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Comparison of ESN and Urea as Sources of Fall- and Spring-Applied N Fertilizer for Corn Production

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Abstract
We continue to search for methods and products that will increase nitrogen (N) use efficiency in corn production. Several years ago a controlled release N fertilizer was developed. The fertilizer is urea coated with a substance that controls the rate of N release based upon the temperature and amount of soil water. It is currently sold in Iowa as ESN. The objective of this study was to compare the response of corn to addition of ESN and urea at different N rates and different times of application.

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Comparison of ESN and Urea as Sources of Fall- and Spring-Applied N Fertilizer for Corn Production

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Introduction

We continue to search for methods and products that will increase nitrogen (N) use efficiency in corn production. Several years ago a controlled release N fertilizer was developed. The fertilizer is urea coated with a substance that controls the rate of N release based upon the temperature and amount of soil water. It is currently sold in Iowa as ESN. The objective of this study was to compare the response of corn to addition of ESN and urea at different N rates and different times of application.

Materials and Methods

The study was conducted on the Northern Research Farm from Fall 2002 through Fall 2006. ESN and urea were applied to small plots at rates of 0, 30, 60, 90, 120, 150, and 180 lb N/acre in November in 2002, 2003, and 2004. Urea was applied at the same rates in the spring for the Fall-Spring comparison. A Spring-application-only study had the two N fertilizers applied in late April or early May each year. The previous crop in all years was soybeans. The experiments were harvested in mid- to late-October each year by combining the three center rows of each 6-row plot.

The treatments were arranged as a factorial in a randomized complete block design with four replications each year. The two factors were fertilizer material and N rate.

Results and Discussion

Fall studies. Corn grain yields (Table 1) increased with increasing fertilizer N in all three years ($p>F=<0.01$). Yields ranged from about 120 bushels/acre to a high of 222 bushels/acre over the three years. Comparison of the fertilizer materials, averaged over N rates, shows mixed results. In 2003, the Fall-applied urea treatments yielded less than the Fall ESN and the Spring urea treatments. In 2004, there was a tendency for the Spring urea treatments to have higher yields than either the Fall urea or the Fall ESN applications. The difference was not statistically significant ($p>F=0.22$). In 2005 both Fall-applied treatments yielded less than the Spring-applied urea.

We suspect that the ESN material that we used for the 2004 study may have been scratched through the coating. This would mean that the ESN would essentially be no different than the urea. In 2005, it was raining the day the fertilizers were applied in the Fall and it is possible that the ESN absorbed water which then froze causing at least some of the coatings to rupture. Again, the ESN would act like urea. Given the uncertainty about the ESN, it is not possible to recommend that ESN should be used as a Fall N source in north central Iowa.

Spring studies. The Spring application studies were conducted from 2003 through 2006 (Table 2). Grain yields increased with N rate in all years ($p>F=0.01$). When averaged over N rates, there was a statistically significant 8 bushels/acre increase in yields in the ESN treatments in 2004 and 2005. There were no differences due to fertilizer material in 2003 and 2006.

We believe that use of ESN for Spring-applied N may be economically feasible as long as the yield increase from the ESN is worth more than the extra cost of the ESN fertilizer.

Table 1. Corn grain response to addition of urea and ESN at different N rates and different application times.

	2003			2004			2005		
N Rate	Fall urea	Fall ESN	Spring urea	Fall urea	Fall ESN	Spring urea	Fall urea	Fall ESN	Spring urea
lb/a	---bu/a---								
0	125	131	138	139	143	145	178	155	160
30	144	169	157	163	163	168	172	178	194
60	162	181	175	183	171	178	184	199	204
90	178	187	180	175	187	182	200	209	221
120	173	186	181	192	192	200	216	198	226
150	182	193	186	195	195	202	207	218	231
180	197	184	189	202	199	204	218	222	226
Average	166	177	172	178	178	183	196	197	209
Statistics		p>F			p>F			p>F	
N rate (N)		<0.01			<0.01			<0.01	
Material (M)		0.06			0.22			0.03	
N*M		0.73			0.88			0.57	

Table 2. Corn grain response to spring application of urea and ESN.

	2003		2004		2005		2006	
N rate	ESN	urea	ESN	urea	ESN	urea	ESN	urea
lb/a	---bu/a---							
0	112	114	141	149	151	137	133	143
30	149	141	157	145	181	167	167	172
60	169	173	178	164	200	199	186	182
90	183	172	182	179	226	218	199	187
120	175	185	207	200	214	206	207	200
150	175	175	220	198	205	201	199	209
180	169	180	214	213	215	209	200	205
Average	161	163	186	178	199	191	184	185
Statistics		p>F		p>F		p>F		p>F
N rate (N)		<0.01		<0.01		<0.01		<0.01
Material (M)		0.71		0.06		0.07		0.80
N*M		0.61		0.50		0.98		0.56