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Strategizing & Implementing a Soil Health Management System

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Location: IA, IL, IN

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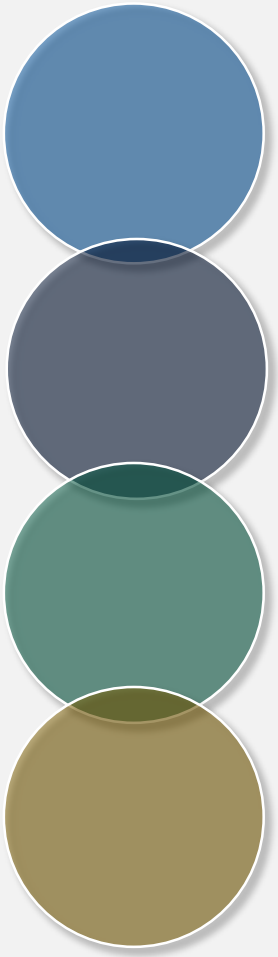
Objectives

1. Identify key components of practices and activities to develop a Soil Health Management System
2. Describe the interaction, dependency and synergy between practices in a SHMS
3. Recognize barriers to implementation
4. Describe an entry level strategy to develop a SHMS

Soil Health Management System



Collection of NRCS conservation practices, BMPs, activities, that focus on maintaining or enhancing soil health

Address all 4 of the soil health principles

Create a “synergistic” effect so that the system is successful and sustainable

Cropping system specific

Best Accepted New Technology

- Conservation activities that might not be in an NRCS conservation practice standard. Examples:
  - Companion cropping
  - Traffic management
  - Precision application of nutrients and pesticides
  - Use of floatation tires

Soil Health Management System

- Achieving soil health through:
  - a Quality No-till/ Strip-till System
  - Diverse and Strategic Cover Crops
  - Adapted Nutrient Management
  - Integrated Weed & Pest Management
  - Diverse Crop Rotations
  - Precision Farming Technology
  - Prescriptive Buffers and Constructed Practices

Soil Health is not a destination…it's a Journey


Quality no-till/strip-till


Adapted nutrient management


New technology
and
integrated weed &
pest management


Prescribed cover crops


Diverse crop rotation


Quality no-till/strip-till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ed & pest management


Prescribed cover crops


Diverse crop rotation


No-Till / Strip-Till
Planter set-up and maintenance is critical

Goal: Every seed at the exact same depth…

Spread the Weight!

Spread residue

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Poor Structure = Yield Loss

No-Till Planter Attachments

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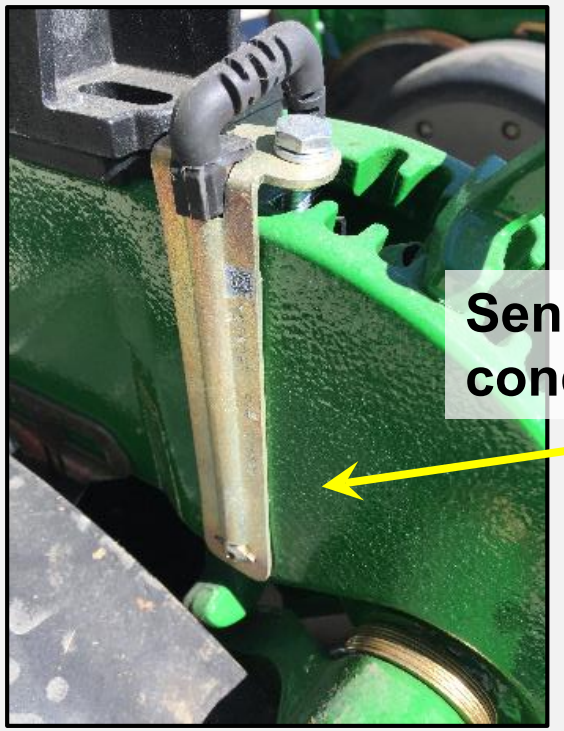
No-Till Planters

