RESIDUAL SOIL NITROGEN AND NITROGEN RESPONSE OF CORN ON SANDY LOAM SOIL

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Background

• In Wisconsin, PPNT and PSNT have been available since 1989 and 1994, respectively.

• Numerous N response studies have been collected at Hancock (sandy), Lancaster, Marshfield and Arlington (silt loam) agricultural research stations.
Background

• Very little N response data has been collected on sandy loam (intermediate) soils in Wisconsin.

• Cook (2000) found that approximately 35% of applied nitrogen fertilizer to agricultural fields (sandy loam) was leaching to groundwater while following UW nitrogen recommendations.
Objectives

- To determine the EONR on sandy loam soil.
- To determine background soil N content for PPNT (0-3 ft) adjustments.
- To determine the critical soil N-sufficiency value for PSNT (0-1 ft).
- To determine the potential for N carry over on sandy loam soil (leaching).
Materials and Methods

- A 3 year on-farm study (1997-1999) at 14 locations in Portage and Waupaca Counties.
- RCB design with 3 replications (Billet and Rosholt).
- Treatments were:
  - Corn on Alfalfa:
    - 0 - 160 lbs N/ac (40 lbs increments) at 3 locations in 1997.
    - 0 - 120 lbs N/ac (30 lbs increments) at 2 and 3 locations in 1998 and 1999, respectively.
  - Corn on Corn:
    - 0 – 200 lbs N/ac (50 lbs increments) at 3 locations in 1998 and 1999.
Materials and Methods

• Ammonium nitrate (NH$_4$-NO$_3$) was hand placed at V6 stage (12 – 18 in.).

• Soil NO$_3$-N samples were taken in early April (PPNT), June (PSNT), fall (Oct-Nov) and the following spring (April) to a depth of 3 ft in 1 foot increments.

• Corn grain yields were determined by hand harvesting the center 2 rows of each plot (20ft x 30ft) and reported at 15.5 % moisture.
Effects of N rate (lb N/ac) on EONR and corn grain yield @ EONR at 13 location with differing management in Wisconsin, 1997-1999.

<table>
<thead>
<tr>
<th>Year</th>
<th>Rotation</th>
<th>EONR*</th>
<th>Yield @ EONR</th>
<th>Pr&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>lb N/ac</td>
<td>bu/ac</td>
<td>0.05</td>
</tr>
<tr>
<td>1997</td>
<td>A/C</td>
<td>0</td>
<td>156</td>
<td>0.18</td>
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<tr>
<td>1997(I)</td>
<td>A/C</td>
<td>0</td>
<td>197</td>
<td>0.24</td>
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<tr>
<td>1998</td>
<td>A/C</td>
<td>0</td>
<td>165</td>
<td>0.48</td>
</tr>
<tr>
<td>1998</td>
<td>A/C</td>
<td>0</td>
<td>70</td>
<td>0.54</td>
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<tr>
<td>1999(I)</td>
<td>A/C</td>
<td>0</td>
<td>211</td>
<td>0.34</td>
</tr>
<tr>
<td>1999</td>
<td>A/C</td>
<td>0</td>
<td>149</td>
<td>0.38</td>
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<tr>
<td>1999</td>
<td>A/C</td>
<td>117</td>
<td>175</td>
<td>0.047</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1998(I)</td>
<td>C/C/C</td>
<td>142</td>
<td>192</td>
<td>0.01</td>
</tr>
<tr>
<td>1998(I)</td>
<td>C/C/C</td>
<td>200</td>
<td>208</td>
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<tr>
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<td>C/C/C</td>
<td>137</td>
<td>178</td>
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<tr>
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<td>C/C/C</td>
<td>86</td>
<td>168</td>
<td>0.003</td>
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<tr>
<td>1999</td>
<td>C/C/C</td>
<td>141</td>
<td>166</td>
<td>&lt;0.0001</td>
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<tr>
<td>1999</td>
<td>C/C/C</td>
<td>58</td>
<td>167</td>
<td>0.01</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>127.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Assumes $0.25/lbs for N and $2.00/bu for corn.

(I) Irrigated Locations
Preplant (PPNT) soil NO$_3$-N content (0-3 ft) at 0 lb N/ac for 6 C/C/C locations, 1998-1999.
“Present” PPNT Adjustment

Standard N Rec

120 lb N/ac

↓

Adjusted N Rec

120 - 50 = 70 lb N/ac

Soil NO₃-N Test Result

100 lb N/ac

↓

Corrected Soil NO₃-N

100 - 50 = 50 lb N/ac
“New” PPNT Adjustment

1. **Standard N Rec**
   - 120 lb N/ac

2. **Soil NO₃-N Test Result**
   - 100 lb N/ac
   - **Corrected Soil NO₃-N**
     - 100 - 30 = 70 lb N/ac

3. **Adjusted N Rec**
   - 120 - 70 = 50 lb N/ac
Relationship between PSNT (ppm) and relative yield (%) at 0-1 ft for all locations, 1997-1999.

\[ y = -0.28x^2 + 9.84x + 11.57 \]

\[ R^2 = 0.68 \]
Relationship between PSNT (ppm) and relative yield (%) at 0-2 ft for all locations, 1997-1999.

\[ y = -0.86x^2 + 19.50x - 11.47 \]

\[ R^2 = 0.79 \]
Relationship between corn grain yield (bu/ac), fall and spring soil NO₃-N (lb/ac) and N rate (lb N/ac) at 3 locations, 1997.
Relationship between corn grain yield (bu/ac), fall and spring soil NO$_3$-N (lb/ac) and N rate (lb N/ac) at 5 locations, 1998.
Relationship between corn grain yield (bu/ac), fall and spring soil NO$_3$-N (lb/ac) and N rate (lb N/ac) at 6 locations, 1999.
Conclusions

- EONR for corn were:
  - 0 lb N/ac for corn on alfalfa.
  - 130 lb N/ac for corn on corn.

- Background N content (0-3 ft) was 30 lb N/ac, below the present 50 lb N/ac.
Conclusions

• PSNT critical N levels were 17 ppm (0-1 ft) and 11 ppm (0-2 ft). Below the standards of 21 ppm and 15 ppm.

• As N rates increase, fall N content increases – especially above 80-100 lb N/ac rates.
Conclusions

• Residual N crediting (Fall to spring)
  – Spring N losses increase as the fall N content increases - especially above 80-100 lb N/ac rates (1997-1998).
  – Losses occurred during years (1997-1999) of below normal precipitation, which suggests that under years of normal or above normal over-winter precipitation, losses could be greater.
Conclusions

• Residual N crediting (Fall to spring)
  – In 1999, spring soil N increased due to above normal air temperatures and below normal over-winter precipitation.
  – When over-winter precipitation are below-normal N retention is possible.
  – WINTER of 2002 – 2003??

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