# Nitrification Inhibitor Claims- Are They True?

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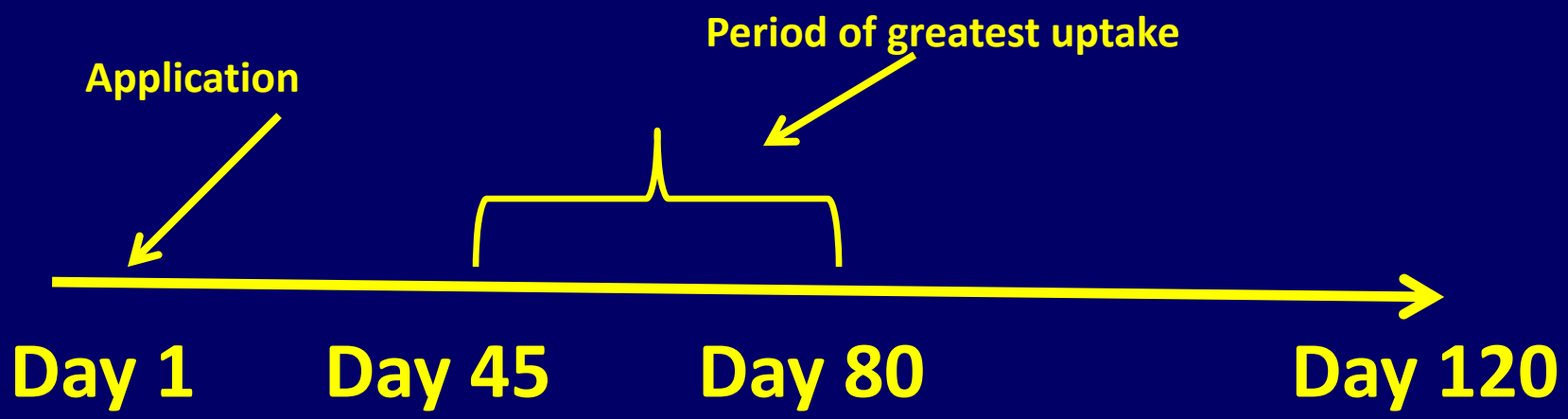
**Nitrification-**

