Results from On-farm N Rate Response Trials

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Questions?

• Are N rate recommendations too low?
• High yield producers use higher rates.
• Are yields held back by N rates that are too low?
Nitrogen Rate and Timing Studies - Wisconsin

- Jefferson, Dodge, Walworth Cos. - Matt Hanson
  - Silt loam soils

- South Central Wis. – Kevin Shelley, NPM program
  - Silt loam soils
  - 11 trials, 1999-2002, Soybean/corn, corn/corn

- Portage & Waupaca Cos. – Bill Pearson
  - Sandy loam soils
Locations of on-farm nitrogen rate response experiments

- 21 trials (1999-2002) M. Hanson
## Nitrogen Recommendations for Corn

<table>
<thead>
<tr>
<th>Organic matter</th>
<th>Sands &amp; loamy sand</th>
<th>Other soils</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Irrigated</td>
<td>Non-irrigated</td>
</tr>
<tr>
<td>---%---</td>
<td>lb N/acre</td>
<td></td>
</tr>
<tr>
<td>&lt;2</td>
<td>200</td>
<td>120</td>
</tr>
<tr>
<td>2-9.9</td>
<td>160</td>
<td>110</td>
</tr>
<tr>
<td>10-20</td>
<td>120</td>
<td>100</td>
</tr>
<tr>
<td>&gt;20</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>
Optimum N Rate for Corn

- Soil-specific characteristic
- Not affected by annual variations in yield
- Year-specific adjustments for soil nitrate and organic N inputs needed
Adjustments to Base N Rates

• Nitrogen Credits
  – Legumes
  – Manure
• Soil nitrate tests
• Tillage/residue adjustment
Maximum and optimum levels for yield response to applied N

Yield bu/acre vs. N rate, lb/acre

\[ y = -9 \times 10^{-5} x^2 + 0.0314 x + 95.887 \]

\[ R^2 = 0.0353 \]

Data from M. Hanson, Jefferson Co.
On-Farm Nitrogen Rate and Application Time for Corn Comparisons

1999 – 2002: 11 Comparisons on 6 Farms

Kevin Shelley
UW Nutrient and Pest Management Program
South-Central Region

<table>
<thead>
<tr>
<th>Reps</th>
<th>Preplant N (82-0-0)</th>
<th>Sidedress N (28% UAN)</th>
<th>Total N (lbs/acre)</th>
<th>Average Yield (bu/acre)</th>
<th>Marginal* Return ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>120</td>
<td>120</td>
<td>215</td>
<td>370.12</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>150</td>
<td>150</td>
<td>210</td>
<td>352.00</td>
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<tr>
<td>3</td>
<td>150</td>
<td>30</td>
<td>180</td>
<td>207</td>
<td>341.85</td>
</tr>
</tbody>
</table>

* Corn price = $1.90/bu; N = $.23/lb (82-0-0), $.30/lb (28% UAN); Preplant N application = $5/acre; sidedress N application at cultivation = $2/acre; Ringwood silt loam, 3.2% OM
<table>
<thead>
<tr>
<th>Reps</th>
<th>Fall N (82-0-0)</th>
<th>Spring Preplnt N (82-0-0)</th>
<th>Sidedress N (28% UAN)</th>
<th>Total N* (lbs/acre)</th>
<th>Average Yield (bu/acre)</th>
<th>Marginal** Return ($/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>170</td>
<td>0</td>
<td>175</td>
<td>195</td>
<td>411.75</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>170</td>
<td>40</td>
<td>215</td>
<td>194</td>
<td>399.78</td>
</tr>
<tr>
<td>2</td>
<td>180</td>
<td>0</td>
<td>0</td>
<td>185</td>
<td>183</td>
<td>376.10</td>
</tr>
<tr>
<td>2</td>
<td>180</td>
<td>0</td>
<td>40</td>
<td>225</td>
<td>186</td>
<td>373.58</td>
</tr>
</tbody>
</table>

* 5 lbs N credited from starter

** Corn price = $2.25; N = $.15/lb (82-0-0), $.21/lb (28% UAN); Sidedress N application at cultivation = $2/acre. Plano silt loam = 2.9% OM
<table>
<thead>
<tr>
<th>Year</th>
<th>Recom.</th>
<th>EONR</th>
<th>Yield @ ONR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998 (I)</td>
<td>200</td>
<td>142</td>
<td>192</td>
</tr>
<tr>
<td>1998 (I)</td>
<td>200</td>
<td>200</td>
<td>208</td>
</tr>
<tr>
<td>1998</td>
<td>120</td>
<td>137</td>
<td>178</td>
</tr>
<tr>
<td>1999</td>
<td>120</td>
<td>141</td>
<td>166</td>
</tr>
<tr>
<td>1999</td>
<td>120</td>
<td>58</td>
<td>167</td>
</tr>
</tbody>
</table>

