NITROGEN MANAGEMENT RESULTS

Anthony Martin
Northeast Iowa Regional Agronomist
Outline

• Nitrogen Modeling
  • Climate FieldView Nitrogen Advisor

• Nitrogen Sensors
  • OptRx

• Nitrogen Rate

Top: Iowa State University http://cnrc.agron.iastate.edu/nRate.aspx
Quick Q/A

Why are we doing corn research?
Our goal is to improve the competitiveness of Iowa soybean farmers. Recognizing that many farmers follow a corn/soybean rotation, we feel that this work is beneficial to all and not just those growing corn.

Are my checkoff dollars being spent on this research?
No. Funding for trials, surveys and sampling work done on corn comes from project partners and research grants.

Should I plant corn or soybeans in 2018?
Plants soybeans
Climate FieldView Nitrogen Advisor

- Tool is for nitrogen MANAGEMENT
- “Recommended rates” were set up using dummy applications
- Some rate changes were allowed
- Different trial layout in 2017

<table>
<thead>
<tr>
<th>Rep</th>
<th>Climate Nitrogen Advisor</th>
<th>Normal N Mgmt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rep 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rep 2</td>
<td>Climate Nitrogen Advisor</td>
<td>Normal N Mgmt</td>
</tr>
<tr>
<td>Rep 3</td>
<td>Climate Nitrogen Advisor</td>
<td>Normal N Mgmt</td>
</tr>
<tr>
<td>Rep 4</td>
<td>Climate Nitrogen Advisor</td>
<td>Normal N Mgmt</td>
</tr>
</tbody>
</table>

Rep 1
- Climate Nitrogen Advisor
- Normal N Mgmt
- Normal N Mgmt - 40 lbs N
- Normal N Mgmt + 40 lbs N

Rep 2
- Climate Nitrogen Advisor
- Normal N Mgmt
- Normal N Mgmt - 40 lbs N
- Normal N Mgmt + 40 lbs N

Rep 3
- Climate Nitrogen Advisor
- Normal N Mgmt
- Normal N Mgmt - 40 lbs N
- Normal N Mgmt + 40 lbs N

Rep 4
- Climate Nitrogen Advisor
- Normal N Mgmt
- Normal N Mgmt - 40 lbs N
- Normal N Mgmt + 40 lbs N
Information Used in Model

- **Planting**
  - Crop
  - Hybrid/Variety
  - Relative Maturity
  - Target Yield
  - Population (Avg.)
  - Planting Date

- **Nitrogen**
  - Fertilizer
  - Incorporation
  - Rate
  - Date
  - Stabilizer

- **Practices**
  - Previous Crop
  - Tillage System
  - Primary Tillage Date
  - 2017/16/15 Tillage
  - 2017/16/15 Manure

- **Soil**
  - Texture
  - Organic Matter
  - Soil pH
  - Soil CEC
  - Pattern Tile
Information Used in Model

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  - Crop
  - Hybrid/Variety
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- **Soil**
  - Texture
  - Organic Matter
  - Soil pH
  - Soil CEC
  - Pattern Tile
Predicted Nitrogen Balance

Observed 2 week prediction

Historical Data

Available lbs N/ac

Potential Remaining at black layer
12 lbs N/ac
Weather dependent range: 20 lbs N/ac Deficit to 35 lbs N/ac Remaining

Target Yield: 200 bushel per acre
Soil: Loam
Planting: 110 days, 34,000 seed per acre
Practices: Reduced...
Predicted Nitrogen Balance

- Observed
- 2 week prediction
- Historical Data
Trial Results

- Optimum N rates were within trial boundaries for almost all trials
- Normal and Model rates identical for 3 trials
- Climate rec produced highest yield in 4 trials