**Ammonium N is transformed to nitrite (Nitrosomonous bacteria) then nitrate (Nitrobacter bacteria)**

**Nitrogen use efficiency-**

**Worldwide about 33% NUE**
**(Raun and Johnson, 1999)**

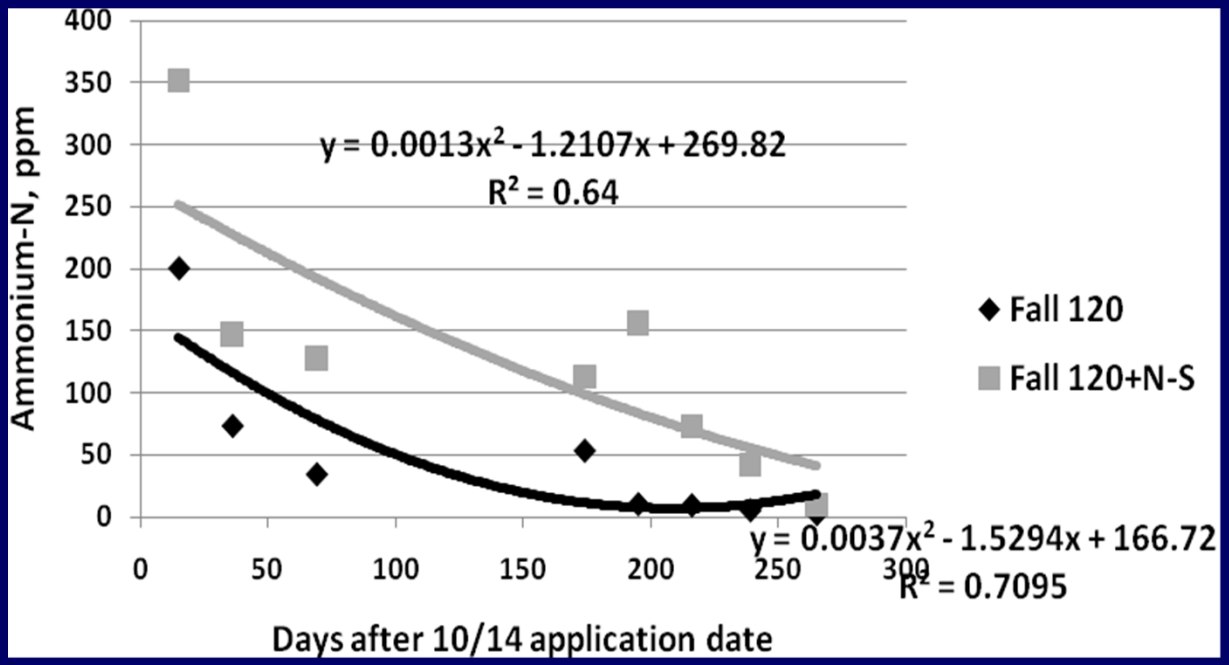
# Corn N timeline



**Nitrification inhibitors-**

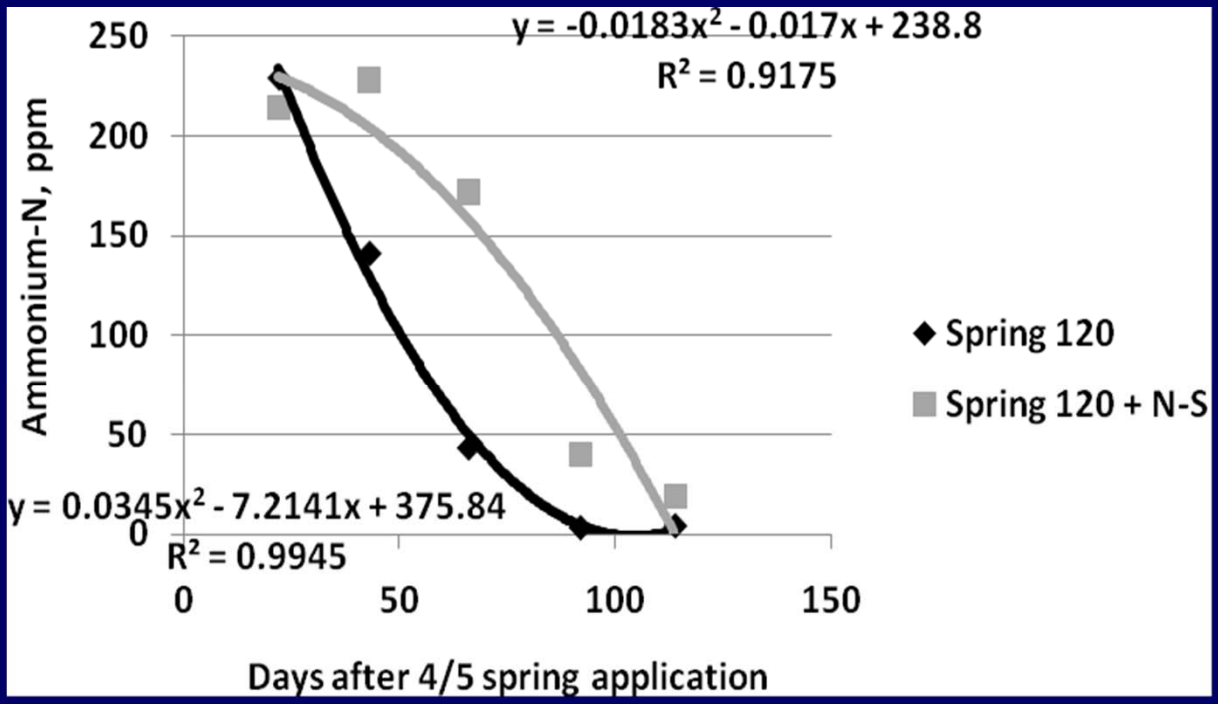
**N-Serve® /Instinct®**
**nitrapyrin (2-chloro-6-[trichloromethyl] pyridine)**

**DCD, dicyandiamide**




Fall N, Touchton et al., 1978

Spring N,Touchton et al., 1978



Some studies showed a yield increase with N-Serve, while others showed no yield increase. Yield increases were more a result of weather between application and N uptake rather than performance of the product.

Yield increases over the seven years in Minnesota were 15 bushels per acre more for fall anhydrous ammonia + N-Serve over fall anhydrous ammonia alone, and 27 bushels per acre more for spring anhydrous ammonia compared to fall anhydrous ammonia (Randall et al., 2008).

