Agronomic and Soil Quality Benefits of Cover Crops

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OUR GOAL

Manage agricultural land to:

- Optimize crop yield and quality
- Minimize environmental N losses
- Maintain and/or improve soil quality
Cover Crops

Benefits:

1. Increased crop yields.
2. Ability to capture residual N.
3. Ability to add N to soils through nitrogen fixation.
4. Improved physical quality (water storage, transmission).
Brookston clay loam soil
### Crop Rotations

**Continuous crops**
- Corn
- Soybean
- Winter Wheat
- Winter Wheat + Red Clover

**2 year Rotations**
- Corn-Soybean
- Winter Wheat-Soybean
- Winter Wheat+Red Clover –Soybean

**3-year Rotations**
- WW-Corn-Soybean
- WW+RC-Corn-Soybean
- Corn-Soybean-Soybean

**4-Year Rotations**
- WW-C-S-S
- WW+RC-C-S-S
Soil Inorganic N – Spring (0-60 cm depth)

Soil Inorganic N (kg N ha⁻¹)

Control
Red Clover

WW
WW-S
WW-C-S
Cumulative Winter Wheat Yields

- Continuous WW
- WW+Red clover
- WW-C-S-S
- WW+RC-C-S-S

Year: 2002 to 2012

Cumulative Winter Wheat Yield (t ha\(^{-1}\))

Yield levels: 0 to 40
Cumulative Corn Grain Yields

- **Cumulative Corn Grain Yield (t ha⁻¹)**

- **Continuous corn**
- **Corn-Soybean**
- **W-C-S-S**
- **W+RC-C-S-S**

Data for the years 2002 to 2012 is shown, with cumulative yields plotted over time for each treatment.
Soybean Yields

- **Continuous Soybean**
- **WW-C-S**
- **WW+RC-C-S**

Soybean Yield (t ha$^{-1}$)


- 70 bu/ac
- 50 bu/ac
- 25 bu/ac
Cumulative Soybean Yields

Cumulative Soybean Yield (t ha$^{-1}$)

Continuous Soybean
WW-C-S-S
WW+RC-C-S-S

Soybean Yield (t ha$^{-1}$)

Continuous Soybean
WW-C-S
WW+RC-C-S
Surface Runoff & Tile Drainage Volume

Cumulative Flow (kL ha\(^{-1}\))

<table>
<thead>
<tr>
<th>Surface Runoff</th>
<th>Tile Drainage</th>
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<tbody>
<tr>
<td>No cover crop + CDS</td>
<td>No cover crop + Tile drainage</td>
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<tr>
<td>Cover crop + CDS</td>
<td>Cover crop + Tile drainage</td>
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</tbody>
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1999 2000 2001 2002 2003 2004 2005
Nitrate Loss

Surface Runoff

- No Cover crop + CDS
- Cover crop + CDS
- No Cover crop + Tile drainage
- Cover crop + Tile drainage

Tile Drainage

Cumulative Nitrate Loss (kg N ha⁻¹)
Saturated Hydraulic Conductivity (ksat)

- No CC+CDS
- CC+CDS
- No CC+Tile drainage
- CC+Tile drainage
Cover crop study (2012)

Treatments

- Control (no cover crop)
- Oats (56 lbs/ac)
- Nitro radish (12 lbs/ac)
- Oilseed radish (12 lbs/ac)
- Yellow mustard (12 lbs/ac)

Planting date: Aug. 20, 2012
SAGES
OATS
2012
SAGES
NITRO
RADISH
2012
Cover crop biomass - 2012

Cover crop biomass (t ha⁻¹)

- Yellow mustard
- Oats
- Oilseed radish
- Nitro radish

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Cover crop N uptake - 2012

Cover crop N content (kg N ha\(^{-1}\))

- Yellow mustard
- Oats
- Oilseed radish
- Nitro radish

[Bar chart showing the N uptake of different cover crops]
Cover crop benefits

- Enhanced crop yields (especially corn)
- Capture and release of N to the following crop
- Reduced surface runoff
- Improved saturated hydraulic conductivity
- Increased C and N returns to soil
- Reduced nitrate leaching losses

- Also note the sizeable benefit of crop rotations in general vs. continuous cropping.
Acknowledgements

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Future Research

Study 1: Rotations with/without red clover

- Crop yields & N uptake
- Soil organic carbon (SOC)
- Inorganic N leaching/recovery
New Cover Crop Study (2)

Objectives

To determine:

1) Crop yields and quality.

2) Soil physical quality (soil strength/hardness, soil water storage and transmission, soil aeration, soil physical quality index values);

3) SOC & SON amounts, types and profile distributions;

4) Nitrate leaching in the soil profile;

5) Reductions in synthetic fertilizer requirements;
New Cover Crop Study (2)

Control - No cover crop

Single Species
- Nitro radish (NR)
- Sesbania (SE)
- Phacelia (PH)
- Red clover (RC)

Mixtures
- Nitro radish + phacelia
- Nitro radish + sesbania
- Phacelia + red clover
- Nitro radish + sesbania + phacelia + red clover