COVER CROPS AND NUTRIENT CYCLING

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- Wisconsin Fertilizer Research Council
- SARE
- UWEX
- Wisconsin Farmers
OUTLINE

• Cover crop use in the US
• The long-term benefits of cover cropping
• The short-term benefits of cover cropping
406,000 ac of cover crop in MN (6th)
553,000 ac of cover crop in WI (3rd)
Figure 8. Cover crop species used by survey - percentage of respondents

- Winter Cereal Grains: 72%
- Brassicas: 62%
- Legumes: 58%
- Annual Grasses: 56%
- Multi-species Mix: 34%
- Two-species Mix: 29%
- Summer Annual Broadleaf: 17%
- Other: 6%

n=721
WHAT DO WE WANT COVER CROPS TO DO?

Desired Cover Crop Benefits (% of Respondents)

- Soil compaction reduction: 58%
- Soil erosion reduction: 56%
- Nitrogen scavenging: 41%
- Weed control: 40%
- Increases yields for future crops: 36%
- Nitrogen source: 36%
- Fibrous rooting system: 27%
- Deep tap roots: 22%
- Economic return (haying, grazing, etc): 17%
- Other: 15%
- Decreases future production costs: 11%
- Winter kills easily: 9%
- Winter hardiness: 8%
- Disease reduction: 7%
- Insect control: 5%

Figure 18. Cover crop benefits desired by cover crop survey respondents (percentage of respondents).
Desired Cover Crop Benefits - Cover Crop Users

- Increases soil organic matter: 73.9%
- Reduces soil erosion: 51.2%
- Reduces soil compaction: 36.2%
- Controls weeds: 28.1%
- Provides a nitrogen source: 22.8%
- Provides nitrogen scavenging: 17.0%
- Increases yields in following cash crop: 15.8%
- Economic return: 12.0%
- Fibrous rooting system: 10.0%
- Deep tap roots: 9.5%
- Decreases cost of producing the following cash crop: 4.6%
- Attracts pollinators to my farm: 4.1%
- Winter kills easily: 4.0%
- Other: 3.2%
- Winter hardiness/survival: 1.8%
- Reduces diseases: 1.6%
- Controls insects: 1.5%

Source: 2013-2014 SARE/CTIC Cover Crop Survey
LONG-TERM BENEFITS

• Reduction in soil erosion
• Long-term improvement in the soil condition that leads to:
  • Increased yields
  • Reduction in N fertilizer need
  • Higher yields in years with environmental stresses
COVER CROPS AND SOIL LOSS

- Can use RUSLE2 to do simulations to evaluate the potential benefit of cover crops in reducing soil loss.
- The magnitude of the reduction will be dependent on:
  - Crop rotation
  - Soil type
  - Tillage
**COVER CROPS AND SOIL LOSS**

- Edmund Clay Loam, 4% slope
- T = 2 ton/ac/yr
- Continuous corn silage rotation
- Cover crops (rye) drilled in October
- Cover crop (rye) aerially applied in September
- No-till vs. spring chisel

<table>
<thead>
<tr>
<th>Tillage</th>
<th>Cover Crop</th>
<th>Soil Loss (ton/ac/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-till</td>
<td>None</td>
<td>2.1</td>
</tr>
<tr>
<td></td>
<td>Aerially-applied</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td>Drill-seeded</td>
<td>1.1</td>
</tr>
<tr>
<td>Chisel plow</td>
<td>None</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>Aerially-applied</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>Drill-seeded</td>
<td>2.2</td>
</tr>
</tbody>
</table>
MAKING COVER CROPS PAY (SHORT-TERM)

- Providing a nitrogen credit (green manure)
- Increasing subsequent crop yield (most likely corn)

Three types of cover crops have been evaluated in WI:

- Legumes (for the N credit)
- Grasses (for a yield bump)
- Radish (for an N credit or a yield bump)
Table 9.5. Green manure nitrogen (N) credits.

<table>
<thead>
<tr>
<th>Crop</th>
<th>&lt; 6” growth</th>
<th>&gt; 6” growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>40</td>
<td>60–100&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Clover, red</td>
<td>40</td>
<td>50–80&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Clover, sweet</td>
<td>40</td>
<td>80–120&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Vetch</td>
<td>40</td>
<td>40–90&lt;sup&gt;a,b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Use the upper end of the range for spring-seeded green manures that are plowed under the following spring. Use the lower end of the range for fall seedings.

<sup>b</sup> If top growth is more than 12 inches before tillage, credit 110–160 lb N/a.
OPTIONS FOR CLOVERS IN WINTER WHEAT
Corn response to nitrogen, Janesville 2010

For clover:
- Equation: $y = 176.8 + 0.5318x - 0.0021x^2$
- $r^2 = 0.3083$
- $N_{\text{max}} = 127$

For no clover:
- Equation: $y = 104.9 + 0.9459x - 0.0026x^2$
- $r^2 = 0.9021$
- $N_{\text{max}} = 182$

Stute and Shelley, unpublished
Pictures taken October 1, 2013
SUMMER SEEDED LEGUMES

Oct. 25, 2013
Ballweg, UWEX

Berseem
117 lb-N/ac AGB

Crimson
177 lb-N/ac AGB
GRASSES

- Reduces soil erosion
- Reduces nitrate leaching
- Potential to use as a forage crop
STUDY DESIGN

