Managing Nitrogen Based on Data not Anecdotes

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Crop Pest Management Short Course
9-11 Dec. 2014, Minneapolis, MN

University of Minnesota
Driven to Discover™
Overview

• Present-day challenges with data and information

• Update on nitrogen research
“Not everything you read on the internet is true”

Abraham Lincoln

**Present-Day Challenges:**
- Overload of information
- Sorting through information
- Deciding on precision and accuracy of information
- Deciding on applicability of information
John Doe Traditionally, most farmers make their phosphorus (P) and potassium (K) applications in autumn rather than in the spring. Fertility experts at the University of Minnesota say the agronomic benefits of P and K applications in either season are roughly the same. However, there are some potential payoffs from jump-starting your next-season fertility program sooner rather then later. Here are few key reasons to make nutrient applications this fall a priority:

1. **Fall applications correspond well with tillage practices.** When your primary tillage pass is made in the fall, you can incorporate nutrients into the soil profile. Working nutrients into a large volume of soil is particularly helpful for enhancing K availability for the next crop you plan to grow.

2. **Soil compaction is less of a risk.** Weather conditions vary with the year, but fields are typically drier in the fall than they are in the spring. So
• Morrill Act was signed into law by President Abraham Lincoln on July 2, 1862
  – The purpose of the Land-Grant Universities was (without excluding other scientific and classical studies) to teach such branches of learning as are military tactic, agriculture and the mechanic arts

• In 1887, Congress funded Research Agricultural Experiment Stations under direction of the LGUs (Hatch Act) to conduct local research

• In 1914 Congress creates the Cooperative Extension (Smith-Lever Act) to disseminate the knowledge gained at the LGUs to farmers, homemakers, and end users
Non-Traditional Products

How much will I get back from this investment? Is this an investment?

• Typical claims
  • Replace fertilizers and cost less
  • Make nutrients in the soil more available
  • Supply micronutrients
  • It’s a natural product

• Use testimonials by farmers and partial data
Non-Traditional Products

• What to do?
• “If it sounds too good to be true, it probably is”
• Contact University Extension for unbiased advice
• An additional resource “Compendium of Research Reports on Use of Non-traditional Materials for Crop Production”

http://extension.agron.iastate.edu/compendium/
Nitrogen Decisions

• Nitrogen management is risk management
  – So many unpredictable variables can make it a “game of chance”

• Need to manage based on probability
  – **Good idea**: Derive from sound principles, unbiased data and proven over the years
  – **Bad idea**: Tradition or anecdotal accounts

• Our decisions can have long-term implications on sustainability
  – Environmental quality and profitability
MRTN Rate = 99 (108) 122
EONR and Yield
Nitrogen Management is Not Just Pounds of N per acre

• Often discussions on nitrogen management revolve only around the topic of rate of application
  – 1) Adequate availability to the crop
  – 2) Minimize the amount of leftover nitrogen at the end of the season

• Other variables are also important
  – Source, time, application method, prevailing weather conditions, region/soil of the state
Nutrient Management
Sidedress time (late May-early June)

- V3: 10 lb N/acre
- V6: 22 lb N/acre
- V12: 68 lb N/acre
- Silking: 135 lb N/acre
- Milk: 180 lb N/acre
- R3: 225 lb N/acre

Physiological maturity:
- R6

Nutrient Management

- Leaching and runoff potential
- Com nitrogen use

Annual rainfall pattern

May | Jun | Jul | Aug | Sep
Can We Use Crop Sensors To Improve N Management?
**Pope Co. MN, C-S, 2013**

The graph shows the relationship between **Corn yield (bu/ac)** and **SPAD value** with two distinct datasets:

- **V8** dataset:
  - Linear equation: \( y = 6.7216x - 134.95 \)
  - Coefficient of determination: \( R^2 = 0.6863 \)

- **V12** dataset:
  - Linear equation: \( y = 10.116x - 372.55 \)
  - Coefficient of determination: \( R^2 = 0.8943 \)
Dakota Co. MN, C-C 2013

For plot 1:

\[ y = 8.4071x - 224.28 \]
\[ R^2 = 0.9238 \]