**Instinct® is a new formulation of Nitrapyrin that can be mixed with ammonium fertilizers and can stay on the soil surface without incorporation.**

**Research so far at Minnesota, Illinois, Iowa and Nebraska have shown little yield benefit to the use of Instinct over N fertilizer alone, although the product inhibits nitrification.**

**(Kentucky, Schwab, unpublished data)**

## DCD- a nitrification inhibitor

## Found in

AgrotainPlus (Agrotain, Int.)
SuperU (Agrotain, Int.)
Guardian DF (Conklin)
Guardian DL (Conklin)

| | DCD | | |
|---|---|---|---|
| | No. of comparisons | | |
| | Total | With significant advantage | Average response |
| | | | % |
| **Timing** | | | |
| Fall | 4 | 1 | +1.6 |
| Spring | 15 | 3 | +3.4 |
| Sidedress | 3 | 1 | +1.4 |
| **N Source** | | | |
| Ammonium sulfate | 2 | 0 | -1.0 |
| Anhydrous ammonia | 6 | 1 | +3.6 |
| Urea | 4 | 4 | +2.2 |

From Malzer et al., 1989

**Yield increases in potato with DCD were more consistently achieved with potato in the Malzer survey.**

## Nitrification and urease inhibitors

Ammonium thiosulfate

Nutrisphere®

**ATS has nitrification inhibiting properties.**
**It is not as effective generally as nitrapyrin and DCD,**

**ATS is most effective as a nitrification inhibitor at concentrations of 25 ppm S. (0.1% ATS)**

**Under warm conditions (>60$^{o}$ F), mineralization is complete in a week.**
**Under cooler temperatures, mineralization is slower; about 3 weeks.**

**In a fall application of aqua ammonia with ATS compared with nitrapyrin, similar ammonia concentration was found in the spring with the two products (Goos and Johnson, 1999.)**

**ATS affects the both steps of nitrification- ammonium to nitrate and nitrite to nitrate.**

**Higher than recommended concentrations of ATS can result in an accumulation of nitrite. Studies that used the recommended concentration of ATS did not see an accumulation of nitrite.**

**Nutrisphere,**
**SFP Specialty Products, LLC, Leawood, KS**

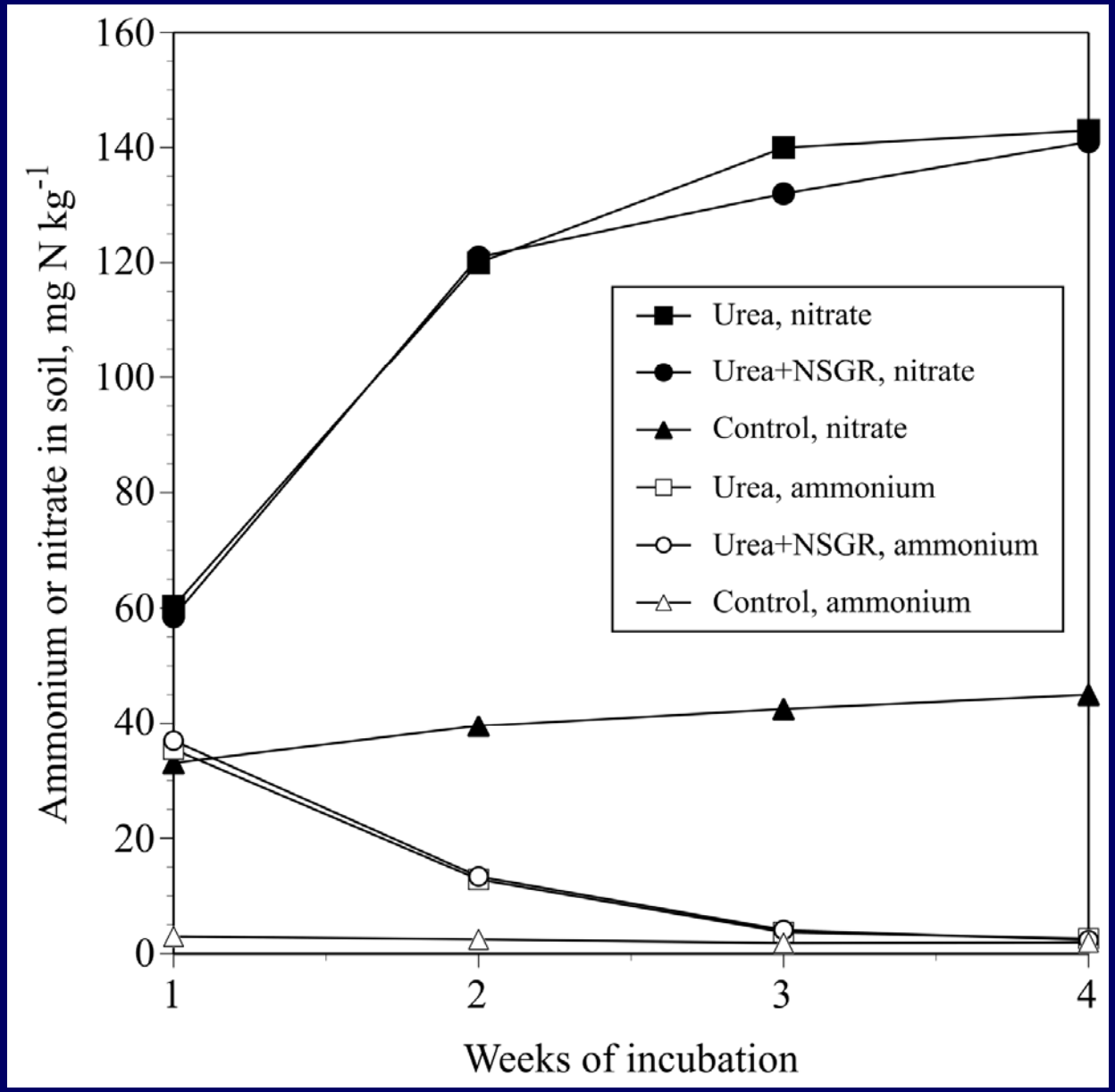
**Formulation for dry fertilizer-**
**30-60% maleic-itoconic copolymer,**
**pH 2.5-5**

