Midwest Opportunities
To Regenerate Soil Health

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Unlock the Secrets
In the Soil

USDA
United States Department of Agriculture
Natural Resources Conservation Service
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
Soil Health Principles To Support High Functioning Soils

- **Feed**
  - diverse, continuous inputs (C sources, energy)

- **Protect**
  - habitat (aggregates and organic matter)

- Maximize living roots
- Maximize diversity
- Maximize cover
- Minimize disturbance

Healthy, Productive Soils System Criteria

USDA is an equal opportunity provider and employer.
The Fence Row Effect
Soil Health Principles at work
Making Soil Health A Priority!

- What does *Soil Health* mean?
- Key Indicators/Functions =
  - Improving organic matter
  - Improving aggregate stability
  - Increasing water infiltration
  - Increasing available water
  - Improving nutrient cycling
  - Balancing and diversifying soil biology
Making Soil Health A Priority!

These are broadly accepted and listed in numerous peer reviewed papers and text books as indicators and functions that drive improved **production**, **resilience** to extreme growing conditions, and reduce **costs** that lead to **net economic gains**.

- Improving organic matter
- Improving aggregate stability
- Increasing water infiltration
- Increasing available water
- Improving nutrient cycling
- Balancing and diversifying soil biology
Making Soil Health A Priority!

production, resilience, and reduce costs

Improving organic matter

• stores and steadily releases crop nutrients, (production, resilience, costs)
• holds water and increases water availability, (production, resilience)
• improves infiltration of rainfall into the root zone, (production, resilience)
• improves air/gas exchange and (production, resilience)
• increases yields. (production)
Making Soil Health A Priority! 

**production, resilience, and reduce costs**

**Improving aggregate stability**

- Reduces crusting for better crop emergence (production)
- provides resistance to erosion and lost nutrients (production, resilience, costs)
- improves infiltration of rainfall and irrigation water (production, resilience)
- increases water availability for plants and soil organisms (production, resilience)
- More...
Making Soil Health A Priority!

production, resilience, and reduce costs

Increasing water infiltration

• improved irrigation efficiency (costs)
• Harvest more rainfall and irrigation water for crop growth (production)
• Reduces nutrient loss from runoff (production, costs)
• Reduces ponding and saturated soils for timely planting and field operations (resilience)
• Reduces denitrification (production, resilience)
Making Soil Health A Priority!
production, resilience, and reduce costs

Increasing water infiltration and available water
• improved irrigation efficiency (costs)
• More water available for crop growth and process (production)
• Reduces nutrient loss from runoff, ponding (production, costs)
• provides water for important biological processes and cycles (production, resilience, costs)
• serves as a temperature regulator for plants during extreme weather (resilience)
Making Soil Health A Priority! production, resilience, and reduce costs

Improving nutrient cycling-biologically driven

• Delivers “time released” nutrients to crops (resilience)
• Biologically supplied nutrients enhance or complement applied nutrient management strategies (production, costs)
• improves nutrient availability to crops during extreme events (resilience,)
• reduces nutrient loss pathways by providing backup sequestration in non-crop seasons (costs)
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

Are practical and logical
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/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
We can package a system of practices that improve soil health! Quality No-Till/Strip-till
Prescribed Cover Crops
New Technology and Integrated Weed & Pest Management
Diverse Crop Rotation
Adapted Nutrient Management
Developing Nutrients Management Strategies for Soil Health Cropping Systems

- 4–Rs

Must include SOM and Organic Nutrient Contribution
A simple approach to Understanding C:N Ratios and biological drivers for corn production and water quality
Nitrogen Mineralization and Immobilization

Nitrogen transformations

Biology
Only 30-55% of Inorganic Fertilizer is Directly Used by Plants

<table>
<thead>
<tr>
<th>Fertilizer N applied (lb/ac)</th>
<th>Corn grain yield (Bu/ac)</th>
<th>Total N in corn plant (lb/ac)</th>
<th>Fertilizer-derived N in corn (lb/ac)</th>
<th>Soil-derived N in corn (lb/ac)</th>
<th>Fertilizer-derived N in corn as % of total N in corn</th>
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</thead>
<tbody>
<tr>
<td>45</td>
<td>62</td>
<td>76</td>
<td>25</td>
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<td>140</td>
<td>77</td>
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<td>55</td>
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</tbody>
</table>

Effect of tillage on microbial activity

Havlin et al. (1999)

Which tillage system has more microbial activity when the crop benefits from the CO₂ ?
<table>
<thead>
<tr>
<th>Material</th>
<th>C:N Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rye Straw</td>
<td>82:1</td>
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<tr>
<td>Wheat Straw</td>
<td>80:1</td>
</tr>
<tr>
<td>Oat Straw</td>
<td>70:1</td>
</tr>
<tr>
<td>Corn Stover</td>
<td>57:1</td>
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<tr>
<td>Rye Cover Crop (Anthesis)</td>
<td>37:1</td>
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<tr>
<td>Rye Cover Crop (Vegetative)</td>
<td>26:1</td>
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<tr>
<td>Mature Legumes</td>
<td>25:1</td>
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<tr>
<td><strong>Balanced Microbial Diet</strong></td>
<td>24:1</td>
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<tr>
<td>Daikon Radish</td>
<td>19:1</td>
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<tr>
<td>Crimson Clover</td>
<td>17:1</td>
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<tr>
<td>Ryegrass (Vegetative)</td>
<td>15:1</td>
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<tr>
<td>Young Alfalfa</td>
<td>13:1</td>
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<tr>
<td>Hairy Vetch Cover Crop</td>
<td>11:1</td>
</tr>
<tr>
<td>Soil Microbes (Average)</td>
<td>8:1</td>
</tr>
</tbody>
</table>
Strategically…
Planning the System Using the Step by Step Approach

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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