POTASSIUM FERTILIZATION OF CORN IN REDUCED TILLAGE PRODUCTION SYSTEMS

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ABSTRACT

Potassium (K) deficiency can be a problem on soils that have been managed with reduced tillage practices. The large amount of residue left on the soil surface can depress soil temperature and interfere with plant growth, nutrient uptake, and ultimately grain yield. Soil temperature influences both K up-take by root and K diffusion through the soil. The appearance of K deficiency in fields managed with conservation tillage systems has been reported with greater frequency in resent years and has become a concern for producers. In these experiments, addition of K to starters containing N and P was shown to improve early season growth, nutrient uptake, earliness, and yield of corn grown in a long-term ridge-tillage production system on soils that were not low in available K.

INTRODUCTION

The use of conservation-tillage has increased in recent years because of its effectiveness in conserving soil and water. Potassium (K) deficiency can be a problem on soils that have been managed with reduced tillage practices. The large amount of residue left on the soil surface can depress soil temperature early in the growing season Low soil temperature can interfere with plant root growth, nutrient availability in soil, and crop nutrient uptake. Soil temperature influences both K uptake by roots and K diffusion through the soil. Low soil water content or zones of soil compaction also can reduce K availability. Potassium uptake in corn is greatest early in the growing season and accumulates in plant parts at a relatively faster rate than either dry matter, N or P. Cool spring temperatures can limit early- season root growth and K uptake by corn.

In plant physiology, K is the most important cation not only in regard to concentration in tissues but also with respect to physiological functions. A deficiency in K affects such important physiological processes as respiration, photosynthesis, chlorophyll development, and regulation of stomatal activity. Plants suffering from a K deficiency show a decrease in turgor making resistance to drought poor. The main function of K in biochemistry is its function in activating many different enzyme systems involved in plant growth and development. Potassium also influences crop maturity and plays a role in reducing disease and stalk lodging in corn. The appearance of K deficiency in fields managed with conservation tillage systems has been reported with greater frequency in resent years and has become a concern for producers. Starter fertilizer applications have proven effective in enhancing nutrient uptake and yield of corn even on soils that are not low in available nutrients. The objective of these studies was to determine if

K applied as a starter at planting could improve K uptake and yield of corn on soils that had been managed in a ridge-tillage production system.

Two separate studies were conducted at the North Central Kansas Experiment Field. Both experiments were conducted on a Crete silt loam soil in areas that had been ridge-tilled since 1984. Both sites also were furrow irrigated. Potassium deficiencies had been observed in these two areas prior to the initiation of the studies. Ear leaf K concentrations had proven to be below published sufficiency ranges.

MATERIALS AND METHODS

Experiment 1.

This field experiment was conducted for three crop years, 2000-2002. Soil test results showed that initial pH was 6.2, organic matter was 2.4%, Bray-1 P and exchangeable K in the top 6 inches of soil were 40 and 420 ppm, respectively. Treatments consisted of the liquid starter fertilizer N-P_2O_5-K_2O combinations 30-15-5, 15-30-5 , 30-30-0 and 30-30-5. A no starter check also was included. Starters were made using 28% UAN, ammonium polyphosphate (10-43-0), and potassium thiosulfate (0-0-25-17). Nitrogen was balanced so that all plots received 220 lbs/a N regardless of starter treatment. On plots receiving no K as KTS, ammonium sulfate was included in order to eliminate sulfur as a variable. Starter fertilizer was applied 2 inches to the side and 2 inches below the seed at planting.

Experiment 2.

This experiment was conducted during the 2002-2003 growing seasons on a site that was lower in soil test K than the previous experiment. Analysis showed that initial soil pH was 6.9; organic matter was 2.5%; Bray-1 P was 35 ppm, and exchangeable K was 150 ppm. Treatments consisted of liquid starter fertilizer rates of 0, 5, 15 or 25 lbs/a K_2O applied in combination with 30 lb N, 15 lb P_2O5 and 5 lb/acre S. A 30-15-15-0 treatment was included to separate the effects of K and S. The K source used in this treatment was KCL. The source of K used in all other treatments was potassium thiosulfate. Starter fertilizer was again applied 2 inches to the side and 2 inches below the seed at planting. Nitrogen was balance on all plots to give a total of 220 lbs/acre. Both experiments were furrow irrigated

RESULTS

Experiment 1.

The 30-30-5 starter treatment increased corn 6-leaf stage dry matter and tissue K content decreased the number of days from emergence to mid-silk and increase grain yield as compared to the 30-30-0 treatment (Table 1). A small amount of K applied as a starter on this high soil test K soil resulted in better growth, nutrient uptake and 12 bu/a greater yield than starter that did not include K. In all cases, the 30-30-5 starter also was superior to the 15-30-5 treatment, indicating that N is an important element of starter fertilizer composition. All starter treatments improved growth and yield over the no-starter check.

Experiment 2.

Grain yield was maximized with application of 15 lbs of K_2O in the starter (Table 2). Addition of 15 lbs/a K_2O to the starter increased grain yield by 13 bu/acre over the starter

containing only N and P. No response to sulfur was seen at this site. All combinations improved yields over the no-starter check.

Even though soil test K was in the high range, addition of K in the starter fertilizer increased early season growth and yield of corn. At this site, 15 lbs/acre K_2O was required to reach maximum yield. In the previous experiment on a soil much higher in available K only 5 lbs/acre K was need to maximize yields.

CONCLUSION

Nutrient management in conservation tillage systems can be challenging. The increased amounts of crop residue present in these systems can cause early season nutrient deficiency problems that the plant may not be able to overcome later in the growing season. Early season P and K nutrition is essential for maximizing corn yield. In these experiments, addition of K to starters containing N and P has been shown to improve early season growth, nutrient uptake, earliness, and yield of corn grown in a long-term ridge-tillage production system.

Table 1. Starter fertilizer combinations effects on V6 dry weight, K uptake, days from emergence to mid-silk, and yield of corn, Experiment 1, 2000-2002.

Treatments $N-P_2O_5-K_2O$	V6 Dry Weight	V6 K Uptake	Days To Mid-Silk	Grain Yield
lb/acre	lb/acre			bu/acre
0-0-0 Check	210	6.2	79	162
30-15-0	382	10.9	71	185
15-30-5	355	15.2	71	173
30-30-0	395	11.2	71	184
30-30-5	460	15.2	68	195
LSD(0.05)	28	1.5	2	10

Table 2. Starter fertilizer combinations effects on V6 dry weight, K uptake, days from emergence to mid-silk, and yield of corn, Experiment 2, 2002-2003.

Treatments $N-P_2O_5-K_2O$	V6 Dry Weight	V6 K uptake	Days to Mid-Silk	Grain Yield
lb/acre	lb/acre			bu/acre
0-0-0-0 Check	208	6.9	82	161
30-15- 5-5	312	12.8	76	189
30-15-15-5	395	16.2	72	198
30-15-25-5	398	16.9	72	197
30-15-0	290	8.8	76	185
30-15-15-0	398	16.1	72	198
LSD(0.05)	31	1.9	2	11