SOIL NITRATE TESTS FOR WISCONSIN CROPPING SYSTEMS

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Why Use Soil Nitrate Tests?

- Agronomic and environmental benefits
- Predict corn N needs
  - Improved accuracy
  - Site-and year-specific
- Minimize nitrate loss
Preplant Soil Nitrate Test (PPNT)

- Measures residual (carryover) nitrate
  - Corn after corn
  - Medium and fine textured soils
  - Normal or below normal rain
  - Available N exceeds crop need
- Not useful on sands, loamy sands
Preplant Soil Nitrate Test (PPNT)

- Collect samples in early spring (preplant)
- Sample 0-1 ft. and 1-2 ft. depths
- Combine 15 cores per 20 acres
- Dry or freeze soon after sampling
- Nitrate in 2-3 ft. depth predicted
- Nitrogen recommendations
Nitrogen Recommendations Based on the Preplant Soil Nitrate Test

Example:

STD. N REC.

160 lb N/a

SOIL NITRATE

140 lb N/a

CORRECTED SOIL NITRATE

140 – 50 = 90 lb N/a

N RECOMMENDATION

160 – 90 = 70 lb N/a
Average adjustment in corn N recommendations based on preplant nitrate tests, 1989-1996.
Pre-Sidedress Soil Nitrate Test (PSNT)

- Estimates N availability from organic N sources
  - Confirm N credits
  - Manure and legume history
  - Corn after alfalfa
- Not useful on sands, loamy sands
Pre-Sidedress Soil Nitrate Test (PSNT)

- Shallow samples (0-1 ft.)
- Legume and manure N included
- Partial accounting for carryover nitrate
- Short sampling and analysis time
- Sidedress N required
### Corn Nitrogen Recommendations Based on Presidedress Soil Nitrate Test (PSNT)

<table>
<thead>
<tr>
<th>PSNT Result — ppm N —</th>
<th>Soil Yield Potential*</th>
<th>N Application Rate, lb/a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very High/High</td>
<td>Medium/Low</td>
</tr>
<tr>
<td>&gt; 21</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20-18</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>17-15</td>
<td>100</td>
<td>40</td>
</tr>
<tr>
<td>14-13</td>
<td>125</td>
<td>80</td>
</tr>
<tr>
<td>12-11</td>
<td>150</td>
<td>80</td>
</tr>
<tr>
<td>&lt; 10</td>
<td>160 **</td>
<td>120 **</td>
</tr>
</tbody>
</table>

* To determine a soil's yield potential, consult UWEX publication A2809, Soil test recommendations for field, vegetable and fruit crops, or contact your agronomist or county agent.

** Unadjusted nitrogen application rate.
Using Soil Nitrate Tests

- **Corn after corn:**
  - Preplant test
    - Highest potential for carryover
    - Adjust N credits separately
      - Second year credits
      - Manured sites
    - PSNT
      - Direct adjustment for N credits
      - Partial carryover measurement
Using Soil Nitrate Tests

- Corn after alfalfa:
  - Use standard legume N credit
  - PSNT
    - Confirms legume credit
    - For PSNT < 21 ppm N, apply up to 40 lb N/acre
  - Do not use preplant test
Using Soil Nitrate Tests

• **Corn following soybean:**
  - Reduce base N rate by 40 lb N/acre
  - Use preplant soil nitrate test
  - Use both 40 lb N/acre and N test adjustments
Using Soil Nitrate Tests

• **Manured sites:**
  – PSNT
    • Direct assessment of N credit
    • Confirms N credit
    • Useful for unknown manure rates
  – Preplant Test
    • Accounts for carryover nitrate from previous years
    • Separate N credit needed for current or second year additions.
Summary

- Preplant test
  - Corn after corn
  - Sites without organic N
  - Manure & legume history with standard N credits
Summary

- Presidedress test (PSNT)
  - Manure & legume history
  - Confirm N credits
Procedure for N Crediting/PSNT Evaluation

- High (56%) and medium (45%) yield potential soils.
- Sites include N fertilizer, manure, legume N, and rotation variables.
- Soil nitrate tests, EONR determined.
Gross economic return from three N recommendation methods at 101 Wisconsin locations, 1989 to 1999.
Gross economic return at 31 sites with high yield potential soils and average to above average May-June air temperatures, 1989 to 1999.

