

Fertilizer Nitrogen Management in No-Till Cotton: Maximizing Your Investment

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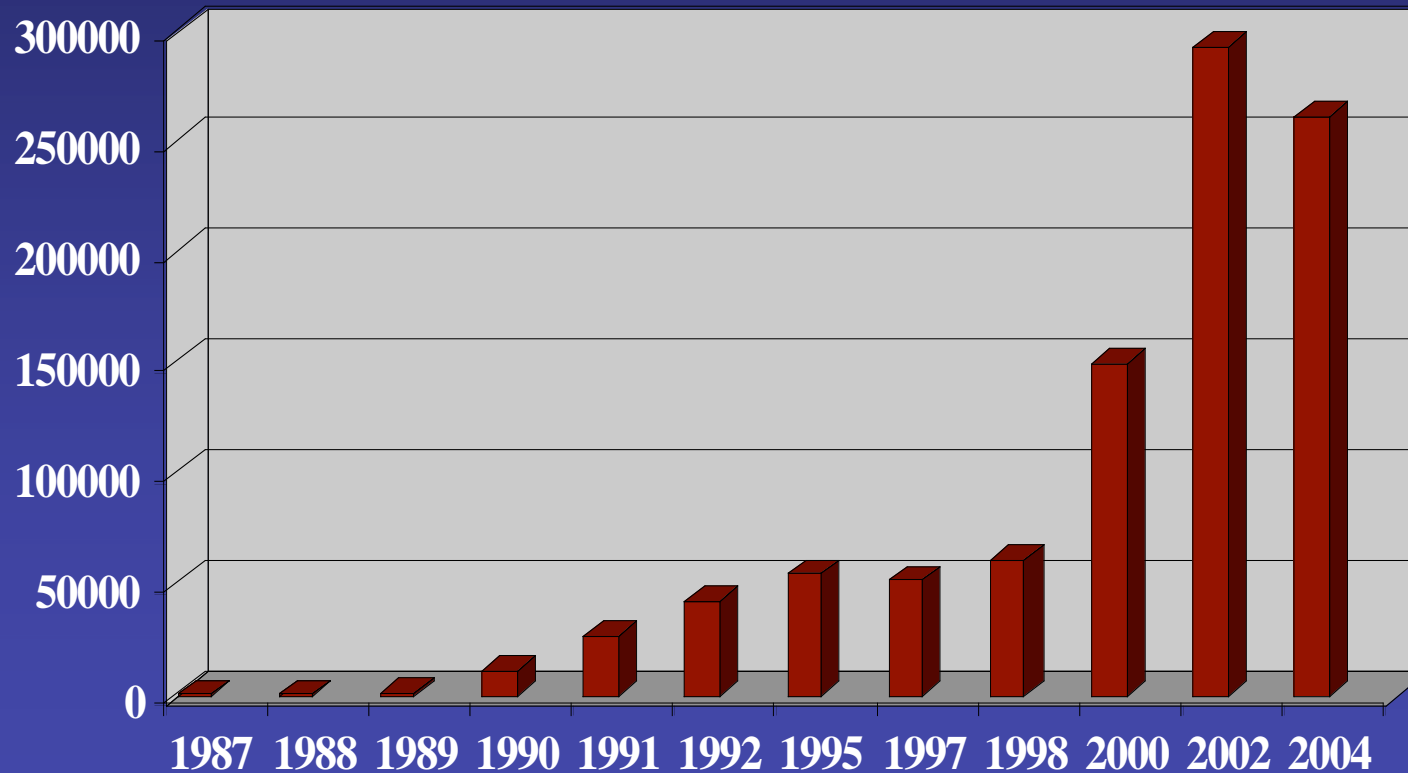
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INTRODUCTION

Findings from a 10-y study in Miss. (Parvin et al., 2003):

- AN highly profitable (NR=\$92.03/acre) due to high yield (1143 lb/acre) achieved at a lower rate of N (80 lb/acre).
- Subsurface banded UAN efficient (40 lb/acre), but lower profit (NR=\$51.31) due to lower yield (1040 lb/acre).
- Surface dribbled UAN profitable (NR=\$71.98) at a higher rate of N (120 lb/acre) and slightly lower yield (1102 lb/acre).
- Urea most profitable (NR=\$106.28) at a high rate of N (160 lb/acre) and the greatest yield (1186 lb/acre).

