High Yielding Corn: Nitrogen and Best Management Practices

Fluid Technology Round Up
Dec 6, 2016

4R Plant Nutrition:
• Right Source
• Right Rate
• Right Time
• Right Place

Russell French, CCA
Strategic Account Manager
DuPont Pioneer
Amarillo, TX
Farmers ask:
Do I need more/less fertilizer?

When do I need to apply?

Is Product A better than B?

Is Method A better than B?

Will it pay?

What would you do if you were me?
Plot Locations (2010-2013)
Spatial and Temporal Analyses
Stress at Four Critical Intervals Most Affects Grain Yield

• (1) At or just before V7
  • Determines number of kernel rows around the ear
• (2) 1-2 weeks before pollination
  • Determines number of kernel rows along the length of the ear
• (3) During pollination
  • Determines the maximum number of kernels that can be produced
• (4) Latter part of grain fill
  • Determines the weights of individual kernels

What can we control?
## Irrigation Capacity Impact on Yield

<table>
<thead>
<tr>
<th>Irrigation Capacity GPM/A</th>
<th>Predicted Yield</th>
<th>2011 Yield</th>
<th>2012 Yield</th>
<th>2013 Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 - 3.9</td>
<td>120-160</td>
<td>75</td>
<td>140</td>
<td>170</td>
</tr>
<tr>
<td>4.0 - 4.4</td>
<td>160-180</td>
<td>120</td>
<td>180</td>
<td>205</td>
</tr>
<tr>
<td>4.5 – 4.9</td>
<td>190-220</td>
<td>177</td>
<td>221</td>
<td>240</td>
</tr>
<tr>
<td>5.0 - 5.5</td>
<td>230-250</td>
<td>223</td>
<td>238</td>
<td>254</td>
</tr>
<tr>
<td>5.6 - 5.9</td>
<td>250-270</td>
<td>234</td>
<td>265</td>
<td>262</td>
</tr>
<tr>
<td>6.0+</td>
<td>270+</td>
<td>242</td>
<td>265</td>
<td>270</td>
</tr>
</tbody>
</table>
## 2010 Plot Averages by Nitrogen Timing

<table>
<thead>
<tr>
<th>No Post Tassel Nitrogen</th>
<th>Nitrogen Applied Brown Silk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>19 Plots</strong></td>
<td><strong>21 plots</strong></td>
</tr>
<tr>
<td>Avg Yield 217 bu/acre</td>
<td>Avg Yield 248 bu/acre</td>
</tr>
<tr>
<td>Low yield: 170 bu/acre</td>
<td>Low yield: 183 bu/acre</td>
</tr>
<tr>
<td>High yield: 269 bu/acre</td>
<td>High yield: 302 bu/acre</td>
</tr>
<tr>
<td>3 plots over 240+ bu/acre</td>
<td>14 plots over 240+ bu/acre</td>
</tr>
</tbody>
</table>
## Nitrogen Effectiveness by Timing

1998 – 2007 TX & OK Hi-Plains

<table>
<thead>
<tr>
<th>N Application Timing</th>
<th>75%+ Total N as Pre-Plant</th>
<th>75%+ Total N as In-Season</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avg Yield</td>
<td>207.7</td>
<td>215.9</td>
</tr>
<tr>
<td>Avg #N Used/A</td>
<td>247</td>
<td>192</td>
</tr>
<tr>
<td>N Use/Bushel</td>
<td>1.19</td>
<td>0.86</td>
</tr>
</tbody>
</table>

**In-Season N 28% more efficient than preplant**

Source: Better Harvest Inc., Dumas, TX
Comparision of Yields and N Use (lbs. N/bu.) of Corn by N Application Timing
(781 fields from 1998 thru 2009 in the HiPlains Area of Texas and Oklahoma)

<table>
<thead>
<tr>
<th>N Application Timing</th>
<th>Avg. bushels / Acre</th>
<th>Avg. N use / Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 #/ac of N Post-Pollination (100)</td>
<td>210.9</td>
<td>184</td>
</tr>
<tr>
<td>1-20 #/ac of N Post-Pollination (28)</td>
<td>201.5</td>
<td>183</td>
</tr>
<tr>
<td>21-40 #/ac of N Post-Pollination (147)</td>
<td>217.4</td>
<td>202</td>
</tr>
<tr>
<td>41-60 #/ac of N Post-Pollination (191)</td>
<td>219.8</td>
<td>195</td>
</tr>
<tr>
<td>61-80 #/ac of N Post-Pollination (166)</td>
<td>219.7</td>
<td>196</td>
</tr>
<tr>
<td>81-100 #/ac of N Post-Pollination (105)</td>
<td>231.0</td>
<td>212</td>
</tr>
<tr>
<td>101+ #/ac of N Post-Pollination (42)</td>
<td>233.9</td>
<td>219</td>
</tr>
</tbody>
</table>
Table 1. Nitrogen uptake timing and quantities for old and new hybrids.