All sites corn/corn; (I) = irrigated; N applied sidedress. Data from Bill Pearson
Corn yield response to N rate, Hancock, 2001. (EONR = economic optimum N rate)
Effect of N timing on the relationship between N rate and corn grain yield, Hancock 2002.

\[
y = 46 + 0.82x - 0.0009x^2 \\
R^2 = 0.9973
\]

\[
y = 50 + 0.069x + 0.0004x^2 \\
R^2 = 0.9923
\]
## N Source/timing and N rate effects on corn grain yield at Hancock, WI, 2003

<table>
<thead>
<tr>
<th>N source</th>
<th>N timing</th>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCU</td>
<td>PP</td>
<td>203</td>
<td>199</td>
<td>208</td>
<td>219</td>
<td>208</td>
</tr>
<tr>
<td></td>
<td>PP + 4 wk</td>
<td>183</td>
<td>203</td>
<td>206</td>
<td>198</td>
<td>198</td>
</tr>
<tr>
<td>Am. Sulfate</td>
<td>4 wk &amp; 8 wk</td>
<td>175</td>
<td>184</td>
<td>204</td>
<td>189</td>
<td>188</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
<td>187b</td>
<td>195ab</td>
<td>206a</td>
<td>202a</td>
<td></td>
</tr>
</tbody>
</table>

No N control = 107 bu/acre

EONR = 188 lb N/acre, Yield @ EONR = 206 bu/acre
## Recommended Timing of Nitrogen Applications for Corn

<table>
<thead>
<tr>
<th>Soil</th>
<th>Fall</th>
<th>Preplant</th>
<th>Sidedress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medium/Fine Texture</td>
<td>OK*</td>
<td>Optimum</td>
<td>OK</td>
</tr>
<tr>
<td>Well-Drained</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium/Fine Texture</td>
<td>No</td>
<td>OK</td>
<td>Optimum</td>
</tr>
<tr>
<td>Poorly Drained</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coarse texture</td>
<td>No</td>
<td>No</td>
<td>Optimum</td>
</tr>
</tbody>
</table>

*Includes use of BMPs for fall-applied N.
Minnesota on-farm N response trials

• N rates (7) 0-180 lb N/acre
• Small plot trials (14) 1989-1999
  - Corn after soybean
  - SE & SC Minnesota
• Field-size strip studies (15) 1997-2001
  - Corn after soybean
  - SC Minnesota

Randall et al., 2003
EONR from 13 small-plot and 13 field-size studies.

![Graph showing yield vs. N rate with points at 0, 30, 60, 90, 120, 150 and yield values 122, 142, 146, 164, 174, 172, 150, 152, 153, 175. EONR = 105 lb N/A and EONR = 99 lb N/A.]
Optimum fertilizer N rates using the LSD (0.10) and QRP statistical models for 13 small-plot sites.

LSD avg. 71 lb/A
QRP avg. 86 lb/A

Site A B C D E F G H J K L M N
Optimum N Rate (lb/A)
UM Rec.
Optimum fertilizer N rates using the LSD (0.10) and QRP statistical models for field-size sites.

The LSD model gives an average optimal N rate of 87 lb/A, while the QRP model yields an average of 100 lb/A. The figure shows the optimal N rates for different sites, with the LSD and QRP models indicated by distinct colors. The UM Rec. line represents the recommended N rate, which is consistent across sites.

Site-specific optimal N rates are as follows:
- CC: 106 lb/A (LSD), 145 lb/A (QRP)
- DD: 93 lb/A (LSD), 90 lb/A (QRP)
- EE: 104 lb/A (LSD), 120 lb/A (QRP)
- FF: 95 lb/A (LSD), 68 lb/A (QRP)
- GG: 90 lb/A (LSD), 55 lb/A (QRP)
- HH: 104 lb/A (LSD), 120 lb/A (QRP)
- II: 169 lb/A (LSD), 145 lb/A (QRP)
- JJ: 60 lb/A (LSD), 90 lb/A (QRP)
- KK: 65 lb/A (LSD), 90 lb/A (QRP)
- LL: 90 lb/A (LSD), 90 lb/A (QRP)
- MM: 90 lb/A (LSD), 90 lb/A (QRP)
- NN: 113 lb/A (LSD), 90 lb/A (QRP)
- OO: 96 lb/A (LSD), 90 lb/A (QRP)
Summary

- On farm N response trials in Wisconsin support current N recommendations.
- Response data indicate recommended rates are usually higher than observed optimum.
- Similar findings in IA and MN.