

Evaluation of a Polymer-Coated Urea on Corn and Winter Wheat

There are several new fertilizer technologies currently being marketed for agricultural producers. A product developed and marketed by Agrium Corporation called ESN[®] is a polymer-coated urea fertilizer that is designed to slowly release nitrogen (N) into the soil. The overall goal of the product is to minimize N losses and maximize crop uptake of the N.

Studies were done with winter wheat and corn in 2005. The objective of the winter wheat studies was to compare ESN to normal grower practices and determine if ESN could provide greater yields through greater N efficiencies. For corn, applying N in split applications with most of the N being applied at sidedressing is the standard practice used by most corn growers in this region. Therefore, the main objective of the corn studies was to compare preplant-applied ESN to sidedress-applied UAN fertilizer.

WINTER WHEAT

This wheat project was conducted at three locations in Delaware during the 2005 growing season. Winter wheat yields were near-normal for most of the state in 2005. At Site 1a and 2, all ESN treatments received 15 lb N/ac as ESN in the fall except the ESN Fall treatment, which received 75 lb N/ac as ESN. The 34-0-0 fall treatment received 75 lb N/ac as ammonium nitrate in the fall. The ESN1, ESN2, and ESN3 treatments received 60 lb N/ac as a mixture of ESN and ammonium nitrate in the spring (Table 1). The UAN (Mis) treatment received 175 lb N/ac as UAN in the spring; this was applied because of a miscommunication with the farm manager. Therefore, additional studies were initiated in the spring of 2005 on winter wheat that had not received any N fertilizer in the fall or early spring prior to the initiation of our studies.

Site 1b was established at the same location as Site 1a and was within 50 yards of the initial study. Site 3 was established at a new location in Sussex County. All six treatments received 75 lb N/ac in one spring application on April 1. Because this second study was established in the spring, it was not possible to have fall-applied treatments. Therefore, we compared two slightly different ESN products at these two

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additional study sites. The ESN1, ESN2, and ESN3 treatments utilized ESN that was received from Agrium Corporation in the spring of 2004, while the ESN2* and ESN3* treatments was product that was received in the spring of 2005 and was designed to have a slightly slower release rate. All studies had four replications of each treatment in randomized block designs. Individual plots were 15 feet wide and 400 feet long. Grain yield was determined with a plot combine by harvesting the center 6.66 feet of each strip and weighing the grain in a weigh wagon.

Visual observations of wheat health followed similar trends with wheat yields, however, the fall N treatments yielded better than expected based on visual appearances. Visual observations that were made when the wheat was flowering suggested that the fall ESN treatments were not as severely N deficient as the fall ammonium nitrate treatments, however, the fall ESN treatments showed N deficiency symptoms that would be quite disturbing to most wheat growers. The yield results (Table 1) from these wheat studies suggest that the best overall treatment was ESN3, which contained 30% of N as ESN and 70% as 34-0-0. At Site 3, the ESN3 treatment was 15 bu/ac better than ESN1, 10 bu/ac better than ESN2, and 9 bu/ac better than UAN. Visually the ESN3 treatment appeared to have better N status than all other N treatments at both Site 1b and Site 3 and was slightly greener than the UAN treatment. This work will be repeated in future years before making final conclusions and recommendations.

Table 1. Winter wheat yield response to different N sources at four sites in 2005.

Treatment	N Rate	Grain Yield		Treatment	N Rate	Grain Yield	
		Site 1a	Site 2			Site 1b	Site 3
	lb N/ac	---- bu/ac ----			lb N/ac	---- bu/ac ----	
ESN1	75	58	69	ESN1	75	75	61
ESN2	75	61	79	ESN2	75	83	66
ESN3	75	67	83	ESN3	75	87	76
UAN(Mis)	175	86	97	UAN	75	82	67
ESN Fall	75	52	68	ESN2*	75	78	62
34-0-0 Fall	75	35	67	ESN3*	75	84	71
LSD _(0.05)		6.3	7.7	LSD _(0.05)		5.8	5.6
CV(%)		5.8	6.6	CV(%)		4.7	5.5

NOTES:

ESN1 = 70% of N as ESN; 30% of N as 34-0-0

ESN2 = 50% of N as ESN; 50% of N as 34-0-0

ESN3 = 30% of N as ESN; 70% of N as 34-0-0

Fall treatments were incorporated before planting winter wheat

Spring Fert applied on 3/17/2005 on 1st studies & 4/1/2005 on 2nd studies

*ESN with a slightly slower N release rate

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CORN

Table 2 shows the corn grain yields from an irrigated study conducted at the Research and Education Center in Georgetown, DE on a loamy sand soil. For the 150 lb N/ac preplant treatment, the ESN yielded 35 bu/ac more than the urea treatment. For the sidedress treatments, although there was no significant difference between N sources at the 150 lb N/ac rate, the ESN was significantly greater than UAN at the 100 lb N/ac rate. The comparison of greatest interest, however, for this region is between ESN applied preplant versus UAN applied as a sidedress. For this comparison, the UAN sidedress treatment out yielded the ESN preplant treatment by 17 bu/ac. This comparison suggests that the ESN released the N too early, and this N was lost from the soil through leaching.

