Adjusting nutrient management when using cover crops

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Multi-site and multi-year research is underway to evaluate cover crops as funded by the WI Fertilizer Research Council.

Objectives:

• Evaluate growth of fall seeded cover crops and their effect on soil nitrate
  • post corn silage harvest and manure application
  • no-till

• Determine yield and optimal N rate for corn following different cover crops
Research was conducted at UW Agricultural Research Stations

- **Arlington,**
  South Central WI
  - Plano silt loam
  - Very deep, well drained

- **Marshfield,**
  North-central WI
  - Withee silt loam
  - Somewhat poorly drained

- **Lancaster,**
  SW “Driftless” WI
  - Fayette silt loam
  - Well-drained
  - 2-6% slopes; moderately eroded
Evaluating cover crops following corn silage harvest and fall manure application

Four treatments:

• No cover crop
• Spring Barley (71-140 lb/ac)
• Winter rye (75-120 lb/ac) – terminated in spring
• Triticale (69-173 lb/ac)
  • Harvested as a forage crop
Evaluate the effects of cover crops on key parts of the production system

• Fall erosion control – how well does it grow and cover?
• Fall soil nitrate – how much less nitrate was potentially leached?
• Presidedress nitrate test – did the cover crop take away from this estimate of the manure N credit?
• Yield – were the covers a benefit or cause a drag?
• Response to N – is more or less N required to achieve optimal yields?
All fall manure is not alike.
Cover crop growth
Fall growth of cover crop ranges from minimal to excessive.

<table>
<thead>
<tr>
<th></th>
<th>Date</th>
<th>Fall’14</th>
<th>Date</th>
<th>Fall’15</th>
<th>Date</th>
<th>Fall’16</th>
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<td></td>
<td></td>
<td>ton/ac</td>
<td></td>
<td>ton/ac</td>
<td></td>
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<tr>
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<tr>
<td>Rye</td>
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<tr>
<td>Barley</td>
<td></td>
<td>0.25</td>
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<td>1.16</td>
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<tr>
<td>Triticale</td>
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<td>0.25</td>
<td></td>
<td>0.78</td>
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November 13, 2014
Lancaster ARS
1/8 ton DM biomass
November 14, 2014

Arlington ARS

1/3 ton DM biomass
November 16, 2016

Marshfield ARS

¾ to 1 ton DM biomass
Fall Soil nitrate
One-third of a ton of biomass can lead to a decrease of 25 lb-N/ac in the upper 2’ of soil

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<thead>
<tr>
<th>Site</th>
<th>Cover</th>
<th>DM</th>
<th>Fall 2014 nitrate-N reduction</th>
<th>DM</th>
<th>Fall 2015 nitrate-N reduction</th>
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<tr>
<td></td>
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<td>ton/ac</td>
<td>lb-N/ac</td>
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<td>Rye</td>
<td>1/3</td>
<td>19</td>
<td>1/3</td>
<td>24</td>
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<tr>
<td></td>
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<td>23</td>
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<td>18</td>
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<td></td>
<td>Triticale</td>
<td></td>
<td>25</td>
<td></td>
<td>19</td>
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<tr>
<td>LAN</td>
<td>Rye</td>
<td>1/8</td>
<td>6</td>
<td>3/4</td>
<td>25</td>
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<tr>
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<td>Barley</td>
<td></td>
<td>8</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Triticale</td>
<td></td>
<td>5</td>
<td></td>
<td>21</td>
</tr>
<tr>
<td>MAR</td>
<td>Rye</td>
<td>1/4</td>
<td></td>
<td></td>
<td>1</td>
</tr>
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<td></td>
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<td>2</td>
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<td></td>
<td>Triticale</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
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Manure nitrogen credits
Cover crops wipe out some of the manure N credit based on PSNT

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<tr>
<th></th>
<th>ARL</th>
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<th>LAN</th>
<th></th>
<th>MAR</th>
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<tr>
<td></td>
<td>ppm</td>
<td>N credit</td>
<td>ppm</td>
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<tr>
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<td>35</td>
<td>13</td>
<td>35</td>
<td>16</td>
<td>60</td>
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<tr>
<td>Barley</td>
<td>18</td>
<td>100</td>
<td>16</td>
<td>60</td>
<td>8</td>
<td>0</td>
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<tr>
<td>Rye</td>
<td>11</td>
<td>10</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Triticale</td>
<td>5</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
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</table>
Yields
Yield drag flowing covers, although with spring barley can be reduced with more N

<table>
<thead>
<tr>
<th>Nitrogen Rate (lb-N/ac)</th>
<th>Corn Yield (bu/ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>17 bu/ac</td>
</tr>
<tr>
<td>Winter Rye</td>
<td>(1.5 ton DM/ac)</td>
</tr>
<tr>
<td>Spring Barley</td>
<td>(0.75 ton DM/ac)</td>
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</tbody>
</table>

Arlington ARS
Flat responses at LAN, but still yield drag with spring barley. Larger yield drag (+30 bu/ac) with winter rye.