<table>
<thead>
<tr>
<th>Normal N Rate</th>
<th>Low N Rate</th>
<th>High N Rate</th>
<th>Climate FieldView</th>
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<tbody>
<tr>
<td>Rate</td>
<td>Yield</td>
<td>Rate</td>
<td>Yield</td>
</tr>
<tr>
<td>150</td>
<td>171.2</td>
<td>110</td>
<td>162.8</td>
</tr>
<tr>
<td>135</td>
<td>223.6</td>
<td>-</td>
<td>-</td>
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<tr>
<td>165</td>
<td>213.9</td>
<td>100</td>
<td>190.3</td>
</tr>
<tr>
<td>165</td>
<td>252.9</td>
<td>100</td>
<td>222.5</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>104</td>
<td>239.4</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>140</td>
<td>222.9</td>
</tr>
<tr>
<td>202</td>
<td>214.7</td>
<td>189</td>
<td>211.3</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>150</td>
<td>173.8</td>
</tr>
</tbody>
</table>
Trial Results

- Yield and partial profit not aligned for all locations
- Small change over 2017 trials -0.2 bu/ac or +$0.34/ac
- Overall -3.2 bu/ac or -$0.82/ac
- Nitrogen Timing and Form showed greater response

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Climate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yld (bu/ac)</td>
<td>Partial Profit ($/ac)</td>
</tr>
<tr>
<td>2016</td>
<td>228.9</td>
<td>$783</td>
</tr>
<tr>
<td></td>
<td>224.7</td>
<td>$745</td>
</tr>
<tr>
<td></td>
<td>198.0</td>
<td>$658</td>
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<tr>
<td></td>
<td>217.4</td>
<td>$698</td>
</tr>
<tr>
<td></td>
<td>221.7</td>
<td>$748</td>
</tr>
<tr>
<td></td>
<td>217.9</td>
<td>$757</td>
</tr>
<tr>
<td></td>
<td>210.9</td>
<td>$731</td>
</tr>
<tr>
<td></td>
<td>218.8</td>
<td>$743</td>
</tr>
<tr>
<td></td>
<td>251.8</td>
<td>$809</td>
</tr>
<tr>
<td>2017</td>
<td>176.5</td>
<td>$587</td>
</tr>
<tr>
<td></td>
<td>223.6</td>
<td>$771</td>
</tr>
<tr>
<td></td>
<td>205.5</td>
<td>$688</td>
</tr>
<tr>
<td></td>
<td>244.3</td>
<td>$834</td>
</tr>
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<td></td>
<td>244.5</td>
<td>$845</td>
</tr>
<tr>
<td></td>
<td>234.7</td>
<td>$794</td>
</tr>
<tr>
<td></td>
<td>216.1</td>
<td>$709</td>
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<tr>
<td></td>
<td>182.4</td>
<td>$589</td>
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</table>
## Yield Results

<table>
<thead>
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<th>Normal</th>
<th></th>
<th>Climate</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Yld (bu/ac)</td>
<td>Partial Profit ($/ac)</td>
<td>Yld (bu/ac)</td>
<td>Partial Profit ($/ac)</td>
</tr>
<tr>
<td>Manure</td>
<td>222.4</td>
<td>$721.33</td>
<td>215.1</td>
<td>$714.67</td>
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<tr>
<td>Single Spring</td>
<td>214.4</td>
<td>$744.00</td>
<td>211.1</td>
<td>$742.88</td>
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<tr>
<td>Sidedress</td>
<td>223.5</td>
<td>$754.97</td>
<td>218</td>
<td>$756.34</td>
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</table>

### Normal Climate

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th></th>
<th>Climate</th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Yld (bu/ac)</td>
<td>Partial Profit ($/ac)</td>
<td>Yld (bu/ac)</td>
<td>Partial Profit ($/ac)</td>
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<tr>
<td>Manure</td>
<td>222</td>
<td>$743.71</td>
<td>222</td>
<td>$747.54</td>
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<tr>
<td>Single Spring</td>
<td>200.1</td>
<td>$678.94</td>
<td>199.4</td>
<td>$674.56</td>
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</tbody>
</table>
Efficiency

- Yield response to change in nitrogen
- Economic optimum at .13 bu/lbs N
- Higher rates closer to optimum
- Climate showed better results than Normal
Scenario

You applied 75 lbs N with UAN at planting. The plan is to come back at V5 and sidedress NH3. Yield goal is 210 bu/ac, c/s rotation.