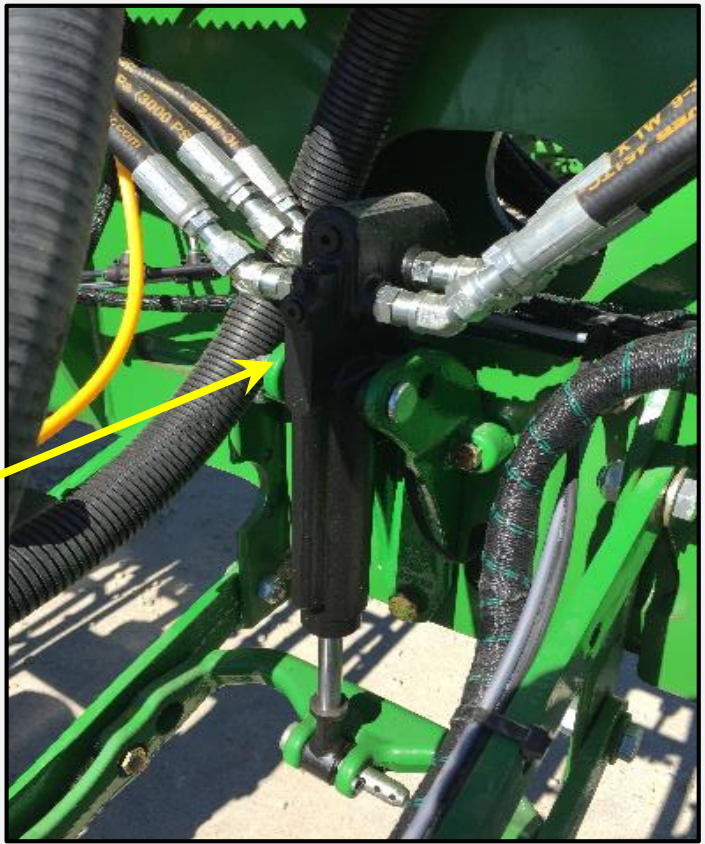


Sense and adapt to field conditions on the go!

With Space Shuttle Tech

Precision downforce

in sub inch increments.



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- Discussion-

What is a common issue you have seen with these practices?

- No-till/ Strip-till
- Cover Crops
- Nutrient Management
- Weed & Pest Management

Quality no-till/strip-till

Adapted nutrient management

New technology and integrated weed & pest management

Prescribed cover crops

Diverse crop rotation

Compounding extent of soil degradation and effect on other cycles

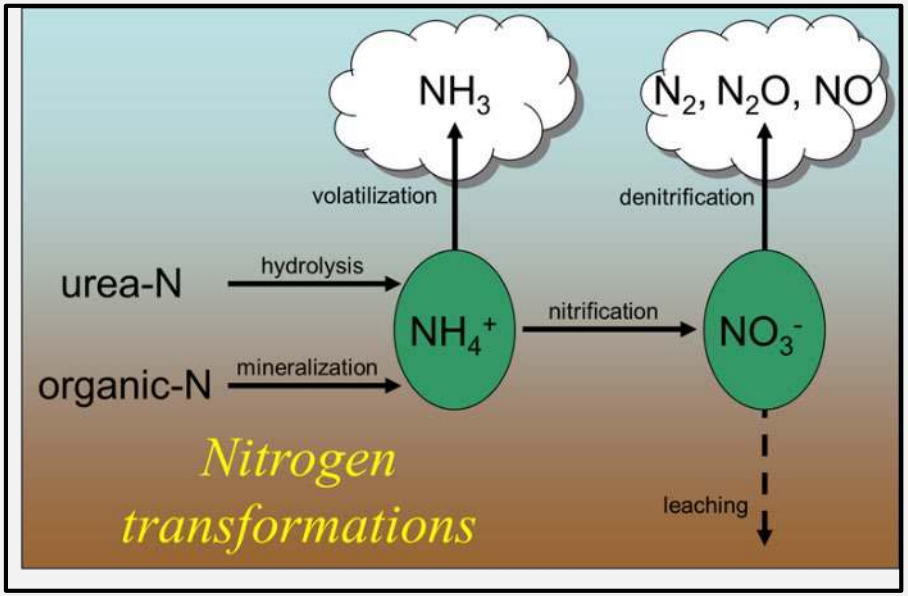
Denitrification:

