Building Your Soil Health System on Sound Principals.
2018 Corn Yields

BU / ACRE
- < 139.20
- 139.20 - 176.80
- 176.80 - 201.20
- >= 201.20
- Data Withheld

USDA-NASS
2018 Corn Yields

Corn for Grain Yield
United States

Bushels per Acre


USDA-NASS
2-8-19
Have We Lost Soil Function?
Can We Regenerate Functions

Tallgrass Prairies are the most productive ecosystems in USA

Adapted from Blanco-Canqui, H. et al. 2015
SOIL HEALTH:

- The continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans.
SOIL HEALTH:

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

- Nutrient cycling
- Water (infiltration & availability)
- Filtering and Buffering
- Physical Stability and Support
- Habitat for Biodiversity (90% is mediated by soil microbes)
A changing vision of soil...

- The concept of “fixed” soil properties has been shattered by **soil health farmers**.
- They have **CHANGED** the health and function of their soil.
Soil Health Principles

Maximize Presence of Living Roots

Minimize Disturbance

Maximize Biodiversity

Maximize Soil Cover
Soil Health Principles To Support High Functioning Soils

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

- **Maximize**
  - living roots
  - diversity
  - cover

- **Minimize**
  - disturbance

- **Protect**
  - habitat (aggregates and organic matter)
The Fence Row Effect
Principles at work

J. Maloney Brownsburg, IN

Neighbor
We can package a system of practices that improve soil health!

- Quality No-Till
- Ecological Nutrient Management
- Prescribed Cover Crops & Grazing
- Integrated Pest Management
- Diverse Crop Rotation
Principles for Success
… We Must have a Game Plan

Game Plan Principles for:
• Nutrient Management
• Cover Crop Termination
• Pest Management
• Weather- read the defense!
Principle Nutrients Management Strategies for Soil Health Cropping Systems

Game-Plan Principles for:

• Nutrient Management

• Adaptive Management
Principles for Success

... We Must Adapt the Game Plan

• 4-Rs

Must include SOM and Organic Nutrient Contribution
Understanding Nitrogen Mineralization and Immobilization

Nitrogen transformations

Biology

NH$_4^+$ → N$_2$, N$_2$O, NO

Volatilization

Denitrification

Hydrolysis

Nitrification

Leaching
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>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>62</td>
<td>76</td>
<td>25</td>
<td>54</td>
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<td>89</td>
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<td>88</td>
<td>140</td>
<td>77</td>
<td>63</td>
<td>55</td>
</tr>
</tbody>
</table>

Effect of tillage on microbial activity

Which tillage system has more microbial activity when the crop benefits from the \( \text{CO}_2 \)?

Havlin et al. (1999)
Starter Nitrogen + S

Precision nutrient placement and rate

No-Till planters
Strategically…
CC should complement the following crop
What about Corn?
Strategically…
CC should match desired C:N Ratio

<table>
<thead>
<tr>
<th>Material</th>
<th>C:N Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rye Straw</td>
<td>82:1</td>
</tr>
<tr>
<td>Wheat Straw</td>
<td>80:1</td>
</tr>
<tr>
<td>Corn Stover</td>
<td>57:1</td>
</tr>
<tr>
<td>Rye Cover Crop (Anthesis)</td>
<td>37:1</td>
</tr>
<tr>
<td>Rye Cover Crop (Vegetative)</td>
<td>26:1</td>
</tr>
<tr>
<td>Mature Legumes</td>
<td>25:1</td>
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<tr>
<td><strong>Balanced Microbial Diet</strong></td>
<td><strong>24:1</strong></td>
</tr>
<tr>
<td>Daikon Radish</td>
<td>19:1</td>
</tr>
<tr>
<td>Crimson Clover</td>
<td>17:1</td>
</tr>
<tr>
<td>Ryegrass (Vegetative)</td>
<td>15:1</td>
</tr>
<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>

N Immobilization

N Mineralization

Good for Soybean

Good for Corn
Strategically…
CC should complement the following crop
…Which is better?

Corn into:
High Carbon (Cereals Rye/Wheat)

…or
Low Carbon C:N
Cover Crop (Vegetative), Winter Kill or Legume (Clover/Peas)
Strategically…
CC should complement the following crop

Corn into a mix:
Low C:N (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
Principles for Success
… We Must have a Game Plan

Game-Time Decisions for:
• Nutrient Management
• **Cover Crop Termination**
• Pest Management
• Weather
Planning the System Using the If >than / Then Approach

Terminate the Cereal Rye at 12”… Or…
Planning the System Using the If > than / Then Approach

…Or…> than 16”- Then

• Plant green
  1. Spray 1-2 days BEFORE planting or
  2. Spray AFTER planting (same day or within 1-2 days)
  3. Advantages and risks with each option
     (see Table 1 in Purdue AY-353-W)
Principles for Success
… We Must have a Game Plan

Game-Time Decisions for:
- Nutrient Management
- Cover Crop Termination
- Pest Management
- Weather - read the defense!
Pest Management Game Plan-

- **Integrated (and Adaptive) Pest Management Systems**
  - Utilizes holistic management
  - Limit pest opportunities
  - Integrates predator/prey relationships
  - Employs beneficial biology and cultural practices
  - Are seldom based on preventative chemistry
  - Utilize technology and chemical treatments when necessary
Common prey: Snails, slugs, caterpillars, and other soft-bodied insects in soil and moist or

Additional habitat: Larvae reside in damp areas where prey is found, and under bark. Fireflies pupate in soil, under rocks, or in leaf litter.

Conservation strategies: Tall grass in field edges or nearby habitat can shelter adults and should be protected or supplemented. Reduce tillage to protect egg-laying sites as well as larval habitat and overwintering sites. Flowers with an open structure and exposed nectar sites, such as those in the sunflower family, may attract pollen and nectar-seeking adults.
...Let it bee
Principles for Success
... We Must have a Game Plan

Game-Time Decisions for:

- Nutrient Management
- Cover Crop Termination
- Pest Management
- Weather- read the defense!

Sometimes it just rains…
How can we rebound from such a bad situation?
Do you have a Plan for variable situation?

Feb. 25
Early Establishment is Usually Better!
...Plan for it.
How can we gain resilience to harsh weather?

When in doubt... Plant!
Soil Health Principles

Provide Continuous Living Roots

Minimize Disturbance

Maximize Biodiversity

Maximize Soil Cover
Crop Talk!

- Listen to what the crop is telling you...

I feel great!

Thanks for the nice soil!
The Golden Principle-
Lack of cover is
tseldom a good thing!
Things don’t always go the way you plan….

Plan anyway
Plans Following Sound Principles Lead to Good Soil Health Decisions

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