<table>
<thead>
<tr>
<th>Era of hybrid release</th>
<th>N at R1</th>
<th>N at R6</th>
<th>Post-flowering N uptake</th>
<th>Increase in post-flowering N uptake</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>lbs N / acre</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Old (1940 to 1990)†</td>
<td>102</td>
<td>145</td>
<td>43</td>
<td>28%</td>
</tr>
<tr>
<td>New (1991 - 2011)</td>
<td>97</td>
<td>152</td>
<td>55</td>
<td></td>
</tr>
<tr>
<td>Old (1970)‡</td>
<td>125</td>
<td>162</td>
<td>37</td>
<td>40%</td>
</tr>
<tr>
<td>New (2000)</td>
<td>125</td>
<td>177</td>
<td>52</td>
<td></td>
</tr>
</tbody>
</table>

† Ciampitti and Vyn, 2012 ‡ Haegele et al., 2013
Research conducted over the last five years has shown that nitrogen needed for grain development originates from both remobilized N and continued N uptake from the soil; and newer hybrids take up additional N post-flowering compared to older hybrids.
Center Pivot applied UAN post tassel

late N  no late N

Photo by Alyssa Abbott, DuPont/Pioneer Account Manager; NE Illinois
Pivot Applied UAN Post Tassel

No late N

Late N

Photo by Alyssa Abbott, DuPont/Pioneer Account Manager; NE Illinois
Photo by Alyssa Abbott, DuPont/Pioneer Account Manager; NE IL
Photo by Alyssa Abbott, DuPont Pioneer Account Manager; NE IL
Power of Proactive N Management
Momence 2015

P1417AMX | 268# Total N
Fertigation: 60# @ V6 | 60# @ V12 | 40# @ R1

P1417AMX | 168# N
Fertigation: 60# @ V6

Minimal Saturation

Heavy Saturation

P1197AM | 268# Total N
Fertigation: 60# @ V6 | 60# @ V12 | 40# @ R1
Photo by Alyssa Abbott; DuPont Pioneer Account Manager

P1197AM | 168# N
Fertigation: 60# @ V6
2015 Pivot Trial
Momence, IL

Summary
Yield (dry): 1,946.49 bu
Total Area: 18.10 acre
Moisture: 18.96 %
Net Yield: 107.56 bu/acre
Date: Oct 23, 2015

203 bu/a

60 bu/a
Corn Nitrogen Management Ladder

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Lbs N/Bu</th>
<th>Treatment Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 5</td>
<td>0.8</td>
<td>Pre-Plant NPK Band + Starter + Side-Dress/V6 fertigation + Brown Silk Fertigation (4X)</td>
</tr>
<tr>
<td>Step 4</td>
<td>0.9</td>
<td>Pre-Plant NPK Band + Starter + sidedress/V6 fertigation (3X)</td>
</tr>
<tr>
<td>Step 3</td>
<td>1.0</td>
<td>Preplant N Band + Sidedress band (2X)</td>
</tr>
<tr>
<td>Step 2</td>
<td>1.1</td>
<td>“Spoon Feed” Pivot application 100%</td>
</tr>
<tr>
<td>Step 1</td>
<td>1.2</td>
<td>1 Banded N Application Preplant</td>
</tr>
<tr>
<td>Floor</td>
<td>1.3</td>
<td>1 Broadcast Application Pre-Plant</td>
</tr>
</tbody>
</table>
Pumps at each Pivot
18,000 Gal Tank
12 row coulter rig for side dressing 32-0-0 UAN in strip-till
Sidedress UAN with coulter rig in heavy residue with wet soil. No pre herbicide movement, no fertilizer burn.

Sidedress anhy burn due to wet soil. Pre herbicide barrier disturbed by shank.
## 2013 Top 10 Highest Average Plots
### Texas & Oklahoma Panhandles

<table>
<thead>
<tr>
<th>Location</th>
<th>Avg Yield</th>
<th>Plant Date</th>
<th>GPM/acre</th>
<th>Tillage</th>
<th>Starter</th>
<th>Miticide Pre-Tassel</th>
<th>Post Tassel Nitrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sherman Co</td>
<td>285.2</td>
<td>5-17-13</td>
<td>5.5</td>
<td>ST</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Hansford Co</td>
<td>284.5</td>
<td>5-4-13</td>
<td>6.0</td>
<td>ST</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Hansford Co</td>
<td>282.2</td>
<td>5-10-13</td>
<td>5.3</td>
<td>ST</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Moore Co</td>
<td>281.4</td>
<td>4-30-13</td>
<td>6.0</td>
<td>ST</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Texas Co</td>
<td>280.9</td>
<td>5-17-13</td>
<td>5.6</td>
<td>ST</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Ochiltree Co</td>
<td>275.0</td>
<td>5-17-13</td>
<td>6.0</td>
<td>ST</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Sherman Co</td>
<td>267.2</td>
<td>5-13-13</td>
<td>5.4</td>
<td>ST</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Moore Co</td>
<td>265.4</td>
<td>4-29-13</td>
<td>5.0</td>
<td>ST</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Texas Co</td>
<td>263.4</td>
<td>5-13-13</td>
<td>6.0</td>
<td>NT</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Hansford Co</td>
<td>262.7</td>
<td>5-22-13</td>
<td>4.5</td>
<td>ST</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
Strip-Tilled & Fertilized
Fertilizer placement