<table>
<thead>
<tr>
<th>Nitrogen Rate (lb-N/ac)</th>
<th>None</th>
<th>Winter Rye</th>
<th>Spring Barley</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 bu/ac</td>
<td>35 bu/ac</td>
<td></td>
</tr>
<tr>
<td>(1.25 ton DM/ac)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.5 ton DM/ac)</td>
<td></td>
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</tbody>
</table>
Same trend at MAR with small yield drag with barley, larger drag with rye.

<table>
<thead>
<tr>
<th>Nitrogen Rate (lb-N/ac)</th>
<th>Corn Yield (bu/ac)</th>
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<tbody>
<tr>
<td>0</td>
<td>None (~0 bu/ac)</td>
</tr>
<tr>
<td>50</td>
<td>Winter rye (~1 ton DM/ac)</td>
</tr>
<tr>
<td>100</td>
<td>Spring Barley (~1 ton DM/ac)</td>
</tr>
<tr>
<td>150</td>
<td>5 bu/ac</td>
</tr>
<tr>
<td>200</td>
<td>15 bu/ac</td>
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</table>

The graph shows the relationship between nitrogen rate and corn yield for different crop treatments. The data points indicate a yield drag effect with increasing nitrogen rates, especially noticeable with winter rye and spring barley compared to the control (None).
No yield drag, but different optimum N rate for winter rye (Lancaster 2015)

\[ R^2 = 0.97 \]

\[ R^2 = 0.99 \]
No statistical difference in yields among no cover and winter-killed covers (Arlington 2015)
Corn

Average Yield Difference of the 50 trials displayed: \textbf{0.0} bu/acre.

90\% Confidence Interval for the Average Yield Difference: from \textbf{-1.0} to \textbf{1.0} bu/acre.

Soybean

Average Yield Difference of the 12 trials displayed: \textbf{0.2} bu/acre.

90\% Confidence Interval for the Average Yield Difference: from \textbf{-0.6} to \textbf{1.0} bu/acre.
**Corn yields, 2009-2014**

Cover crop resulted in:
- Yield improvement
- No change
- Yield reduction

- 3/28 site-years
- 25/28 site-years

**Soybean yields, 2009-2013**

- 1 site-year
- 4/18 site-years
- 14/18 site-years

**Figure 2.** Trends with respect to cover crop effect on corn yields at 28 site-years from 2009 to 2014.

**Figure 3.** Trends with respect to cover crop effect on soybean yields at 18 site-years from 2009 to 2013.
2013 Corn Yields
Washington County, WI
No-till corn following winter wheat

![Graph showing corn yield (bu/ac) vs. nitrogen rate (lb/ac) for different treatments. The graph includes data points for 'None' and 'Radish' treatments, with error bars indicating variability.]
Yield response from Janesville in 2010 shows a 46 lb-N/ac N credit from red clover (plus yield gains)
What nutrient management adjustments should I make when using cover crops

• With grass cover crops –
  • Use nitrogen in starter fertilizer
  • Don’t expect residual soil nitrate (i.e. no PPNT credit)
  • If excessive growth, reduce the N credit you are taking with fall applied manure (how much – I don’t know yet)

• With radish –
  • No change

• With legumes –
  • Can take a 40 to 60 pound N credit with good growth
Questions?
Comments?
Concerns?
Grasses

Winter rye (or cereal rye)
Annual ryegrass
Oat
Barley
Triticale

- Establish and grow quickly
- Scavenge soil nitrogen
- High C:N ratio
Brassicas

Radish
Mustard
Turnip

- Slower to establish
- Scavenge soil nitrogen (even more than the grasses if given enough time)
- Medium C:N ratio
Legumes

- Red Clover
- Berseem Clover
- Crimson Clover
- Hairy Vetch

- Slower to establish
- Fix N from atmosphere
- Low C:N ratio