, SDACD, “We have worked together to engage others to promote soil health, protect native grasses, and protect and enhance water quality and quantity.

Find the interview with JP and Holly Heber at <http://bit.ly/JPHollyHeber> and others on [YouTube](https://www.youtube.com/user/NRCSSouthDakota) (<https://www.youtube.com/user/NRCSSouthDakota>) keyword search “USDA NRCS South Dakota.”

**Infiltration Through Soil Profiles  
Under Three Different Farming  
Systems.  
(Dr. Tom Schumacher – Part 1)**



Dr. Tom Schumacher, Retired, SDSU, walks us through the experimental setup he used with large rainfall simulators, the type developed for the Universal Soil Loss Equation (USLE), on three different farming systems to evaluate soil infiltration. The data Dr. Tom discusses is based on experimental runs conducted four years after this land was taken out of CRP and then continuously treated with a moldboard plow, a chisel plow and no-till. With the use of TDR probes that sense moisture at 10 cm (4inches) and 40 cm (16 inches), Dr. Tom shows what happens to soil moisture at 4 and 16 inches in the moldboard plow treatment and what the runoff consequences are and he briefly compares them to the other two treatments. In the next video we will continue as Dr. Tom walks us through the no-till and chisel plow treatments.

# Crop Planting Guide: Soil Temperature & Germination

[David Karki](#) – 3/29/2017



## Soil Temperature & Seed Germination

Successful crop production to maximize profitability starts at planting. Selecting the best cultivar, preparing seed bed, maintaining optimum crop nutrient needs, and seeding at appropriate rates, date, and time are just a few variables a farmer considers during each planting season. Regardless of where you are located, it is hard to go out and plant on a pre-determined date because of year-to-year weather variability.

Seed germination, one of the key elements of good crop stand, is largely dependent on soil temperature. The minimum soil temperatures required by different crops for germination can vary widely, and are reached on different dates each year. Small grains such as wheat, oats, barley, rye, etc. have lower germination temperature requirements than row crops, such as corn and soybeans.

## S.D. Crop Germination Requirements

**Wheat:** Among field crops grown in South Dakota (SD), wheat has the lowest soil temperature germination requirement at around 35°F. If the soil temperature is suitable and 30-day forecast shows above freezing temperatures, growers can consider seeding spring wheat early. The earliest planting of spring wheat is suggested for Southeast and Southcentral SD (desired range: March 25th- April 15th), whereas the latest planting is suggested for Northern regions in the state- NW, NC, and NE with desired range of April 8th- April 27th.

**Corn & Soybeans:** Corn and soybean are warm season crops that require fairly high soil temperatures for germination. Corn and soybean seeds can be vulnerable to chilling injury if water in the soil is cold, especially from melting snow. Germination temperature for corn is about 50° F whereas, soybeans require slightly higher temperature at 54°F. However, seeds of these two crops have shown the best germination at warmer temperatures (60°F – 70°F). The earliest suggested planting date for corn is for the Southeast region with a desired range of May 1st- May 15th , and the latest one for the northwest region (desired range: May 12th- May 26th). Similar trends are true for soybean as well.

**Other Crops:** Other important SD crops such as alfalfa, oat, pea, sorghum, and sunflower require germination soil temperatures of 45°F, 43°F, 42°F, 65°F, and 60°F respectively.

# Doctoring the soil

May 03, 2017

By Susan V. Fisk

**When you are tired or hungry, you're not as productive. You may need to rest or eat. If you push yourself too far, you may get ill.**

Lars Munkholm tests the soil for physical properties, which help him determine how effective their conservation agriculture techniques are at improving soil health. Photo credit David Croft.

Soil gets tired and hungry, too. How do growers know that? When the fields are not as productive. Maybe yields are down, or diseases infect the plants. The soil can become too compact. It can lack nutrients needed to grow good crops. It may be more prone to erosion or have other physical problems. Conservation agriculture uses alternative methods to fallow and fertilization to revive soil while still nurturing the overall environment. Just like a doctor prescribes different treatments for different patients, scientists often recommend different methods for returning soil to health, depending on the soil's characteristics. Lars Munkholm and research teammates at Aarhus University studied the impact of conservation agriculture techniques over a span of 11 years on two different farms. They combined the use of these techniques:

- creating very little soil disturbance (no-till or reduced tillage),
- ensuring permanent organic soil cover (residues and cover crops), and
- diversifying the crops grown on the farmland (crop rotation).