- Anaerobic conditions cause Losses of N_2, NO and N_2O

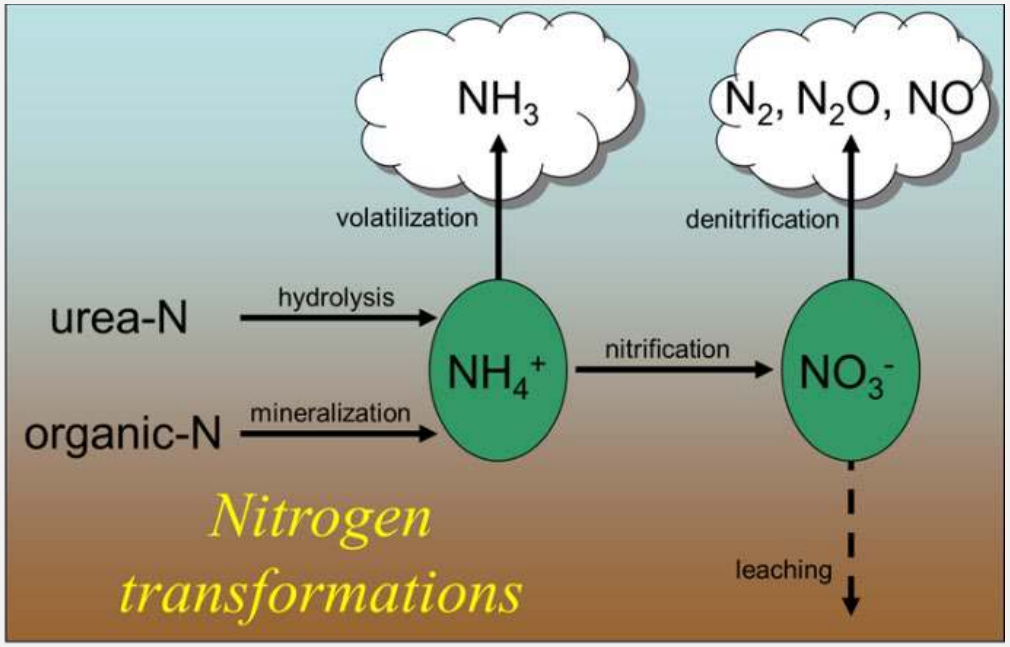
Leaching

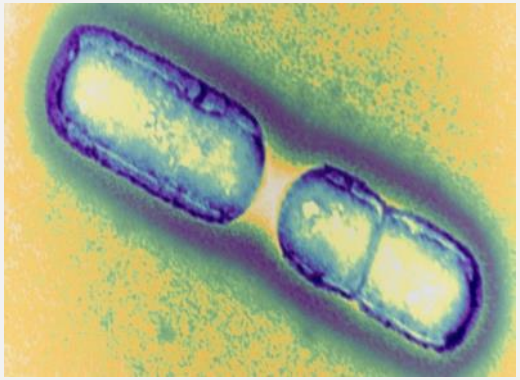
- Plenty of heat to convert ammonium to nitrate
- Nitrate leaves with the water