**Formulation for liquid fertilizer-**
**40% maleic-itoconic copolymer, pH 1-2**

**Product literature states that nitrification inhibition is based on product ability to tie-up copper- a critical metal used by nitrification bacteria.**

**Effects of N additive, averaged over source (UAN and urea) and N rate on corn grain yield, earleaf-N and grain-N, Scandia, KS (2-year average).** From Gordon, 2008.

| Treatment | Yield, bu/acre | Earleaf N, % | Grain N, % |
|---|---|---|---|
| Check | 152 | 1.72 | 1.13 |
| Urea/UAN | 168 | 2.57 | 1.26 |
| ESN | 185 | 2.96 | 1.33 |
| Nutrisphere-N | 183 | 2.96 | 1.35 |
| Agrotain | 183 | 2.98 | 1.36 |
| LSD 5% | 6 | 0.09 | 0.04 |




**(Research by R.J. Goos, in Franzen et al., J. Plant Nut 2011)**

# More recent laboratory studies by Dr. Goos

## Objective of these studies

- To compare several new fertilizer additives to older products
- New additives: Nutrisphere-N, StayN, N-Zone, NStay, OAC+
- Older products: Nitrapyrin, DCD, ATS, CaTS, NBPT

- Paper by Goos, 2012 Great Plains Soil Fertility Proceedings

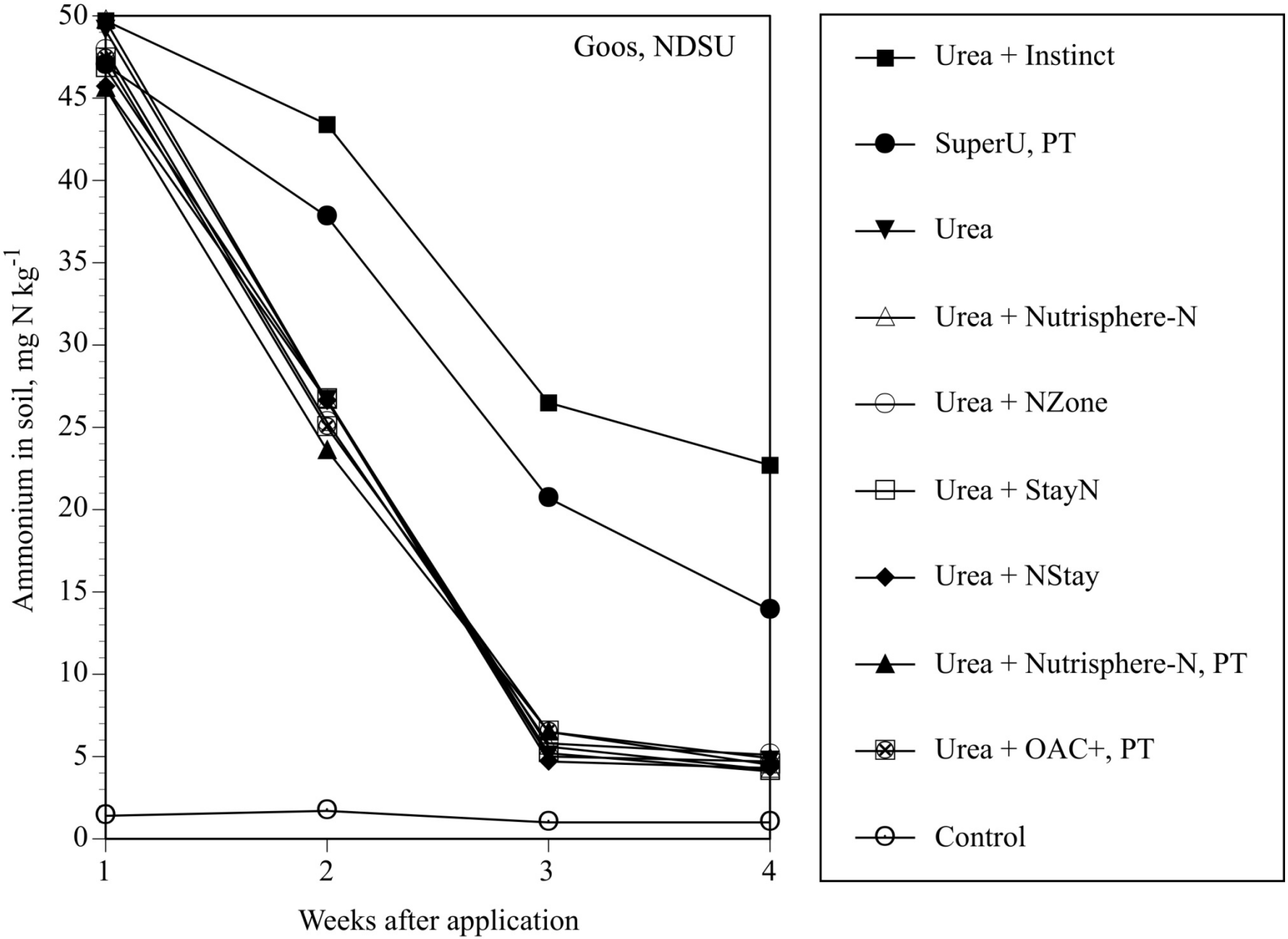
# Nitrification studies

- Urea granules incubated with soil with minimal water movement
- Residual ammonium determined after 1, 2, 3, and 4 weeks

Goos, 2012


Goos, 2012

Goos, 2012


Goos, NDSU
Ammonium in soil, mg N kg-1
Weeks after application
0
5
10
15
20
25
30
35
40
45
50
1
2
3
4
Urea + Instinct
SuperU, PT
Urea
Urea + Nutrisphere-N
Urea + NZone
Urea + StayN
Urea + NStay
Urea + Nutrisphere-N, PT
Urea + OAC+, PT
Control

Goos, 2012

# Conclusions...

- None of the new products worked as well as the “old” products