- Current trends:
 - Decreasing availability of ammonium nitrate to growers
 - Increasing fertilizer N prices
 - Increased acreage of no-till cotton in Miss.



Research results:

- decreased NH_3 loss with urease inhibitor (Beyrouy et al., 1988)
- N losses up to 30% of surface applied urea (Beyrouy et al., 1988)
- [N-(n-butyl)] thiophosphoric triamide (NBPT) is an effective urease inhibitor (Bremner et al., 1991)
- NBPT treated urea increased N-use-efficiency for rice (Aly et al., 2001)

N Fertilizer Use in MS

(Nutrient short tons, 2004)

- Ammonium nitrate 20,089
- Nitrogen solutions (UAN) 57,119
- Urea 31,867

Price/lb N

- AN (34%) \$0.37
- UAN (32%) \$0.38
- Urea (46%) \$0.40

Average N rate, MS 2005 =120 lb/ac

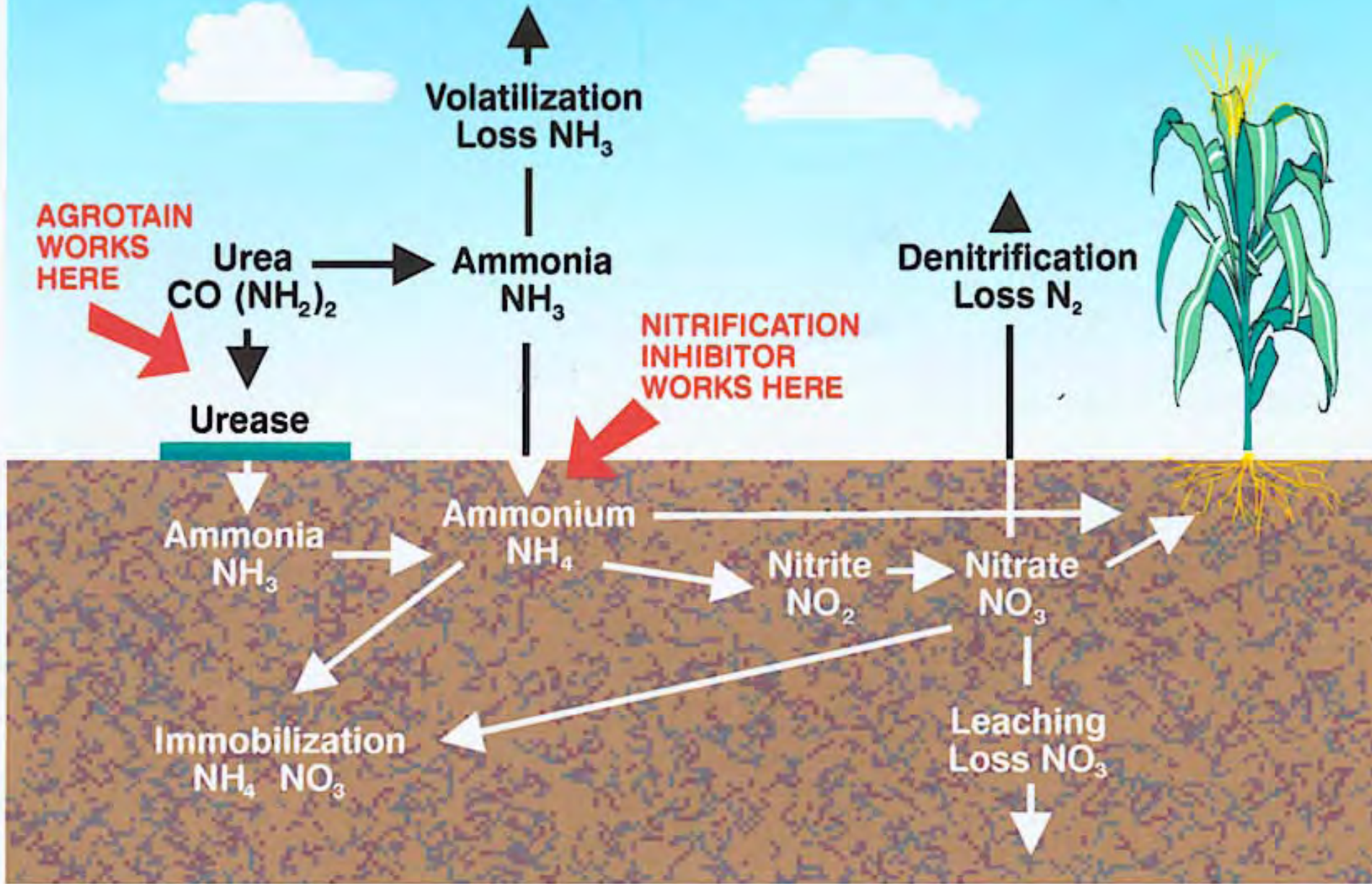
Urea Hydrolysis

Increased potential for NH_3 volatilization
w/no-till due to greater urease activity on crop
residues



Urease enzyme is a catalyst for hydrolysis reaction

NITROGEN CYCLE



OBJECTIVES

1. Determine effects of fertilizer N source and placement on N-use-efficiency by no-till cotton
