Effective Nitrogen and Potassium Banding for Corn with Strip Tillage and High-Clearance Applicators

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Research Context:
On-going Experiments with Strip-Till and No-till Corn and Associated Management Options:
1. Nutrient Placement, Rate, Timing, and Source
2. Corn Management (hybrid, plant density, rotation)
3. Greenhouse gas emissions from different 4R N management
Whole-plant, grain, cob and stover nutrient (macro- and micro-) determination at maturity
Whole-Plant Corn Analysis at the R1 Stage

1. Sampling from field; 2. Weighting fresh weight; 3. Select five sub-sample and separate sub-samples into leaf, stem (with husk), ear-shoot (R1); 4. Chopping; 5. Bagging; 6. Weighting all fresh weights
Higher and Later N Uptake in Modern Corn Hybrids

Mean N rates in lbs N acre⁻¹:
151       153

Source: S. M. Mueller and T.J. Vyn 2016 (Frontiers in Plant Science)
Critical Ear-leaf Nitrogen Concentrations (R1 stage) for High Yield Corn (2010-2016)

Kovacs and Vyn, Agronomy J., 2017
Timing and Source of N Uptake by Plants and Grain

Ciampitti et al., 2013 Agronomy Journal
What About Late-Season N?

Photo by Mike Shuter, 2014
UAN applied by Y-Drops (2015-2016)
Late-Split N Applications with Older versus “Modern” Pioneer Hybrids (2014-2016)
Methodology

Main Treatment:
N rates

<table>
<thead>
<tr>
<th>Treat. Name</th>
<th>Lbs N V3-V4</th>
<th>Lbs N V12-V14</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>140</td>
<td>140</td>
<td>140</td>
</tr>
<tr>
<td>180</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>220</td>
<td>220</td>
<td>220</td>
</tr>
<tr>
<td>180S</td>
<td>140</td>
<td>40</td>
</tr>
<tr>
<td>220S</td>
<td>180</td>
<td>40</td>
</tr>
</tbody>
</table>

Sub-Treatment:
Hybrid (Release year)
4. Pioneer 1360 HR (2014)
Corn Grain Yields After Late-Split N Applications
Wanatah, IN, (2014-2015)

Source: Mueller et al., Agron. J., 2017
S.M. Mueller et al., Agronomy Journal, 2017
Average of 4 hybrids
Nitrogen Timing in Continuous Corn on Irrigated Sandy Soil (LaCrosse, IN) with DKC66-42 in 2016

Source: Lia Olmedo Pico and T. Vyn, 2016
Corn Yield Dependency on Kernel Weights in 2017 across the N Rate and Timing Treatments

Source: Lia Olmedo Pico and Tony Vyn, unpublished, 2017
Hybrid Recovery of Late-Season N Applications?
Grain Yield Response to N Rate with Pioneer Era Hybrids (average of 2016-2017)

$$y = 2.0359x - 3840.3$$  
$$R^2 = 0.9706$$

$$y = 0.7589x - 1404.9$$  
$$R^2 = 0.9623$$

Source: Mueller and Vyn, unpublished, 2017
Nitrogen Recovery Efficiency with Pioneer Era Hybrids (Two N timing treatments; 2016 only)

Source: Mueller and Vyn, unpublished, 2017
On-farm Studies with Intentional Late-Season N applications of 30 to 50 pounds
Practical Methods to Apply Late-Season N

Grain Yield (bu/acre)

N Treatment
120 170 220 170S 220S

120 170 220 170S 220S

N Treatment

Farm Cooperators:
Mike Shuter and Aaron Howell
2017 Equipment Option Focus: Side-dress Nitrogen Timing and Placement

1. At-plant (zero vs. 77 and 177 pounds per acre; all broadcast)
2. At-plant 77 pounds/acre plus V5 @ 80 pounds (Y-Drop vs. Coulter)
3. At-plant 77 pounds/acre plus V8 urea + Agrotain (broadcast)
4. At-plant 77 pounds/acre plus V12 @ 80 pounds (Y-Drop vs. Coulter)
Broadcast Urea + Agrotain at V-8
# Corn Yield Response from Sidedress N Trial in 2017 (LaCrosse, IN; sandy loam soil)

<table>
<thead>
<tr>
<th>Nitrogen Rate and Timing</th>
<th>Total N (lbs/acre)</th>
<th>Yield (bu/acre)</th>
<th>% Fert. N Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero N except a common starter (19-17-0)</td>
<td>23</td>
<td>120 e</td>
<td>-</td>
</tr>
<tr>
<td>At-plant broadcast UAN (50%) + nothing</td>
<td>100</td>
<td>190 d</td>
<td>56</td>
</tr>
<tr>
<td>At-plant broadcast UAN + nothing</td>
<td>200</td>
<td>231 a</td>
<td>50</td>
</tr>
<tr>
<td>At-plant UAN (50%) + Y-Drop UAN (50%) at V5</td>
<td>180</td>
<td>227 ab</td>
<td>59</td>
</tr>
<tr>
<td>At-plant UAN (50%) + Coulter UAN (50%) at V5</td>
<td>180</td>
<td>221 bc</td>
<td>61</td>
</tr>
<tr>
<td>At-plant UAN (50%) + Urea Agrotain (50%) at V8</td>
<td>180</td>
<td>217 c</td>
<td>59</td>
</tr>
<tr>
<td>At-plant UAN (50%) + Y-Drop UAN (50%) at V12</td>
<td>180</td>
<td>229 a</td>
<td>66</td>
</tr>
<tr>
<td>At-plant UAN (50%) + Coulter UAN (50%) at V12</td>
<td>180</td>
<td>215 c</td>
<td>53</td>
</tr>
</tbody>
</table>

Source: Vyn, Thompson, West, 2017
Sidedress UAN and Instinct™ Application (2010-2016)
The Choice!

