

Corn Response to Nitrogen, Potassium, and Sulfur in Southeast Iowa

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Introduction

Many experiments have been conducted at this farm over the years to study the corn grain yield response to nitrogen (N) and potassium (K). Only one experiment included combinations of N and K rates, and the results showed a positive interaction between these two nutrients. A deficiency in one nutrient reduced the maximum yield level and limited the yield response to increasing rates of the other. Scarce research was conducted in this region of the state to study the corn response to sulfur (S) fertilization, and results showed small and inconsistent responses. A new long-term experiment was established in 2013 to study the continuous corn responses to several combinations of N, K, and S. No Iowa research has studied the possible interactions among these three nutrients. Results for the first three years summarized in a previous report confirmed the N by K interaction and showed no statistically significant corn yield increases from S application. This report summarizes data across five years, although one year was omitted due to low yields and extreme rainfall.

Materials and Methods

A study with continuous corn was conducted from 2013 to 2017 on an area with Mahaska soil. Annual treatments replicated three times were combinations of N, K, and S application rates. The N rates were 0, 75,

150, 225, and 300 lb N/acre using UAN sidedressed and injected when corn was between the V4 and V5 growth stage. The K rates were 0, 24, 48, and 72 lb K₂O/acre using potash fertilizer (potassium chloride) broadcast in the spring before the last disking or field cultivation. The S rates were 0 or 50 lb S/acre (gypsum broadcast before planting in the spring). The plots were managed with chisel-plow/disk tillage, a target corn population of 35,000 plants/acre, and a 30-in. row spacing. Grain yield was adjusted to 15.5 percent moisture.

Results and Discussion

Corn grain yield was low and variable in 2013 due to excess spring rainfall and the results are not included in this report. That year there was no yield response to K or S, but yield was 59 bushels/acre without N being applied and 127 bushels/acre with rates of either 225 or 300 lb N/acre. Corn yields were much higher from 2014 to 2017. The average yield for plots receiving S and the two highest N and K application rates was 210, 234, 211, and 240 bushels/acre in 2014, 2015, 2016, and 2017, respectively.

There were significant grain yield increases from K fertilization that were not statistically different for the two highest rates of 48 and 72 lb K₂O/acre. Soil-test K of plots not receiving K ranged from Very Low or Low according to ISU interpretation categories for both the dry and moist tests (see ISU Extension publication PM 1688). By fall 2016, soil-test K for plots receiving the different K rates ranged from Low to Very High.

Figure 1 summarizes the average grain yields from 2014 to 2017 by showing results

for each N application rate with or without S and with K (average of the two highest K rates) or without K. The graphs for plots without K (Graph A) or with K (Graph B) show a large yield increase from N application, but small increases from S application for any N rate and with or without K fertilization. The average corn yield increase from S application (5 bu/ac) was not statistically significant at the most commonly used 0.05 probability level but was significant when using a less rigorous 0.10 level. The yield response to S was statistically similar for all N and K rates.

The data in Figure 1 show a significant yield response to K fertilization for all N application rates, which was expected because soil-test K of plots not fertilized with K ranged from Very Low to Low over time. Graph C shows more clearly the corn response to N and K for averages across the two S rates and an obvious interaction between N and K fertilization. Corn yield levels were higher with adequate rates of both nutrients, but the yield increase with higher N application rates was greater when

K was applied. Graph C also shows with K applied, a lower N rate seemed to maximize yield more than without K, but the difference was not statistically significant. Previous results for N-K rate combinations in two long-term experiments conducted in northern Iowa showed sufficient K increased the corn response to N fertilization. The N rate needed to maximize yield did not change with or without K being applied, or was higher when K was adequate.

Conclusions

Adequate fertilization with N, K, and S were needed to maximize corn yield. Responses to N and K were large but the response to S was small. Sulfur did not influence the relative corn response to N and K, but a K deficiency reduced yield and the capacity of corn to respond to applied N. However, excess application of one nutrient did not require an excess application of the other.

Acknowledgements

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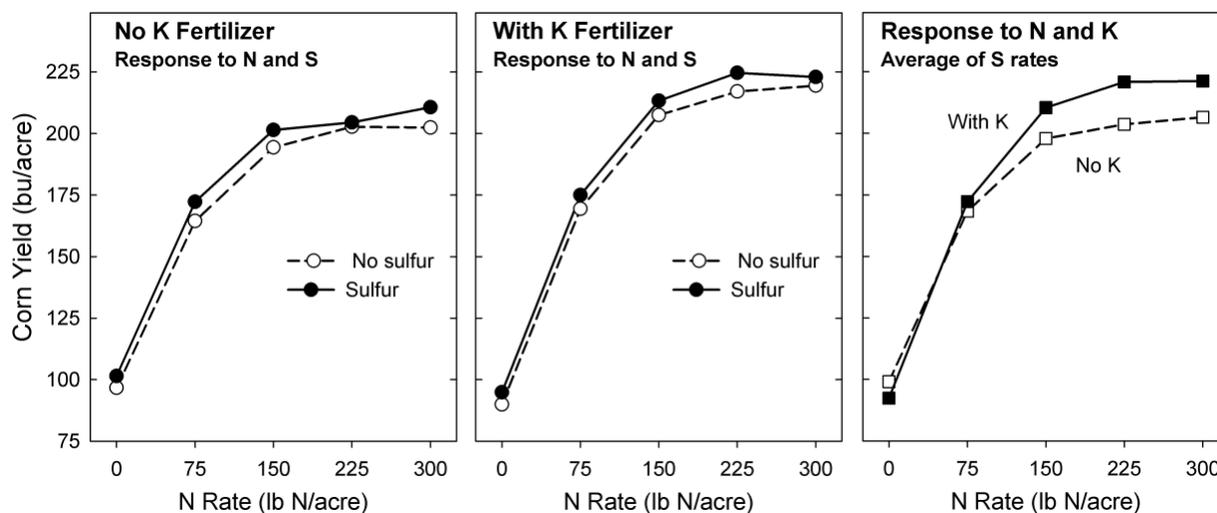


Figure 1. Corn grain yield response to N and S with or without K fertilization (averages from 2014 to 2017).