Soybean Response to Sidedressed Liquid Potassium Fertilizer in Northeast Iowa

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Introduction

Extensive research in Iowa has assessed the corn and soybean response to different potassium (K) fertilizer placement methods using granulated potash fertilizer (0-0-62), including a long-term experiment at this farm. However, no study had evaluated sidedressing K fertilizer for corn or soybean, although postemergence nitrogen sidedressing for corn is a common practice. Therefore, a study was initiated at the ISU Northeast Research Farm, Nashua, in 2017 to evaluate the value of sidedressed liquid K fertilizer for corn-soybean rotations.

Materials and Methods

The study consisted of two, 2-yr trials with corn in the first year and soybean in the second. One trial began in 2017 on an area with Kenyon loam soil and the other began in 2018 on an area with Kenyon and Floyd loam soils. Both trials were established on plots of previous K trials with management histories useful for this new study. There were four blocks in both trials, each with a large area testing Low and a small area testing Very High due to different past K fertilization rates, but otherwise similar management. For the first year of both trials (corn), four preplant K rates of 0, 45, 90, and 135 lb K_2O/acre (granulated potash 0-0-62) were broadcast in the spring before field cultivation to four plots located in the large low K testing area of each block. No preplant K was applied to the small high-testing area of each block. All five plots of each block had the same size (30 ft wide by 50 ft long). After planting corn, each plot was divided 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.

A previous report summarized the results for both corn trials. Preplant K rates of 90 and 135 lb K_2O/acre maximized corn yield in 2017 and 2018, respectively, and the yield level was similar to that of the high-testing plots. Sidedressed K increased corn ear-leaf K concentrations in plots that received the 90-lb preplant rate or less, but increased corn grain yield only when no preplant K was applied.

For soybean (second year of both trials), no preplant K was applied, and liquid K fertilizer was sidedressed at the V6 growth stage to the same subplots it had been sidedressed the previous year. Upper soybean trifoliate leaves were sampled at the R2-R3 growth stage and were analyzed for K concentration. Soybean grain yields were adjusted to 13 percent moisture. Therefore, the second year of both trials evaluated the residual effects of broadcast K rates that had been applied before the previous year corn with or without reapplying sidedressed K. This report summarizes the results for soybean in 2018 and 2019.

Results and Discussion

Soil samples (6-in. depth) were collected from plots of both trials before planting soybean and were analyzed for soil-test K by the ammonium-acetate and Mehlich-3 tests using the moist sample procedure. In the 2018 trial, soil-test K was 58, 69, 85 (all Low), 93 (Optimum), and 192 ppm (Very High) for plots that had received 0, 45, 90, and 135 lb K_2O/acre for the previous year corn and the

high-testing plots, respectively. In 2019, soil-test K for similar treatments was 67, 80 (both Low), 111 (Optimum), 149 (High), and 370 (Very High) ppm.

Figure 1 shows in both trials there was a large soybean leaf K concentration response to broadcast K that had been applied to the previous corn, with linear increases up to the highest rate (or soil-test K level). Sidedressed K increased leaf K concentrations further only for corn preplant rates of 90 lb K_2O/acre or less in 2018, but in 2019 increased leaf K for all corn preplant rates (including the high-testing plots). A large soybean leaf K response to K fertilization has been observed before, even in high-testing soils, because vegetative tissues have a high limit for K uptake, even when fertilization does not increase yield.

Figure 2 shows soybean grain yields were higher with increasing broadcast K applied to the previous corn crop. Rates of 90 and 135 lb K_2O/acre that had been applied to the previous corn maximized soybean yield in 2018 and 2019, respectively. Overall, yield increases were greater in 2019 than in 2018 for unknown reasons since the lowest soil-test K values did not differ much between the two years (rainfall has not been studied yet).

Additional soybean grain yield increases from liquid K sidedressed at 45 lb K_2O/acre were statistically significant only when preplant rates for the previous corn had been 45 lb K_2O/acre or less in 2018 and 90 lb K_2O/acre or less in 2019. Soil-test K of these plots was Low in both years except for the 90-lb corn preplant K rate that was Optimum. Soybean yield in 2018 was statistically similar for the high-testing plots and corn preplant K rates of 90 or 135 lb K_2O/acre with or without sidedressed K. In 2019, soybean yield was statistically similar for the high-testing plots and the 135-lb corn preplant K rate with or without sidedressed K.

Iowa State University (ISU) suggested 2-yr K application rates for the corn-soybean rotation applied once before corn are 220 and 156 lb K_2O/acre for soil-test categories Very Low and Low, respectively. A removal-based rate is suggested for soils testing Optimum, which would have been 134 lb K_2O/acre for these trials. Since soil-test K of the low-testing areas before corn of both trials was Low, 156 lb K_2O/acre should have been applied to avoid soybean yield loss in the second year, which is higher than the highest applied rate of 135 lb K_2O/acre. However, Figure 2 shows the residual K from 90 and 135 lb K_2O/acre applied to the previous corn maximized soybean yield in 2018 and 2019, respectively, without a need for additional sidedressed K application. These rates of 90 and 135 lb K_2O/acre also had maximized previous year corn yield in 2017 and 2018, respectively, without a need for sidedressed K fertilizer.