Another study was conducted at four locations in 2005 (Table 3). Sites 2, 3, and 4 were located in Sussex County on coarse-textured soils, while Site 1 was located in New Castle County on a silt loam soil. Sites 2 and 3 were conventionally tilled, while Sites 1 and 4 were no-tilled. With this study, we compared four treatments. All studies were planted with 25 lb N/ac applied in a 2x2 starter band as UAN. Treatment 1 was ESN applied broadcast before planting and incorporated. Treatment 2 was ESN applied broadcast on the soil surface after planting and was not incorporated; this treatment was applied at emergence or shortly after. Treatment 3 was ESN applied broadcast when the corn was about 10 inches tall. Treatment 4 was UAN applied in a dribble band on the soil surface the same day as Treatment 3. Each plot was about 400 feet long and 15 feet wide (six corn rows). Each treatment was replicated four times in randomized block designs. At Site 4, there were no significant differences in yields among any of the treatments, but this is not surprising considering that extra N was accidentally applied to the study area by the farmer while sidedressing the rest of the field. At the three other sites, although most differences among yields were not statistically significant, the highest yielding treatment was the UAN sidedress treatment. Site 2 showed dramatic yield differences between the preplant and the sidedress treatments, which suggests that this site experienced significant N losses between planting and sidedressing. It is worth noting that there appeared to be no lateral movement of the ESN prills on the soil surface at the two no-till sites following significant rainfall events.

A third study was located on a sandy loam soil at the Research and Education Center (Table 4). This site included different ESN treatments and also included Agrotain, which is a urease inhibitor marketed by Agrotain International. At this site, preplant ESN was 64 bu/ac better than urea, 37 bu/ac better than 34-0-0, and 36 bu/ac better than UAN when applied either preplant or prior to emergence. Preplant ESN that was incorporated yielded 21 bu/ac better than ESN that was applied on the soil surface after planting but before emergence. This poor performance of the surface-applied ESN compared to the incorporated ESN was likely caused by the significant movement of the surface-applied ESN that occurred during a heavy rainfall shortly after application. This site was conventionally tilled and there was no residue remaining on the soil surface after planting. This lack of residue caused the surface-applied ESN to move into low-lying pockets where water pooled during heavy rainfall events. This likely resulted in non-uniform availability of N to the corn plants during the season. With the exception of the

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surface-applied early-season ESN treatment, all ESN treatments showed excellent performance at this location. The UAN with Agrotain treatments yielded no differently than the UAN treatments without Agrotain; however, rainfall did occur within a few days of each application.

Table 2. Corn yield response to ESN at Research and Education Center.

TRT #	Preplant	Sidedress	Preplant	Sidedress	Total	Grain
	Source	Source	Rate	Rate	N Applied	Yield
			lb N/ac	lb N/ac	lb N/ac	bu/ac
1	Control	Control	0	0	0	23
2	ESN	none	100	0	100	58
3	ESN	none	150	0	150	132
4	ESN	ESN	30	70	100	110
5	ESN	ESN	30	120	150	147
6	Urea	none	100	0	100	64
7	Urea	none	150	0	150	97
8	Urea	UAN	30	70	100	86
9	Urea	UAN	30	120	150	149
					LSD	16
					CV (%)	14.6
NOTES:						
All preplant treatments were incorporated						
All sidedress treatments were incorporated with row cultivator						

Table 3. Corn grain yields from four treatments at four locations in Delaware.

TRT #	Source/Placement	Grain Yield at Four Locations			
		Site 1	Site 2	Site 3	Site 4
----- bu/acre -----					
1	ESN preplant incorporate	161	112	121	168
2	ESN preemerge not incorporated	165	113	123	167
3	ESN sidedress not incorporated	163	160	119	162
4	UAN sidedress, dribbled in band	168	163	126	166
	CV (%)	2.7	13.2	5.0	2.1
	LSD _(0.05)	7.0	28.8	11.5	5.6
NOTES:					
All treatments received 25 lb N/ac as 2x2 band of UAN at planting					
Sites 1 & 2 received an additional 110 lb N/ac for each treatment (Total N was 135)					
Sites 3 & 4 received an additional 90 lb N/ac for each treatment (Total N was 115)					
Site 4 received an accidental application of 60 lb N/ac by fertilizer dealer at 12-in stage					
Trt 1 was applied a day or two prior to planting and incorporated with a field cultivator					
Trt 2 was applied shortly before or shortly after corn emergence					
Trt 3 and Trt 4 were applied on the same day when corn was about 10-in stage					

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Table 3. Corn yield response to various N treatments at Research and Education Center.

Trt #	Preplant Source	Preplant N Rate lb N/ac	Preplant Method	Sidedress Source	Sidedress Rate lb N/ac	Sidedress Method	Total N Rate lb N/ac	Grain Yield - bu/ac -
1	ESN	170	Broadcast	NONE	0		170	152
2	Urea	170	Broadcast	NONE	0		170	88
3	AN	170	Broadcast	NONE	0		170	115
4	NONE	0		ESN	170	Broadcast	170	131
5	NONE	0		UAN	170	Broadcast	170	116
6	NONE	0		UAN_AT	170	Broadcast	170	117
7	AS	30	Broadcast	UAN	140	Dribble	170	147
8	AN	30	Broadcast	UAN	140	Dribble	170	143
9	AN	30	Broadcast	UAN	140	Knife	170	148
10	AN	30	Broadcast	UAN_AT	140	Dribble	170	146
11	ESN	85	Broadcast	UAN	85	Dribble	170	154
12	ESN	85	Broadcast	ESN	85	Broadcast	170	148
13	AN	85	Broadcast	UAN	85	Dribble	170	121
14	AN	30	Broadcast	UAN	170	Dribble	200	163
							LSD	18
							CV (%)	9.3
NOTES:								
Trts 1-3 were incorporated before planting								
Trts 4-6 were applied after planting but before emergence								
Trts 7-14 the preplant was incorporated the sidedress was not								
UAN_AT is UAN with Agrotain at 14-day rate								
Sidedress treatments were applied when corn was about 10 inches tall								

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