2. Determine effects of a urease inhibitor (UI) on N-use-efficiency of urea N-sources by no-till cotton

METHODS

- General
 - No-till
 - N rate 120 lb/acre, split 50% @planting and early square
 - ^{15}N enriched fertilizer @ $\cong 1.4\%$
 - Varieties: ST 4892 BR (2005), DP 445 BR (2006)
 - Urease inhibitor in Agrotain® [N-(n-butyl)] thiophosphoric triamide or NBPT
 - Marietta fine sandy loam, pH = 7.8
 - Automated rainfall data collection

- Treatments
 - No N check
 - Ammonium nitrate (AN) broadcast
 - Urea broadcast
 - Urea w/Agrotain broadcast
 - UAN subsurface banded
 - UAN dribbled
 - UAN w/Agrotain dribbled
- Randomized complete block, four replications



Urea, AN, and urea treated with Agrotain broadcast within microplots using a pump type sprayer, 5.25 X 6.56 ft microplots, harvested 3.23 ft of center row @ 1st open boll

UAN subsurface banded, UAN dribbled, and UAN w/Agrotain dribbled were applied 8" from drill using a 2 oz syringe



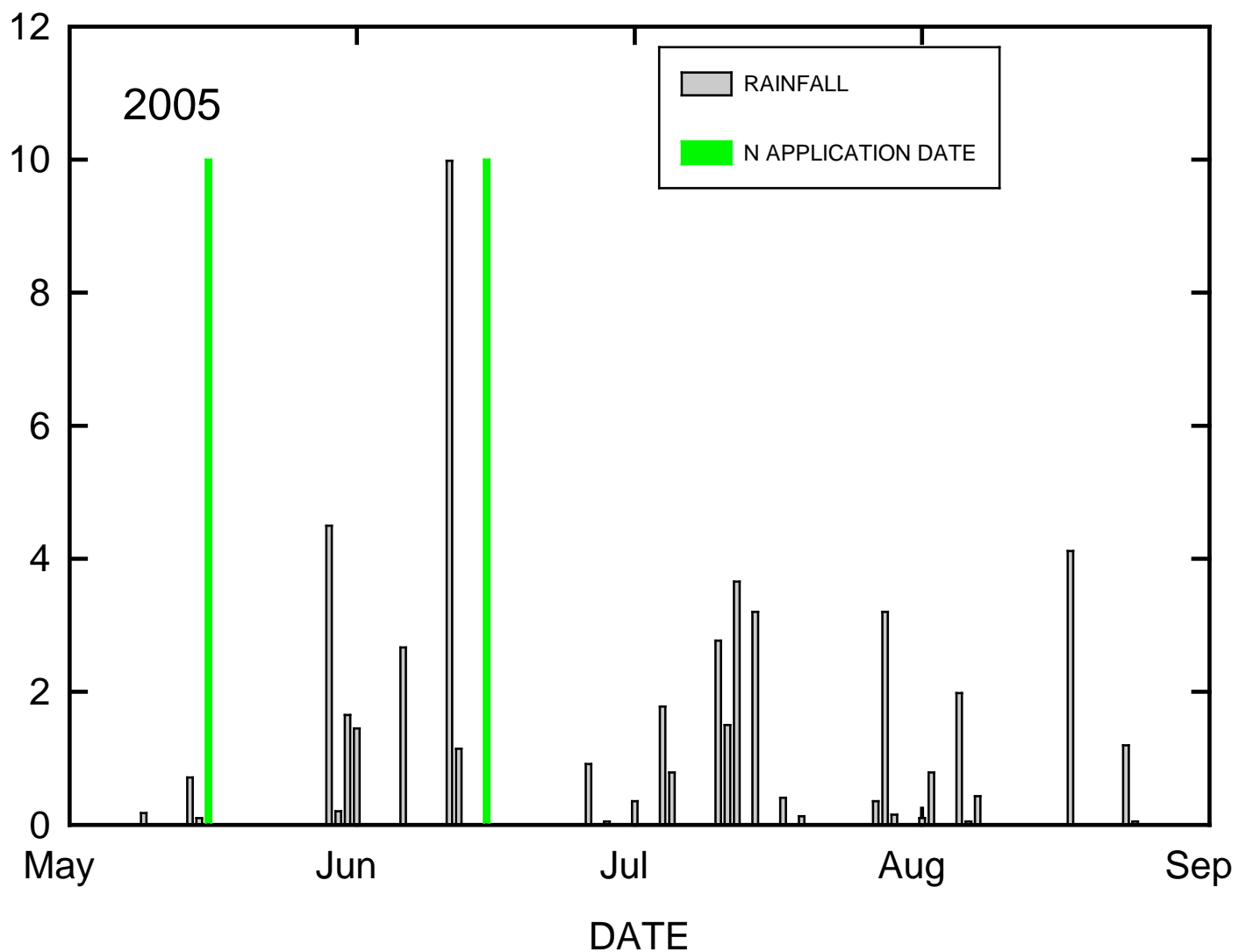
Screens placed under rows to collect residues



