CORN YIELD RESPONSE TO FALL AND SPRING APPLIED CONTROLLED-RELEASE UREA VS. SPRING CONVENTIONAL UREA

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Abstract

Nitrogen (N) application to corn has been proven to increase yields, but concerns about nitrate-N in ground and surface water have led to investigation of controlled-release N fertilizer. The objective of these experiments is to compare corn grain response to controlled-release urea (ESN) and conventional urea. Two field studies are being conducted at two locations in Iowa and corn yield data will be reported from 2003-2005. All N treatments were hand broadcast in 30 lb N/a increments from 0 lbs. to 180 lbs. in both fall and spring applications, then incorporated into the soil using standard tillage practices for the area. In the spring study, grain yield increased with N rate at all locations every year and there were significant differences due to N material at four of five site-years. Average grain yields were 177 bu/a for the ESN and 171 bu/a for the conventional urea. In the fall study, grain yield increased with N rate at all locations every year and there were significant differences due to N material at two of three site-years. On average, grain yields were 180 bu/a for the fall applied conventional urea, 184 bu/a for the fall applied ESN, and 188 bu/a for the spring applied conventional urea.

Introduction

A new type of nitrogen fertilizer has recently become available. ESN, manufactured by Agrium, Inc., is a controlled-release, polymer-coated urea product. The goal of this product is to release N over the growing season at a slower rate than other commercial N fertilizers. The release of ESN is based on the temperature of the soil, with increased soil temperatures leading to increased N release rates. This product is being evaluated in an on-going study to determine the efficiency of N use by corn and to see if lower rates of N can be applied with the same or better corn grain yields.

Materials and Methods

Treatments for the fall applied study were applied in late fall for all years of the study. Urea and ESN were hand broadcast at rates of 0, 30, 60, 90, 120, 150 and 180 lb N/a, then lightly incorporated into the soil. Urea was applied to a third set of treatments the following spring and incorporated. The previous crop was soybean in all years of the study. The corn was planted in mid to late April for all three years of the study.

The spring applied study was started in 2003 at two different locations, one in north central and the other in northwest Iowa. ESN and conventional urea were hand broadcast in mid-April at the same N rates as the fall studies, then lightly incorporated into the soil using standard tillage practices for the area. The plots were then planted with a hybrid and population suitable for the area.

Whole plant samples were taken at physiological maturity to determine biomass production and the N content of the biomass. Grain yield was determined by machine harvesting the center 2 or 3 rows of each plot. All grain yields were adjusted to 15.5% moisture.

Results

Fall applied studies

Corn grain yields increased with N rate (p>F = 0.01) at site 1 in 2003 (Fig. 1). Average yields were highest with fall applied ESN (p>F = 0.06). The N rate by N material interaction was not significant in 2003. Yields also increased with N rate (p>F = 0.01) at site 2 in 2004 (Fig. 2). Average yields were highest with spring applied urea but differences due to N material were not statistically significant. The interaction (N rate*N material) at site 2 was not significant in 2004. In 2005, corn grain yields increased with N rate (p>F = 0.01) at site 3 (Fig. 3). Average yields were highest with spring applied urea (p>F = 0.03). The interaction was not significant in 2005. Averaged over years and N rates, corn grain yields were 180 bu/a for fall applied urea, 184 bu/a for fall applied ESN, and 188 bu/a for spring applied urea (Table 1).

Spring applied studies

Corn grain yields increased with N rate (p>F = 0.01) at sites 4 and 5 in 2003 (Fig. 4, 5). Average yields were highest with ESN at site 1 (p>F = 0.08). The interaction at both sites in 2003 was not significant. Yields also increased with N rate (p>F = 0.01) at site 6 in 2004 (Fig. 6). Average yields were higher with ESN at site 6 (p>F = 0.06). The interaction at site 6 was not significant in 2004. Yields increased with N rate (p>F = 0.01) at sites 7 and 8 in 2005 (Fig. 7, 8). Average yields were highest with ESN at both sites (p>F = 0.01, 0.07). The interaction at site 7 was significant (p>F = 0.02) while it was not significant at site 8. The ESN had a higher average yield at 4 of the 5 sites during this study. Averaged over years and N rates, grain yields were 177 bu/a for the ESN and 171 bu/a for the conventional urea (Table 2).

Conclusions

We observed a higher average yield for the fall applied ESN at 1 of the 3 sites during the duration of the fall study. The ESN in the spring applied study had a higher average yield at 4 of the 5 sites during the three years of the study. This indicates a potential use for ESN to replace or compliment other types of N fertilizer. However, the value of this product to farmers will depend on the cost of ESN and the consistency of a response. We are continuing the spring applied study for 2006 and the data will be published later. A study was started last fall comparing fall applied ESN and aqua ammonia to spring applications of the same material. In addition to that study we also put out a small study comparing spring applied ESN to spring applied aqua ammonia.