- These reactions are hard to control, so if you need an inhibitor, use the most effective ones available

Goos, 2012

Laboratory studies clearly show that Nutrisphere has no nitrification or urease inhibiting properties. What is most curious is why some studies show some response.

| | No Response | Positive |
|---|---|---|
| North Dakota | 10 | 0 |
| Kansas | 7 | 5 (4 at Scandia) |
| Minnesota | 2 | 0 |
| Illinois | 3 | 1 |
| Arkansas/Mississippi | 3 | 0 |

Idaho work on barley showed a yield increase, but no increase in N uptake. No yield increase in wheat

**One possible reason for the yield increase is the pH of the product, particularly with the liquid formulation. Acid pH lowers the rate of nitrification. Perhaps it is not the Nutrisphere that is active. Perhaps it is its acidity?**

## SUMMARY-

Nitrapyrin and DCD are proven nitrification inhibitors. Their use is limited due to the inability to predict when they would be economically beneficial. Growers tend to use these products to push their timing and spread work loads, rather than use them to improve overall N use efficiency

## SUMMARY-

Ammonium thiosulfate is a limited use nitrification inhibitor due to the rate of mineralization of the fertilizer. It may be of some value if used at the correct rate, but other products appear to be more consistent in their activity.

## SUMMARY-

Nutrisphere has no nitrification inhibition properties and should not be used for this purpose.

## SUMMARY-

N-Zone has no nitrification properties and is not labeled as a urease inhibitor.

N-Stay and Stay-N were tested as nitrification inhibitors.

The results of careful laboratory experiments did not support their use for this purpose.