Corn and Soybean Response to Sidedressed Liquid Potassium Fertilizer in Southwest Iowa

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Introduction

Previous Iowa research, including a long-term experiment at this research farm and many other fields, has assessed the corn and soybean grain yield response to different potassium (K) fertilizer placement methods using granulated potash fertilizer (0-0-62). However, no study had evaluated post-emergence sidedressing K fertilizer, although nitrogen sidedressing for corn is a common practice. Therefore, a study was initiated at the ISU Armstrong Research Farm, Lewis, in 2018 to evaluate the value of sidedressed liquid K fertilizer for corn and soybean grown in rotation.

Materials and Methods

A 2-yr trial with corn in the first year and soybean in the second was established on an area with Exira silty clay loam soil. The site has been managed with no-till and continued as such for this study. Both crops were planted using a 30-in. row spacing. New treatments were applied to plots of a previous K trial that had useful management histories for this new study. There were four blocks, each with five large plots measuring 40 by 50 ft. Soil-test K of four plots of each block was 193 ppm on average (6-in. depth, ammonium-acetate test using dried soil samples), which is in the upper portion of the Optimum interpretation category. One plot of each block tested 268 ppm on average (Very High) due to higher previous K fertilization rates. All plots had similar management practices.

In the first year (2018), preplant broadcast K rates of 0, 45, 90, or 135 lb K_2O/acre (granulated potash 0-0-62) were randomized to the four lower-testing plots of each block 2 to 3 weeks before planting corn. No preplant K was applied to the high-testing plots. After planting corn, each plot was subdivided into two subplots to apply sidedress liquid K fertilizer at 0 or 45 lb K_2O/acre (potassium acetate 0-0-24) at the V6 growth stage by injection to the center of each inter-row to a depth of 3 to 4 inches. Corn ear-leaf blades were sampled at the R1 growth stage (silking) and were analyzed for K concentration. Corn grain yield was adjusted to 15 percent moisture.

In the second year (2019), no preplant K was applied before planting soybean. Soil-test K ranged from 176 ppm to 207 ppm (upper Optimum to lower High) for plots that had received 0 to 135 lb K_2O/acre before corn and no sidedress K fertilizer, and was 261 ppm (Very High) for the high-testing plots that had received no preplant K for corn. Liquid K fertilizer at 45 lb K_2O/acre was sidedressed at the V6 growth stage to the same subplots it had been sidedressed for corn. Upper soybean trifoliate leaves were sampled at the R2-R3 growth stage and were analyzed for K concentration. Soybean grain yield was adjusted to 13 percent moisture. Therefore, soybean evaluated the residual effects of broadcast K rates that had been applied for corn with or without reapplying sidedressed K.

Results and Discussion

Figure 1 shows preplant broadcast K rates applied to the lower-testing plots before corn greatly increased leaf K concentrations of corn and also of the following soybean crop. For both crops, leaf K was even greater for the

high-testing plot areas that had received no preplant K for corn. Additional sidedressed liquid K fertilizer slightly increased further corn leaf K concentrations for all preplant treatments. In soybean, however, sidedressed K further increased leaf K only when no preplant K was applied for corn. A large crop leaf K response to K fertilization has been observed before, even in high-testing soils, because of a high limit for K uptake of vegetative crop tissues.

Figure 2 shows grain yield for both crops. In spring 2018 there was excessive rainfall and strong wind in early July causing corn green snapping, both of which caused high yield variation. There was a small corn yield response, and the 45-lb rate maximized yield. The 135-lb rate decreased yield to a level lower than the 45-lb and 90-lb rates, but not below yield of the control that received no preplant K. Yield was even lower than control for the high-testing plots that had received no K fertilizer for corn. In 2019, there was a small soybean yield response to K applied before corn, and a similar maximum yield was attained by the 135-lb rate and the high-testing plots. Additional sidedressed K fertilizer increased yield for rates applied before corn of 0 to 90 lb K_2O/acre, but not for the 135-lb rate or the high-testing plots.

The result shows the lowest 45-lb preplant K rate was sufficient to maximize corn yield within expectation given the Optimum soil-test K level. Previous research in this area and other Iowa regions has shown a 25 percent probability of a small response of no-till corn yield in soils testing Optimum, for which only a removal-based rate is suggested by ISU guidelines in extension publication PM 1688. However, a corn yield reduction by the highest rate of 135 lb K_2O/acre and even lower yield for the high-testing plots that received no preplant K was not expected. Initial soil-test K ranged from the upper portion of the Optimum category to Very High. Decades long research has shown only a 1 percent probability of crop response to K in soils testing Very High (for which K fertilization is not suggested), but showed no yield decreases from K fertilization either. Corn stands were variable due to a very wet spring and summer wind damage, but were not always lower in plots where yield was decreased. Therefore, lower corn yield for the highest K rate and the high-testing plots cannot be explained well, other than by random variability.

A small soybean yield response either to broadcast K before the previous corn crop or sidedressed K fertilizer is reasonable. Soil-test K before planting soybean had decreased to the middle portion of the Optimum category, for which there is a small probability of response to K and soil-test maintenance based on K removal is suggested by ISU.

Conclusions

Results showed that with soil-test K in Optimum category, all preplant K rates applied for corn greatly increased corn ear-leaf K and soybean leaf K in the following year. An ISU suggested preplant removal-based rate of 45 lb K_2O/acre maximized corn yield, a 90-lb rate did not increase yield further, but a 135-lb rate decreased yield. A small corn yield response to a low removal-based rate was expected, but a yield decrease by the highest rate was not, which was probably due to random variability. Yield of the following soybean crop increased slightly as rates applied before corn increased.