Table 1. Corn grain response to N material averaged over N rate. 2003-2005.

Year	Location	Fall Urea	Fall ESN	Spring Urea
2003	1	166	177	172
2004	2	178	178	183
2005	3	196	197	209
Average		180	184	188

Table 2. Corn grain response to N material averaged over N rate, 2003-2005.

Year	Location	ESN	Urea
2003	4	162	163
2003	5	148	144
2004	6	186	178
2005	7	199	191
2005	8	190	178
Average		177	171

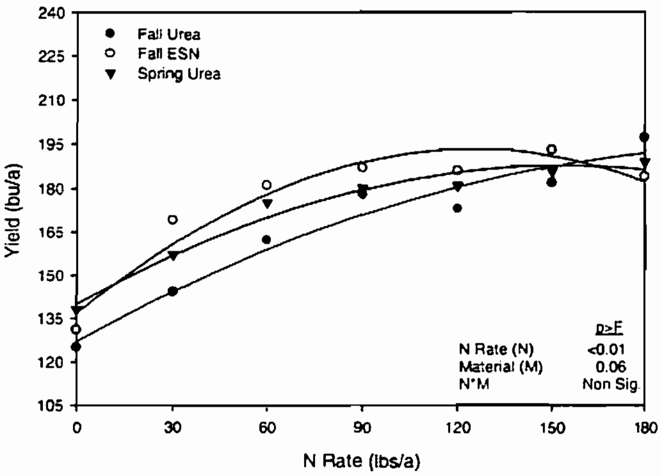

Figure 1. Relationship between N rate and corn grain yield at site 1, 2003.

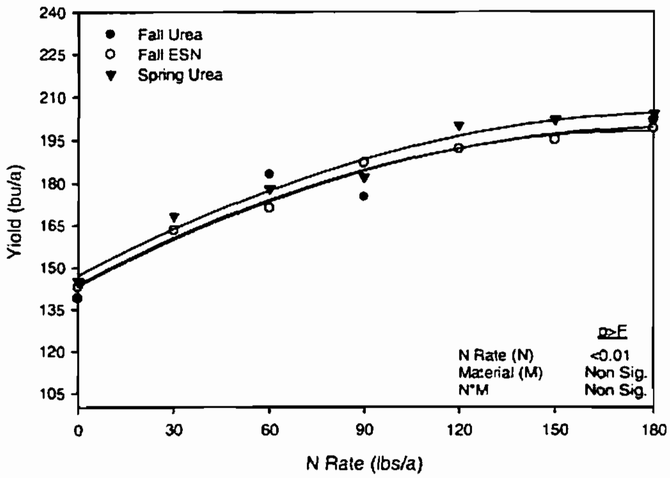

Figure 2. Relationship between N rate and corn grain yield at site 2, 2004.

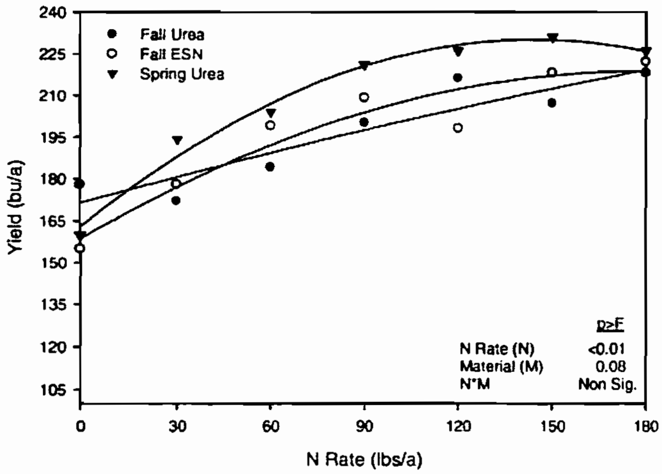

Figure 3. Relationship between N rate and corn grain yield at site 3, 2005.

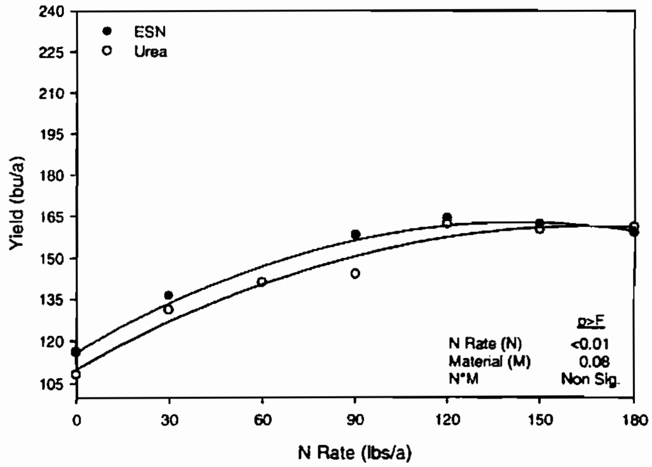

Figure 4. Relationship between N rate and corn grain yield at site 4, 2003.

