Precision Input Cost Management: Focus on Nitrogen

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Mississippi State University
Disclaimer

- Cotton Incorporated will neither confirm nor deny my existence, let alone agree with or disagree with any of the thoughts or data provided henceforth. The thoughts presented from this point forward are done so by a guy from Illinois who works cotton in Mississippi.

- Dealing with any aspect of cotton production may produce the highest of highs, the lowest of lows, and may lead to the need for a banker, a preacher, a doctor, a liquor store, a gun salesman, or a combination of all.
Nitrogen

• Provided to the plant in greatest quantity
  • Not used efficiently by the plant (Hunt et al. 1998; Hutmacher et al. 2004)

• Significant expense
  • $350 – $450 per ton depending on which dealer you talk to
  • 1 ton = 181 gallons (11.06 lbs/gallon)
  • 1 gallon = 3.54 lbs N
  • 1 ton = 640 lbs N
  • 100 lbs/Ac = $55-$70 per acre

• Bollgard II/Roundup Ready Flex Technology fee in GA: $412.20 per bag

• 45,000 seeds per acre = $74.20 per acre Technology Fees
Nitrogen Recommendations

**Georgia:** Based on yield goal
- 750 lbs/A = 60 lbs N/A
- 1000 lbs/A = 75 lbs N/A
- 1250 lbs/A = 90 lbs N/A
- 1500 lbs/A = 105 lbs N/A

**South Carolina:**
- Dryland = 70 lbs N/A
- Irrigated = 90 lbs N/A
- Adjust both up or down 20-30 lbs/A depending on yield potential and field history

**Mississippi:** Based on yield goal & soil texture
- 50-60 lbs N/bale on light textured soils
- 60-70 lbs N/bale on medium textured soils
- 70-80 lbs N/bale on heavy soils

**Average application rates:**
- Georgia: 70 – 120 lbs/A
- South Carolina: 90 – 120 lbs/A
- Mississippi: 90 – 120 lbs/A
N Uptake and Partitioning By Cotton

Source: Univ. of Arizona
Nitrogen Removal

<table>
<thead>
<tr>
<th></th>
<th>Yield/A</th>
<th>N</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>Ca</th>
<th>Mg</th>
<th>S</th>
<th>Cu</th>
<th>Mn</th>
<th>Zn</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed &amp; Lint</td>
<td>2600</td>
<td>63</td>
<td>25</td>
<td>31</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>0.18</td>
<td>0.33</td>
<td>0.96</td>
</tr>
<tr>
<td>Stalks, Leaves, &amp; Burs</td>
<td>3000</td>
<td>57</td>
<td>16</td>
<td>72</td>
<td>56</td>
<td>16</td>
<td>15</td>
<td>0.05</td>
<td>0.06</td>
<td>0.75</td>
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</tbody>
</table>

• 2600 lbs seed & lint = 1000 lbs lint

• What about a 1500 lb crop?

• Question: If we are applying 120 lbs and removing 63 – 94 lbs, where is the remainder?

Source: NC State University
The Nitrogen Cycle

The nitrogen cycle, including most inputs, losses and transformations. Red arrows indicate potential losses from soils, while black arrows indicate inputs or transformations.

Source: Texas A & M
The Eternal Question

• How much nitrogen should I apply?

• Answer: depends

• Things to consider:
  • Yield potential
  • Field history
  • Previous crop
  • Soil texture
  • Nitrogen source
  • Application method
Mississippi Cotton 2011

N application @ 4-LF

Cotton Lint Yield (lbs lint/acre)

- 1/3 ESN
- 2/3 ESN
- ESN
- Urea
- 0 N

Nitrogen Rate (lbs N/acre)

Source: Dr. Bobby Golden
Cotton Yield Response to Nitrogen

No differences among N sources within each rate

Source: Dr. Bobby Golden
No Yield Response to Nitrogen???

- Is Bobby Golden a lunatic?

- 20 studies were conducted across the Cotton Belt in 2009 and 2010
  - 11 of 20 locations had no response to nitrogen

- Why was there no response to N is so many studies?
  - “This is why research isn’t relative on my farm”

- Mentality
Pre-Sidedress Soil Nitrate Tests

- Have been beneficial for predicting N fertilizer needs in other crops
- Not used to a great extent in cotton production
- Beltwide N project confirmed residual $\text{NO}_3^{-}$ is present in Cotton Belt soils
- Data indicates that 21 lbs N are required per bale of lint produced
Extractable Soil Nitrate

Source: Main et al. 2013
Field Variability
Effects of Excessive Nitrogen Application

- Alter vegetative and reproductive growth
- Delay maturity
  - Clawson et al. 2008
  - Varco et al. 1999
- Insects are drawn to rank, lush cotton
  - Willers et al. 2001
- Decrease profitability

<table>
<thead>
<tr>
<th>Nitrogen (Lb/A)</th>
<th>Plant height (Inches)</th>
<th>Plant nodes</th>
<th>NACB</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>29.2</td>
<td>16.6</td>
<td>4.3</td>
</tr>
<tr>
<td>40</td>
<td>31.4</td>
<td>17.1</td>
<td>4.9</td>
</tr>
<tr>
<td>80</td>
<td>33.1</td>
<td>18.0</td>
<td>5.3</td>
</tr>
<tr>
<td>120</td>
<td>34.7</td>
<td>18.5</td>
<td>5.9</td>
</tr>
<tr>
<td>LSD (0.05)</td>
<td>0.9</td>
<td>1.0</td>
<td>0.5</td>
</tr>
</tbody>
</table>
Nitrogen Application Rates and Tarnished Plant Bugs

Number of Plant Bug Sprays

Nitrogen Application Rate (lb/a)
Total Plant Bugs – Unsprayed Plots

Nitrogen Application Rate (lb/a)

Total plant bugs
Where Are We Going?

• Precision agriculture
  • Somewhat of a misnomer

• Field management on a spatial level
  • Multiple factors may need to be included to get the most bang for your buck

• More convenient access to massive amounts of reliable data than ever before
Accuracy vs Precision

Measure of bias

Accurate but not Precise

Precise but not Accurate

Measure of spread

Not Accurate or Precise

Both Accurate & Precise

Source: http://1.bp.blogspot.com/_LpvA4lv5DbE/SwVFCc5oK7I/AAAAAAAAADo/PR25UL3t4tw/s1600/Accuracy+vs+Precision.jpg
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Information Collection and Processing

- Agriculture has seen unprecedented advances in information collection capabilities

- Soil maps, Veris maps, site-specific soil sampling, application maps, yield maps, elevation, etc...

- What do we do with this data?
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Closing Thoughts

• Given current market prices and environmental concerns, we must continue to refine and improve nitrogen use efficiency

• Willingness to change/adapt

• Experiment

• Change is going occur
  • “Shift happens”
Thank You

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