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Effect of Controlled-Release N Fertilizer on Corn Grain Yield

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Abstract
We are continuing to look for technology that will enable us to manage nitrogen (N) fertilizer efficiently. Past research has studied the effect of nitrification inhibitors, sulfur coating, and time of application on N-use efficiency. Recently a controlled-release polymer-coated urea material (ESN) has become available. Evaluation of the material in terms of efficiency of use on corn is necessary to help crop producers decide if the extra cost of ESN can be recovered either by applying less material or by producing higher yields at current N rates. The objective of this study is to evaluate the effect of spring applications of ESN and urea on a corn-soybean cropping system.

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Introduction

We are continuing to look for technology that will enable us to manage nitrogen (N) fertilizer efficiently. Past research has studied the effect of nitrification inhibitors, sulfur coating, and time of application on N-use efficiency. Recently a controlled-release polymer-coated urea material (ESN) has become available. Evaluation of the material in terms of efficiency of use on corn is necessary to help crop producers decide if the extra cost of ESN can be recovered either by applying less material or by producing higher yields at current N rates. The objective of this study is to evaluate the effect of spring applications of ESN and urea on a corn-soybean cropping system.

Materials and Methods

This study was conducted at the Northwest Research and Demonstration Farm and the Northern Research and Demonstration Farm from 2003 to 2005. ESN and urea were hand applied in late April at rates of 0, 30, 60, 90, 120, 150, and 180 lb N/acre. The previous crop was soybean in all years. The corn was planted in May and machine harvested in October in all years. Plot yields were weighed in the field and a subsample was retained in order to determine moisture content. Yields were adjusted to a moisture content of 15.5% and are reported on a per acre basis.

Results and Discussion

Northwest Research and Demonstration Farm. Grain yields at the Northwest Farm ranged from 116 bushels/acre to 164 bushels/acre for ESN treatments and from 108 bushels/acre to 162 bushels/acre in urea treatments in 2003 (Table 1). Grain yield increased with the N rate up to a rate of about 120 lb N/acre. The yield of the ESN treatments averaged over N rates was 148 bushels/acre. The yield of the urea treatments averaged over N rates was 144 bushels/acre. Unfortunately, the experiment was damaged by hail in 2004 so data was not collected that year. Yields were higher in 2005 than in 2003 and increased with addition of N fertilizer ($p>F=<0.01$). Yield of the ESN treatments averaged over N rates was 190 bushels/acre. Yield of the urea treatments averaged over N rates was 178 bushels/acre, a difference that was statistically significant.

Northern Research and Demonstration Farm. Grain yields increased with N rate all three years at this location and were especially high in 2004 and 2005 (Table 2). Averaged across N rates, the yield of ESN treatments was 162 bushels/acre in 2003, 186 bushels/acre in 2004, and 199 bushels/acre in 2005. The average yield of urea treatments was 163 bushels/acre in 2003, 178 bushels/acre in 2004, and 191 bushels/acre. The differences in yields due to N materials were statistically significant in 2004 and 2005.

Discussion. The results of these five studies suggest that use of ESN may be beneficial for farmers in northern Iowa, depending on the extra cost of this material. Yields of the ESN treatments averaged over locations and years were 177 bushels/acre compared with average urea yields of 171 bushels/acre. Further studies need to be conducted to find how the ESN material performs when not incorporated into the soil, and to study its efficiency as a fall-applied fertilizer.

Table 1. Corn grain yield response to N rate and N material at the Northwest Research Farm, 2003 and 2005.[a]

	2003		2005	
N rate	ESN	Urea	ESN	Urea
lb/acre	bu/acre			
0	116	108	184	154
30	136	131	186	181
60	141	141	180	179
90	158	144	194	168
120	164	162	198	181
150	162	160	198	191
180	159	161	193	189
Average	148	144	190	178
Statistics	p>F		p>F	
N rate (N)	<0.01		<0.01	
Material (M)	0.08		<0.01	
N*M	0.53		0.02	

[a]The experiment was lost to hail in 2004.

Table 2. Corn grain yield response to N rate and N material at the Northern Research Farm, 2003–2005.

	2003		2004		2005	
N rate	ESN	Urea	ESN	Urea	ESN	Urea
lb/acre	bu/acre					
0	112	114	141	149	151	137
30	149	141	157	145	181	167
60	169	173	178	164	200	199
90	183	172	182	179	226	218
120	175	185	207	200	214	206
150	175	175	220	198	205	201
180	169	180	214	213	215	209
Average	162	163	186	178	199	191
Statistics	p>F		p>F		p>F	
N rate (N)	<0.01		<0.01		<0.01	
Material (M)	0.71		0.06		0.07	
N*M	0.61		0.50		0.98	