Soybean Response to Sidedressed Liquid Potassium Fertilizer in Northern Iowa

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Introduction

A long-term experiment at this Iowa State University (ISU) research farm and many other trials in Iowa fields have assessed the corn and soybean grain yield response to potassium (K) fertilizer placement methods using granulated potash fertilizer (0-0-62). However, no study had evaluated postemergence sidedressing of K fertilizer, although sidedressing of nitrogen fertilizer for corn is a common practice. Therefore, a study was initiated in 2017 to evaluate the value of sidedressed liquid K fertilizer for corn-soybean rotations.

Materials and Methods

The study consisted of two trials, one began in 2017 on an area with predominantly Nicollet clay loam soil and the other in 2018 on an area with predominantly Webster clay loam soil. Corn was planted in the first year and soybean in the second. New treatments were applied to plots of old trials with management histories useful for this study. There were four blocks in both trials, each with five plots measuring 40 by 50 ft. On average, soil-test K (6-in. depth, ammonium-acetate test on dried samples) was Low for four plots and Very High for the other plot due to different past K rates (154 and 250 ppm in 2017, and 155 and 220 ppm in 2018). All other management practices were similar for all plots.

For corn (first year), preplant K rates of 0, 45, 90, or 135 lb K_2O/acre (granulated potash 0-0-62) were randomized to the four low-testing plots of each block and broadcast in the spring before field cultivation. No preplant K was applied to the high-testing plot of each block. After planting corn, each plot was subdivided into two subplots to sidedress liquid K fertilizer at rates of 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 in.

For soybean (second year), no preplant K was applied, and liquid K fertilizer at 45 lb K_2O/acre was sidedressed at the V6 growth stage to the same plots 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.

A previous report summarized results for corn. In both trials, ear-leaf K concentrations were greatly increased by all preplant K rates, were the highest for the high-testing plots, and were increased further by liquid sidedressed K for all preplant rates. Yield was maximized by the 135-lb K rate in 2017 and the 90-lb rate in 2018. Sidedressed K increased yield further only for preplant rates of 0 and 45 K_2O/acre. Yield increase from the preplant 45-lb rate was greater than from the 45-lb sidedressed rate without preplant K.

This report summarizes the results for soybean in 2018 and 2019. The soybean second year evaluated residual effects of broadcast K rates that had been applied for corn with or without reapplying sidedressed K.

Results and Discussion

Figure 1 shows in both trials there was a large soybean leaf K concentration response to all rates applied before corn. A large soybean leaf K response to K has been observed before, even in high-testing soils, which is explained by a high limit for K uptake of vegetative tissues. In the 2018 trial, leaf K increases were smaller as the K rate applied before corn increased. In the 2019 trial, further leaf K increases from sidedressed K were much smaller and similar for all rates applied before corn.

Figure 2 shows in both trials soybean grain yield increased with increasing K rates applied before the previous year corn crop (and without K sidedressing for the corn). In the 2018 trial, soybean yield with 90 and 135 lb K_2O/acre applied before corn reached the same maximum yield level of the high-testing plots. Yield increases were expected for all K rates applied before corn but not for the high-testing plots. Soil-test K before soybean was Low to Optimum for rates of 0 to 135 lb K_2O/acre applied for corn, and was High for the high-testing plots. In the 2019 trial, there was greater yield response to residual K from applications before corn, and yield for the 135-lb rate was only two bushels/acre less than for the high-testing plots. In this trial, soil-test K explains the soybean responses to residual K, because the test results were Low to the upper portion of the Optimum category for rates of 0 to 135 lb K_2O/acre applied before corn and was High for the high-testing plots.

The K rates suggested in ISU PM 1688 for a single application for corn-soybean rotations are 220 and 156 lb K_2O/acre for categories Very Low and Low, respectively, a removal-based rate for the Optimum category, and no K for the upper portion of the High category and for the Very High category. Because the initial soil-test K before corn was Low in low-testing areas of both trials, a rate of 156 lb K_2O/acre should have been applied to avoid yield loss of the following soybean. Figure 2 shows, however, that residual K from the 135-lb rate (lower than suggested) maximized soybean yield in 2018, and in 2019 was short of maximizing yield by only two bushels/acre. Corn yield had been maximized by rates of 90 or 135 lb K_2O/acre. Yield of both crops would have been maximized if the suggested K rate (156 lb) had been applied before corn.

Figure 2 shows additional K supply by sidedressing 45 lb K_2O/acre further increased soybean yield of the 2018 trial when 0, 45, or 90 lb K_2O/acre were applied before corn, but only the increase from the 45- and 90-lb rates attained the maximum yield of the higher rates. The sidedressed K was not sufficient to maximize yield when no K had been applied before corn. In the 2019 trial (Figure 2), sidedressed K further increased soybean yield when 0, 45, 90, or 135 lb K_2O/acre were applied before corn, but only the increase from the 90- and 135-lb rates attained yield to the maximum observed for the high-testing plots. Sidedressed K was not sufficient to maximize yield when 0 or 45 lb K_2O/acre had been applied before corn.

Conclusions

Broadcast K fertilizer rates applied only before corn slightly lower than the one-time application suggested by ISU for corn-soybean rotations would have maximized grain yield of both crops. Additional K by sidedressing liquid K fertilizer further increased soybean leaf K concentration for all K rates applied before corn. However, sidedressed K further increased soybean grain yield only when K rates much lower than recommended had been applied before corn. Therefore, producers should sidedress liquid K fertilizer only as a rescue option when appropriate preplant rates were not applied.

