Adapt-N Overview
The N Management 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
Adapt-N History

• 1970’s through early 2000’s: field research on space-time aspects of N response

• 1980’s to early 2000’s: initial software model development

• 2008-2013: Adapt-N prototype tool available as free web interface, supported by grant funding

• 2011-current: extensive field testing in the Corn Belt and the Northeast, and model revisions through on-farm trials

• 2013-2017: Adapt-N licensed and commercialized through Agronomic Technology Corp as partnership

• Nov. 2017-Current: Acquired by Yara Digital Farming
Tulane Nitrogen Challenge

A Grand Challenge to combat hypoxia...

- 77 global entrants in 2015 spanning a variety of technologies
- 5 finalists announced in 2016 implemented their technologies on a corn field in Louisiana for the entire 2017 season
- Adapt-N selected as the $1 million winner

Winning criteria: drive yield while reducing nitrogen loss
Modeling

01 Weather
35 years of high-res weather at granular and aggregated levels

02 Nitrogen
Full N cycle modeled
All major nitrogen types, application approaches, treatments
All of the 4Rs: rate, source, time, placement
All forms of N loss simulated

03 Crop
Multi-crop modeling, GDD/growth stages, rooting depth impact, uptake analysis, cover crops, CRMs

04 Soil
All major production soils with unique properties for mineralization, water, and chemical movement in 2” increments

05 Field
Tillage system impact
Subfield variations
Water runoff

06 Water
Water transport
Field saturation
Fertigation, irrigation guidance

Our strengths
• Strong science base
• Proven precision and benefits
• Transparency
Continuous improvement

Changes released to users

Lab Research

Model adjustments / re-analysis

Field experiments

Adapt-N Lab

Data analysis

On-farm trials
Additional Research Information
Independent Adapt-N Evaluation on Commercial Farms

125 field trials where dynamic and static N rates compared (2011-2016)
Strip Trial Diversity
Soil Texture and Organic Matter Content

Legend (OM%)
- 0.9-1.98
- 1.98-3.06
- 3.06-4.14
- 4.14-5.22
- 5.22-6.3

[Diagram showing soil texture and organic matter content classification with various symbols and color codes.]
Model calibration and testing

- 200+ University-coordinated replicated strip trials
- In collaboration with researchers, consultants, and growers
- Adapt-N vs. Grower rates and Multi-rate N response trials
- Many additional “informal” strip trials by users

$30/acre average grower profit increase

80%+ success rate

N losses reduced by 35%

Published, peer-reviewed results
Adapt-N

avg N rate 6 lbs/ac below the Optimum N Rate
RMSE = 30 lbs/ac

Sela et al. 2017, Journal of Environmental Quality

Adapt-N Grower potential yield

\[ y = 0.922x + 24.81 \]
\[ R^2 = 0.56, \ p<0.01 \]
Major N Processes in Adapt-N Model

- Net additions:
  - Mineralization - immobilization
  - Urea hydrolysis

- Transformations
  - Nitrification

- Losses
  - Denitrification (nitrification)
  - Ammonia volatilization
  - Leaching
  - Plant N uptake

- Modifications for Enhanced Efficiency Compounds
  - All processes impacted by soil and crop dynamics
Flexible Zone Creation Modes

<table>
<thead>
<tr>
<th>Point-Based</th>
<th>Polygon-Based VRT</th>
<th>Gridded VRT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast, easy, N recommendations either flat rate or by manual zone</td>
<td>Fast, powerful VR rec using user-defined management zones</td>
<td>Comprehensive 60x60 ft gridded VR prescriptions with unlimited geometries</td>
</tr>
</tbody>
</table>
VRT Recommendation

FIELD RECOMMENDATION

Recommendation for 06/22/2015
40 / 68 / 100 / 3,595
lbs N/acre (min/avg/max/total)

Grower   FIPS 19 - Iowa
Farm     FIPS 047 - Crawford
Field    Denison
Acres    54

FIELD CONFIGURATION

Planting Date 05/01/2015
Maturity Class Grains: 107 day corn
Previous Crop Grain Corn
Tillage Method No-Till
Rainfall Since Planting 9.4"
Estimated Growth Stage V8

Organic Matter (%)  2.50  2.50  2.50
Harvest Population  30,000  30,000  30,000
Yield Target (bu/acre)  180  191  220
Detailed support for all recommendations gives users key insights into our modeling results so ground observations and other tools can be used in complement.
Graphs provide added insight
Graphs provide detailed insight

N Loss Breakdown
Date: 2014-06-06
Total Precipitation: 18 Inches
Gaseous Loss: 30.7 N lbs/acre
Leaching Loss: 37.1 N lbs/acre
Flexible export options

- Dynamically view the impact of rate adjustments

- Export as Shapefile or to source system
- Specify N product(s) and rounding options
- Set min and max values
- Adjust all rates by a % or fixed amount
- Fine tune individual rates
Multi-year analysis

Improve nitrogen planning by selecting from historical weather years to compare recommendations under different scenarios.
2015 vs. 2012

FIELD RECOMMENDATION

2015
19” rain
0 / 41 / 115 / 1,379

2012
4” rain
0 / 24 / 100 / 790
Email/SMS Alerts

The following fields and/or zones have recommended Nitrogen application values that exceed their alert threshold. Summary:

- 3 farms
- 3 fields
- 4 zones, max: 85, min: 65, avg: 73

Alert Threshold: 40

<table>
<thead>
<tr>
<th>Farm</th>
<th>Field</th>
<th>Zone</th>
<th>Stage</th>
<th>Rec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jones</td>
<td>Jones</td>
<td>Main</td>
<td>V5</td>
<td>65</td>
</tr>
<tr>
<td>Reed</td>
<td>Reed</td>
<td>Main</td>
<td>V5</td>
<td>85</td>
</tr>
<tr>
<td>Reed</td>
<td>Reed</td>
<td>adapt N Trial</td>
<td>V5</td>
<td>75</td>
</tr>
<tr>
<td>Rons</td>
<td>Rons</td>
<td>adapt N Trial</td>
<td>V5</td>
<td>70</td>
</tr>
</tbody>
</table>

Recommendations generated at 2015-06-10 04:47:05 Eastern.


