The Power of Soil Health

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Livestock and Grazing Specialist
Sustainable Farming Association of MN
What is Soil Health?

- Soil health = soil function
- Soil function =
  - ability to infiltrate, capture and store water.
  - and the ability to cycle nutrients.
85 - 90% of soil function is mediated by soil microbial activity
Wealth generation comes from the soil.
Precipitation
Power of Healthy and Active Microbes

Brown’s Ranch, Bismarck, ND, 8/20/13

~30 cover crop species, planted 6/26, 0.5” rain, picture taken 8/20, 1PM, 100 degrees F
Nitrogen
Rhizobial Bacteria
Other benefits of legumes:

• Diversify crop rotation
• Opportunities to integrate livestock
• Respectable cash crop yields with lower inputs
• Reduced weed pressure
Phosphorus
Arbuscular Mycorrhizal Fungi (AMF)
Arbuscular Mycorrhizal Fungi

• Many species. Associated with specific plants
• Not all plants have AMF associations
• Only associated with a living root
• Tillage detrimental to AMF
Our role is to provide a home for soil microbe populations.

“If you build it, they will come.”
1. Keep the soil covered

• Cover crops can provide “armor” to protect the soil from wind and water erosion.
Protection from the elements

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Images: Scott Haase
Protection from the elements
2. Minimize soil disturbance
3. Increase crop diversity
Crop Diversity

- Warm season grass
  - Corn, millets, sorghum
- Warm season broadleaves
  - Sunflower, soybean, cowpea
- Cool season grass
  - Oats, wheat, annual ryegrass
- Cool season broadleaves
  - Clovers, turnips, radish
Power of Diversity

• One species = one benefit.
• Multiple species = multiple benefits
  – Mustards exude nematode toxins
  – Buckwheat exudes chemical to make P more available to future crops
  – Variety of leaf types and sizes maximizes photosynthetic efficiencies
  – Full season pollinator/beneficial insect habitat
  – Multi-species companion blend under sunflower crop to attract beneficial insects
Power of Diversity
May 29, 2014
Early August 2014
2016 Penn State Report

• 2 pasture plantings
  – 2 species mix (grass and legume)
  – 5 species mix

• Avg. 31% more forage production in multi-species seeding than 2 species mix
  – Monitored for 9 years
  – Even after some species disappeared from the stand.
4. Keep living roots in the soil
Living roots???
Living roots = microbial activity
5. Integrate Livestock
“Livestock are the missing link in soil health.”

Fara Brummer, NDSU Extension Specialist
“Science has yet to replicate what comes out of the back end of a cow in a jug or bag.”

Steve Lutz, USDA Soil Scientist, retired.
Mechanical Manure Application
# 2015 Crop Special Sorts

**Corn Owned - Manure, MN**

<table>
<thead>
<tr>
<th>Owned Acre’s</th>
<th>15 Fields</th>
<th>386 Fields</th>
</tr>
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<tbody>
<tr>
<td>Owned Acre’s</td>
<td>266 Fields</td>
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<table>
<thead>
<tr>
<th></th>
<th>Manure</th>
<th>Manure &amp; Commercial</th>
<th>No Manure</th>
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<tbody>
<tr>
<td>2015 Yield/Ac</td>
<td>201</td>
<td>204</td>
<td>203</td>
</tr>
<tr>
<td>2015 Net Return/Ac</td>
<td>$97</td>
<td>$52</td>
<td>$7</td>
</tr>
<tr>
<td>5 Year Yield/Ac</td>
<td>177</td>
<td>177</td>
<td>175</td>
</tr>
<tr>
<td>5 Year Net Return/Ac</td>
<td>$249</td>
<td>$223</td>
<td>$184</td>
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Finbin.umn.edu
50% of dry lot manure N lost before we get it to the field.
What happens when we put livestock into the system?

