

Comparison of ESN, Urea, and Aqua Ammonia as Sources of 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 on 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, urea, and aqua ammonia at different N rates.

Materials and Methods

The study was conducted from 2003 through 2007. ESN and urea were applied to small plots at rates of 0, 30, 60, 90, 120, 150, and 180 lb N per acre in spring just prior to planting in all years. Both N sources were incorporated within hours of application. The previous crop in all years was soybean. The experiments were harvested in mid- to late-October each year by combining the two center rows of each 4-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.

A study comparing spring application of ESN with spring application of aqua ammonia (AA) was conducted in 2006 and 2007. The ESN was hand broadcast at rates of 0, 60, 120, and 180 lb N per acre. Aqua ammonia was injected into the plots in the spring at the same rates of N. The previous crop in both years was soybean. The experiments were harvested as described above. The experimental design was the same as described above.

Results and Discussion

ESN-Urea study. Corn grain yields (Table 1) increased with increasing fertilizer N in all four years ($p > F = < 0.01$). Yields varied among years reflecting differences in growing season weather. Comparison of the fertilizer materials, averaged over N rates, shows mixed results. In 2003, the ESN treatments yielded three bushels/acre more than the urea treatments. Data were not collected in 2004 due to hail damage. ESN treatments yielded 14 bushels/acre more than urea in 2005. Average grain yields of ESN and urea treatments were not statistically different in 2006 and 2007. Averaged over N rates and years, ESN treatments yielded 158 bushels/acre while urea treatments yielded 154 bushels/acre.

ESN-AA study. Corn grain yields increased with N addition in both years of the study (Table 2). The yields varied somewhat between 2006 and 2007 with the highest yields occurring in 2007. There was not a response to the N fertilizer material in either year. This was likely because weather conditions didn't favor N loss from the soil because there was not a response to ESN in the ESN-urea studies in 2006 and 2007 either (Table 1).

Conclusions

Based upon our results we believe that use of ESN for spring-applied N is a reasonable alternative to the use of urea as long as the yield increase from the ESN is worth more than the extra cost of the ESN fertilizer. Producers should not expect a positive response to ESN every year. However, in years when weather conditions result in losses of N it is likely that ESN will be a more efficient N source than urea.

Table 1. Corn grain response to spring-applied urea and ESN fertilizers at Sutherland, 2003, 2005–2007.

N material	N rate lb/acre	Yield ^a	Yield ^a	Yield ^a	Yield ^a
		2003	2005	2006	2007
Urea	0	73	156	176	101
	30	88	183	169	117
	60	95	181	189	142
	90	97	170	198	159
	120	109	183	198	173
	150	108	193	209	168
	180	109	191	218	156
	Average		97	179	194
ESN	0	79	186	163	99
	30	92	188	159	125
	60	95	182	185	130
	90	107	196	206	157
	120	111	201	208	158
	150	109	201	220	153
	180	107	196	238	170
	Average		100	193	197
Statistics		-----p > F-----			
N rate		< 0.0001	< 0.0001	< 0.0001	< 0.0001
Material		0.0885	< 0.0001	NS	NS
N rate*Material		NS	0.0191	NS	0.0214

^a15.5% moisture**Table 2. Corn grain response to spring applied ESN and aqua ammonia fertilizers at Sutherland, 2006-2007.**

N Material	N rate lb/acre	Yield ^a	Yield ^a
		2006	2007
AA	0	144	143
	60	182	188
	120	204	202
	180	180	220
Average		178	188
ESN	0	144	151
	60	168	192
	120	204	203
	180	191	209
Average		177	189
Statistics		-----p > F-----	
N rate		< 0.0001	< 0.0001
Material		NS	NS
N rate*Material		NS	NS

^a15.5% moisture