Soil Testing Lab Update and Late Season Nitrogen in Corn

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Services

• Soil Testing
• Plant Analysis
• Lime Testing
• Water Testing
Services

- Diagnostic Testing for agents
- Shipping Labels
- Online Payments
Common Soil Testing Mistakes

• Collect too few soil cores
• Collect cores for the wrong depth
  – pH, P, K deeper than 6”
  – N,S, Cl only 6”
• Testing for unnecessary elements
## Soil Tests for Kansas Crops

<table>
<thead>
<tr>
<th>Crop</th>
<th>pH</th>
<th>P</th>
<th>K</th>
<th>OM</th>
<th>Zn</th>
<th>NO3</th>
<th>S</th>
<th>Cl</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
<td>Subsoil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alfalfa</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Corn</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Grass</td>
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<td>x</td>
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<td>x</td>
</tr>
<tr>
<td>Oats</td>
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<tr>
<td>Sorghum</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Soybean</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Sunflower</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Wheat</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
Nitrogen fertilization guidelines and late N fertilizer applications in corn
Background - Late N application

- Previous studies showed significant amount of N uptake post-flowering.

From: Jason DeBruin, DuPont Pioneer.
Late N application and fertilizer N recommendations

• The effect of late N applications on grain yield.

• Can we increase nitrogen use efficiency with late N applications?

• How this may affect fertilizer recommendations?

  – \( N = (\text{yield goal} \times 1.6) - \text{Soil NO}_3^- - (\% \text{ SOM} \times 20) + \)
    Previous crop adjustments
Procedures

• Four locations in 2016 (ongoing in 2017).

• Application rate based on KSU fertilizer recommendation.
  – With rates of +/- 50 lbs N/acre

• Two application times:
  1. All N fertilizer at planting
  2. Split late application with 40% of the total rate at VT-R1.
Measurements

• R1 Ear leaves for N content
• Plant and grain biomass and N content
• Yield
• Grain N content
• End of season soil profile N
## Soil properties – 2016 locations

<table>
<thead>
<tr>
<th>Site</th>
<th>County</th>
<th>Soil Type</th>
<th>Soil Texture</th>
<th>Previous Crop</th>
<th>Irrigation</th>
<th>NH$_4$-N</th>
<th>NO$_3$-N</th>
<th>pH</th>
<th>OM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Republic</td>
<td>Crete</td>
<td>Silt Loam</td>
<td>Soybeans</td>
<td>Irrigated</td>
<td>2</td>
<td>6</td>
<td>6.4</td>
<td>3.2</td>
</tr>
<tr>
<td>2</td>
<td>Brown</td>
<td>Kennebec</td>
<td>Silt Loam</td>
<td>Soybeans</td>
<td>Dry Land</td>
<td>3</td>
<td>5</td>
<td>6.8</td>
<td>2.3</td>
</tr>
<tr>
<td>3</td>
<td>Shawnee</td>
<td>Eudora</td>
<td>Silt Loam</td>
<td>Soybeans</td>
<td>Irrigated</td>
<td>1</td>
<td>3</td>
<td>7.2</td>
<td>1.3</td>
</tr>
<tr>
<td>4</td>
<td>Lyon</td>
<td>Chase</td>
<td>Silty Clay Loam</td>
<td>Soybeans</td>
<td>Dryland</td>
<td>13</td>
<td>3</td>
<td>7.2</td>
<td>2.9</td>
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</tbody>
</table>
## Nitrogen application rates

<table>
<thead>
<tr>
<th>Site</th>
<th>-50</th>
<th>-25</th>
<th>KSU Rec</th>
<th>25</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>N rates (lbs/acre)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – Republic</td>
<td>157</td>
<td>182</td>
<td>207</td>
<td>232</td>
<td>257</td>
</tr>
<tr>
<td>2 – Brown</td>
<td>180</td>
<td>205</td>
<td>230</td>
<td>255</td>
<td>280</td>
</tr>
<tr>
<td>3 – Shawnee</td>
<td>183</td>
<td>208</td>
<td>233</td>
<td>258</td>
<td>283</td>
</tr>
<tr>
<td>4 – Lyon</td>
<td>73</td>
<td>98</td>
<td>123</td>
<td>148</td>
<td>173</td>
</tr>
</tbody>
</table>