Additional sidedressed liquid K fertilizer increased corn leaf K slightly for all preplant rates but increased soybean leaf K only when no K had been applied for corn, did not increase first-year corn yield, and increased soybean yield when rates lower than suggested for the 2-yr rotation were applied before corn. Therefore, producers should sidedress liquid K fertilizer only as a rescue

option when appropriate preplant K rates were not applied.

Acknowledgements

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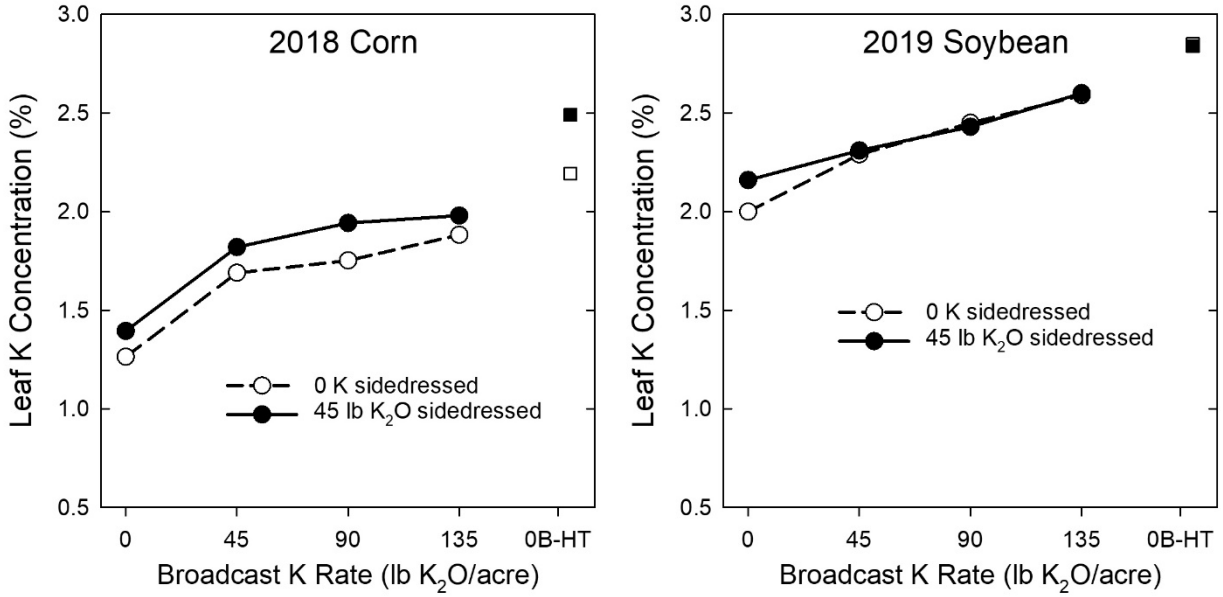

Figure 1. Corn and soybean leaf K concentration responses to sidedressed liquid K fertilizer for preplant broadcast rates for corn of 0 to 135 lb K_2O/acre in low-testing plots and for high-testing plots without preplant K (0B-HT).

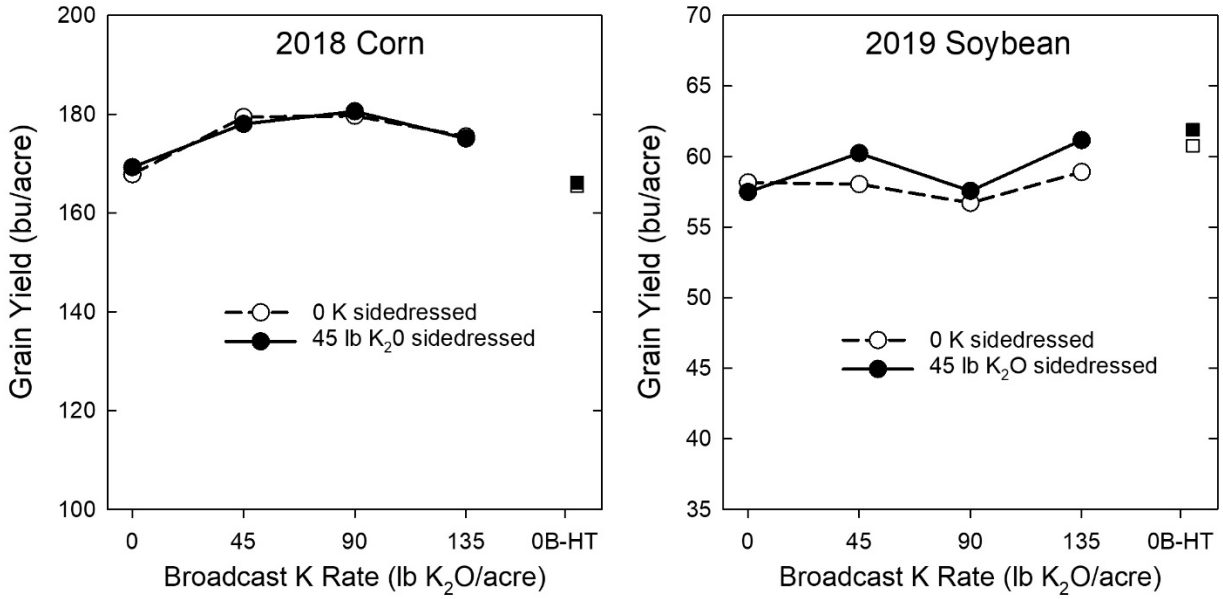

Figure 2. Corn and soybean grain yield responses to sidedressed liquid K fertilizer for preplant broadcast rates for corn of 0 to 135 lb K_2O/acre in low-testing plots and in high-testing plots without preplant K (0B-HT).