Adapt-N

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Holly Trytten, Chief Architect
What is Adapt-N?

➢ Highly scalable computational nitrogen solution that offers benefits to farmers, consultants, fertilizer retailers, and society by
  • Precisely estimating N needs in complex production environments
  • Facilitating the use of other beneficial management and technologies

➢ Effectively addresses multiple environmental concerns

➢ Developed at Cornell University (since 2002), licensed to Agronomic Technology Corp in 2013. Currently available for 95% of corn acres in US.
THE CHALLENGE:
- Many sources of N
- Many loss pathways
- Highly dynamic system
- Highly influenced by production environments: weather, soil, and management

OUR SOLUTION:
- Data and computation
- Integration and education
Our strengths

- Strong science base
- Proven precision and benefits
- Transparency
Adapt-N: Nitrogen Recommendations

How much N needed right now

Breakdown of recs

Simple to modify and test impact of new decisions

Flexible: Subfield, zone or whole field options

Combines new layers of yield, agronomic and other data

Proactive “alerts” and monitoring for anticipated N deficiencies

Export as .shp, etc.

FIELD RECOMMENDATION

Recommendation for 10/19/2016
0 / 47 / 95 / 2,553
lba N/acre (min/avg/max/total)

Grower Smith
Farm Home
Field South
Acres 54

ZONE RECOMMENDATION STATISTICS

<table>
<thead>
<tr>
<th>Zone</th>
<th>N Mineralization</th>
<th>Total N Loss</th>
<th>N Uptake</th>
<th>Virtual PSNT</th>
<th>Root Zone Saturation %</th>
<th>Rainfall Since Planting</th>
<th>Estimated Growth Stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>min</td>
<td>16</td>
<td>86</td>
<td>88</td>
<td>0.5</td>
<td>73</td>
<td>22.5</td>
<td>V10</td>
</tr>
<tr>
<td>avg</td>
<td>22</td>
<td>115</td>
<td>116</td>
<td>0.7</td>
<td>92</td>
<td>22.5</td>
<td>V10</td>
</tr>
<tr>
<td>max</td>
<td>27</td>
<td>134</td>
<td>140</td>
<td>0.9</td>
<td>100</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

NOTE: This recommendation uses these modified parameters: $3.15/bushel, $0.41/bu N, 0.99 lbs N/bu.
## Communication and Transparency

### Scenario: 06/15/17

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sidedress N Recommendation</td>
<td>40 lbs N/Acre</td>
</tr>
<tr>
<td>Rec Range (lbs N/Acre)</td>
<td>36 - 46 lbs N/Acre</td>
</tr>
<tr>
<td>Commercial Fertilizer Already Applied</td>
<td>85 lbs N/Acre</td>
</tr>
</tbody>
</table>

### Supporting Estimates and Assumptions:

- **Expected N in crop at harvest**: 235 lbs N/Acre
- **N mineralization so far**: 59 lbs N/Acre
- **N loss since planting / since 11/1/16**: 10 / 64 lbs N/Acre
- **Additional N credits**: 25 lbs N/Acre
- **N in crop now**: 8 lbs N/Acre
- **Expected Future Fertilizer Loss**: 8 lbs N/Acre
- **Future Net N Credits**: 16 lbs N/Acre
- **N in soil now**: 137 lbs N/Acre
- **Rainfall since planting / since 11/1/16**: 3.0"/19.3"
- **Current Nitrates N top 12"**: 81 lbs N/Acre
- **Virtual PSNT: 22 ppm**
- **Current plant available water / Maximum plant available water**: 5.4"/5.8"
Adapt-N Field Validation

- Midwest, Northeast and Southeast
- 2011-2016
- On-farm, mostly with independent consultants and researchers
- Two replicated trial types
  - Adapt-N vs. Advanced Grower
  - Multi-N Rate


Adapt-N Results Summary

Adapt-N vs. Grower Trials (IA, NY, n=113)
- Profits: +$26/ac
- N inputs: -40 lbs/ac
- Environmental impacts:
  - Simulated: -36%
  - Measured (lysimeter): -34%

Multi-Rate Trials - IN, OH, WI (n=17)
- Bias from EONR: -9 lbs/ac
- RMSE: 29 lbs/ac