1. All N fertilizer at planting (100%)
2. Split applied at VT-R1 (60% planting – 40% VT)
Fertilizer N application

76 in clearance
Soil Fertility Research and Extension

Yield response by location

<table>
<thead>
<tr>
<th>Site 1</th>
<th>Total N Fertilizer (lbs/acre)</th>
<th>Yield bu/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>156</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>181</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>206</td>
<td>200</td>
<td>250</td>
</tr>
<tr>
<td>231</td>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td>256</td>
<td>300</td>
<td>350</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site 2</th>
<th>Total N Fertilizer (lbs/acre)</th>
<th>Yield bu/a</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>180</td>
<td>50</td>
<td>100</td>
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<td>205</td>
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<td>255</td>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td>280</td>
<td>300</td>
<td>350</td>
</tr>
</tbody>
</table>

Location 1

Location 2
Yield response by location

Location 3

Location 4
Yield across locations

N rate, Diff from recommended rate (lbs/acre)

Yield bu/a

0 N control
At planting
Split-N

Locations

Check
-50
-25
0
25
50
Ear leaf N concentration

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Ear leaf N concentration

N rate, Diff from recommended rate (lbs/acre)

- 0 N control
- At planting
- Split-N

* * * *

0.0 0.5 1.0 1.5 2.0 2.5 3.0

Ear leaf N (%)

check -50 -25 0 25 50
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Grain N concentration

N rate, Diff from recommended rate (lbs/acre)

Grain N (%)

0 N control
At planting
Split-N

*
N use efficiency definitions

Production efficiency – based on harvested crop product (grain)
- Partial factor productivity (PFP): \( \frac{bu/a}{lb/a} \) N fertilizer
- Agronomic efficiency (AE): \( \frac{\Delta bu/a}{lb/a} \) N fertilizer

Recovery efficiency – Based on nutrient recovery by the crop (uptake)
- Partial Nutrient Balance (PNB): \( \frac{lbs/a N \text{ in grain}}{N \text{ fertilizer}} \)
- Apparent Recovery Efficiency (RE): \( \frac{\Delta lb/a N \text{ uptake}}{lb/a N \text{ fertilizer}} \)
Apparent Recovery Efficiency
(lb increase in total N uptake per lb of N applied)

\[ RE = \frac{(N_t - N_c)}{N_r} \]

- \( RE \) = Apparent Recovery Efficiency
- \( N_t \) = Nitrogen uptake
- \( N_c \) = Nitrogen uptake from 0 N control
- \( N_r \) = Nitrogen fertilizer rate
Apparent Recovery Efficiency across locations

- N rate, difference from recommended rate (lbs/acre)

- NUE (RE)

- All pre-plant
- Split N

- N rate, difference from recommended rate (lbs/acre)
End of season residual soil profile N

Residual profile, 0-24 in NO3-N (ppm)

Total N Fertilizer (lbs/acre)

- 0 N control
- At planting
- Split -N

* Indicates significant difference from the control.
Summary

• Preliminary results showed soil-applied N post-flowering can provide N for corn uptake.
  – N movement to the root zone for uptake can be a limitation under dryland?

• Potentially more benefit as rescue N application, particularly from fall-applied N.
Summary

• Current N fertilizer recommendations may be high at high yielding sites.

• No yield penalty with late N applications
  - Possible yield advantage during years with early season N loses?

• Fertilizer recovery efficiency was higher with split late-N applications
  - Long term effect on NUE???
Late N Fungicide and Foliar N
Experimental Design

- Soil applied N 0, 160 and 200 lbs. N/acre
- Some treatments 120+40 and 160+40
- Fungicide applied to all N treatments
- Foliar N applied to some split treatments
Preplant N Rates and Yield

Corn grain yield response to N fertilizer application rates at planting at 3 locations in 2016. Different letters indicate statistically significant differences at the p<0.1.
Fungicide Split N and Yield

Corn grain yield response to foliar N fertilizer and fungicide application with the 200 lbs. N/a rate across 3 locations in 2016. Different letters indicate statistically significant differences at the p<0.1.
Summary

• Corn yield responded to N fertilizer at all locations
• There was no yield difference between 160 and 200 lbs. N/acre rates
• Fungicide increased yields at the 200 lbs. N/acre rate
• Grain N concentration increased significantly with 4.5 lbs./acre additional foliar N
Questions?

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www.agronomy.ksu.edu/extension/