Cover Crops and Fertility- What the Research Shows

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Introduction

- Limited use of cover crops in corn/soybean/winter wheat rotations in Ontario
- Declining use of red clover as an underseed in winter wheat
- Use of cover crops is encouraged in Ontario following summer applied manure because it is assumed that:
  - potential for loss of nitrogen via leaching and/or denitrification during the fall and winter period is reduced
  - manure credit to next year’s crop is increased.
Cover Crop/Manure Trial

- Strip block design
- Minimum 2 replicates
- Cover crops:
  - Oat
  - Oilseed radish
  - Field pea
  - Control
- Two manure rates
  - Farmers “typical” manure rate
  - No manure
Manure applied following wheat harvest in August

Summary of type of manure applied, *average* application rates and manure-N applied and soil fertility in surface 15cm.

<table>
<thead>
<tr>
<th>Manure Type</th>
<th>Sites</th>
<th>Corn Sites</th>
<th>Manure Properties</th>
<th>Soil Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kl / Mg ha(^{-1})</td>
<td>kg N ha(^{-1})</td>
<td>kg N ha(^{-1})</td>
<td>pH</td>
</tr>
<tr>
<td>Liquid Cattle</td>
<td>5</td>
<td>5</td>
<td>74.3</td>
<td>125</td>
</tr>
<tr>
<td>Liquid Hog</td>
<td>11</td>
<td>8</td>
<td>46.4</td>
<td>139</td>
</tr>
<tr>
<td>Solid Cattle</td>
<td>7</td>
<td>4</td>
<td>48.3</td>
<td>61</td>
</tr>
<tr>
<td>Solid Poultry</td>
<td>7</td>
<td>5</td>
<td>10.3</td>
<td>56</td>
</tr>
</tbody>
</table>
• 22 sites evaluated for corn yield response

• All plots received the cooperator’s starter N rate ranging from 0 to 30 kg-N ha\(^{-1}\)

• Cover crop/manure rate plots split
  – no nitrogen
  – 150 kg-N ha\(^{-1}\) as sidedress UAN.
• Measurements
  – Cover crop biomass
  – End of season cover crop biomass N content
  – End of season soil N content
  – Corn yield
  – MERN estimation using delta yield approach similar to Lory and Scharf (2003)
Manure application and *oat* cover crop effect on biomass, biomass N, and soil N

Biomass, biomass-N and soil N bars that contain the same letter are not different at the 5% level of probability. Statistical differences were identified using log(x+1) transformed data.
Manure application and **Oilseed Radish** cover crop effect on biomass, biomass N, and soil N

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<table>
<thead>
<tr>
<th>Cover crop</th>
<th>C:N ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Manure</td>
</tr>
<tr>
<td>Oilseed radish</td>
<td>24</td>
</tr>
<tr>
<td>Oats</td>
<td>28</td>
</tr>
<tr>
<td>Weed</td>
<td>19</td>
</tr>
</tbody>
</table>
Manure application and **Field Pea** cover crop effect on biomass, biomass N, and soil N

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</thead>
<tbody>
<tr>
<td></td>
<td>No Manure</td>
</tr>
<tr>
<td>Peas</td>
<td>13</td>
</tr>
<tr>
<td>Oats</td>
<td>26</td>
</tr>
<tr>
<td>Weed</td>
<td>18</td>
</tr>
</tbody>
</table>
Manure application, **Oat** cover crop and nitrogen effect on corn yield and MERN

Yield and MERN bars that contain the same letter are not different at the 5% level of probability.
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Manure application, and cover crop effect on pre-sidedress soil nitrate

PSNT bars that contain the same letter are not different at the 5% level of probability.
Cover Crop/Manure Trial: Conclusions

- Oat pea and oilseed radish cover crops planted following fall manure application had increased biomass, sequestered nitrogen and reduced soil nitrogen.
- Oat and oilseed radish did not reduce corn nitrogen fertilizer requirements.
- Field pea reduced corn nitrogen fertilizer requirements by approximately 20 kg N ha$^{-1}$ when no manure was applied.
What About Red Clover?
Impact of cover crops on PSNT soil nitrates.

Serran, 2006
Red clover effects on N credit, yield and profit of conventional-till corn

<table>
<thead>
<tr>
<th>Corn Price&lt;sup&gt;2&lt;/sup&gt;</th>
<th>N Cost</th>
<th>Cover crop</th>
<th>MERN&lt;sup&gt;3&lt;/sup&gt;</th>
<th>MEY&lt;sup&gt;4&lt;/sup&gt;</th>
<th>Profit&lt;sup&gt;5&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$ Mg^{-1}$</td>
<td>$ kg^{-1}$</td>
<td>kg N ha&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>kg ha&lt;sup&gt;-1&lt;/sup&gt;</td>
<td>$ ha&lt;sup&gt;-1&lt;/sup&gt;</td>
</tr>
<tr>
<td>150</td>
<td>1</td>
<td>No-Red clover</td>
<td>143</td>
<td>9454</td>
<td>1293</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Red clover</td>
<td>79</td>
<td>9886</td>
<td>1382</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difference</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>100</td>
<td>1</td>
<td>No-Red clover</td>
<td>129</td>
<td>9338</td>
<td>823</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Red clover</td>
<td>74</td>
<td>9841</td>
<td>889</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difference</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>150</td>
<td>1.5</td>
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<td>Difference</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
<tr>
<td>100</td>
<td>1.5</td>
<td>No-Red clover</td>
<td>107</td>
<td>9068</td>
<td>773</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Red clover</td>
<td>63</td>
<td>9713</td>
<td>863</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Difference</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

<sup>1</sup> Analysis conducted using 19 paired comparison of red clover-no-red clover
<sup>2</sup> Corn price after drying, handling and marketing
<sup>3</sup> Maximum economic rate of nitrogen calculated using a quadratic function
<sup>4</sup> Maximum economic yield at MERN
<sup>5</sup> Profit based on nitrogen rate and corn yield at MERN and clover establishment cost of $40 ha<sup>-1</sup>
Poor red clover stands
– Red clover application timing/frost tolerance
– Drilling versus broadcasting
– Wheat row configuration
– Wheat cultivar
– Wheat N rate
– Wheat tillage system
– Light versus drought competition
Nitrogen Effect on Red Clover


Effect of nitrogen rate on returns for winter wheat, average of 12 Ontario locations, 2006, 2007. (N @ 1.00 $Cdn kg-1, wheat @ 114 $Cdn t-1)
Tillage Effect on Red Clover
Poor red clover stands – Variable N Application?

Key questions:
• What is the relationship between NDVI and N credit?
• What is the correlation between RC biomass and nitrogen credit?

Need for N credit accuracy?

Effect of nitrogen rate on returns for corn, average of 19 pair-wise comparisons between 1990-99. (N @ 1.00 $Cdn kg-1, corn @ 100 $Cdn t-1)
Questions?

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