What rate would you apply?
Scenario

How would you change your answer if you knew that record setting rains would occur over the next month?
Perfect Storm

- Base Rate 58 lbs N
  - Fall MAP + Spring 28% UAN
- Planted 5/7
- Corn following Soybean
- NH3 sidedress 60/90/120 lbs N

- Remainder of field was sidedressed at 120 lbs N
Perfect Storm

March-August Rainfall
*Remainder of field averaged between 205 and 220 bu/ac
This is just an example to show that we can’t always predict what will happen.

A randomization test suggested no evidence between Normal N and +30 lbs and some evidence of a significant yield difference between Normal N and Climate FieldView Pro.

*Remainder of field averaged between 205 and 220 bu/acre
Summary from Climate FieldView project

• If sampling results are available for the field, use them in the model

• Rates trended toward field optimal

• Partial Profitability showed similar results between Normal and Climate FieldView recommendations in 2017

• Efficiency greater for most Climate FieldView locations
Continuation of Project

- Continue project in 2018
- Look at Nitrogen Zone management tool
  - Rx setup
- Recruit fields with minimal history
  - Reduce familiarity
Ag Leader OptRx

- Identifying healthiest or nitrogen rich strips
  - Initial pass required
- Adjustments made on the go
- Initial installation and use can be tricky
- Similar technologies available
- 22 trials over 3 years
2017 Results

- Half of the locations showed positive yield response to variable rate N
- Average return in 2017 was $4.39
- One location showed no response to additional N
## 2015-2017 Project Results

- First year involved some trial and error
- Six trials showed negative response to additional N
- Positive average return over years

<table>
<thead>
<tr>
<th>Year</th>
<th>Total N Change (lbs N/a)</th>
<th>Yield Response (bu/a)</th>
<th>Return ($/a)</th>
<th>Total N Change (lbs N/a)</th>
<th>Yield Response (bu/a)</th>
<th>Return ($/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-9.6</td>
<td>-1</td>
<td>$1.11</td>
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<tr>
<td>2016</td>
<td>29</td>
<td>4.9</td>
<td>$3.88</td>
<td>-7</td>
<td>-0.7</td>
<td>$0.73</td>
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<tr>
<td>2017</td>
<td>27</td>
<td>7.4</td>
<td>$14.45</td>
<td>-2.5</td>
<td>0.8</td>
<td>$4.39</td>
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</tbody>
</table>
2015-2017 Project Results

- First year involved some trial and error
- Six trials showed negative response to additional N
- Positive average return over years

<table>
<thead>
<tr>
<th>Base Rate + OptRx vs Base Rate</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>27 lbs N</td>
<td>6.4 bu/a</td>
<td>$10.38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Base Rate + OptRx vs Base Rate + Normal</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>-6.3 lbs N</td>
<td>-0.2 bu/a</td>
<td>$2.27</td>
</tr>
</tbody>
</table>
Pricing

- Used equipment can be acquired relatively cheap
- $8000-$10000 full system new
- Work with local dealer for setup and first use

<table>
<thead>
<tr>
<th>Range</th>
<th>Return</th>
<th>3 Sensors</th>
<th>4 Sensors</th>
<th>5 Sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>$0.73</td>
<td>6,164</td>
<td>8,219</td>
<td>10,274</td>
</tr>
<tr>
<td>Average</td>
<td>$2.27</td>
<td>1,982</td>
<td>2,643</td>
<td>3,304</td>
</tr>
<tr>
<td>High</td>
<td>$4.39</td>
<td>1,025</td>
<td>1,367</td>
<td>1,708</td>
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</table>
Summary from Nitrogen Sensor project

• There was an initial learning curve with systems

• Familiarity trends towards more positive results

• Average returns positive through all years of project

• Fields where no additional N was needed, OptRx performed better than normal rate
Multi-Rate Nitrogen Study