APPLICATION RATE: 100 lb. N, 40 lb. P₂O₅

Broadcast and disked
6 in. deep

Injected
15 inch centers,

111 ppm N
19 ppm P

3” incorporation depth

6200 ppm N
1200 ppm P

4” deep band

Banding allows a 25-33% reduction in a broadcast rate for immobile nutrients
- Nutrient deficiency caused by heavy residue and cool, wet soil.

- Corn root growth decreases 5-fold when 70°F to 58°F and P uptake decreased 4-fold.

- Early June before ST and CT soil temps are equal.
## Starter Effects on Corn Yield (bu/a) 3-Year Average

<table>
<thead>
<tr>
<th>Starter</th>
<th>In-furrow</th>
<th>2x2</th>
<th>2X0</th>
<th>Row Band</th>
<th>Broadcast</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-15-5</td>
<td>172</td>
<td>194</td>
<td>190</td>
<td>179</td>
<td>179</td>
</tr>
<tr>
<td>15-15-5</td>
<td>177</td>
<td>197</td>
<td>198</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>30-15-5</td>
<td>174</td>
<td>216</td>
<td>212</td>
<td>192</td>
<td>192</td>
</tr>
<tr>
<td>45-15-5</td>
<td>171</td>
<td>215</td>
<td>213</td>
<td>195</td>
<td>195</td>
</tr>
<tr>
<td>60-15-5</td>
<td>163</td>
<td>214</td>
<td>213</td>
<td>201</td>
<td>201</td>
</tr>
<tr>
<td>Average</td>
<td>171</td>
<td>207</td>
<td>205</td>
<td>189</td>
<td>189</td>
</tr>
</tbody>
</table>

Dr. Barney Gordon, Kansas State University
Positional Availability

BMP for Fertility

Pre-Plant 6” to 10” below seed

Side-Dress

Whorl

Dribble

2nd leaf blade

1st leaf blade

1st leaf collar

1st leaf sheath

Coleoptile

Nodal roots

Mesocotyl

Lateral seminal roots

Radicle

Pop up allows In-Furrow Technology

Pop-Up

2X2
Girth (rows around) is determined by 8-leaf stage so ear girth can be affected by early moisture stress & nutrient deficiency
Starter Fertilizer @ V6
Dual Starter Placement
Utilize best of In-Furrow Technology
Dual Starter Placement
Utilize best of In-Furrow Technology
2x0 Surface Band
Adjusting N Rate in Season

- Ear size estimate @ R1
- Plant Pop in 1/1000 acre

- Use Factor to Estimate Yield
  \((\text{girth} \times \text{length} \times \text{pop}) \times \text{Specific Hybrid Factor}\)

- Evaluate Plant Health, Subsoil Moisture, Extended Forecast

- + or – N amount post tassel based on new goal
Adjusting N Rate in Season

- Ear size estimate 2014
- \((17 \times 40 \times 36) \times 0.0118 = 288\)
- Potential yield was 285 to 290. 150 lbs on 7-25
- Post-tassel N application increased from 50 to 90 units of N/acre
• Final ear size was 17-by-40 average
• 288 estimate
• 285 bu/a was final yield 2014
• .84 lbs applied N/bu
150# N + 0# P preplant band
Soil test 96 ppm on P₂O₅ (manure)

10 gal starter per acre 2x0 (APP + 28-0-0-5)

3) 50# N 32-0-0 at V6

4) 100# N 32-0-0 beginning R2

3 pints Comite per acre by air at V14

6.8 oz Aproach Prima at R3

July Yield Estimate (19x40x34K) (.0118) = 305 bu/acre

2015 yield: 300 bu
16x41x38K = 294 bu/a est
8-3-16

+50N recommended and applied.
100N total post tassel, 300N total

38000 population
16.5 x 37 x 40 = 288 bu/a set
9-12-16

Final yield: 285 bu/a

2016

401C

16.5 x 37 x
A Special “Thank You” to my Colleague

Alyssa Abbott - DuPont Pioneer
Thank you!!!!!

Questions????