Both applied and soil available N are at risk of loss



Nitrogen Mineralization and Immobilization





Biology

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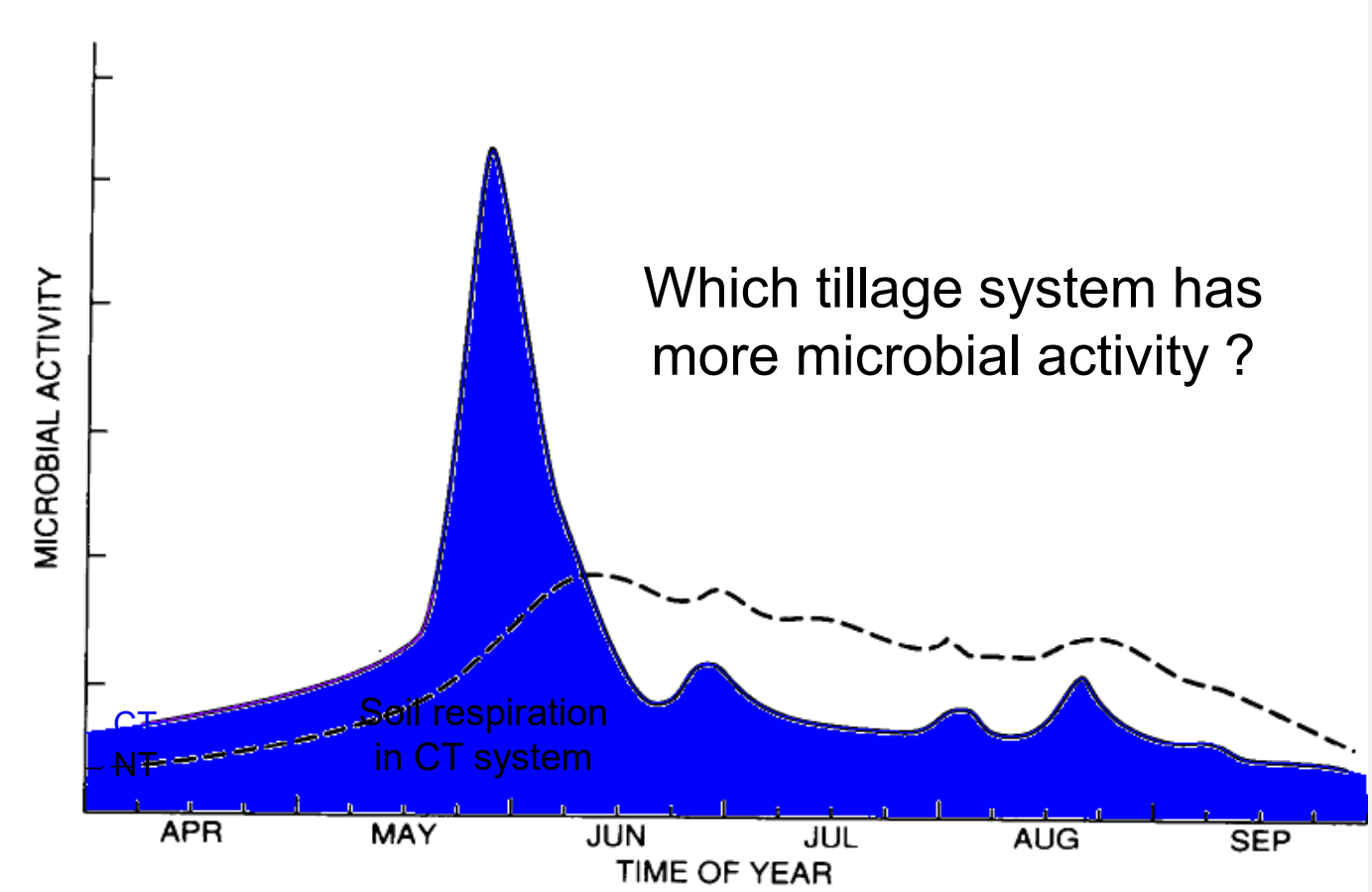
Only 30-55% of Inorganic Fertilizer is Directly Used by Plants

Fertilizer N applied (lb/ac)	Corn grain yield (Bu/ac)	Total N in corn plant (lb/ac)	Fertilizer-derived N in corn (lb/ac)	Soil-derived N in corn (lb/ac)	Fertilizer-derived N in corn as % of total N in corn
45	62	76	25	54	33
89	73	130	49	81	38
178	88	140	77	63	55

Calculated from Reddy and Reddy, 1993 and modified from Weil & Brady, The Nature and Properties of Soils, 15th ed.

Effect of tillage on microbial activity



Havlin et al. (1999)

