

PROGRESS REPORT FOR 2009 FIELD SEASON

Title: Can Arkansas Corn Growers Increase their Profit Margin by Using Agrotain?

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BACKGROUND INFORMATION

This project evaluated the potential of a synthetic urease inhibitor (Agrotain) for reducing N losses (ammonia volatilization) from the surface applied urea. The 2009 was the third and last year of the study. Field studies were conducted to evaluate the effect of urea and urea treated with Agrotain on corn grain yield, leaf N concentration, and grain N uptake.

PROCEDURES

Similar to the previous years replicated field experiments were conducted at five locations on soils commonly used for corn production in Arkansas. Two sites were located on commercial farms in Clay (CLZ91) and Jackson (JAZ91) County. The other three sites were located on University of Arkansas Agricultural Experiment Station Research Stations in Desha (DEZ91), Lee (LEZ91), and Mississippi (MSZ91) county. Information on previous crop, corn cultivar, and agronomically important dates are listed in Table 1.

Soil samples were collected from the 0- to 6-inch depth at each site and composited by replicate prior to planting and fertilization. Soil samples were processed and analyzed by standard methods of the University of Arkansas Soil Testing and Research Laboratory in Marianna Arkansas. When needed P, K, S, and Zn fertilizers were applied to each site following University of Arkansas Cooperative Extension Service soil-test recommendations for corn. All sites were irrigated and irrigation timing was managed by the cooperating growers or using the University of Arkansas Cooperative Extension Service Irrigation Scheduler program at AES sites.

Experimental plots were 25-ft long and 4-rows wide. The experimental treatments were arranged as a randomized complete block. Each treatment was replicated four to five times.

Urea or urea plus Agrotain each were applied at five total N rates of 60, 120, 180, 240, and 300 lb N/acre. A control of 0 N (no N fertilizer) was also included. The first 30 lb N/acre increment of N was applied before planting and the balance of each total-N rate was sidedressed onto soil surface by hand as urea only or urea treated with Agrotain when plants were at the 5-to 9-leaf stage (Table 2).

When corn was at mid-silk stage, ear-leaf samples were collected from 15 plants/plot, dried in the oven at 70 C to constant weight, and ground to pass through a 60-mesh sieve. Corn ear-leaf samples were analyzed for total N by Kjeldahl method. At the AES sites, the two center rows of each plot were harvested with a plot combine. At commercial farm sites, two 12.5-ft long sections from each one of the two center rows (a total of 25 ft/plot) were hand harvested. At harvest grain subsamples were collected and analyzed for total N as described above. Grain N uptake was calculated by multiplying grain yield by N concentration.

Analysis of variance was performed using the GLM procedure of SAS. Sites were analyzed separately. Mean separations were performed by the Waller Duncan minimum significant difference test at significance levels of 0.10.

2009 RESULTS

In the 0-to 6-inch depth the soil texture ranged from sandy loam to clay (10-46% clay), soil pH ranged from 6.1 to 7.2, and preplant soil NO₃-N ranged from 7 to 16 ppm (Table 2). Grain yield of the corn fertilized with N was significantly ($P \leq 0.0705$) higher than non-fertilized corn at all sites (Table 3). Grain yield of non fertilized corn ranged from 6 to 96 bu/acre and yield of corn fertilized with N ranged from 43 to 209 bu/acre. There was a trend of increasing grain yield with increasing N application rate.

Application of 180 to 300 lb N/acre produced maximum grain yields. Grain yield of corn fertilized with urea treated Agrotain was numerically higher than the grain yield of corn treated with urea only. At two sites, CLZ91 and MSZ91, the Grain yield of corn fertilized with 120 lb N/acre from urea-treated Agrotain was significantly ($P = 0.10$) higher than corn fertilized with 120 lb N/acre from urea alone. Grain yield of corn fertilized with 300 lb N/acre of urea treated Agrotain was significantly ($P = 0.10$) higher than corn that received the same amount of N from urea alone at LEZ91 and MSZ91.

