Summary of Current University of Tennessee Institute of Agriculture Research Evaluating Urea-Nitrogen-Fertilizer Additives or Coatings

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INTRODUCTION

Loss of nitrogen through ammonia volatilization (escaping of ammonia gas into the atmosphere) has been of concern to growers for some time. The problem is primarily associated with the use of urea as a nitrogen source in conservation tillage systems where urea-containing fertilizer materials are broadcast or banded onto the soil surface and **not quickly** incorporated by tillage, rainfall or irrigation.

Urea nitrogen when applied to a soil is hydrolyzed by the urease enzyme (urea amidohydrolase) and converted first to ammonium carbonate [$(NH_4)CO_3$] and then to ammonia gas (NH3). Urease is everywhere in the environment and can be found in soils, manures, on plants and plant residues. Within the soil, this ammonia gas becomes the ammonium cation through a reaction with the soil water and is held onto the soil cation exchange complex instead of being lost.

Four factors of major importance when considering potential for nitrogen volatilization are **temperature, soil pH, soil moisture and nitrogen rate.** In general — for a moist soil — as soil temperature, soil pH and nitrogen rate increase, losses of nitrogen as ammonia gas increase from surface applied non-incorporated urea-containing-fertilizers. This fact sheet briefly summarizes the results of current University of Tennessee field research evaluating the effects of urea-nitrogen fertilizer treated with various chemical additives or coatings on corn grain yield. These yields were compared to yields obtained with ammonium nitrate (no nitrogen volatilization loss expected) and untreated urea (highest volatilization loss of nitrogen expected).

RESEARCH DETAILS

Some initial work was completed in 2011 and after 2012, more studies were conducted at two locations each year as shown in Table 1 (2011 site included).

Table 1. Locations and Soil Types for Tennessee Nitrogen Fertilizer Additive/Coating Studies 2011-2015					
West TN Region			Middle TN Region		
Year	Location	Soil Type	Year	Location	Soil Type
2011	Milan	Loring silt loam	2011	No study	No study
2013	Milan	Loring/Henry silt loam	2013	Springfield	Hamblen silt loam
2014	Jackson	Memphis/Loring silt loam	2014	Springfield	Staser silt loam
2015	Jackson	Memphis silt loam	2015	Springfield	Hamblen silt loam

The studies were set up in an experimental design so that yield and other results could be evaluated using commonly accepted statistical procedures. Corn was planted in six row plots that were 30 feet long, and the middle two rows of each plot were harvested for yield determinations. Generally at planting we tried to achieve a plant population of about 32,000 per acre.

Lower nitrogen rates of 110 and 150 pounds of nitrogen per acre were used to better ensure the separation of products that may not have any effect in reducing volatilization. The nitrogen fertilizers and additives/coatings evaluated are shown in Table 2. Products were applied to the urea as suggested on the product label. Product effects on yield were looked at over the combined nitrogen fertilizer rates for each product.

Table 2. Nitrogen Fertilizers and Additives/Coatings Used in This Study		
Fertilizer	Stabilizer active ingredient	Stabilizer trade name
Ammonium nitrate	NA	NA
Urea	untreated	NA
Urea	NBTP*	Agrotain (20%)
Urea	NBTP*	Agrotain (26.7%)
Urea	Ca salt of Maleic polymer (CSMP)	Nutrisphere-N (30-40%)
Polymer coated urea (ESN)	Semipermeable Polymer coating of the urea granule	Environmentally Smart Nitrogen (ESN) (44-0-0)

*N butyl thiophosphoric triamide

YIELD RESULTS

Yield results for all seven site years are shown in Table 3. Ammonium nitrate appears to be the best product for avoiding volatilization loss of nitrogen in these no-till corn systems studied. The NBTP products and ESN also give better results than untreated urea but not always as good as ammonium nitrate.

Table 3. Average Corn Yield Results (bushels per acre) by Product Used, Location and Year

Product used	West Tennessee Locations					Middle Tennessee Locations			
	2011	2013	2014	2015		2011	2013	2014	2015
1. Ammonium nitrate	176* a	198 a	207 a	163 a		NA	206 a	212 ab	204 a
2. Untreated Urea	149 b	126 d	147 c	111 d		NA	143 d	223 a	144 c
3. Nutrisphere Urea	149 b	134 d	152 c	121 c		NA	159 cd	211 ab	143 c
4. Agrotain (20%) Urea	175 a	159 c	170 b	140 b		NA	202 ab	224 a	172 b
5. Agrotain ultra (24%) Urea	NA	170 bc	166 b	138 b		NA	180 bc	217 ab	163 b
6. Environmentally Smart Nitrogen (polymer coated Urea)	NA	178 b	175 b	147 b		NA	179 bc	198 b	165 b

* Numbers followed by the same letter are not significantly different $P \leq 0.05$

NA No data obtained

SUMMARY OF RESULTS

Evaluation of corn grain yield at each site for seven site years produced the following summary results:

- Ammonium nitrate use resulted in the highest corn grain yields in seven of seven site years.
- Untreated Urea use gave the lowest corn grain yields in six of seven site years.
- Ca salt treated Urea product (Nutrisphere) resulted in corn grain yields similar to untreated Urea corn grain yields for all seven site years.
- NBPT product (Agrotain 20 percent) equaled Ammonium nitrate three of seven site years and exceeded untreated Urea for six of those seven site years. Agrotain ultra (26.7 percent) performed similarly to Agrotain (20 percent).
- Polymer coated urea (ESN or Environmentally Smart Nitrogen) yields equaled Ammonium nitrate one out of six site years, equaled NBTP products six of six site years and exceeded untreated Urea yields five of six site years. ESN was not included in the test conducted in 2011.

FURTHER INFORMATION

An excellent source of additional information can be found in the Arkansas Extension publication FSA2169 “Nitrogen Fertilizer Additives.” This publication can be read online or printed from the following link: pubs.uaex.edu/PubsWebPublic.asp.

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