For plot 2:

\[ y = 6.7953x - 135.66 \]
\[ R^2 = 0.9789 \]
Using Canopy Sensors

- The earlier the sensing the greater the flexibility to apply nitrogen, **BUT**
- The earlier the sensing the lesser the predictive power
- The later the sensing the greater the predictive power, **BUT**
- The later the sensing the lesser the flexibility to apply nitrogen and greater potential for yield loss
Anhydrous Ammonia Timing
(2-yr study)

26 lb N/acre more
7 bu/acre less yield
Canisteeo-Glencoe and Webster clay loam, 0 to 2 percent slopes
Seaton silt loam soil 3-6% slope
Marna silty clay loam 0-2% slopes and Nicollet silty clay loam 1-3% slopes
Marna silty clay loam 0-2% slopes and Nicollet silty clay loam 1-3% slopes
Dakota Co. MN, C-C, 2013

Sparta loamy fine sand

Urea PP+V4
Others PP
Dakota Co. MN, C-C, 2014

Waukegan silt loam, 1 to 6% slopes

Urea PP+V4
Others PP
Pope Co, MN, C-C, 2013

Arvilla sandy loam

Urea PP+V4
Others PP
Pope Co, MN, C-C, 2014

Arvilla sandy loam

Urea PP+V4
Others PP
Pope Co. MN, C-S, 2013

Arvilla sandy loam

Urea PP+V4

Others PP

Corn yield (bu/ac)

N rate (lb/ac)
Pope Co. MN, C-S, 2014

Arvilla sandy loam

Urea PP+V4
Others PP
## Irrigated Sandy Soil Corn

<table>
<thead>
<tr>
<th>Trt</th>
<th>Dakota Co. corn/corn</th>
<th>Pope Co. corn/corn</th>
<th>Pope Co. Corn/soybean</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check</strong></td>
<td>150   100   87   69</td>
<td>82   83   79   83</td>
<td>111   174   126   118</td>
</tr>
<tr>
<td><strong>Urea</strong></td>
<td>238   208   216  200</td>
<td>180   223   186  149</td>
<td>194   197   187  206</td>
</tr>
<tr>
<td><strong>BMP</strong></td>
<td>223   175   223  176</td>
<td>172   235   162  127</td>
<td>187   159   202  181</td>
</tr>
<tr>
<td><strong>Super U</strong></td>
<td>222   198   214  177</td>
<td>172   234   178  129</td>
<td>179   187   202  179</td>
</tr>
<tr>
<td><strong>ESN</strong></td>
<td>220   188   211  195</td>
<td>172   211   164  138</td>
<td>169   168   200  184</td>
</tr>
<tr>
<td><strong>ESN/Urea</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Corn grain yield (bu/A)
### Quest to Finding the Best Time for Sidedress, 2014

<table>
<thead>
<tr>
<th>Location Rotation</th>
<th>Planting date</th>
<th>Lowest yield</th>
<th>Highest yield</th>
<th>Response equation</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Becker C-C</td>
<td>5/14</td>
<td>30</td>
<td>103</td>
<td>$y = 0.2192x + 36.89$</td>
<td>0.91</td>
</tr>
<tr>
<td>Clara City C-C</td>
<td>5/30</td>
<td>53</td>
<td>137</td>
<td>$y = 0.3202x + 55.229$</td>
<td>0.83</td>
</tr>
<tr>
<td>SWROC C-C</td>
<td>5/30</td>
<td>86</td>
<td>149</td>
<td>$y = -0.0014x^2 + 0.5448x + 92.832$</td>
<td>0.92</td>
</tr>
<tr>
<td>SROC C-C</td>
<td>5/23</td>
<td>47</td>
<td>140</td>
<td>$y = 0.3781x + 51.183$</td>
<td>0.92</td>
</tr>
<tr>
<td>SROC C-S</td>
<td>5/11</td>
<td>71</td>
<td>150</td>
<td>$y = -0.002x^2 + 0.7963x + 70.319$</td>
<td>0.99</td>
</tr>
<tr>
<td>Theilman C-C</td>
<td>5/22</td>
<td>109</td>
<td>206</td>
<td>$y = -0.0033x^2 + 1.1x + 102.85$</td>
<td>0.82</td>
</tr>
</tbody>
</table>
Becker, 2014

Hubbard loamy sand

\[ y = 0.2192x + 36.89 \]
\[ R^2 = 0.9129 \]
Nutrient Management

Soil N with Pre-plant Applications

Soil with 1.6% OM, CEC 8 meq/100g

Hubbard loamy sand
Becker, C-C

Hubbard loamy sand
Soil N with Pre-plant Applications

Soil with 4% OM, CEC 24 meq/100g

Ves loam soil
Sidedress N Source is Important

![Graph showing corn yield in bushels per acre for different sidedress ES/N sources and urea applications.](image-url)
Take Home Message