The fields they studied are in Denmark, and have sandy loam soils. An ideal soil for farming is usually a type of loam, with a good mixture of sand, silt, and clay particles. But sandy loam soils have less clay to hold the soil together. "Very few Danish soils have greater than 15% clay in the topsoil," Munkholm observes. "The clay content varied a bit at both farm sites, which significantly affected a range of soil properties. The studied soils were probably too sandy as compared to the 'ideal' situation even though they are very productive."

Leaving a field fallow, or resting it, means the field is empty for a season or more. The field does not provide income for the grower but the continued fertilization, or feeding, is expensive. A bare field also runs the risk of erosion.



Lars Munkholm tests the soil for physical properties, which help him determine how effective their conservation agriculture techniques are at improving soil health. Photo credit David Croft.

The typical Danish farmer needs to successfully grow food and feed on these soils, making this study important for the nation's agribusiness industry.

A further challenge for Danish farmers with regard to no-till or reduced till is the humid environment. "Denmark is located in a cool and humid climate where soil compaction is a major problem," says Munkholm. "Intensive soil loosening is typically needed to aerate the soil and stimulate drying of the surface soil. However, there is a steadily increasing interest in reduced tillage and no tillage in Denmark."

Typical small grain cereals such as wheat, barley, and oats were the dominant crops in the study. The team rotated these crops with rapeseed and peas. Rapeseed is an oil crop, providing income for the growers. Peas, as part of the legume family, can use nitrogen in the air as "food" and increase the amount of nitrogen available in the soil. This often reduces the need for chemical fertilizers. Researchers also used fodder radish as a winter cover crop. Their large, deep taproots help break up compacted soil.

This study found that in fields with less tillage, leaving crop residue on the soil was a good solution. In addition, growing permanent cover crops kept roots growing in the soil. This broke up soil clumps and made room for air and water. It also created a beneficial environment for soil microbes, fungi, and other organisms such as earthworms and ants.

Munkholm's team looks forward to studying the effects of conservation agriculture techniques for a longer period. "It takes time before changes in crop rotation, residue management, and cover cropping are fully developed in the soil," says Munkholm.

Read [more](#) about Munkholm's work in *Soil Science Society of America Journal*. The Danish Ministry of Food, Agriculture and Fisheries funded this research.



Danish soils are moist and compact, often needing deep tilling to aerate and prepare the soil for planting. Photo credit David Croft.

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In our [last blog](#), we discussed the often-overlooked value of soil health and [living soils](#). What is that value? Well, it all starts with... actually, don't worry about it.

While the evidence in support of [regenerative farming](#) (a philosophy and set of practices that drive soil health/biology forward) seems to be growing, it probably doesn't do much good for us to simply read them. The truth is, even if someone presented the most lopsided statistics in favor of such practices as these accompanied by authoritative quotes in its support, odds are it wouldn't do much good. We humans often need more than just head-knowledge to be converted – we need knowledge that resonates with the heart. This type of deep knowledge is rarely acquired in the classroom or from words on a screen. No, this type of knowledge is acquired only through direct experience.

Luckily, just last week our team was able to witness the benefits of living soils first-hand – no blogs, text books, varying statistics, or farmer testimonials necessary. In our 5-day trip to the [Mount Rushmore State](#), we were fortunate enough to meet with the NRCS' Jeff Hemenway. In that interview, Jeff shared a wide array of knowledge and hard statistics that illuminated the value

of living soils. While these statistics may be hard to argue against, what definitely couldn't be dismissed was seeing them unfold in that very interview.

## SLAKE TEST

The concept of Slake Testing probably isn't new to most of our audience, but for those who may benefit from a definition, [soilquality.org](http://soilquality.org) gives us a perfect explanation:

*“Slaking indicates the stability of soil aggregates, resistance to erosion and suggests how well soil can maintain its structure to provide water and air for plants and soil biota... Limited slaking suggests that organic matter is present in soil to help bind soil particles and microaggregates into larger, stable aggregates.”*

Or put more simply, Slake Testing compares the resilience of two soils – most notably, conventional till versus no-till. For those of you that haven't seen our video of the demonstration on [Facebook](#) or [Twitter](#), take a moment to check it out for yourself by clicking the links. Even a few seconds in and it's not hard to see that two drastically different factors are at play. The conventionally tilled soil begins to break down the second it's submerged. The no-till soil on the other hand maintains its structure throughout. As I sat there, a relative newbie to the soil health movement, it was clear that all of the articles, statistics, and interviews that had been pointing towards the value of living soils were in fact true. I could say this because the evidence was playing out right in front of me.