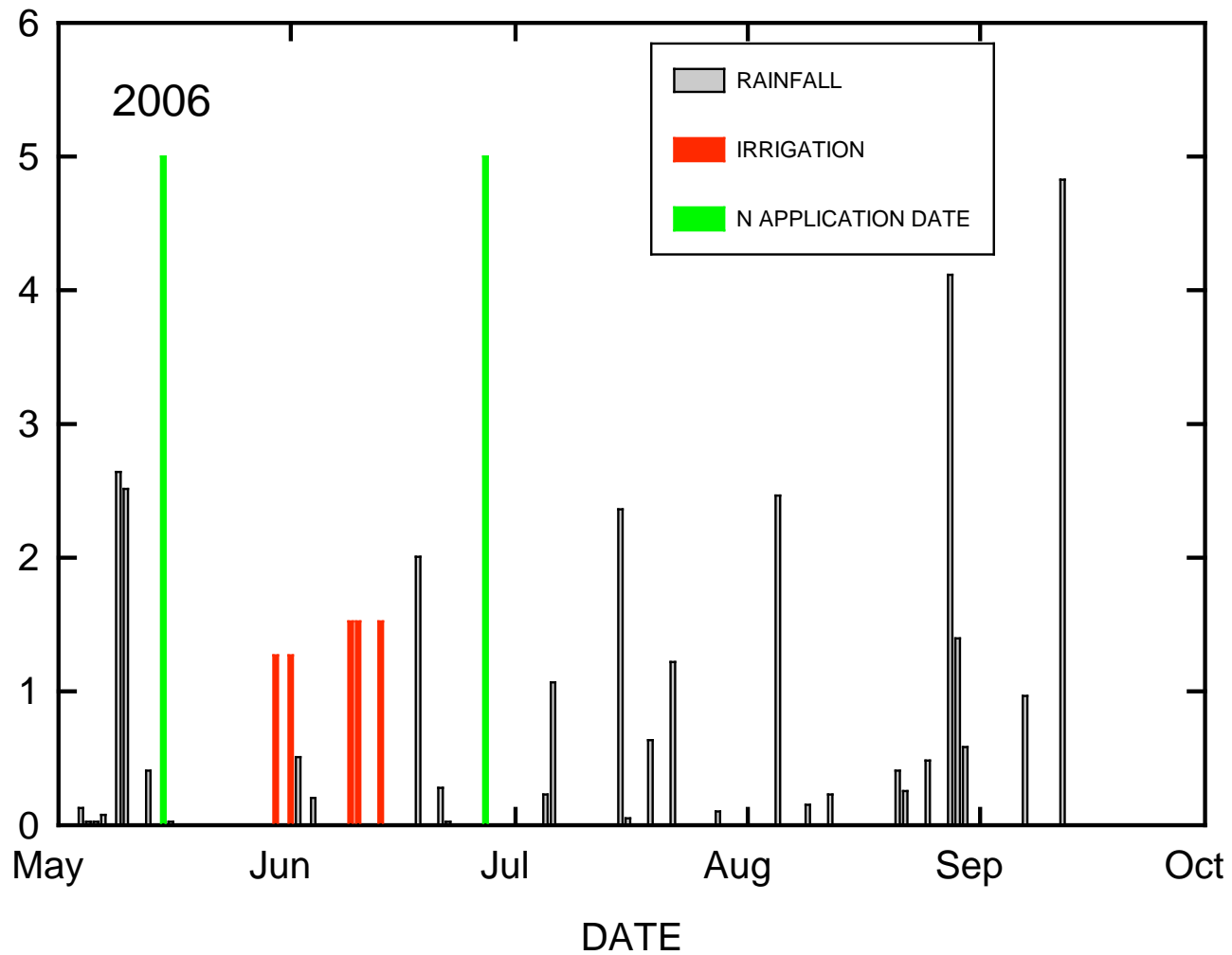
Elemental and isotope analysis were determined w/an automated C/N analyzer coupled to a mass spectrometer