Years since manure and/or legume additions

- UNR
- BVNC
- PSNT

<table>
<thead>
<tr>
<th>Years since</th>
<th>Gross economic return ($/acre)</th>
<th>UNR</th>
<th>BVNC</th>
<th>PSNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 3 (n = 12)</td>
<td>415</td>
<td>415</td>
<td>421</td>
<td>421</td>
</tr>
<tr>
<td>1 to 3 (n = 6)</td>
<td>421</td>
<td>422</td>
<td>437</td>
<td></td>
</tr>
<tr>
<td>&lt; 1 (n = 13)</td>
<td>430</td>
<td>450</td>
<td>451</td>
<td></td>
</tr>
</tbody>
</table>
Effectiveness of N test in predicting optimum corn in rate, inorganic sites

<table>
<thead>
<tr>
<th>Method</th>
<th>Correct</th>
<th>Over Applied</th>
<th>Under Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD.</td>
<td>22</td>
<td>67</td>
<td>11</td>
</tr>
<tr>
<td>PPNT</td>
<td>89</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>PSNT</td>
<td>67</td>
<td>11</td>
<td>22</td>
</tr>
</tbody>
</table>

*Accuracy*:

*High yield potential soils. Correct if ± 30 lb N/a of observed optimum.*
Effectiveness of N test in predicting optimum corn N rate, organic sites

<table>
<thead>
<tr>
<th>Recom. Method</th>
<th>Correct</th>
<th>Over Applied</th>
<th>Under Applied</th>
</tr>
</thead>
<tbody>
<tr>
<td>STD.-BVNC</td>
<td>8</td>
<td>77</td>
<td>15</td>
</tr>
<tr>
<td>PPNT-BVNC</td>
<td>38</td>
<td>38</td>
<td>24</td>
</tr>
<tr>
<td>PSNT</td>
<td>62</td>
<td>23</td>
<td>15</td>
</tr>
</tbody>
</table>

*High yield potential soils. Correct if ± 30 lb N/a of observed optimum. BVNC = Book value N credit
Nitrogen recommendations based on soil nitrate test compared to standard method

- Increased % of correct recommendations
- Reduced % over applied
- Increased % under applied
RESIDUAL NITRATE AND OPTIMUM CORN N RATE

Y = 216 - 0.98 X, X < 220
Y = 0, X > 220, R² = 0.92

OPTIMUM N FERTILIZER RATE, lb/acre

SPRING RESIDUAL NITRATE-N, lb/acre (0-3 ft)
## Nitrogen Recommendations for Corn

<table>
<thead>
<tr>
<th>Organic matter</th>
<th>Sands &amp; loamy sand</th>
<th>Other soils</th>
<th>Yield Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Irrigated</td>
<td>Non-irrigated</td>
<td>Med/low</td>
</tr>
<tr>
<td>---%---</td>
<td>lb N/acre</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 2</td>
<td>200</td>
<td>120</td>
<td>150</td>
</tr>
<tr>
<td>2-9.9</td>
<td>160</td>
<td>110</td>
<td>120</td>
</tr>
<tr>
<td>10-20</td>
<td>120</td>
<td>100</td>
<td>90</td>
</tr>
<tr>
<td>&gt;20</td>
<td>80</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>
USING SOIL NITRATE TESTS

Corn after soybean:
- Use 40 lb N/acre credit
- Use preplant test
- Use both credit and test adjustment
## END-OF-SEASON SOIL NITRATE TEST

<table>
<thead>
<tr>
<th>Interpretation</th>
<th>Nitrate-N (lb/acre, 0-2 ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>--</td>
</tr>
<tr>
<td>Optimal</td>
<td>46-91</td>
</tr>
<tr>
<td>Excess</td>
<td>&gt;91</td>
</tr>
</tbody>
</table>

University of Wisconsin, 1996