Alternative N-fertilizers: Do They Work Better?
Nitrogen management is important to ensure that the crops can use nitrogen fertilizer as well as possible to reduce grower costs and protect the environment from excess nitrogen in the air and water.

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)?
Due to improved management and genetics, corn yields have increased from 1960. Fertilizer N use leveled off around 1980 thus the current corn crop is using more nitrogen and less is being released into the environment.
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 NH₃ and NO₃ 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

- **Early Growth**
- **Rapid Growth**
- **Maturing**
- **Late Loss**

Seasonal Nitrogen Uptake, %

- 0%
- 25%
- 50%
- 75%
- 100%

May June July Aug Sept

80% of requirement after V8 - 10

Sidedress
Different areas use different forms of nitrogen – some areas use predominantly anhydrous, while others will use urea, liquid urea ammonium nitrate, ammonium sulfate or other forms.

Alternative nitrogen fertilizer products may protect nitrogen fertilizers from volatilization or leaching. For instance, slow release fertilizers may more slowly release nitrogen thus protecting the nitrogen from leaching losses and making more nitrogen available for plant growth. Additives may slow transformations from urea to ammonia (a gas) so that the fertilizer has a better chance of getting in to the soil. Other microbial inhibitors protect ammonium from nitrate transformations, which protects the nitrogen from potential leaching.
Products and Treatment Evaluated

- ESN: Polymer coated Urea Driven by temp/moist
- Nfusion/Nitamin: Slow release N
- CoRoN: Slow release Liquid N
- N Demand: Slow release Liquid N
- N Sure: Slow release Liquid N
- Agrotain: Urease Inhibitor
- Nutrisphere: Urease and Nitrification Inhibitor
- CaCl: Stabilizes N
A group of southern agricultural researchers wanted to look at these alternative nitrogen fertilizers to determine whether they made a difference, particularly Nutrisphere, which according to the manufacturing label protects the nitrogen from volatilization and transformation to nitrate, and Environmentally Smart Nitrogen (ESN), which is a true slow-release fertilizer.
Alternative nitrogen trails took place in North Carolina (corn and wheat), Alabama (corn and cotton), Arkansas (corn and cotton), Oklahoma (wheat), Texas (corn, cotton and grain sorghum) and New Mexico (corn and cotton).
Wheat Results
In Oklahoma in 2010, there was no difference between urea, ESN, urea coated Nutrisphere for either conventional or no-till. Nitrogen rate was important and the optimum rate was 75 lb N/ac for both tillage types.
In Oklahoma in 2011, there was no difference between urea, ESN, urea coated Nutrisphere for either conventional or no-till. Nitrogen rate was important and the optimum rate was 75 lb N/ac for conventional-till and 100 lb N/ac for no-till.
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 yield during a 2-year trial in the Piedmont of NC, demonstrated that UAN at the same rate was better than Nitamin (UFP). Rate differed and the optimum rate was 95 lb N/acre.
Wheat yield during a 2-year trial in the Piedmont of NC, demonstrated that fertilizer source made no difference, except one year when ESN yielded less. Optimum nitrogen rate ranged between 95 and 145 lb N/ac, depending on the year.
Corn Results
Many nitrogen sources and some nitrogen rates, including poultry litter (PL) at 2 nitrogen rates, were tested in Alabama. Poultry litter is important in this region and frequently used by the farmers. The corn grain yield is shown as a relative yield to ammonium nitrate (120 lb N), which was the optimum rate. Yields of other products were not significantly better except urea, ammonium sulfate. Some sources produced significantly lower yields – ESN, poultry litter (both rates), CaCl2 only, and both forms of UAN applied at only 80 lb N. The data show that at the same N rates, all nitrogen fertilizer sources, except ESN and poultry litter yielded the same.
In 2010 in Arkansas, N rate was important – optimum rate was 180 lb N/ac and nitrogen source was significantly different with ESN yielding about 10 bu more per acre than urea.
The corn in New Mexico is irrigated. Since dairy production is important in this region, two rates of dairy waste were used: an amount that assume 35% availability and an amount that assume 60% availability. The only nitrogen source that performed differently was manure where the application rate was based on 35% nitrogen availability.
Irrigated corn in the piedmont had an optimum nitrogen rate of 175 lb N per acre. One year (2005) Nitamin performed less well than UAN. In the coastal plain, non-irrigated corn had an optimum N rate also of 175 lb N/ac and there was no difference between UAN and Nitamin.
Irrigated corn in the Piedmont had an optimum nitrogen rate of 145 lb N per acre and there was no difference between any of the nitrogen sources tested (UAN, ESN, UAN-Nutrisphere, UCAN). In the coastal plain, non-irrigated corn had an optimum N rate also of 185 lb N/ac and there was no difference between fertilizer sources.
There was no response to rate or source for corn produced in the Blacklands of Texas; however, yields were limited by extremely dry conditions.

<table>
<thead>
<tr>
<th>Nitrogen Rate (lbs/A)</th>
<th>Grain Yield‡ (bu/A)</th>
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<tbody>
<tr>
<td></td>
<td>UAN</td>
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<tr>
<td>0</td>
<td>74 ‡</td>
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<tr>
<td>50</td>
<td>76</td>
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<tr>
<td>75</td>
<td>86</td>
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<td>100</td>
<td>77</td>
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<td>125</td>
<td>85</td>
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‡ Yields corrected to 15.5% moisture.

Means within the UAN column and rows are not significantly different (P=0.05).
Cotton Yields
Many nitrogen sources, including poultry litter (PL) at 2 nitrogen rates, were tested. The cotton yield is shown as a relative yield to ammonium nitrate, which was the optimum rate. Yields of other products were not significantly better except products where only 40 lbs N/ac were applied – Nitamin 40, UAN 40, and UAN 40+Ca. In other words, there was no source difference but there was a rate difference.
In 2010 in Arkansas, N rate did not affect cotton yield, but ESN produced significantly greater cotton yields.
The cotton in New Mexico is irrigated and the only nitrogen source that performed very differently was Agrotain-urea applied at the same time. Urea applied at the same time performed as well as the other fertilizers, except the manure applied assuming a 35% availability coefficient.
There was no response to rate or source for cotton produced in the Blacklands of Texas; residual soil N levels were sufficient for optimum production. Slow release products and the N stabilizer (Agrotain) did not improve yields.
In the Blacklands region of Texas (Brazos River Valley), there was no response to 2 or 3 foliar applications of CoRoN made at first bloom and on 14-day intervals, compared to traditional soil applied fertilizer N (UAN) based on soil test.
Likewise, in the High Plains region of Texas (Lamesa), there was no response to foliar applications of CoRoN.
And similarly, there was no response to foliar CoRoN in the Trans Pecos region (St. Lawrence) of Texas.
In the Texas Blacklands, there was no response to Nfusion applied as 30:70 or 20:80 blends (Nfusion:UAN) compared to UAN alone.
Although micronaire varied based on nitrogen source and rate, other cotton lint quality factors were the same.
Grain Sorghum Yields
There was a response to N rate up to 60 lb N/ac, but no difference in sorghum yield due to nitrogen source in the Blacklands of Texas.
Many different alternative fertilizers or additives were part of this southern nitrogen fertilizer source and rate work. Nutrisphere, Nitamin, and Agrotain never worked better than the nitrogen fertilizers producers were using (e.g. UAN, urea). ESN performed consistently better on corn and cotton in Arkansas, but performed the same or less well as in Alabama (corn) and North Carolina (corn and wheat), and Oklahoma (wheat).

Taken together, these data show that alternative nitrogen fertilizer products rarely increase yield over traditional nitrogen fertilizer products.
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