Acknowledgements

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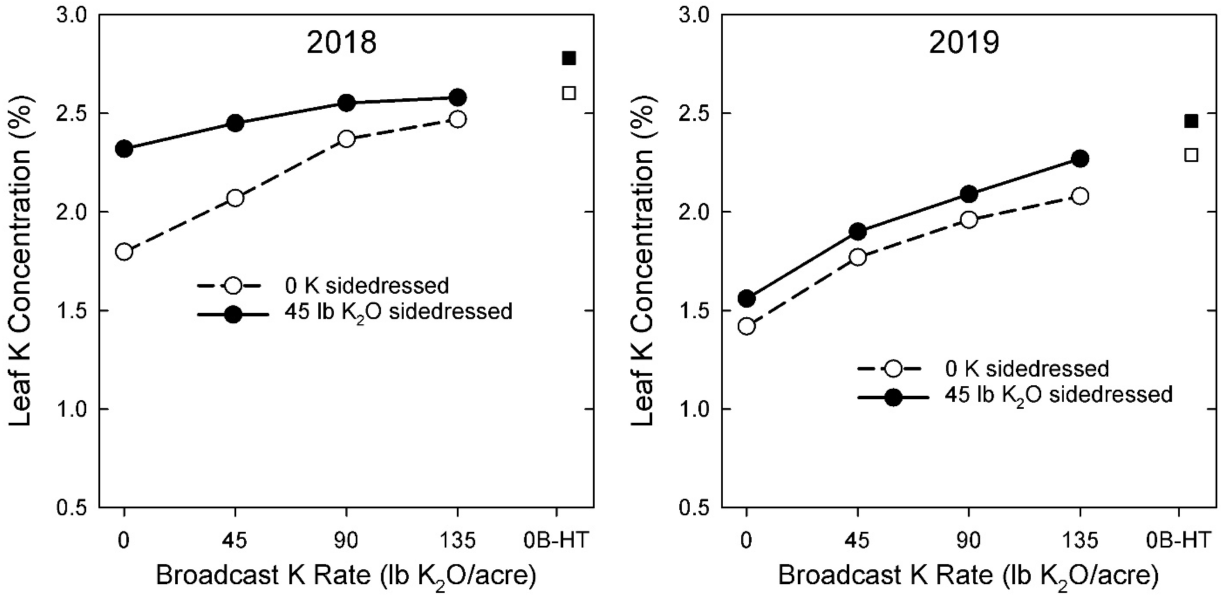

Figure 1. Soybean leaf K concentration responses in 2018 and 2019 trials to sidedressed liquid K fertilizer for broadcast rates of 0 to 135 lb K_2O/acre that had been applied to low-testing plots before the previous corn crop and for high-testing plots receiving no preplant K (0B-HT).

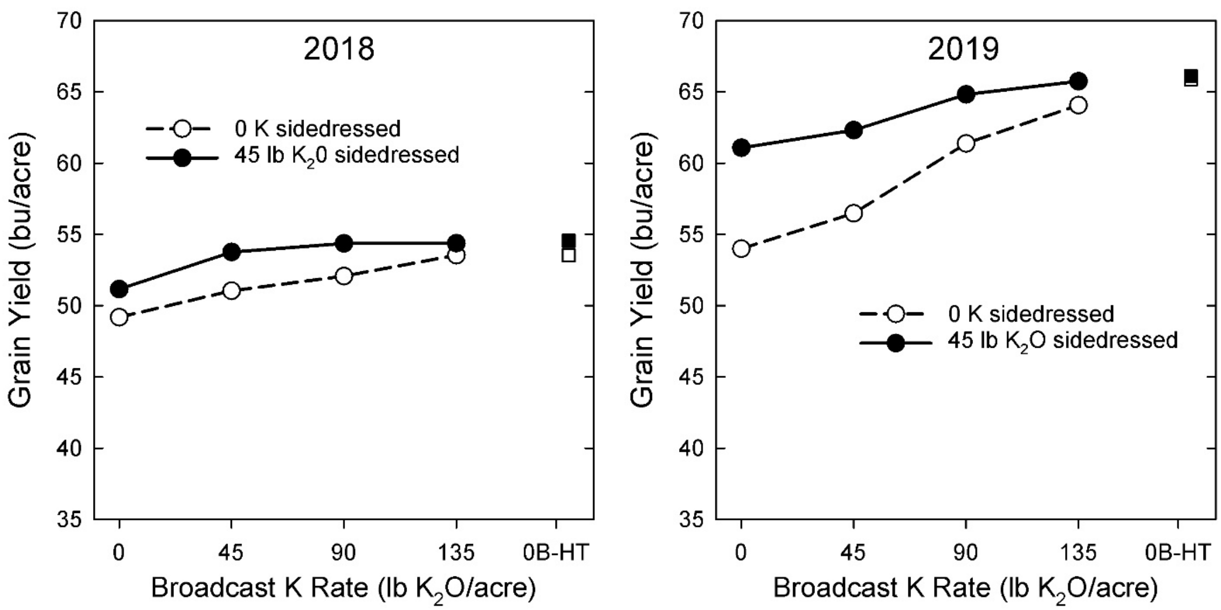

Figure 2. Soybean grain yield responses in 2018 and 2019 trials to sidedressed liquid K fertilizer for broadcast rates of 0 to 135 lb K_2O/acre applied to low-testing plots before the previous corn crop and for high-testing plots receiving no preplant K (0B-HT).