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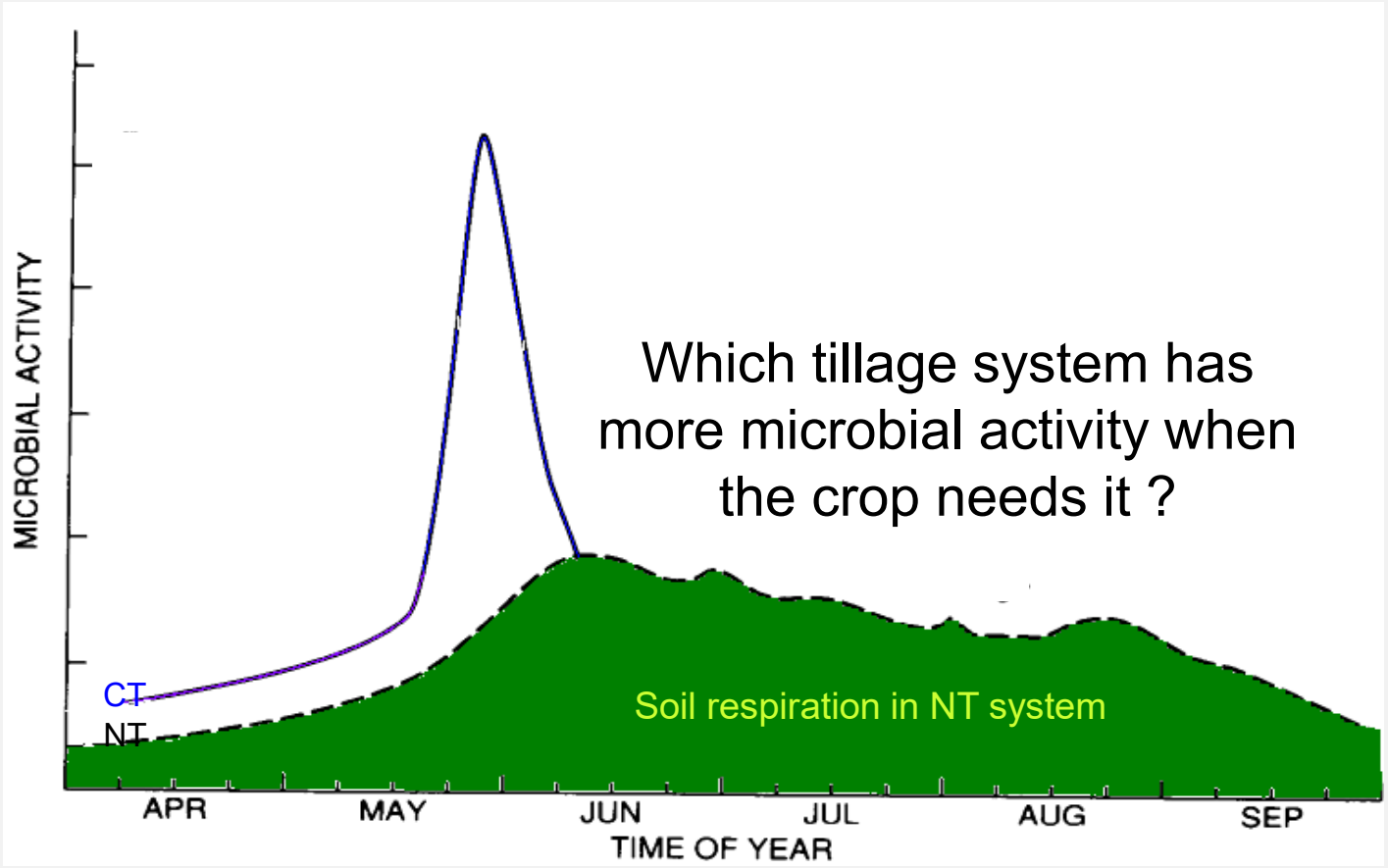
Effect of tillage on microbial activity