- Planned multi-year project

- Nitrogen rates dependent on previous crop

- Yield data coupled with soil attributes for zone creation

- What can we use to identify nitrogen zones
Summary

• Optimum nitrogen rate was within range for most locations
• Economic optimums centered around 150 lbs N/acre for both sets
• One location showed linear results
Soil EC

Overall this was not a good choice for creating zones

Optimum ranges nearly identical for each soil property, 140-160 lbs/A

VRT Result
If zones were created, nitrogen changes would be minimal.
Elevation

Overall a better option for creating zones

Optimum ranges change with elevation. Low Spots and Summits nearly identical

VRT Result
If zones were created, nitrogen changes would be apparent on side sloping areas. Low and high areas would be similar

![Graph showing yield against nitrogen rate for Low Spot, Shoulder, and Summit categories.](image)
Organic Matter

Better option than soil EC and elevation

As Organic Matter increases, response to additional nitrogen decreases.

VRT Result
If zones were created, distinct nitrogen rate changes for organic matter levels
Example: Layout

- Corn following Soybean
- Planted 4/23
- 40 lbs N applied at planting
- Sidedressed NH3 on 6/7
  - Strips of 40, 70, 100, 130, 160 lbs N
- Rx made for sidedress application
Example: Imagery
Example: Optimal

N price=$0.45/lb
Corn price=$3.75/bu
Median Econ. Optimum=148 lb/acre
68% Interval=146 to 150 lb/acre
### Example: Optimal

#### Soil Type

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Nopt Proxy (lb N/acre)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Talcott</td>
<td>151</td>
<td>35</td>
</tr>
<tr>
<td>Hayfield</td>
<td>140</td>
<td>19</td>
</tr>
<tr>
<td>Marshan</td>
<td>131</td>
<td>17</td>
</tr>
<tr>
<td>Dickinson</td>
<td>160</td>
<td>12</td>
</tr>
<tr>
<td>Harcot</td>
<td>146</td>
<td>7</td>
</tr>
</tbody>
</table>

#### Landform

<table>
<thead>
<tr>
<th>Landform</th>
<th>Nopt Proxy (lb N/acre)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footslope</td>
<td>135</td>
<td>16</td>
</tr>
<tr>
<td>Low spot</td>
<td>148</td>
<td>46</td>
</tr>
<tr>
<td>Shoulder</td>
<td>156</td>
<td>20</td>
</tr>
<tr>
<td>Sideslope</td>
<td>124</td>
<td>16</td>
</tr>
</tbody>
</table>

#### Soil Organic Matter

<table>
<thead>
<tr>
<th>Soil Organic Matter</th>
<th>Nopt Proxy (lb N/acre)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1.5</td>
<td>145</td>
<td>10</td>
</tr>
<tr>
<td>1.5 - 2.5</td>
<td>141</td>
<td>30</td>
</tr>
<tr>
<td>2.5 - 3.5</td>
<td>111</td>
<td>3</td>
</tr>
<tr>
<td>3.5 - 5.0</td>
<td>152</td>
<td>28</td>
</tr>
<tr>
<td>5.0 - 6.0</td>
<td>143</td>
<td>29</td>
</tr>
</tbody>
</table>
Project Continuation

• Similar trial setup

• Precision Planting SmartFirmer
  • Organic Matter and Soil Moisture collected
  • 20/20 SeedSense needed

• Additional in-field sampling
5 Takeaways

1. Testing nitrogen rates and prescriptions in your own fields is essential to determine whether optimal return is being met.

2. The more soil sampling data you provide a nitrogen modeling tool, the better and more fine-tuned the results will be.

3. First time users should utilize service providers to help setup and calibrate crop/nitrogen sensors.

4. Early season weather events and possible nitrogen losses should be considered when making in-season nitrogen decisions.

5. Just because there was a positive yield response, does not guarantee a positive economic return.
THANK YOU TO OUR SPONSORS

THE CLIMATE CORPORATION

IFL
Integrated Farm Livestock Management
DEMONSTRATION PROGRAM

IOWA SOYBEAN
Association

Funded in part by the soybean checkoff.
QUESTIONS?

To get involved or for more information, contact your regional agronomist:

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