In-Situ Soil Nitrogen Mineralization in Response to Nitrogen Management for Corn and Soybean in Poorly Drained Soils With and Without Tile-Drainage

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How Much Yield Can We Get Through Mineralization in MN?
Percent of Corn Yield at EONR Obtained from the 0-N Check 53% C-C, 71% C-S

- 3.3 Mg/ha
- 65 kg N/ha
- 13.7 Mg/ha
- 273 kg N/ha
- Ave: 7.3 Mg/ha
- 146 kg N/ha

Site No.
After 4 Years of Constant Management in a Sandy Loam with 4.6% SOM

<table>
<thead>
<tr>
<th>N rate kg ha⁻¹</th>
<th>Corn-Corn mg NO₃⁻⁻N L⁻¹</th>
<th>Corn-Soybean kg NO₃⁻⁻N ha⁻¹</th>
<th>Soybean-Corn kg NO₃⁻⁻N ha⁻¹</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>8.8d</td>
<td>19.7d</td>
<td>10.6c</td>
</tr>
<tr>
<td>135</td>
<td>28.2c</td>
<td>42.9c</td>
<td>10.9c</td>
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<tr>
<td>180</td>
<td>37.2b</td>
<td>46.6bc</td>
<td>15.6b</td>
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<tr>
<td>225</td>
<td>42.7ab</td>
<td>55.8a</td>
<td>25.0a</td>
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<tr>
<td>270</td>
<td>44.3a</td>
<td>53.6ab</td>
<td>15.8b</td>
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<tr>
<td>Mean</td>
<td>32.2a</td>
<td>43.7</td>
<td>15.6</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>N rate kg ha⁻¹</th>
<th>Corn-Corn kg NO₃⁻⁻N ha⁻¹</th>
<th>Corn-Soybean kg NO₃⁻⁻N ha⁻¹</th>
<th>Soybean-Corn kg NO₃⁻⁻N ha⁻¹</th>
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<tbody>
<tr>
<td>0</td>
<td>21b</td>
<td>50c</td>
<td>26</td>
</tr>
<tr>
<td>135</td>
<td>64ab</td>
<td>84b</td>
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<tr>
<td>180</td>
<td>83a</td>
<td>92ab</td>
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<tr>
<td>225</td>
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<tr>
<td>270</td>
<td>100a</td>
<td>112a</td>
<td>41</td>
</tr>
<tr>
<td>Mean</td>
<td>72A</td>
<td>91A</td>
<td>38B</td>
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</table>
Optimum N Rate and Residual N

![Graph showing the relationship between N rate and corn yield and TIN 0-90 cm](image)

- **Corn yield (kg/ha)**
  - Axis ranges from 4000 to 14000 kg/ha
- **TIN 0-90 cm (kg/ha)**
  - Axis ranges from 0 to 180 kg/ha

- **N rate (kg/ha)**
  - Values range from 0 to 280 kg/ha

- **Equations**:
  - \( \Delta = 0.17 \text{ kg TIN/kg N} \)
  - \( \Delta = 0.91 \text{ kg TIN/kg N} \)

- **Points**:
  - (143, 11,719)
  - (143, 81)

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**Nutrient Management**

[Logo of University of Minnesota Extension]

*Driven to Discover*
In undrained soil:
- 19% greater TOC (41 vs 35 Mg/ha)
- 18% greater TN (2.9 vs 2.4 Mg/ha)
Soil and Air Temperature at 0-5 and 0-15 cm Soil Depth
Daily and Cumulative Precipitation and 30-yr Normal Cumulative Precipitation
Volumetric Soil Water Content at 0-5 and 0-15 cm Soil Depth for Drained and Undrained Soils

![Graph showing volumetric soil water content over time for different soil depths and drainage conditions.](image-url)
**2014**

- Adding N in D increase Nmin: Yes
- Adding N in UD decrease Nmin: No
- Soybean less Nmin than corn: Yes
- D greater Nmin than UD: No
2015

Nutrient Management

Adding N in D increase Nmin  Yes
Adding N in UD decrease Nmin  Yes
Soybean less Nmin than corn  Yes
D greater Nmin than UD  Yes for fert. trt only

TIN (kg ha\(^{-1}\))

**Corn 0N**

**Corn 135N**

**Soybean 0N**

**Soybean 45N**

- Drained
- Undrained

5/8 5/22 6/5 6/19 7/3 7/17 8/14 8/28 9/11

5/8 5/22 6/5 6/19 7/3 7/17 8/14 8/28 9/11
Nutrient Management

- Adding N in D increases Nmin: Yes
- Adding N in UD decreases Nmin: Yes
- Soybean has less Nmin than corn: Yes
- D has greater Nmin than UD: Yes
Lab Measurements of Ideal (Potential) May Not Translate Well to Field Conditions

<table>
<thead>
<tr>
<th>Crop</th>
<th>Drainage</th>
<th>Nitrogen</th>
<th>Lab</th>
<th>2014</th>
<th>2015</th>
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<tr>
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<tr>
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<td>34</td>
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<tr>
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<td>33</td>
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<td>Fert.</td>
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<td>130</td>
<td>76</td>
<td>2</td>
</tr>
</tbody>
</table>

____kg ha⁻¹_____

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Nutrient Management

University of Minnesota Extension
Driven to Discover
• 400 samples 0-30 cm deep every 15 cm over a 30 m linear transect
• 180 point samples (0-15, 15-30, 30-60 cm) 10-core composite

Overall, 20 samples per hectare are needed to achieve a TIN estimate with 10% error margin at 0.05 significance level
Summary

• There are many challenges and opportunities around N management
• Quantifying soil N mineralization is not an easy endeavor
• Critically important to improve our understanding of the mineralization process to enhance N management
Questions?

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