Nitrogen concentration in the ear-leaf of corn treated with any N was significantly higher than corn that did not receive any N (Table 4). Concentrations of N in the ear leaf of the non-fertilized corn ranged from 1.24 to 1.83% and concentration of N in the ear-leaf of corn fertilized with N ranged from 1.62 to 3.46%. Concentrations of N in corn ear-leaf increased with increasing N application rate. Similar to the grain yield, N concentrations in the ear-leaf of plants fertilized with Agrotain treated urea were numerically higher than corn fertilized with urea alone. At LEZ91 and when 120 lb of total N was applied the concentrations of the N in the ear-leaf of plants fertilized with urea plus Agrotain was significantly higher than corn fertilized with urea.

The trend in grain N uptake were similar to that of the grain yield and generally increased with increasing N application rate (Table 5).

Table 1. Selected agronomic information for corn N-fertilization experiments conducted at Agricultural Experiment Stations and commercial fields in Arkansas during 2009

| Site ID | Previous crop | Cultivar | Planting dates | | Harvest date | | |
|---------|---------------|--------------|----------------|----------|--------------|---------|--------|
| | | | N application | dates | 1st | 2nd | |
| CLZ91 | soybean | | DKC-6479 | 22-April | 20-May | 12-June | |
| DEZ91 | corn | Stine-9806 | | 4-April | 23-April | 26-June | 25-Sep |
| JAZ91 | - | - | | 19-May | 9-June | 28-Sep | |
| LEZ91 | corn | 10289464_CBX | | 25-April | 1-June | 25-June | 9-Nov |
| MSZ91 | corn | DKC-6723 | | 19-May | 8-June | 29-June | 19-Oct |

a Seedling emergence occurred 7-10 days after planting

Table 2. Selected soil chemical property means (0 -to 6-inch depth) of samples taken before planting the corn – fertilization trials conducted at Agricultural Experiment Stations and commercial fields in Arkansas during 2009.

| Site ID | Soil pH a | Soil NO ₃ -N b | | | | Mehlich-3-extractable nutrients | | | | | |
|---------|------------|---------------------------|-------------------|-----|------|---------------------------------|-----|-----|------|------|----|
| | | P | K | Ca | Mg | Mn | Cu | Zn | Sand | Silt | |
| | Clay | Texture | ----- (ppm) ----- | | | | | | | | |
| ----- | ----- | (%) ----- | | | | | | | | | |
| CLZ91 | 6.2 | 16 | 31 | 68 | 906 | 184 | 258 | 0.8 | 15.2 | 3 | |
| 81 | 16 | Silt Loam | | | | | | | | | |
| DEZ91 | 6.8 | 8 | 38 | 97 | 768 | 132 | 120 | 1.0 | 4.0 | 32 | |
| 52 | 15 | Silt Loam | | | | | | | | | |
| JAZ91 | 6.1 | 5 | 93 | 116 | 527 | 72 | 174 | 0.5 | 7.1 | 76 | 15 |
| 10 | Sandy Loam | | | | | | | | | | |
| LEZ91 | 7.2 | 11 | 54 | 205 | 1786 | 371 | 103 | 1.9 | 5.0 | - | - |
| - | | | | | | | | | | | |
| MSZ91 | 7.1 | 7 | 55 | 308 | 3472 | 683 | 47 | 4.9 | 10.6 | 31 | |
| 23 | 46 | Clay | | | | | | | | | |

a Soil pH was measured in a 1:2 (weight:volume) soil-water mixture.

b NO₃-N measured by ion-specific electrode.

Table 3. Effect of N-fertilizer source (urea and urea plus Agrotain) and rates on corn grain yield in five trials conducted at Agricultural Experiment Stations and commercial farms in Arkansas during 2009.

