Corn Grain Yield and Leaf Potassium Concentration as Affected by Sidedressed Liquid Potassium Fertilizer in South Central Iowa

RFR-A18117

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Introduction

Iowa State University (ISU) extensive past and ongoing research at several research farms and farmer's fields has been investigating the corn and soybean yield response to preplant potassium (K) fertilizer placement methods or to starter K. Largely due to low grain prices, many farmers and crop consultants are asking whether post-emergence K sidedress could be of value to increase corn yield and perhaps reduce the needed K application rate. Post-emergence N sidedress for corn is used by many Iowa farmers, and its effectiveness compared with preplant N application has been compared in numerous trials. However, no ISU study has evaluated sidedress K application. Therefore, the objectives of a study at this research and demonstration farm and similar studies at four other farms was to evaluate how sidedressed liquid K fertilizer affects corn yield and K tissue concentrations when different rates of fertilizer are applied. This report summarizes the results of trials conducted at this research farm.

Materials and Methods

The study was conducted at two fields with a history of corn-soybean rotations managed with chisel-plow/disk tillage. One site (east field) had predominantly Haig silt loam soil, and the other field (west field) had Grundy silty clay loam soil. Two similar trials with corn were conducted in 2017 at the east field and in 2018 at the west field. The two trials at each field were adjacent to each other and had similar management histories, except from 2009 to 2013 when grain was harvested in one trial and both grain and residue were harvested in the other. Each trial had a large area that no K fertilizer had been applied since 2011 and smaller high-testing areas where an annual rate of 120 lb K_2O/acre had been applied until spring 2016 in the east field and spring 2017 in the west field.

Initial soil-test K (6-in. depth, ammonium-acetate test on dried samples) trials conducted in 2017 in the east field were slightly higher for areas with grain harvest than for areas with grain plus residue harvest (125 and 120 ppm for areas without recent K fertilization and 223 and 210 ppm for the high-testing areas). Initial soil-test K of the trials conducted in 2018 in the west field were slightly higher than for trials conducted in 2017, but the differences between the previous harvest management systems were similar (169 and 166 ppm for areas without recent K fertilization, and 231 and 211 ppm for the high-testing areas). According to ISU Extension publication PM 1688, soil-test K values of 120 and 125 ppm are borderline with the very low and low categories, values of 169 and 166 ppm are in the lower portion of the optimum category (for which removal-based K fertilization is recommended), and values of 210 to 231 ppm are in the high category.

There were 10 treatments replicated four times at each trial applied to plots measuring 20 by 50 ft. Eight treatments applied to the low-testing area of each trial were four K rates broadcasted in the spring before disking soybean residue (granulated potash 0-0-62

fertilizer at 0, 45, 90 and 135 lb K_2O/acre), each without or with sidedressed liquid K fertilizer. The liquid K (potassium acetate 0-0-24) was injected at 45 lb K_2O/acre to a depth of 3 to 4 in. at the center of each inter-row at the V6 growth stage. The two other treatments involved only sidedressed K (with/without) for plots located in the high-testing areas of each trial. Non-limiting N and P rates were applied across all trials. Corn Pioneer P1197AM was planted in all trials using a 30-in. spacing. The blades of corn ear leaves were sampled at the silking growth stage (R1) and were analyzed for the K concentration. Grain yield was adjusted to a 15 percent moisture content.

The initial soil-test K differences due to the different harvest management histories were small and within the normal spatial variation observed for a soil receiving a similar K fertilizer rate. Therefore, results presented in this brief report are for averages of the two adjacent trials conducted each year.

Results and Discussion

Figure 1 shows the results observed in 2017. This year was very dry in southern Iowa. In spite of the drought, all broadcasted preplant K increased corn ear-leaf K to the highest rate and the highest concentration was for the high-testing plots that did not receive preplant K fertilizer. The leaf K increases from the sidedressed liquid fertilizer at 45 lb K_2O/acre were very small and not statistically significant, which may be explained by the drought, even though it was injected.