Conclusions

Results from two trials with corn-soybean rotations in low-testing soils at this location showed K fertilizer rates applied only before corn at slightly lower rates than suggested by ISU maximized grain yield of both crops without a need for sidedressed liquid K fertilizer. Sidedressed K for each crop often further increased leaf K concentrations when sufficient or deficient K rates had been applied before the previous year corn. However, additional sidedressed K further increased grain yield of either crop only when K rates much lower than suggested by ISU had been applied before the previous year 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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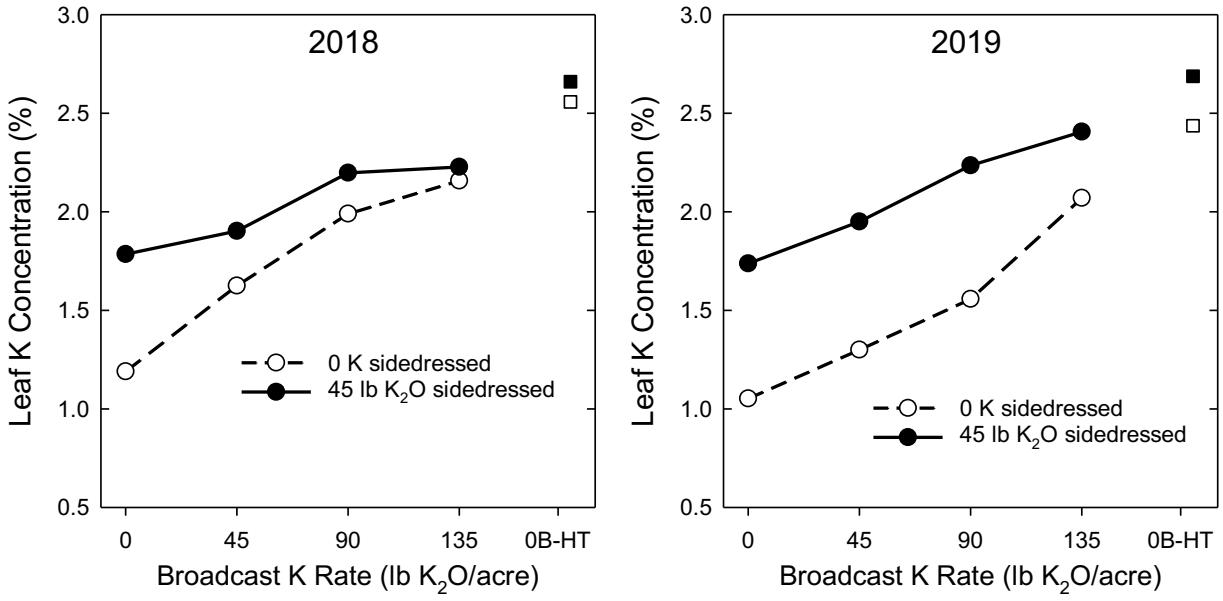

Figure 1. Soybean leaf K concentration responses in 2018 and 2019 to sidedressed liquid K fertilizer for broadcast rates of 0 to 135 lb K_2O/acre that had been applied to low-testing trial areas before the previous corn crop and for high-testing trial areas that received no preplant K (0B-HT).

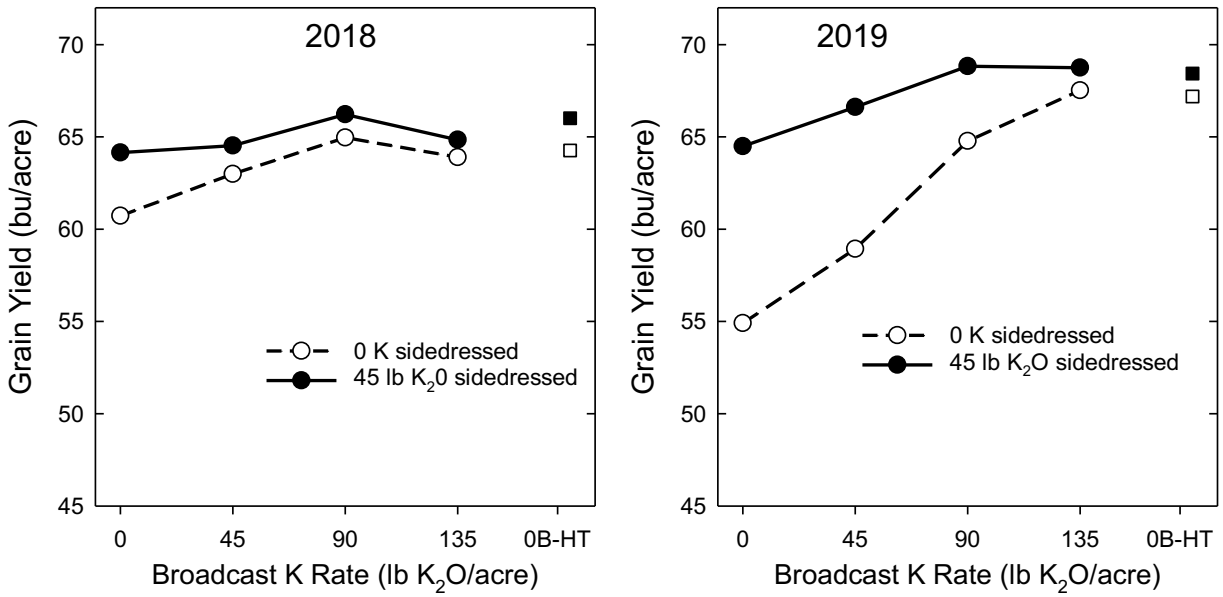

Figure 2. Soybean grain yield responses in 2018 and 2019 to sidedressed liquid K fertilizer for broadcast rates of 0 to 135 lb K_2O/acre that had been applied to low-testing trial areas before the previous corn crop and for high-testing trial areas that received no preplant K (0B-HT).