| N source | N-rate | CLZ91 | DEZ91 | JAZ91 | LEZ91 | MSZ91 | Grain Yield (bu/acre) | | |
|-----------------|---------|---------|---------|--------|---------|-------|-----------------------|-------|--|
| -- (lb/acre) -- | | ----- | | | | | | ----- | |
| None | 0 | 96 | 83 | 94 | 34 | 6 | | | |
| Urea | 60 | 149 | 107 | 134 | 68 | 43 | | | |
| Urea + Agrotain | 60 | 151 | 113 | 132 | 91 | 54 | | | |
| Urea | 120 | 176 | 137 | 140 | 121 | 54 | | | |
| Urea + Agrotain | 120 | 202 | 139 | 145 | 140 | 103 | | | |
| Urea | 180 | 189 | 149 | 148 | 132 | 117 | | | |
| Urea + Agrotain | 180 | 205 | 154 | 159 | 147 | 115 | | | |
| Urea | 240 | 204 | 162 | 137 | 118 | 124 | | | |
| Urea + Agrotain | 240 | 210 | 156 | 154 | 127 | 140 | | | |
| Urea | 300 | 202 | 161 | - | 137 | 133 | | | |
| Urea + Agrotain | 300 | 209 | 166 | - | 165 | 151 | | | |
| P value | | <0.0001 | <0.0001 | 0.0705 | <0.0001 | | | | |
| | <0.0001 | | | | | | | | |
| MSD a | | 20 | 16 | 37 | 22 | 17 | | | |

a, Minimum significant difference at P=0.10 as determined by Waller-Duncan test

Table 4. Effect of N-fertilizer source (urea and urea plus Agrotain) and rates on corn ear-leaf N concentration at early silk stage in five trials conducted at Agricultural Experiment Stations and commercial farms in Arkansas during 2009.

| N source | N-rate --(lb/acre) -- | Ear leaf N(%) ----- | | | | |
|-----------------|--------------------------|---------------------|---------|---------|---------|--|
| | | CLZ91 | DEZ91 | LEZ91 | MSZ91 | |
| None | 0 | 1.87 | 1.83 | 1.73 | 1.24 | |
| Urea | 60 | 2.37 | 2.22 | 1.84 | 1.62 | |
| Urea + Agrotain | 60 | 2.58 | 2.31 | 2.13 | 1.68 | |
| Urea | 120 | 2.84 | 2.57 | 2.52 | 2.27 | |
| Urea + Agrotain | 120 | 3.04 | 2.73 | 2.66 | 2.73 | |
| Urea | 180 | 2.90 | 2.74 | 2.35 | 3.00 | |
| Urea + Agrotain | 180 | 3.23 | 2.89 | 2.86 | 2.84 | |
| Urea | 240 | 3.03 | 2.75 | 2.79 | 3.14 | |
| Urea + Agrotain | 240 | 3.00 | 2.81 | 2.61 | 3.14 | |
| Urea | 300 | 3.32 | 2.67 | 2.75 | 3.25 | |
| Urea + Agrotain | 300 | 3.53 | 2.92 | 2.72 | 3.46 | |
| P value | | <0.0001 | <0.0001 | <0.0001 | <0.0001 | |
| MSD a | | 0.33 | 0.23 | 0.32 | 0.27 | |

a, Minimum significant difference at P=0.10 as determined by Waller-Duncan test

Table 5. Effect of N-fertilizer source (urea and urea plus Agrotain) and rates on nitrogen (N) uptake by corn grain in trials conducted at Agricultural Experiment Stations and commercial farms in Arkansas during 2009.

| N source | N-rate | CLZ91 | DEZ91 | JAZ91 | MSZ91 | Grain N uptake (lb/acre) | |
|-----------------|--------|-------|---------|---------|--------|--------------------------|--|
| --(lb/acre) -- | | ----- | | | | | |
| None | 0 | 56 | 60 | 73 | 6 | | |
| Urea | 60 | 98 | 67 | 104 | 23 | | |
| Urea + Agrotain | | 60 | 94 | 81 | 101 | 31 | |
| Urea | 120 | 118 | 101 | 123 | 28 | | |
| Urea + Agrotain | | 120 | 149 | 104 | 126 | 59 | |
| Urea | 180 | 153 | 109 | 130 | 70 | | |
| Urea + Agrotain | | 180 | 175 | 125 | 142 | 69 | |
| Urea | 240 | 165 | 130 | 113 | 82 | | |
| Urea + Agrotain | | 240 | 188 | 127 | 134 | 98 | |
| Urea | 300 | 177 | 122 | - | 90 | | |
| Urea + Agrotain | | 300 | 178 | 140 | - | 113 | |
| P value | | | <0.0001 | <0.0001 | 0.0240 | <0.0001 | |
| MSD a | | | 20 | 21 | 34 | 18 | |

a, Minimum significant difference at P=0.10 as determined by Waller-Duncan test

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