The grain yield response to broadcast preplant K in 2017 was small (Figure 1). Yield increases over the control were 5, 12, and 5 bushels/acre for preplant rates of 0, 45, 90, and 135 lb K_2O/acre, and yield for the high-testing plots was lower than for the 90-lb rate and similar to the 45- and 135-lb rates. Salt effects with the high 135-lb rate might have occurred, given deficient soil moisture and rainfall because the broadcast K was applied in the spring. Plant population was not reduced, however, and salt effects are unlikely for the high-testing plots because no K was applied in fall 2016 or spring 2017. Liquid sidedressed K at 45 lb K_2O/acre approximately equalized yield for the low-testing areas to about the same highest yield observed for the 90-lb preplant rate, but did not increase yield in the high-testing plots. The yield increase from the sidedressed 45-lb K rate (9 bu) was greater than the increase with a similar preplant K rate (5 bu) compared with the low-testing non-fertilized control.

The 2018 crop year was very different from the previous year, because rainfall was slightly higher than normal. Figure 2 shows broadcast preplant K rates increased leaf K linearly up to the 135-lb rate and the highest concentration was for the high-testing plots. This year, leaf K concentration increases from sidedressed liquid fertilizer at 45 lb K_2O/acre occurred for the preplant rates of 0, 45, and 90 lb K_2O/acre and the increase from the sidedressed fertilizer was much smaller than the increase observed from a similar broadcast preplant K rate.

Figure 2 shows the corn yield levels in 2018 were much higher than the previous year. There was a large response to the broadcast preplant rate of 45 lb K_2O/acre (17 bu), and slightly higher yield for the higher preplant rates or the high-testing plots (2 to 6 bu higher) were not statistically significant. Liquid sidedressed K equalized yield for all preplant treatments to a level of 224 bushes/acre by increasing yield for the control receiving no preplant K (16 bu), slightly increasing yield for the 45- and 90-lb preplant rates (6 bu for both), and not increasing yield for the 135-lb rate and the high-testing plots. As in 2017, the yield increase from the sidedressed 45-lb K rate was greater (16 bu) than the increase with a similar preplant K rate (5 bu).

Conclusions

Results should be interpreted with caution because rainfall was very deficient in 2017, but was slightly higher than normal in 2018. The results showed the expected corn leaf tissue K and grain yield responses to preplant K fertilization, given initial soil-test K values and the interpretations and recommendations in ISU Extension publication PM 1688.

Liquid K fertilizer sidedressed at the V6 corn growth stage at 45 lb K_2O/acre did not increase leaf K concentration in 2017, but increased it in 2018, although the increase was smaller than for a similar preplant K rate. The liquid sidedressed K fertilizer increased corn grain yield in both years, mainly when the preplant K rate was lower than would have been recommended to maximize yield. In both years, and in contrast to results for leaf K concentrations, the liquid sidedressed K rate of 45 lb K_2O/acre increased yield more than a similar preplant K rate.

The observed lower efficacy of a low liquid sidedressed K rate than for a similar preplant K rate at increasing leaf K concentration but greater efficacy at increasing grain yield were results unique to this farm. The leaf K and yield responses at eight similar trials at four other research farms in 2017 and 2018 showed preplant K fertilization was more efficient than a similar sidedressed K rate at increasing both leaf K concentrations and grain yield. Corn growth and rainfall patterns are being studied in detail at this time for all trials because these could affect soil moisture, corn K uptake, and the effectiveness of K fertilization preplant and sidedressed.

Acknowledgements

We appreciate financial support by DuPont-Pioneer and the Fluid Fertilizer Foundation, and in-kind support by Nachurs Company.

