Building A Successful Conservation System To Regenerate Soil Health

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SOIL HEALTH:

The continued capacity of a soil to *function* as a vital, *living ecosystem* that sustains plants, animals, and humans.
Soil Health Principles

Provide Continuous Living Roots

Minimize Disturbance

Maximize Biodiversity

Maximize Soil Cover
The Fence Row Effect
Principles at work

J. Maloney, Brownsburg, IN 2010
Soil Health Management System

Collection of conservation practices that focus on maintaining or enhancing soil health

Address all four of the soil health principles

Create a “synergistic” effect

Cropping system specific
Healthy, Productive Soils System Criteria

Soil Health Management System

- Achieving soil health through:
  - A **Quality** No-till System
  - **Diverse** and Strategic Cover Crops
  - **Adapted** Nutrient Management
  - **Integrated** Weed & Pest Management
  - **Diverse** Crop Rotations
  - **Precision** Farming Technology
  - **Prescriptive** Buffers and supportive practices

Soil Health is not a destination...it’s a **Journey**
We can package a system of practices that improve soil health!

- Quality No-Till/Strip-till
- Adapted Nutrient Management
- Prescribed Cover Crops
- Diverse Crop Rotation
- New Technology and Integrated Weed & Pest Management
We can package a system of practices that Improve Soil Health!

- Quality No-Till
- Ecological Nutrient Management
- Prescribed Cover Crops & Grazing
- Diverse Crop Rotation
- Integrated Weed & Pest Management and Precision Technology
What does Soil Health mean?

Key Indicators =

- Improving organic matter
- Improving aggregate stability
- Increasing water infiltration
- Increasing available water
- Improving nutrient cycling
- Balancing and diversifying soil biology
We can package a system of practices that improve soil health!

- Quality No-Till/Strip-till
- Prescribed Cover Crops
- Diverse Crop Rotation
- New Technology
- Integrated Weed & Pest Management
- Nutrient Management
Planter set-up and maintenance is critical.
Every seed at the exact same depth...
...every seed the exact same environment
No-Till planters

Precision nutrient placement and rate

Sense and adapt to field conditions on the go!

With Space Shuttle Tech
We can package a system of practices that improve soil health!

- Quality No-Till/Strip-Till
- Prescribed Cover Crops
- Diverse Crop Rotation
- New Technology and Integrated Weed & Pest Management
- Adapted Nutrient Management
Developing Nutrients Management Strategies for Soil Health Cropping Systems

• 4–Rs

Must include SOM and Organic Nutrient Contribution
Nitrogen Mineralization and Immobilization

**Nitrogen transformations**

- urea-N → hydrolysis → NH$_4^+$ → nitrification → NO$_3^-$ → leaching
- organic-N → mineralization → NH$_4^+$ → denitrification → N$_2$, N$_2$O, NO

_Biology_
Effect of tillage on microbial activity

Which tillage system has more microbial activity when the crop benefits from the CO$_2$?
Strategically…
CC should match desired C:N Ratio

<table>
<thead>
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Plant available Nitrogen, exactly what we want...right???
“Catch and Release”  
Nutrients
Cover Crop Mgt for N Retention
Strategically…
CC should match desired C:N Ratio

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Good for Corn

Good for Soybean
We can package a system of practices that improve soil health!

- Quality No-Till/Strip-till
- Adapted Nutrient Management
- Diverse Crop Rotation
- New Technology
- Integrated Weed & Pest Management
- Prescribed Cover Crops
Why all the buzz about Cover Crops?

Less Carbon Loss Here

It’s all about the Carbon!
(Organic Matter)

We want more Carbon here
Biomass Production
Annual Cropping Systems

Missed opportunities for resource assimilation and dry matter production

Dry matter production or resource loss (mass / time)

Annual grain crop

Winter cover crop

Spring Summer Autumn Winter

Additional opportunities for resource losses

A. H. Heggenstaller, University of Alberta
Biomass Production
Annual Cropping Systems

Cover crops for resource assimilation and dry matter production

Dry matter production or resource loss (mass/time)

Annual grain crop

Winter cover crop

less opportunities for resource losses

after A.H. Heggenstaller

A. H. Heggenstaller, University of Alberta
To Build Organic Matter We need to Feed the Herd

A acre of healthy soil has over 4 cows worth of microorganisms living in it. (Illustration by Eve Stika)
We can package a system of practices that improve soil health!