- Continuous corn silage w/ fall manure application (10,000 gal/ac of liquid dairy manure)
- Fall-planted winter rye (90 lb live seed/ac)
  1) No cover crop
  2) Winter rye as a cover crop
  3) Winter rye as a forage crop (ryelage)
RYE COVER CROP ABOVEGROUND BIOMASS

Dry matter, lb/ac

Termination date

<table>
<thead>
<tr>
<th>Date</th>
<th>Dry Matter, lb N/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/12/12</td>
<td>115</td>
</tr>
<tr>
<td>5/1/13</td>
<td>11</td>
</tr>
<tr>
<td>5/12/14</td>
<td>11</td>
</tr>
</tbody>
</table>
RYELAGE ABOVEGROUND BIOMASS

- **Harvest date:** 5/10/12, 5/21/13, 5/30/14
- **Dry matter, lb/ac:**
  - 5/10/12: 125 lb N/ac
  - 5/21/13: 73 lb N/ac
  - 5/30/14: 65 lb N/ac
RESULTS

Corn silage yield, 2012
Arlington, WI

Ryelage = 13 ton/ac
RESULTS

Corn silage yield, 2012
Arlington, WI

Yield (65% moisture), ton/ac

N rate, lb N/ac

Total forage: Corn silage + Ryelage

- No CC
- Rye CC
- Ryelage
RESULTS

Corn silage yield, 2013
Arlington, WI

Yield (65% moisture), ton/ac

No CC
Rye CC
Ryelage

Ryelage = 6.5 ton/ac

N rate, lb N/ac
RESULTS

Corn silage yield, 2013
Arlington, WI

Yield (65% moisture), ton/ac

N rate, lb N/ac

Total forage: Corn silage + Ryelage
No CC
Rye CC
Ryelage
**RESULTS**

Corn silage yield, 2014

Arlington, WI

Error bars represent standard error.

Ryelage = 5.8 ton/ac
RESULTS

Corn silage yield, 2014
Arlington, WI

Yield (65% moisture), ton/ac

N rate, lb N/ac

Total forage:
- Corn silage
- + Ryelage

No CC

Rye CC

Ryelage

Error bars represent standard error.
CONCLUSIONS

• Winter rye as a cover crop did not affect corn silage yield
• Winter rye as a forage crop reduced corn silage yield in 2 of 3 years.
  • Led to greater total production in 2 of 3 years and the same amount of total production in 1 of 3 years
• Future research
  • Compare rye to ryegrass and spring barley
RADISH STUDIES

- Three locations in WI
- Radish vs. no radish following winter wheat
- Objective: determine if there is a nitrogen credit for radish
2013 CORN YIELDS
WASHINGTON COUNTY, WI
NO-TILL CORN FOLLOWING WINTER WHEAT

No effect of radish on yield or response to N in 2012 as well.
2013 Corn Yield

Error bars represent standard error.
Penetrometer Data (August 16, 2013)

Error bars represent standard error.

- ○ No Radish
- ▽ Radish
- ■ Radish + 60N

Depth (in)

Soil Resistance (KPa)
RADISH CONCLUSIONS

• Across six site years, we have not been able to determine a nitrogen credit from radish with N response yield data.

• Is it really beneficial for reducing soil erosion?
• It’s doing something to the soil – how often will this result in a yield increase?
• The future of radish as a cover crop will be as part of a mixture.
CAN WE GET COVER CROPS INTO CORN AND SOYBEAN FIELDS THIS FAR NORTH?

- Yes.
- But unclear how much benefit we are going to get from them.
WAYS TO GET COVER CROPS INTO CORN AND SOYBEAN FIELDS

- Interseeding at V8-V10
- Late-season applications
LATE SEEDING

- Corn (grain)
  - Plant dried up to the ear
  - 50% of ground has sunlight
- Corn (silage)
  - Less than two weeks prior to harvest
- Soybean
  - Between 50% senescence and 50% leaf drop

- Drawbacks
  - Higher seeding rates
  - Mixtures are not feasible
Annual ryegrass seeded into soybean
SUMMARY

• Clovers
  • Provide a nitrogen credit, but need to be planted in summer

• Radish
  • No nitrogen credit, but may have some soil benefits.

• Grasses
  • Good for erosion control, but need to kill early in spring
  • The only option for planting a cover after Sept. 1.
WHAT ARE COVER CROPS?

Cover crops are plants seeded into agricultural fields, either within or outside of the regular growing season, with the primary purpose of improving or maintaining ecosystem quality.

The goal of the Midwest Cover Crops Council (MCCC) is to facilitate widespread adoption of cover crops throughout the Midwest, to improve ecological, economic, and social sustainability.

WHAT DO COVER CROPS DO FOR THE ENVIRONMENT?

- Enhance biodiversity
- Increase soil infiltration, leading to less flooding, leaching, and runoff
- Create wildlife habitat
- Attract honey bees and beneficial insects

NEWS

2015 MCCC Meeting
February 17-18, 2015
West Des Moines, IA
Registration is now open!

The MCCC is hiring a Program Manager, please visit the link for details!

There are still events and webinars going on during the winter months, so check out the Upcoming events section and the MCCC Facebook page!
QUESTIONS?
COMMENTS?
CONCERNS?