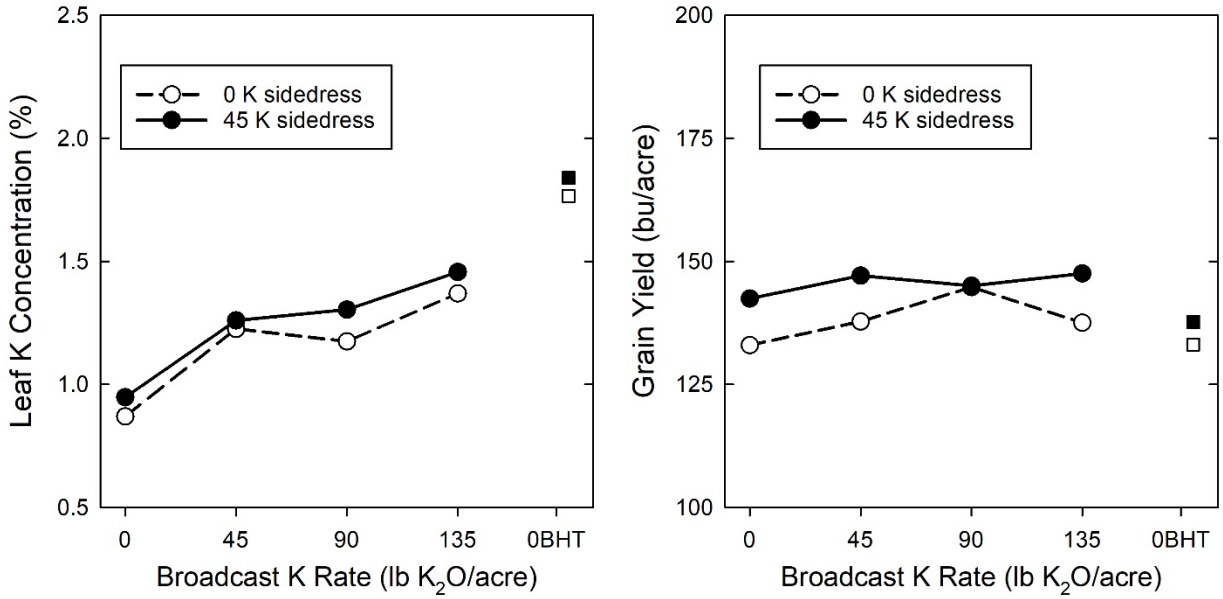

Figure 1. Corn ear-leaf K concentration and grain yield responses in south central Iowa to preplant broadcast granulated K fertilizer with or without sidedressed liquid K fertilizer injected at the V6 growth stage in 2017, and response to only sidedressed K in plots of each trial testing higher in K (0BHT) due to a history of large K application rates.

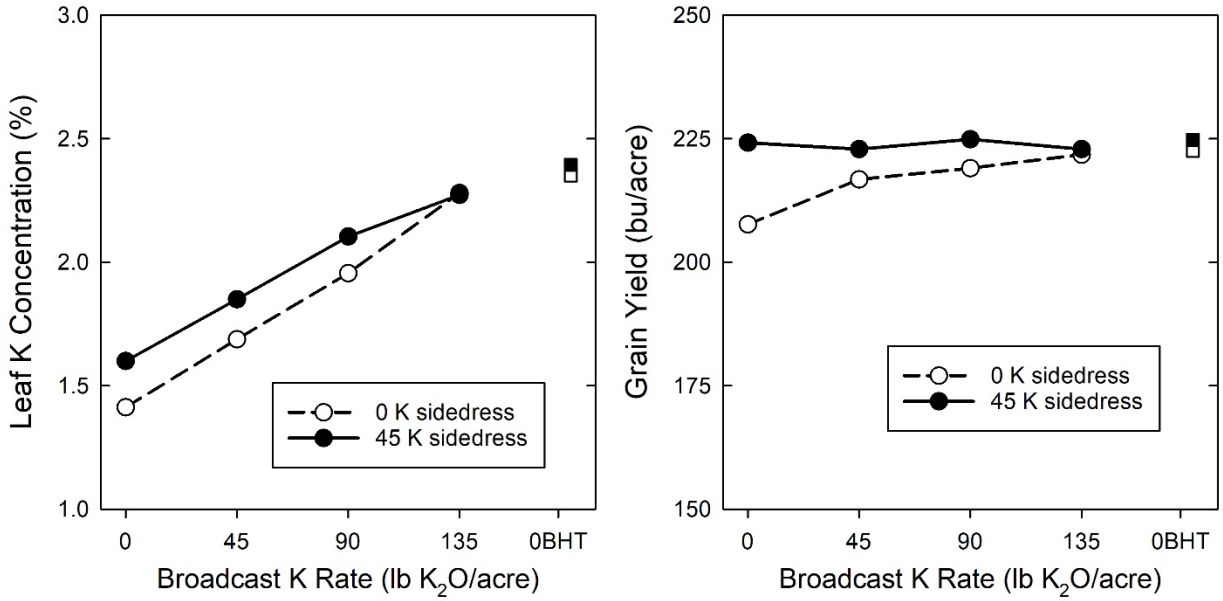

Figure 2. Corn ear-leaf K concentration and grain yield responses in south central Iowa to preplant broadcast granulated K fertilizer with or without sidedressed liquid K fertilizer injected at the V6 growth stage in 2018, and response to only sidedressed K in plots of each trial testing higher in K (0BHT) due to a history of large K application rates.