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

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Introduction

A long-term experiment was established in 2013 to study the responses to nitrogen (N), potassium (K), and sulfur (S) on continuous corn. Research at ISU Southeast Research Farm has looked at the corn yield response to N and K fertilization but not to S application. Results of a study with different N and K fertilization rates for corn at this farm and in northern Iowa have shown a positive interaction between these two nutrients. This means that a deficiency of one nutrient reduces the maximum yield level and also limits the yield response to increasing rates of the other. This type of interaction seldom has been observed between N and P or P and K in Iowa, unless the deficiency is extreme. The study summarized in this report applied several rates of N, K, and S to study the corn responses to these nutrients. No Iowa research has studied the possible interactions among these three nutrients.

Materials and Methods

A study with continuous corn and N, K, and S fertilization treatments was conducted during 2013, 2014, and 2015 on an area with Mahaska soil. To develop this study, we modified some treatments of a previous trial that was conducted from 2009 until 2012 to evaluate the N and K response from two different hybrids. We maintained the N and K treatments, eliminated the two hybrid treatments to use only one hybrid across all plots, and re-randomized the plots that had the hybrids to evaluate two S application rates. The plots were managed with chisel-plow/disk tillage with a target corn population of 35,000 plants/acre, in 30-in. row spacing. Annual treatments replicated three times were the combinations of N, K, and S application rates. The N rates were 0, 75, 150, 225, and 300 lb N/acre (injected sidedressed UAN when corn was between the V4 and V5 growth stage). The K rates were 0, 24, 48, and 72 lb K_2O/acre (potassium chloride broadcast in the spring before the last disking or field cultivation and planting). The S rates were 0 or 50 lb S/acre (gypsum broadcast before planting in the spring). Grain yield was adjusted to 15.5 percent moisture.

Results and Discussion

Continuous corn yields were low and very variable at this farm in 2013 due to excess spring rainfall. In 2013, there were no grain yield responses to K and S, but there were large responses to N fertilization. In 2013, the corn yield was 59 bushels/acre without N applied and increased to 127 bushels/acre with either rates of 225 or 300 lb N/acre. Therefore, the 2013 results are not shown.

Corn yields were much higher in 2014 and 2015 due to normal or better than normal weather, and the yield responses to fertilization were similar in both years. There were small yield increases from K fertilization that did not differ for annual rates of 24, 48, or 72 lb K_2O/acre. Soil-test K of plots receiving K and adequate N was in the Low category for both the dry and moist tests (see ISU Extension publication PM 1688), but were in the High or Very High categories with the higher annual K rates applied. Therefore, Figure 1 summarizes the average yields for 2014 and 2015 without K fertilization or the

average of the three K rates applied. Graphs in Figure 1 for plots without (Graph A) or with (Graph B) K fertilization show a very large yield increase from N application, but no increases from S application for any N rate and with or without K fertilization. Comparing the data in these two graphs also shows a significant yield response to K fertilization for all N application rates. A response to K fertilization was expected because the soil-test K levels of plots not fertilized with K was in the Low category.

Graph C in Figure 1 shows more clearly the corn response to N and K for averages across the two S rates (since corn was unresponsive to S application) and a positive interaction between N and K fertilization. Corn yield levels were higher with adequate rates of both nutrients, and the yield responses to increasing N application rates were greater when K was applied. This graph also shows a lower N rate maximized yield with K more than without K fertilization. Applying more K than the lowest annual K applied (24 lb K_2O)/acre) did not affect the response to N application (not shown).

Previous results for N-K rate combinations in Iowa have shown a positive interaction between these nutrients, but the N rate needed to maximize yield has not changed with or without K or has been higher with K.

Conclusions

Adequate fertilization of both N and K were needed to maximize the benefits on corn yield of applying these nutrients. However, excess application of one nutrient did not require an excess application of the other.

Acknowledgements

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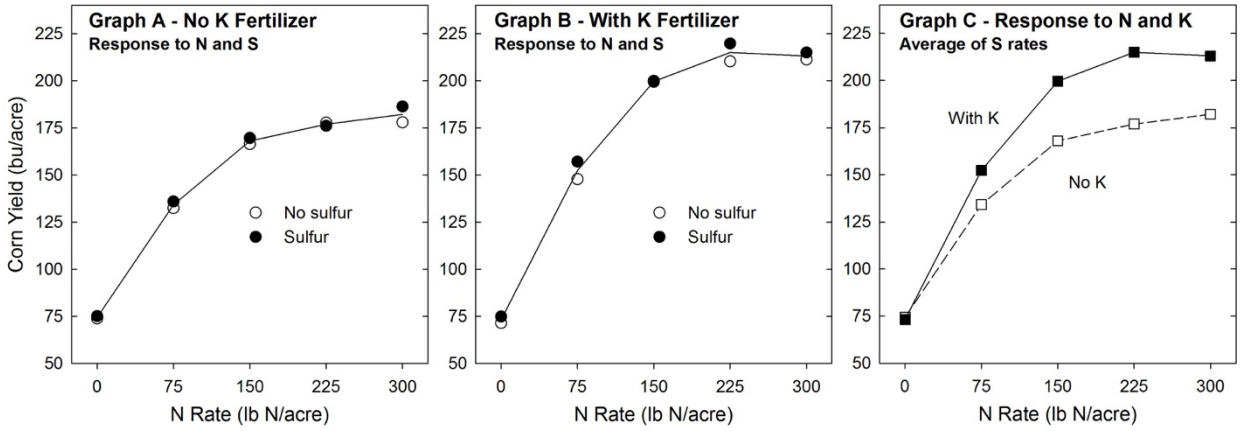

Figure 1. Corn grain yield response to N and S with or without K fertilization (averages for 2014 and 2015).