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<th>N (lbs/ac)</th>
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<th>K (lbs/ac)</th>
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CT = Conventional Tillage, NT = No-Till, LD = Low Diversity, MD = Moderate Diversity, HS = High Synthetics, NS = No Synthetics, Lvst = Livestock.
Value of livestock integration and cover crops
What are producers saying?

• “I haul less manure.”
• “Fed less hay.”
• “I put up less hay and silage.”
• “Weaning calves is less stressful.”
• “We waste more feed than we used to grow.”
• “If you have livestock, this is a no-brainer.”
What are producers saying?

• “The drown out spots are smaller.”
• “We have less weed pressure.”
• “We have seen better yields in dry years than other farms.”
• “The ground is more mellow.”
• “I get field work done in a timely manner during wet years.”
• “No wheel ruts during harvest.”
• “We see more pheasants.”
• “I wish I would have started sooner.”
Soil Health

- Physical
- Chemical
- Biological

SOIL Health
Traditional focus = N - P - K

Carbon

Soil microbes
58% of Corn Crop is Soil Organic Matter!
Photosynthesis

[Diagram showing the process of photosynthesis with arrows indicating sunlight, carbon dioxide, water, oxygen, and carbohydrates]
A variety of solar collectors!
Cover Crop Options
Cover Crop Considerations

• Not the “silver bullet”
• An effective tool to address soil health
  – A great means to “jump start” the system
• First, determine resource concerns you want to address in a particular field
• Then select your cover crop
• Also consider:
  – cropping and herbicide history
  – rotation
  – termination
Resource Concerns

• Increase crop diversity
• Provide soil surface armor
• Build soil aggregates
• Improve water cycle
• Integrated pest management
• Build soil organic matter
• Promote nutrient cycling
• Encourage pollinators and beneficial insects
• Adjust carbon : nitrogen ratios
• Provide food and shelter for wildlife
• Integrate livestock/provide livestock forage
Herbicide Rotation Restrictions in Forage and Cover Cropping Systems

Designing effective herbicide programs while following pesticide label restrictions can be challenging in any cropping system. With rotations that include forage and cover crops, the challenge can be increased—especially when a planned cover crop might be needed as supplemental or emergency forage. In this case, the best approach is to be aware of crop rotation restrictions ahead of time and plan the most effective solution for all possible scenarios.

Herbicide label rotational restrictions

Once a herbicide is used in a cropping system, the restrictions on that label must be followed for the original crop it is used on AND the succeeding crops until all restrictions on that label have been surpassed. These rotational restrictions exist for two reasons:

1. To protect humans and animals from herbicide residues so that a succeeding crop may accumulate at aberrant levels prior to entering the feed or food chain.
2. To ensure good establishment for the following crops by avoiding herbicide carryover injury.

An EPA registered pesticide label is a legal document and the instructions must be followed to avoid violating Federal law. Always check the herbicide label for crop rotational restrictions. Each crop will have a rotational planting interval stated in days or months. If a rotational restriction is not listed for a specific crop, follow the maximum interval. Pay careful attention to any listed exceptions.

What is the difference between a forage crop and a cover crop?

Simply put, a forage crop is planted for animal feed, which can be either grazed by animals or harvested from the field. A cover crop is planted for a variety of reasons—improving soil health, adding nutrients, suppressing weeds—and is not harvested. Typically, the cover crop’s biomass stays in the field and may be incorporated into the soil.