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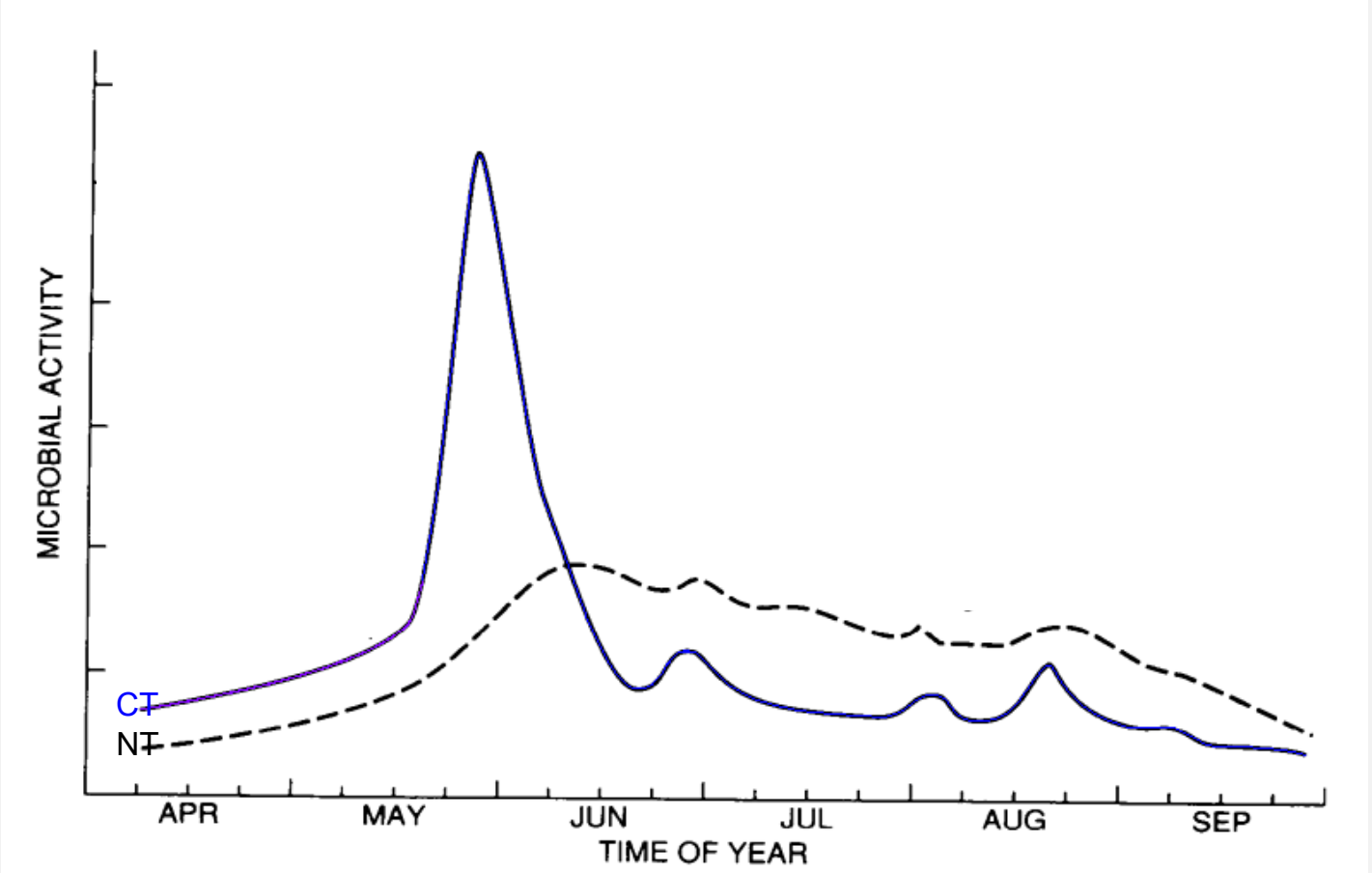
What are the yield determination times for corn? What should your N application protocol be?



Havlin et al. (1999)

No-Till Planters

With Adapted 4R Precision

- Discussion-

What is a common issue you have seen with these practices?

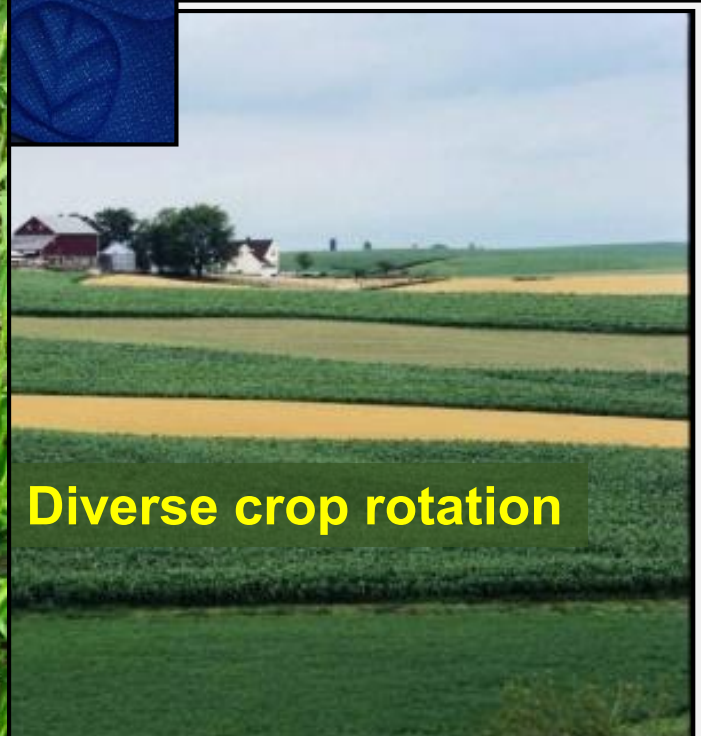
- **Nutrient Management**
- No-till/ Strip-till
- Cover Crops
- Weed & Pest Management


