Alternative N-fertilizers: Do They Work Better?
Nitrogen Management

Goal:

- Match crop need with fertilizer and/or manure applied to optimize production economics
- Ensure maximum nutrient use efficiency by timing and placement of N in such a way as to reduce losses to the environment
- Use the more effective source of nitrogen

• **How can we manage to improve nitrogen use efficiency (NUE)?**
Nitrogen Use Efficiency is Increasing

- U.S corn grain production has increased
- Fertilizer N use has leveled off since 1980

From Cassman et al., 2002
Optimizing Nitrogen Use

• Exploit improvements in nitrogen use efficiency (NUE) from genetics and cultural practices

• Manage N to avoid losses
  - Improve N rate decisions
  - Placement – Control NH$_3$ and NO$_3$ loss
  - Timing – Use sidedress or delayed applications if leaching or denitrification risk is high
  - Use effective sources
Importance of Timing Nitrogen Fertilizer to Crop Growth Stage

Seasonal Nitrogen Uptake, %

- Early Growth
- Rapid Growth
- Maturing
- Late Loss

80% of requirement after V8 - 10
Alternative Nitrogen Fertilizer Products

Slow Release
- Coated fertilizers
- More complex materials

Additives
- Microbial inhibitors
- Others
Objectives of Southern Region Water Program: Nutrient Management Team

Within each state:

- Compare yields from replicated studies for different N fertilizer sources (alternative N fertilizers vs the standard N fertilizer used in that state).

- Each state will compare Nutrisphere and ESN, where appropriate. Some states will compare additional slow release fertilizers or additives.
Individual State Nitrogen Fertilizer Trials
Wheat Results
2010 Wheat Yield: Oklahoma

Conv.: There was no significant yield benefit of using a product or additive compared to UREA at the same rate. Significant rate difference. Optimum yield at 75 lb N/acre.

No-till: There was no significant yield benefit of using a product or additive compared to UREA at the same rate. Optimum yield at 75 lb N/acre.
2011 Wheat Yield: Oklahoma

Conv.: There was no significant yield benefit of using a product or additive compared to UREA at the same rate. Significant rate difference. Optimum rate at 100 lb N/ac.

No-Till: There was no significant yield benefit of using a product or additive compared to UREA at the same rate. Significant rate difference. Optimum rate at 75 lb N/ac.
Wheat Protein: Oklahoma

- Across both locations and years there was no significant difference in grain protein when a product or additive was added when compared to UREA at the same nitrogen rate.
Wheat Yields: Piedmont, North Carolina

Grain Yield (lb/acre)

*Year, Rate, Source
UAN>UFP
95 lb N

UAN better than Nitamin. Optimum rate at 95 lb N/ac.

All fertilizers were the same except ESN (one year). Optimum N rate, 95-145 lb N/ac.

*Rate, Source 120 lb N; ESN <
Corn Results
Relative Corn Yield: Alabama, 2008-2011

Relative Corn Grain Yield

\[ \text{LSD}_{p<0.05} = 0.15 \]
ESN produced greater yields than UAN. Yield increased up to 180 lb N/ac.
UAN, Urea, and Agrotain with Urea performed the same under irrigated conditions.
Corn Yields: North Carolina

All fertilizers performed the same except Nitamin. Optimum rate, 175 lb N/ac.

All fertilizers performed the same. Optimum rate, 175 lb N/ac.
Corn Grain Yield: North Carolina, 2008 and/or 2009

All fertilizers performed the same. Rate differences. Optimum rate, 145 lb N/ac.

Coastal Plain

Mountains

All fertilizers performed the same. Rate differences. Optimum rate, 180 lb N/ac.
## Corn Yield: Texas Blacklands, 2010

<table>
<thead>
<tr>
<th>Nitrogen Rate (lbs/A)</th>
<th>Grain Yield†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UAN</td>
</tr>
<tr>
<td>0</td>
<td>74 ‡</td>
</tr>
<tr>
<td>50</td>
<td>76</td>
</tr>
<tr>
<td>75</td>
<td>86</td>
</tr>
<tr>
<td>100</td>
<td>77</td>
</tr>
<tr>
<td>125</td>
<td>85</td>
</tr>
</tbody>
</table>

† Yields corrected to 15.5% moisture.
‡ Means within the UAN column and rows are not significantly different (P=0.05).
Cotton Yields
Mean Relative Cotton Lint Yields: Alabama, 2008-2010

LSD_{p<0.05} = 0.17
Seed Cotton Yield Response: Arkansas 2010

- **Seed-cotton yield (lb/acre)**
  - Control
  - Total N Rate (lb/acre)
    - 0
    - 30
    - 60
    - 90
    - 120
    - 150

- **Urea**
  - 2,000

- **ESN**
  - 2,200
  - "$\ast$"

Legend:
- Control
- ESN
- Urea
Cotton Yields: New Mexico

UAN, Urea, and Agrotain with Urea performed the same under irrigated conditions, except the 1X Agrotain Urea.
# Cotton Yields: Texas Blacklands, 2010

<table>
<thead>
<tr>
<th>Nitrogen Rate (lbs/A)</th>
<th>UAN</th>
<th>UAN + Nutrisphere (0.5 % v/v)</th>
<th>UAN + Agrotain Ultra (0.2% v/v)</th>
<th>UAN + N-Sure (50/50)</th>
<th>UAN + CoRoN (50/50)</th>
<th>UAN + NDemand (50/50)</th>
<th>Lint Yield†</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1075‡</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>1053</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>971</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80</td>
<td>1057</td>
<td>984</td>
<td>926</td>
<td>937</td>
<td>961</td>
<td>974</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>1040</td>
<td>937</td>
<td>1073</td>
<td>1020</td>
<td>1010</td>
<td>1064</td>
<td></td>
</tr>
</tbody>
</table>

† Yield based on five replications.
‡ Means within the UAN (only) column and rows are not significantly different (P=0.05).
Cotton Lint Yield: Texas Brazos River Valley, 2007

- Untreated
- CoRoN 128 oz/A (2X)
- CoRoN 128 oz/A (3X)

P>F = 0.8099
CV% = 5.2
Mean = 846 lbs/acre

All treatments (including untreated) received recommended soil fertility based on soil test.