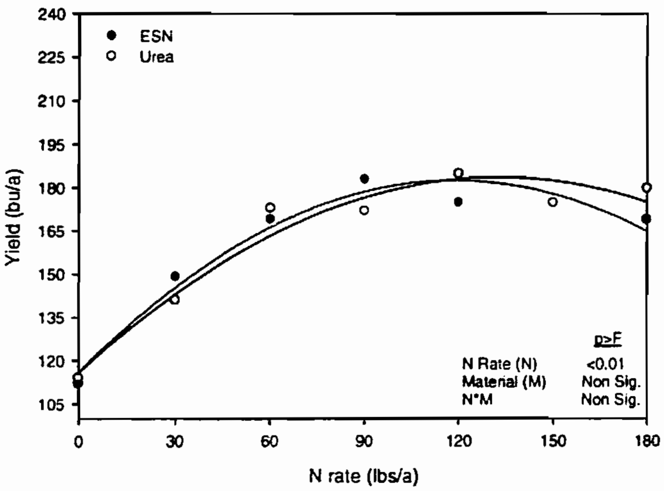

Figure 5. Relationship between N rate and corn grain yield at site 5, 2003.

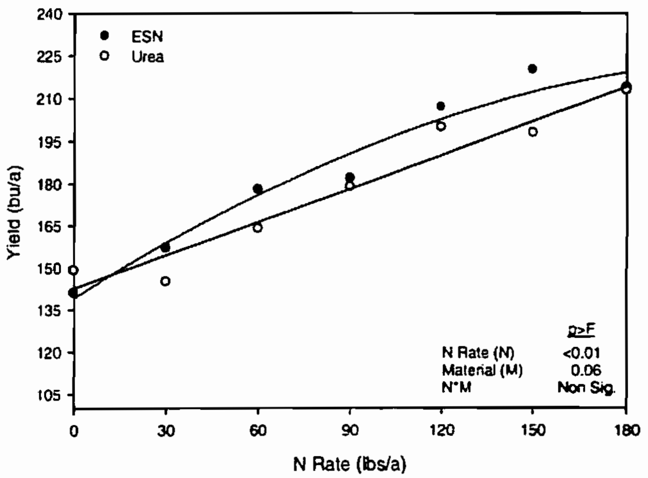

Figure 6. Relationship between N rate and corn grain yield at site 6, 2004.

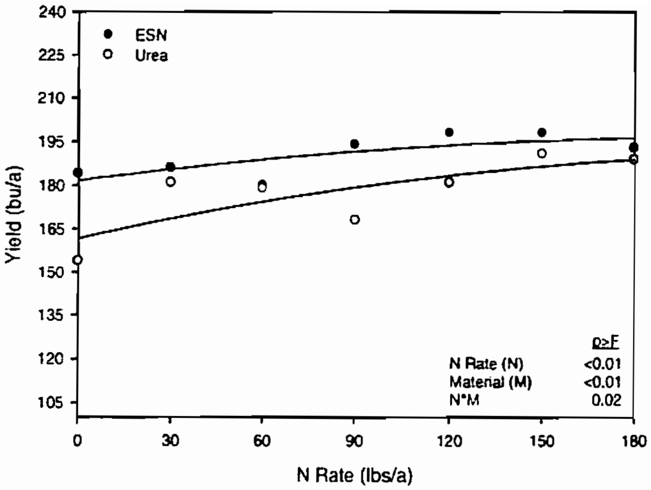

Figure 7. Relationship between N rate and corn grain yield at site 7, 2005.

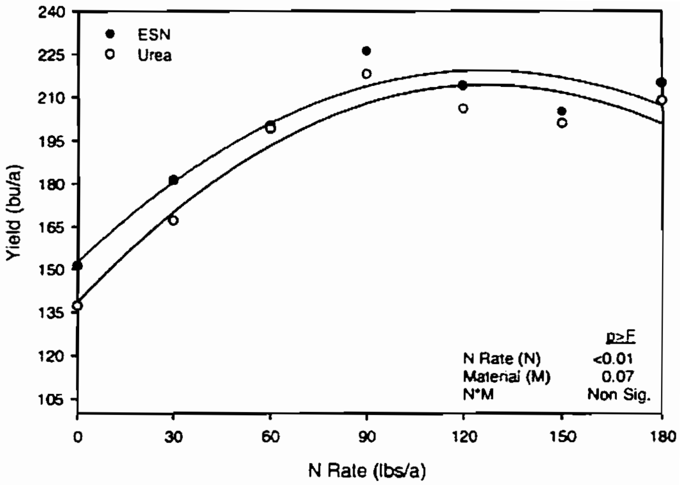

Figure 8. Relationship between N rate and corn grain yield at site 8, 2005.

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