• Careful consideration of information is critical
• Canopy sensing predicts yield better later in the season
• Split N applications work well for irrigated sands
• Split N applications in dry-land may produce similar yields to spring pre-plant
Nutrient Management

Minnesota’s Grand Challenge & Compelling Opportunity Conference

Friday March 6, 2015
Best Western Plus Kelly Inn
St. Cloud, MN
100 4th Avenue South
St. Cloud, Minnesota 56301

http://z.umn.edu/Nconference

Registration Opens at 8:00 am
Morning Sessions 9:00 am - 12:25 pm

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00-9:05</td>
<td>Welcome</td>
<td>Dr. Fabián Fernández</td>
<td>University of Minnesota</td>
</tr>
<tr>
<td>9:05-9:55</td>
<td>Nitrogen Market Update</td>
<td>Dr. Robert Mullen</td>
<td>Potash Corp</td>
</tr>
<tr>
<td>9:55-10:45</td>
<td>Climate Trends And Their Implications</td>
<td>Dr. Mark Seeley</td>
<td>University of Minnesota</td>
</tr>
<tr>
<td>10:45-11:30</td>
<td>Irrigated Corn N Guidelines - What Are They And Where Did They Come From?</td>
<td>Dr. John Lamb</td>
<td>University of Minnesota</td>
</tr>
<tr>
<td>11:35-12:25</td>
<td>Can We Protect Groundwater Supplies Beneath Our Outwash Sands?</td>
<td>Bruce Montgomery</td>
<td>Minnesota Department of Agriculture</td>
</tr>
</tbody>
</table>

12:25-1:15 Lunch (provided by conference)

Breakout Sessions 1:15 pm - 3:45 pm

**Breakout Session 1. Predicting Nitrogen In-Season**

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<th>Time</th>
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<tbody>
<tr>
<td>1:15-2:05</td>
<td>Database-Driven Guidelines To Manage Nitrogen Rate Decisions</td>
<td>Dr. John Sawyer</td>
<td>Iowa State University</td>
</tr>
<tr>
<td>2:05-2:55</td>
<td>Utility Of Sensor Technology For Making In-Season Recommendations For N</td>
<td>Dr. Daniel Kaiser</td>
<td>University of Minnesota</td>
</tr>
<tr>
<td>2:55-3:45</td>
<td>Opportunities And Challenges When Applying Nitrogen In-Season</td>
<td>Dr. Fabián Fernández</td>
<td>University of Minnesota</td>
</tr>
</tbody>
</table>

**Breakout Session 2. Nitrogen Credits**

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<th>Time</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1:15-2:05</td>
<td>Manure Management To Minimize Nitrogen Loss And Improve Crop Use Efficiency</td>
<td>Kovan Klingberg</td>
<td>University of Wisconsin</td>
</tr>
<tr>
<td>2:05-2:55</td>
<td>Nitrogen Management For First- And Second-Year Corn Following Alfalfa</td>
<td>Dr. Jeffrey Coulter</td>
<td>University of Minnesota</td>
</tr>
<tr>
<td>2:55-3:45</td>
<td>Interseeded Cover Crops In Corn-Based Cropping Systems</td>
<td>Dr. Scott Wells</td>
<td>University of Minnesota</td>
</tr>
</tbody>
</table>

**Breakout Session 3. Nitrogen Management for Sandy Soils**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:15-2:06</td>
<td>Nitrogen Fertilizer Use Efficiency For Corn And Its Relationship To Groundwater Quality</td>
<td>Dr. Richard Ferguson</td>
<td>University of Nebraska</td>
</tr>
<tr>
<td>2:05-2:55</td>
<td>Evaluation Of Nitrogen Technologies For Sandy Soils</td>
<td>Dr. Carl Rosen</td>
<td>University of Minnesota</td>
</tr>
<tr>
<td>2:55-3:45</td>
<td>Fertigation As A Management Tool In Irrigated Corn</td>
<td>Joshua Stamper</td>
<td>University of Minnesota</td>
</tr>
</tbody>
</table>
Best Wishes for the 2015 Growing Season