- Quality No-Till/Strip-till
- Adapted Nutrient Management
- Prescribed Cover Crops
- New Technology
- Integrated Weed & Pest Management
- Diverse Crop Rotation
Soil Health Cropping Systems

...Strategy Example: for a (not so diverse) Corn-Soybean Rotation
Strategically…
CC should complement the following crop
What about Corn?
Strategically...
CC should match desired C:N Ratio

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Good for Corn: Wheat Straw, Rye Cover Crop (Vegetative), Ryegrass (Vegetative), Young Alfalfa, Hairy Vetch Cover Crop, Soil Microbes (Average)

Good for Soybean: Rye Straw, Wheat Straw, Oat Straw, Corn Stover, Rye Cover Crop (Anthesis), Mature Legumes, Balanced Microbial Diet

**USDA United States Department of Agriculture**
Strategically…
CC should complement the following crop
…Which is better?

Corn into:
High Carbon
(Cereals Rye/Wheat)

…or

High N (Protein)
Cover Crop
(Clover/Peas)
Strategically…
CC should complement the following crop
Corn into a mix:
High Carbon (Rye)
Provides:
• Erosion Control
• Moisture Savings
Uses/immobilizes:
• Nitrogen/nutrients
• Disease?
Starter N a must
Strategically...
CC should complement the following crop

Corn into:
High N (Protein)
Cover Crop (Clover/Peas)
- Contributes high quality N
- Less likely to harbor disease pathogens
Strategically…

CC should complement the following crop

To Raise N (Protein%)

• Select forage type grasses
• Add Clover/Peas if…
• Terminate Grass when protein is high
• **and consider adding:**
  • Oilseed Radish, Rapeseed if…
Strategically…
CC should complement the following crop

Corn into
a Balanced Mix
High C (carbon)
and
High N (Protein)
Strategically…
CC should complement the following crop

Corn into a mix:

**High Protein**

Can Provide:

- Optimum Nutrient Release
- Extra water during rapid demand
Strategically…
What about Soybeans?

Choices
Do Soybeans need N?

...Sure, but they capture their own!
Strategically…
Soybeans do well into a high carbon Cover Crop.

...Why?
Weed Control, Late Season Water and Nutrient Cycling
Strategically…
Planning the System Using the Step by Step Approach

1. Drill or Aerial Seed Cereal Rye or Annual Ryegrass into Corn Stalks
Strategically…
Planning the System Using the Step by Step Approach

2. Terminate the Cereal Rye at 12”… Or…
2. Plant a short season Soybean into the Rye (preferably early in the season)
Strategically…
Planning the System Using the Step by Step Approach

3. Plant a low C:N mix into or after Soybean
Strategically…
Planning the System Using the Step by Step Approach

4. NT Corn into a:
   Biologically Active
   High Function Soil
Strategically…
Planning the System Using the Step by Step Approach

5. Enjoy The Rewards of Soil Health!
Managing for a Living Ecosystem Requires Dynamic Management

“We can take production and conservation further with management systems that continually build Soil Health.”

USDA is an equal opportunity provider, employer, and lender.”
Unlock the Secrets in the Soil

Soil is a living and life-giving substance, without which we would perish.

As world population and food production demands rise, keeping our soil healthy and productive is of paramount importance. So much so that we believe improving the health of our Nation’s soil is one of the most important endeavors of our time.

By focusing more attention on soil health and by educating our customers and the public about the positive impact healthy soils can have on productivity and conservation, we can help our Nation’s farmers and ranchers feed the world more profitably and sustainably – now and for generations to come.

The resources on this soil health section of our site are designed to help visitors understand the basics and benefits of soil health – and to learn about Soil Health Management Systems from farmers who are using those systems.

So whether you’re a farmer, a researcher, a conservationist or an interested citizen, the information on this site will help you “Unlock the Secrets in the Soil.”

Voices of Soil Health
Soil Health Campaign

- Raised awareness
- Expanded demand for system adapted information
- Raising many good questions
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