(2X) – CoRoN applied @ 1st bloom
14 days later

(3X) - CoRoN applied @ 1st bloom
14 days later
14 days later
Cotton Lint Yield: Texas
Lamesa AGCARES, 2007

Lint yield, lbs/acre

P>F = 0.5366
CV% = 4.6
Mean = 1579 lbs/acre

All treatments (including untreated) received recommended soil fertility based on soil test.

(2X) – CoRoN applied @ 1st bloom
14 days later

(3X) - CoRoN applied @ 1st bloom
14 days later
14 days later
Cotton Lint Yield: Texas
St Lawrence, 2007

P>F = 0.6333
CV% = 3.8
Mean = 1549 lbs/acre

All treatments (including untreated) received recommended soil fertility based on soil test.

(2X) – CoRoN applied @ 1st bloom
14 days later

(3X) - CoRoN applied @ 1st bloom
14 days later
14 days later
Cotton Lint Yield: Texas Blacklands, 2007

Lint Yield (lb/A)

Check | UAN 100 | Nfusion 30:70 | Nfusion 20:80
0 | 125 | 125 | 125
100 | 100 | 100 | 100

LSD = 105
# Cotton Lint Quality: Texas Blacklands, 2007

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Micronaire (units)</th>
<th>Length (in.)</th>
<th>Uniformity (ratio)</th>
<th>Strength (g/tex)</th>
<th>Elongation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No N Applied</td>
<td>4.45 a*</td>
<td>1.11</td>
<td>82.6</td>
<td>28.0</td>
<td>8.5</td>
</tr>
<tr>
<td>32 UAN, 100 lb N/A</td>
<td>4.25 b</td>
<td>1.14</td>
<td>83.3</td>
<td>28.2</td>
<td>8.4</td>
</tr>
<tr>
<td>32 UAN, 125 lb N/A</td>
<td>4.18 bc</td>
<td>1.13</td>
<td>82.3</td>
<td>29.2</td>
<td>8.3</td>
</tr>
<tr>
<td>Nfusion 30:70, 100 lb</td>
<td>4.03 c</td>
<td>1.14</td>
<td>82.3</td>
<td>29.1</td>
<td>8.2</td>
</tr>
<tr>
<td>Nfusion 30:70, 125 lb</td>
<td>4.23 b</td>
<td>1.13</td>
<td>82.9</td>
<td>28.6</td>
<td>8.2</td>
</tr>
<tr>
<td>Nfusion 20:80, 100 lb</td>
<td>4.2 bc</td>
<td>1.14</td>
<td>82.9</td>
<td>28.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Nfusion 20:80, 125 lb</td>
<td>4.25 b</td>
<td>1.13</td>
<td>82.7</td>
<td>27.2</td>
<td>8.6</td>
</tr>
<tr>
<td>LSD</td>
<td>0.19</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Means within a column followed by the same letter are not different (P>0.05).
Grain Sorghum Yields
<table>
<thead>
<tr>
<th>Nitrogen Rate (lbs/A)</th>
<th>Grain Yield†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UAN</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>4442 b‡</td>
</tr>
<tr>
<td>30</td>
<td>4499 b</td>
</tr>
<tr>
<td>60</td>
<td>4965 ab</td>
</tr>
<tr>
<td>90</td>
<td>5301 a</td>
</tr>
<tr>
<td>120</td>
<td>5565 a</td>
</tr>
</tbody>
</table>

† Yields corrected to 15.5% moisture.
‡Means within the UAN (only) column followed by the same letter are not significantly different (P=0.05).
Take Home Message

There were few differences due to Nitrogen Fertilizer Sources for any of the soils, crops, or climates in the Southeast!

- Nutrisphere, Nitamin and Agrotain did not produce better yields at any location for any crop where tested.
- ESN performed better than urea on corn and cotton in Arkansas.
- ESN performed similarly or worse to UAN or urea in Alabama (corn), North Carolina (corn and wheat), and Oklahoma (wheat).
Authors

• Brian Arnall, Oklahoma State University
• Robert Flynn, New Mexico State University
• Mark McFarland, Texas A&M
• Charles Mitchell, Auburn University
• Morteza Mozaffari, University of Arkansas
• Deanna Osmond, NC State University
Publications


Funding

We are indebted to multiple funding sources

- All projects: USDA NIFA Southern Region Water Program
- AL: Alabama Wheat & Feed Grain Committee, Alabama Cotton Commission
- AR: University of Arkansas Division of Agriculture, Agrium Advanced Technologies
- NM: Agrotain International for product and New Mexico Agricultural Experiment Station
- NC: USEPA 319 through NCDENR, Agrium, Corn Growers Association of NC, Georgia Pacific, NC Cooperative Extension, NC Small Grain Growers Association, Southern States, and Yara
- TX: United Sorghum Checkoff Program, Georgia Pacific