For the no-till soil, organic matter, while perhaps unseen by the eye, was there, alive and well. All I could think of during the test was that the no-till soil performed as a unit, one living whole, while the conventionally tilled soil performed less like a cohesive entity, and more simply like... well, dirt. Take this example a step further and apply it to two different fields – one conventionally tilled and one incorporating no-till (which, if done right, is always accompanied by the 4 Principles of Soil Health).

# 4 PRINCIPLES OF SOIL HEALTH

- 1 DO NOT DISTURB**  
MINIMIZE DISTURBANCE
- 2 DISCOVER THE COVER**  
KEEP THE SOIL COVERED
- 3 A RADICLE IDEA**  
KEEP A LIVE ROOT IN SOIL AS MANY DAYS AS POSSIBLE
- 4 DIVERSITY IS KEY**  
FEED THE SOIL WITH DIVERSITY, DIVERSITY, DIVERSITY

It's rather clear that the field using the latter would be more resilient (to shocks like drought or floods) with reduced erosion and higher soil biomass. It doesn't take a PhD in soil science or agronomy to see this... or as Dr. Buz Klot would say, "It's not rocket surgery."

## THE GROWING SOIL HEALTH MOVEMENT

Our one Slake Test in Huron, S.D. last week is not an isolated event. These tests have been on display at conferences and universities throughout the U.S., opening countless eyes along the way. Just look up "[Slake Test](#)" on YouTube and you'll see what I mean.

As anyone who has followed along with Merit or Myth knows, the [evidence of healthy soils](#) is abundant and we like to think that we are playing a small part in helping get that message out there. Regardless, we're not the only ones who are taking notice. Government agencies (spearheaded by a national [NRCS](#) effort), universities, environmental organizations and agribusinesses have begun to make a serious push towards soil health – and they're going all in. Millions of dollars in support of sustainable agriculture are being spent each year. This has led not only to an increase in awareness, but also community. These agencies, organizations, and universities that were once on opposite sides of the fence regarding ag practices are now joining forces. What's more, the farmers themselves have now been given a platform to speak – AND FINALLY THE WORLD IS LISTENING!

This is the power of healthy soils! There's only one thing that can be said...

JOIN THE REVOLUTION!

– Barrett

May 7, 2017 [Blog](#)

# Three Ways to Achieve a 266% ROI with Cover Crops

By [Laura Barrera](#) posted on May 1, 2017 | Posted in [Cover Crops](#), [Nutrient Management](#), [No-Till 101](#)

Rulon Enterprises in Indiana shares how cover crops free up fertility, increase yields and improve soil health, providing a \$69.17-per-acre benefit.

In a down ag economy, no-tillers may be wondering whether cover crops are worth the expense.

But Rulon Enterprises in Arcadia, Ind., finds covers do more than pay their way in their no-till system of 20-plus years.

At the 2015 Iowa Cover Crops Conference, Ken Rulon explained the costs of cover crops for his family's operation in Arcadia, Ind., and the return on investment they've received from pairing covers with their long-term, 'never-till' system.

Ken stresses that his analysis is from data and assumptions for their farm, and other no-tillers may have different results based on their personal desires and farm attributes.

For Rulon Enterprises, the average cost of including cover crops in its rotation is about \$14.27 per acre for seed and \$11.73 per acre for seeding operations, totaling \$26 per acre (Figure 1). The Rulons use oats, radishes, clover, annual ryegrass and cereal rye, with seeding rates varying between mixtures and how they're seeded.

Due to the size of their operation, the Rulons can old seed covers on about 60% of their 6,000 corn and soybean acres each year. In fall 2014, cover crops were seeded on 3,527 acres, and at \$26 per acre the total costs of covers was almost \$92,000.

But when looking at the benefits, Ken finds there's little to no chance of not getting his \$26 back (Figure 2).

"You can slice every benefit category in half and we still calculate a 50% return on investment," he says.