In the legal sense, once the biomass of a cover crop is removed from the field for feed, grazed or harvested, it is considered a forage crop or more precisely a crop. According to the EPA registered pesticide label, it is important to note that even in situations where cover crops are allowed to be grazed or harvested within a crop insurance or cost-share program, the label restrictions must still be followed.
Herbicide restrictions - forages

• Annual ryegrass and/or radish after soybeans treated with Authority Assist™ pre-emergent herbicide:
  • 30 months plus field bioassay
• Pearl millet and/or radish after soybeans treated with Pursuit™ post-emergent herbicide:
  • 40 month plus field bioassay
• The label is the law.
Inter-seed Cover Crop Into Cash Crop
Inter-seeded cover crops for grazing
Seeded annuals ("cover crops") as part of a larger crop rotation
Early season forage crop planted with cover crop
Full season cover crop
“Three crops in two years!”
Corcoran, MN

• 33 acres silage corn harvested 9/1/15
• Pit manure spread
• Cereal rye no-tilled 9/10/15
• Cereal rye chopped and bagged early June 2016 (Filled 10’ silage bag)
• No-tilled soybeans 6/10/16
“Double Cropping”
Results
Double Cropping
“Are complex cover crop blends good feed?”

RFQ = 179, TDN = 65, CP = 17%, NE/L = 0.68
Utilization
Trampling provides soil armor and feeds the microbes
ADG on Complex Cover Crops

- November 2015
- 23 acres
- 14 species complex cover crop blend no-tilled after oats/barley/peas
- 29 days grazing
- Weaned calves = 2.4 #'s/day
- 800 bred heifers = 3.3 #'s/day
- Net/acre >$500 on gain
Bloat, prussic acid, nitrate poisoning and milk taint???
Rye for early spring grazing/calving pasture.

Creates rest and recovery opportunity for pastures in early spring.
Resources

• [http://mccc.msu.edu/](http://mccc.msu.edu/)
**Mandan ARS Cover Crop Chart**

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<th>GROWTH CYCLE</th>
<th>RELATIVE WATER USE</th>
<th>PLANT ARCHITECTURE</th>
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<tbody>
<tr>
<td>A = Annual</td>
<td>♦ = Low</td>
<td>♦ = Upright</td>
</tr>
<tr>
<td>B = Biennial</td>
<td>♦ = Medium</td>
<td>♦ = Upright-Spreading</td>
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<tr>
<td>P = Perennial</td>
<td>♦ = High</td>
<td>♦ = Prostrate</td>
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**Cool Season**

- **Grass**
  - Barley
  - Oat
  - Ryegrass
  - Phacelia
  - Flax

**Broadleaf**

- Wheat
- Spinach
- Turnip
- Field pea
- Berseem clover
- Medic
- Chickpea
- Sunflower
- Sudan grass

**Legumes**

- Cereal rye
- Kale
- Radish
- Lentil
- *B/P Red clover
- Birdsfoot trefoil
- Cowpea
- Safflower
- Teff

**Pearl millet**

**Proso millet**

**Amaranth**

**Foxtail millet**

**Buckwheat**

**Additional Information**

V 1.3. May 2012
Modern fence technology
Energized Fence Basics

• Effective voltage (>7 Kv)
  – Must have digital voltmeter to test
  – Train new animals to fencing

• Adequate grounding
  – Minimum 3 ground rods, 6’ long, 10’ apart

• Proper wire spacing
  – Cattle = 1 wire 32” – 36”
  – 2 wires – 30” and 40”
  – 3 wires – 20”, 30”, 40”

• You get what you pay for. Quality counts.
How did it work?
193 pairs, 400 acres grazed
High Stock Density for Trample
Water
Frost Free Nose Pump
Water system options
Water System Options
Livestock Water Requirements

• Dairy Cows: 20 – 50 gals./day
• Beef Cows: 10 – 25 gals./day
• Calves: 2 – 10 gals./day
• Sheep: 2 – 3 gals./day

• Factors: Air temperature, vegetative growth stage, type of vegetation, precipitation, dew, snow,
Cover crops, diverse rotation and livestock = a recipe for soil health
Cropland Grazing Exchange

• http://www.mda.state.mn.us/cge
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Resources

- Green Cover Seed
- [http://greencoverseed.com](http://greencoverseed.com)
- SmartMix 4
  - Sign in as “GUEST”
  - Fill in questions, including ZIP CODE
  - Enable “SmartMix Auto Adjust”
Thank you!