Pre-Plant

Early Sidedress

Late Sidedress as a Supplement
Strip Tillage and Nutrient Placement Research
Potassium Uptake in Growing Season Over Time in Corn at Three N Rates

Ciampitti et al., 2013 Agronomy Journal
Stratification for P and K in Strip-till Corn and No-till Soybean Rotation with only Starter P (corn) and no Broadcast P or K in 4 Years

Source: Vyn, Global Maize Trial, West Lafayette, 2014
Indiana Corn Yield Responses to K$_2$O Placement and Timing

<table>
<thead>
<tr>
<th>Tillage System</th>
<th>K$_2$O timing</th>
<th>Aspire K product rate (lb/acre)</th>
<th>2016 yield (bu/acre)</th>
<th>2017 yield (bu/acre)</th>
<th>2-year Mean 2016-2017 (bu/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-till</td>
<td>NA</td>
<td>0</td>
<td>225 de</td>
<td>239 cd</td>
<td>232 ef</td>
</tr>
<tr>
<td>No-till</td>
<td>Spring</td>
<td>200</td>
<td>226 de</td>
<td>252 abc</td>
<td>238 bcde</td>
</tr>
</tbody>
</table>

More Yield Gains Possible from Potash Fertilizer (Aspire) with strip-till than with chisel or no-till

<table>
<thead>
<tr>
<th>Tillage System</th>
<th>K$_2$O timing</th>
<th>Aspire K product rate (lb/acre)</th>
<th>2016 yield (bu/acre)</th>
<th>2017 yield (bu/acre)</th>
<th>2-year Mean 2016-2017 (bu/acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring Strip-till</td>
<td>NA</td>
<td>0</td>
<td>220 e</td>
<td>236 d</td>
<td>227 f</td>
</tr>
<tr>
<td>Spring Strip-till</td>
<td>Spring</td>
<td>100</td>
<td>231 bcd</td>
<td>257 a</td>
<td>242 abcd</td>
</tr>
<tr>
<td>Spring Strip-till</td>
<td>Spring</td>
<td>200</td>
<td>233 abc</td>
<td>260 a</td>
<td>245 ab</td>
</tr>
<tr>
<td>Fall Chisel</td>
<td>NA</td>
<td>0</td>
<td>229 cd</td>
<td>246 abcd</td>
<td>236 cde</td>
</tr>
<tr>
<td>Fall Chisel</td>
<td>Fall</td>
<td>200</td>
<td>239 a</td>
<td>254 abc</td>
<td>245 ab</td>
</tr>
</tbody>
</table>

Soil-Test K mean: 214 ppm. 110 ppm.

Mean Yield Gain with 200 rate: 8 bu. 15 bu

Source: Vyn, 2017, Unpublished
Ear-leaf K Concentration Relation to Final Yield in Indiana Experiments (2016-2017)

Earleaf K 2016, Aspire Study, ACRE

\[ y = 5.3112x + 220.95 \]
\[ R^2 = 0.0318 \]

Earleaf K 2017, Aspire Study, ACRE

\[ y = 36.518x + 186.78 \]
\[ R^2 = 0.405 \]

Source: Vyn, 2017, unpublished
Tillage and K₂O Rate Consequences for In-row Soil-test K at 3 depth increments (West Lafayette, IN, 2017)

Source: Vyn, 2017, unpublished
K Source: Aspire (58% K₂O, 0.5% B)
Cautions on Spring Banding of N plus K₂O

When: How close to planting time and rainfall timing?

Where: Separation from the seed row and soil texture?

Source: urea/ammonium?

Rate: Less than 150 pounds/acre of actual N plus K₂O has less injury potential
Conclusions

• Modern hybrids take up more total N at the same N rates, and more post-silking than old hybrids, so there could be more yield and N efficiencies to gain with late-split N.

• Late-split N hasn’t often increased grain yield compared to all N applied at normal side-dress in Indiana corn-soybean situations, but it has consistently increased plant N recovery efficiency. It also permits N rate in-season N rate flexibility and an opportunity to reduce total N rates.

• More rate/timing etc. research needed multiple-position nutrient placement to increase nutrient availability over the critical uptake periods and address stratification issues.
Acknowledgments

Funding:
- Indiana Corn Marketing Council
- Dupont-Pioneer
- Dow AgroSciences (2009- )
- 4R Nutrient Stewardship
- The Mosaic Company
- Monsanto Company

Equipment:
- John Deere Crop Systems Unit

Seed:
- Pioneer Hi-Bred, Int'l.
- Monsanto
- Dow AgroSciences
Thank you!