## WHAT DO COVER CROPS COST?

| Cover Crop Acres and Costs Fall 2014     |                      |  |                    |                    |
|--|----------------------|--|--------------------|--------------------|
| <b>SEED COSTS</b>                        |                      |  |                    |                    |
|  | <b>Cost/Acre</b>     | <b>Acres</b>                               | <b>Seed Cost</b>   |                    |
| Oats (32#) + Radish (2.5#)               | \$16.38              | 240  | \$3,931.20         |                    |
| Oats (24#) + Radish (2.5#) + Clover (6#) | \$18.40              | 1005                                       | \$18,492.00        |                    |
| Annual Rye Grass (18#)                   | \$14.04              | 200  | \$2,808.00         |                    |
| Cereal Rye Grass - Plant (35#)           | \$12.05              | 607  | \$7,314.35         |                    |
| Cereal Rye Grass - Aerial (40#)          | \$12.05              | 1,475                                      | \$17,773.75        |                    |
|  | 3,527                | <b>Seed Cost =</b>                         |                    | <b>\$50,319.30</b> |
|  |                      | <b>Seed Cost/Acre = \$14.27</b>            |                    |                    |
| <b>Planting Costs for Season</b>         |                      |  |                    |                    |
|  | <b>Quantity</b>      | <b>Rate</b>                                | <b>Total Cost</b>  |                    |
| Aerial Seeding Cost                      | 1,475                | \$13.93                                    | \$20,546.75        |                    |
| Tractor Hours                            | 140                  | \$35.00                                    | \$4,900.00         |                    |
| Labor                                    | 210                  | \$15.00                                    | \$3,150.00         |                    |
| Fuel                                     | 720                  | \$3.50                                     | \$2,520.00         |                    |
| Planter Repairs/wear                     | 2,052                | \$5.00                                     | \$10,260.00        |                    |
| <b>Total Other Costs</b>                 | <b>Acres = 3,527</b> |  | <b>\$41,376.75</b> |                    |
|  |                      | <b>Planting Cost/Acre = \$11.73</b>        |                    |                    |
|  |                      | <b>Total Cover Crop Cost = \$91,696.05</b> |                    |                    |
|  |                      | <b>Total Cost/Acre Planted = \$26.00</b>   |                    |                    |

RULON ENTERPRISES – IOWA COVER CROPS CONFERENCE 2/17/2015

FIGURE 2. Each line item shows a benefit the Rulon family in Arcadia, Ind., is gaining from using cover crops in their continuous no-till system. Even if they cut the benefits in half, they'd still see a return on their \$26-per-acre expense for cover crops, Ken Rulon says.

### 1. Using Covers to Reduce Fertilizer

One category they're saving on is their fertility program. Based on 20 years of 1-acre grid soil testing data and actual fertilizer use, as well as data from nearby no-tiller Cameron Mills' farm and tile discharge data out of Purdue University, the Rulons are spending \$16 less in phosphorus (P) and potassium (K) fertilizer per acre every year compared to Tri-State fertilizer recommendations. Ken notes that since they've added cover crops 8 years ago, it seems the amount of P available to the plant increases, even without a prescription application. Rodney, Ken's cousin who developed their prescription fertility equations, stresses that they focus on 1-acre grid testing — and not crop removal — because with 36-40 inches of rain in a year, their area will normally see more nutrient leaching than is actually used by the crop. Using cover crops to capture those excess nutrients in the soil and prevent them from leaching into the water supply has great value, Ken says. The Rulons also figure they capture 40 pounds of nitrogen (N) per acre in organic matter, but are not reducing their N rates from it yet. Ken says they hope in the long run it's contributing to yield increases. "In our plots, oats and radishes following soybeans produce the highest yields," Ken says. "They capture nutrients and contribute to rapid increases in earthworm populations. "Cereal rye is second. Cereal rye grows organic matter a lot faster than the radishes."

### 2. Using Covers to Increase Yields

The Rulons are also seeing their yields increase from their system. Comparing their 5-year yield averages to their county average, **the Rulons' soybean yield is 113% of the county yield average, and their corn yield is 114%.**

Ken says the operation sees on average a 7.1-bushel corn yield increase when it follows cover crops vs. no cover crops.

