Institute of Ag Professionals

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Minnesota Crop Production Retailers Association Trade Show

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Timing of Nitrogen Application in Corn to Optimize Yields and Minimize Water Quality Concerns

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Today’s Talking Points

• Ohio agriculture
• Thoughts on application time of N
• Ohio research on N application time
Western Half
Most Productive
Crop Land
Compare MN to OH

• More organic matter
• More coarse soils, sands
• Shorter growing season
• Colder soils at planting
• Better natural drainage
• More use of anhydrous ammonia
• More continuous corn
Better Mascot
Historical N Recommendations

1990’s

- Maximum Yield
- Price of N < 20 cents/lb
- More N, cheap insurance
Historical N Recommendations 2000’s

- Maximum Return to N
- Price of N > 40 cents/lb
- Economic optimal rate
- Consider grain price and N price
- Return on investment

N Rate Calculator
N Recommendations Trend 2010’s

- Environmental regulation
- Hypoxia/algae blooms
- Water nitrate warnings

4 Rs
4 Rs

Right Source
Right Rate
Right Place
Right Time
When Is the Best Time?

Fall
Pre-plant
At planting
In-season
Factors Affecting Application Time of N

- Convenience
- Weather
- Soils fit for equipment
- N Source
It’s About Managing Risk

• Production
  – Optimal yield
  – Logistics
  – Enough time to apply to all fields
  – Insure weather windows

• Water Quality
  – N does not leave field
  – No added N with no crop
  – Tight interpretation of the 4Rs
  – Apply to growing crop
Minnesota Naturally Has Lower N Loss Risk

- Anhydrous ammonia
- Good soil organic matter
- Cold soils when no crop
Vulnerable to N Loss
Most to Least

- Urea-ammonium nitrate
- Urea
- Ammonium sulfate
- Anhydrous ammonia
N Sources Compared

• Anhydrous ammon
  – Longest to convert to nitrate N
  – Gas
  – Hazard handling risk
  – More difficult to apply, knife
  – No bulk storage
  – Limited availability

• UAN – 28%
  – Nitrate component may be lost immediately
  – Liquid product
  – Can tank mix other products
  – Application simple
  – On-farm storage
COMPONENTS OF 28% SOLUTIONS

- Ammonium Nitrogen
- Nitrate Nitrogen
- Urea
When Does the Corn Plant Need Nitrogen?
NITROGEN ACCUMULATION - CORN

% of Total Uptake

VE  V6  V12  V18  R2  R5  R6
Critical Stages of Corn Development

Yield = (Ears/A x Kernels/Ear x Kernel wt)
Key Development Growth Stages for Yield

• V6: Row per ear determined, switch to nodal roots
• V12 – V18: Number of kernels per row determined
• VT-R1: Pollination
• R2 – R3: Kernel abortion
• R4 – R6: Kernel size
Application Time Results from NW OH

- Clay soil with 3 – 5% OM
- Tiled
- Prone to summer drought
- Yield avg 180 bu/A, good years 220
- Total N applied 150 or 180 lb/A
- At planting, In-season, Split (starter + V4)
- Four years
2012 Yield for Application Time - UAN

At Planting
- 129.5b bu A⁻¹

Split
- 136.2a bu A⁻¹

at GS V4
- 136.0a bu A⁻¹

Isd = 5.6
2013 Yield for Application Time - UAN

at Planting: 163.0

Split: 172.1

NS
2014 Yield for Application Time - UAN

- 2 x 2 split: 171.2a, 169.8a
- Popup split: 166.7ab, 161bc
- at Planting: 158.5c
- at GS V4: 170.5a

Legend:
- Blue: 10 + 170 lb/A
- Red: 30 + 150 lb/A
- Green: 180 lb/A

Lsd = 7.4
2015 NWARC Field Notes

• Rainfall, June 5 – July 20
  – 13.4 inches; normal 5.6 inches
• Corn planted May 13
• Sidedress UAN June 23
Grain Yield for N Rate
UAN Applied at Planting

Split 180# 164.5
At GS V4 180# 151.2
2015 Ears from Zero N Check
2014 Grain Yield Starter UAN Placement Methods (rates combined)

Popup: 163.4 bu A⁻¹

2x2: 170.5 bu A⁻¹

P < 0.01
2014 Harvest Population – UAN Placement Method (rates combined)

- popup: 27,000 plants acre\(^{-1}\)
- 2 x 2: 28,687 plants acre\(^{-1}\)

p < 0.05
2015 Grain Yield Starter UAN Placement Methods (rates combined)

P < 0.01

138.4

158.3

Popup

2x2
2015 Harvest Population
UAN Starter

<table>
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<tr>
<th>Plants acre⁻¹</th>
<th>Popup 10#</th>
<th>Popup 30#</th>
<th>2 x 2 10#</th>
<th>2 x 2 30#</th>
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<tr>
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<td>30,124a</td>
<td>23,875b</td>
<td>31,000a</td>
<td>30,875a</td>
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</table>

p < 0.05
## Starter Fertilizer Salt Injury Potential

<table>
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<th>Starter Fertilizer</th>
<th>Salt Index</th>
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<tbody>
<tr>
<td>3-18-18</td>
<td>8.5</td>
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<tr>
<td>6-24-6</td>
<td>11.50</td>
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<tr>
<td>6-30-10</td>
<td>13.80</td>
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<td>9-18-9</td>
<td>16.70</td>
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<td>10-34-0</td>
<td>20</td>
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<tr>
<td>28-0-0</td>
<td>67</td>
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</table>
Conclusions

• Split yielded more 3/4 years
• No starter benefit
• More opportunities with 2 x 2 starter placement than popup
  – Can increase N with 2 x 2
  – Limited to < 10 lb N with popup
Why Not Delay Application to V8 or Sidedress at V8

• Risk of wet conditions for two weeks at V8
• Appearance
APPEARANCE

Starter

No Starter
Summary

• Single application best yield
  – What if it rains for two weeks at that time?
  – Starter lessens that concern

• In a split system, what is the optimum N rate at planting?

• What is the best time for the split application?
What decision tools perform best for making corn N fertilizer rate recommendations?

Where do they work best? When do they work best?

Empirical-Based Models

Crop Growth Models

Encira
Maize-N
Climate: Nitrogen Advisor
Adapt-N

Proximal Canopy Sensing

Remote Imagery

Soil Tests

PPNT Pre-Plant Soil Nitrate Test
SDNT Side-Dress Soil Nitrate Test

Courtesy Ramson, University of Missouri
Ed’s Thought On Corn N Needs

• At planting 20%
• Between V7 and V10 50%
• Between V16 & tasseling 20%
• Early grain fill 10%
It does not matter when nitrogen is added as long it is still there when the crop needs it!

If I could predict the weather I would be able to develop a perfect nitrogen plan.
Questions