Multi-Rate Trials - NY (n=14)
- Bias from EONR: -10 lbs/ac
- RMSE: 29 lbs/ac
Adapt – N vs Grower . . . N Rate vs. Yield Differences

Analysis by Dr. Jim Schepers for NutrientStar

- Lower rates did not result in yield losses
- Higher rates justified by higher yields

Adapt-N lower than Grower in 83% of trials
40 lbs/ac average reduction in N rate
Highlighted Partnerships

Sponsors and Recognitions
- USDA
- Walmart
- General Mills
- The McNeil Foundation
- The Walton Family Foundation
- EDF Environmental Defense Fund

Major Clients
- Willard
- United Suppliers
- Agrium
- Smithfield
- Crop Production Services
- NutrientStar

Integration Partners
- SST Software
- EFC Systems
- AgWorks
- NY Farm Viability Institute
- Ag Professional Weekly
- TULANE Nitrogen Reduction Challenge
- AG Professional Weekly
- ESN
Tulane Challenge

Phase 2:
2017 Technology Proving
Hardwick Farm, Newellton, LA
What we knew ahead of time….

Soil and Crop:
- Soil type: Sharkey clay
- Corn yield potential: 220 bu/ac
- Tillage: Minimum (broad beds) with cover crop
- Hybrid: 118 day CRM hybrid
- Rooting depth: 30”
- Prices: $3.50 per bushel; $0.34 per lb N
- OM contents (LOI): 2.1 to 4.1% in N to S gradient
- Experimental design: Spatially-balanced randomized

Notable Equipment and Materials:
- Furrow irrigation capability
- Precision Planting
- Low-clearance sidedress equipment only
- Available fertilizer formulations (incl. inhibitors)

Pre-defined days for farm access
Timeline

CC killed

Plant

Side dress (V5)

Hi-Clearance Application (V13)

R5

5.6” on April 2 (V3)

5.5” in 20 days after SD
**PSNT Result (April 3)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field PSNT:</td>
<td>4 ppm</td>
</tr>
<tr>
<td>Adapt-N Virtual PSNT:</td>
<td>6 ppm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected N in crop at harvest</td>
<td>225 lbs N/Acre</td>
</tr>
<tr>
<td>N mineralization so far</td>
<td>69 lbs N/Acre</td>
</tr>
<tr>
<td>N in crop now</td>
<td>0 lbs N/Acre</td>
</tr>
<tr>
<td>N in soil now</td>
<td>0 lbs N/Acre</td>
</tr>
<tr>
<td>Expected Future Fertilizer Loss</td>
<td>45 lbs N/Acre</td>
</tr>
<tr>
<td>Rainfall since planting / since 11/01/16</td>
<td>6.8&quot;/24.5&quot;</td>
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<tr>
<td>Root zone inorganic N</td>
<td>40 lbs N/Acre</td>
</tr>
</tbody>
</table>

Planted: 2017-03-23
Growth Stage: V3
May 11 Field Conditions

- high rainfall post-sidedress
- Anticipated N shortage
- Anticipated high yield

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Yield Target</th>
<th>N Rate N/Acre</th>
<th>Rec Range (lbs N/Acre)</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>220 bu/acre</td>
<td>Current Yield Target</td>
<td>30 lbs N/Acre</td>
<td>27 - 32</td>
<td>Details &gt;</td>
</tr>
<tr>
<td>240 bu/acre</td>
<td>Alternative Yield Target</td>
<td>40 lbs N/Acre</td>
<td>32 - 38</td>
<td>Details &gt;</td>
</tr>
<tr>
<td>250 bu/acre</td>
<td>Alternative Yield Target</td>
<td>50 lbs N/Acre</td>
<td>43 - 51</td>
<td>Details &gt;</td>
</tr>
</tbody>
</table>

Recommendation based on 2017's configuration and the simulation year's supporting estimates, and assumptions:

- 34/97 lbs N/Acre N mineralization since planting / since 11/01/16
- 76 lbs N/Acre N in crop now
- 11.5"/29.2" Rainfall since planting / since 11/01/16

Shapefile sent to Craig Clark, custom applicator

Photo by Leah Cook
R5 Stage (July 11)

Photos by Leah Cook