The Rulons have also dedicated a 100-acre field to joint research with Purdue University and the NRCS since 2008. The multirep strip plots compare corn that follows various cover crops vs. no cover crops, along with different N rates.

| WHAT ARE THE ECONOMIC BENEFITS OF COVER CROPS? |  |   |       |                     |
|--|--|---|-------|---------------------|
| Data   | BENEFITS ANALYSIS  |   |       |                     |
| Source   |  | Per acre                                  | Acres | Total Benefit       |
| Ion/Mills                                      | Fertilizer Saved-P&K (Mills+Rulon+Purdue Tile Discharge) | \$16.23                                   | 3,527 | \$57,243.21         |
| Mills  | Fertilizer Saved-N (40#/Ac Invested in OM Increase)      | \$0.00                                    | 3,667 | \$0.00              |
| Rulon  | Corn Yield Inc. (3yr/9reps CC Plot Data: 7.1bu@\$5)      | \$35.50                                   | 2,052 | \$72,846.00         |
| Rulon  | Soybean Yield Increase (Less Disease:1.95bu@\$12)        | \$23.40                                   | 1,475 | \$34,515.00         |
| Rulon  | Drought Tol.(2004-14 Actual:16%every4th=6.9Bu@\$5)       | \$34.50                                   | 3,527 | \$121,681.50        |
| NRCS   | Biology & Soil Quality (OM increases 2X of no cc)        | \$6.00                                    | 3,527 | \$21,162.00         |
| NRCS   | Erosion Reduction (2 ton/acre @ \$4)                     | \$8.00                                    | 3,527 | \$28,216.00         |
| FSA  | CSP Program Payment (\$40,000)                           | \$10.91                                   | 3,667 | \$40,000.00         |
| <b>Total Cover Crop Benefit =</b>              |  |   |       | <b>\$335,663.71</b> |
| <b>Net Economic Benefit =</b>                  |  |   |       | <b>\$243,967.66</b> |
| <b>ROI = 266%</b>                              |  | <b>Net Benefit/Acre Planted = \$69.17</b> |       |                     |

RULON ENTERPRISES – IOWA COVER CROPS CONFERENCE 2/17/2015

Click to enlarge

**FIGURE 1. Ken Rulon shares the cost breakdown of his cover crops. Between the seed cost and cost of seeding — including labor — Rulon Enterprises spend \$26 per acre on cover crops. Ken admits it’s tough to write the check to buy cover crop seed every fall, but the number crunching he’s done shows they’ll see a return on investment.**

Every year they do stand counts after emergence. Ken says they planted an average corn population of 33,000. For the corn that followed cereal rye the final stand was 28,500, while the corn that didn’t follow a cover crop had a stand of almost 32,500.

But when it came to the yields between the two in 2013, the corn grown into cereal rye yielded 187.6 bushels per acre, 4.2 bushels more than the corn following no cover crop, when averaged across all of the N rates. The corn following oats and radishes yielded 190.5 bushels per acre, 7.1 bushels more.

Three years of data for corn shows if the crop yields 7.1 bushels higher, at \$5 per bushel the Rulons are capturing a benefit of \$35.50 per acre.

Soybeans also gain a yield boost following cereal rye. Ken says they’ve tested it numerous times over the years and always see a 1.5- to 3-bushel increase. If the yield increase is 1.95 bushels, at \$12 soybeans they get a benefit of \$23.40 per acre.

The biggest benefits come during drought years. Ken says the farm experienced the three driest Julys in its history from 2011-13. In those years, their farm’s average yield was 130% of the

county average, almost twice the normal difference. The biggest benefits are when the crop has the highest price.

### 3. Using Covers to Improve Soil Health

The final benefits the Rulons are obtaining from their no-till, cover crop system include reduced erosion and increased soil biology and soil quality, which based on numbers from the NRCS, provide a \$14-per-acre benefit. The Rulons also receive a Conservation Stewardship Program payment of \$40,000 annually, which breaks down to \$10.91 an acre over 3,667 acres. Ken calculates the total benefit of cover crops on their farm comes to \$69.17 per acre, for a 266% return on investment. “It’s a little bit tough when you go to write Beck’s a check for \$85,000 for cover crop seed in August,” he says. “But when we sit down and go through it, we just cannot find any data where the cover crop yielded less than straight no-till. So at some point you have to say it has some value.” He notes that these benefits don’t typically happen in the first year of cover crops. They’re the combination of many practices, including investment in drainage, variable-rate seeding, N application based upon yield goals, and of course, the farm’s 23 years of 100% continuous no-till. Ken also adds that no-tillers must deal with some successes and failures with cover crops, and proper management plays a crucial role in achieving the benefits. “We know for a fact that if we let cereal rye get way too big, and then plant soybeans too wet, there is a potential 5% yield hit,” he says.



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