Quality no-till/strip-till


Adapted nutrient management


New technology and integrated
weed & pest management


Prescribed cover crops

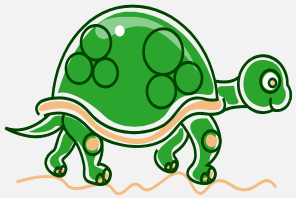

Diverse crop rotation

Strategically…CC Should Complement the Following Crop

What about Corn?

Strategically…CC should match desired C:N Ratio

Material	C:N Ratio	
Rye Straw	82:1	Good for Soybean
Wheat Straw	80:1	
Oat Straw	70:1	
Corn Stover	57:1	
Rye Cover Crop (Anthesis)	37:1	
Rye Cover Crop (Vegetative)	26:1	
Mature Legumes	25:1	
Balanced Microbial Diet	24:1	
Daikon Radish	19:1	Good for Corn
Crimson Clover	17:1	
Ryegrass (Vegetative)	15:1	
Young Alfalfa	13:1	
Hairy Vetch Cover Crop	11:1	
Soil Microbes (Average)	8:1	



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

Corn into:

- High Carbon (Cereals Rye/Wheat)

…or

- High Nitrogen (Protein)
- Cover Crop (Clover/Peas)

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

Corn after

High C (Corn)

plus

High N (Protein)

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Strategically…

CC should complement the following crop

Corn strategy:

- Strip planting
  - Easy spring management
- Other innovations

Strategically…CC Should Complement the Following Crop

Corn into a mix:

High Protein

Can Provide:

- Optimum Nutrient Release
- Extra water

During rapid demand

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!

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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

2. Terminate the Cereal Rye at 12”…

Strategically…Planning the system

2. **Plant a short season Soybean into the Rye (preferably early in the season)**

Strategically…Planning the system

3. Plant a low C:N mix into or after Soybean

Strategically…Planning the system

3. Plant a low C:N mix into or after Soybean

Strategically… Planning the system

18 months into the system we have had:

Three no-till plantings (Minimized Disturbance)

Year round ground cover (Maximized Ground Cover)

Added diversity that was lacking (Maximized Diversity)

Two winters of a living root (Maximized Living Roots)

Strategically…Planning the system

4. **NT Corn into a: Biologically active high functioning soil**

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Strategically…Planning the system… <u>for a higher level</u>?

5. Add a Small Grain and make it a true rotation

A Small Grain gives endless options…

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Strategically…Planning the system… <u>for a higher level</u>?

6. Maximize Diversity by companion cropping…

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Strategically…Planning the system… <u>for a higher level</u>?

7. Maximize Diversity by adding livestock…with high end grazing systems

Strategically… Planning the system

5.or 8. Enjoy The Rewards of Soil Health!

Managing for a Living Ecosystem is Key to Optimum Production

- Discussion-

What are the roadblocks to the systems approach?

- a Quality No-till/ Strip-till System
- Diverse and Strategic Cover Crops
- Adapted Nutrient Management
- Integrated Weed & Pest Management
- Diverse Crop Rotations
- Precision Farming Technology
- Prescriptive Buffers and Constructed Practices

- Discussion-

What are the benefits to the systems approach?

- a Quality No-till/ Strip-till System
- Diverse and Strategic Cover Crops
- Adapted Nutrient Management
- Integrated Weed & Pest Management
- Diverse Crop Rotations
- Precision Farming Technology
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