Rainfall/Fertilization 2005



Rainfall/Irrigation/Fertilization 2006



Cotton N Content Response

Treatment	Total N content, lb/acre		
	2005	2006	2-y ave.
No N check	62	96	79
Ammonium nitrate	88	151	120
Urea	69	121	95
Urea w/Agrotain	100	134	117
UAN banded	120	135	128
UAN surface dribbled	111	117	114
UAN dribbled w/Agrotain	136	144	140
LSD _{0.05}	22.4	27.5	17.8

% N Derived From Fertilizer Response

Treatment	N derived from fertilizer, %		
	2005	2006	2-y ave.
Ammonium nitrate	39.6	29.9	35
Urea	19.3	24.8	22
Urea w/Agrotain	34.3	28.2	31
UAN banded	45.8	35.8	41
UAN surface dribbled	46.4	27.9	37
UAN dribbled w/Agrotain	45.4	30.6	38
LSD _{0.05}	4.5	5.1	3.3

Fertilizer N Recovery Response

Treatment	Fertilizer ¹⁵ N recovery, %		
	2005	2006	2-y ave.
Ammonium nitrate	28.1	43.0	35.6
Urea	11.1	29.6	20.4
Urea w/Agrotain	28.7	36.1	32.4
UAN banded	46.2	48.2	47.2
UAN surface dribbled	43.5	34.8	39.2
UAN dribbled w/Agrotain	49.9	43.8	46.9
LSD _{0.05}	10.2	9.1	5.9

Price of Agrotain®

- \$45/gal
- 1 gallon treats 1 ton dry urea
- 2.3 quarts treats 1 ton UAN 32%
- Price of urea w/Agrotain /lb N \$0.45
- Price of UAN 32% w/Agrotain /lb N \$0.42
- Price of AN \$0.37

Cost Benefit at 120 lb N/acre

Urea

- \$48.00/acre w/o Agrotain
- \$54.00/acre w/Agrotain
- 22 lb N/acre increase in efficiency
@ \$0.40/lb urea N = \$8.80/acre
= \$2.80/acre cost benefit

UAN 32%

- \$45.60/acre w/o Agrotain
- \$50.40/acre w/Agrotain
- 26 lb N/acre increase in efficiency
@ \$0.38/lb UAN N = \$9.88/acre
= \$5.08/acre cost benefit

CONCLUSIONS

1. Agrotain treated urea improved no-till cotton N use efficiency comparable to AN
2. UAN treated with Agrotain improved N use efficiency when surface dribbled and was as effective as soil incorporated UAN

When to use a urease inhibitor?

- Conditions for NH_3 volatilization
 - no-till
 - temperatures above 65°F
 - high organic matter/surface residues
 - high humidity
 - surface applied urea
 - alkaline soil pH