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Potassium Fertilization Effects on Soil-Test Potassium and Yields of Corn and Soybeans

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Abstract
Iowa State University (ISU) interpretations for soil-test potassium (K) and fertilizer recommendations were updated in 2002. However, additional research is needed to confirm or continue improving the recommendations. The most significant change in the recommendations was to increase the soil-test K levels suggested for optimum crop production. The new interpretation classes (Very Low to Very High) and recommendations are explained in the ISU Extension publication Pm-1688, so details are not provided here. For example, the range of soil-test K values previously classified as Optimum (for which maintenance K fertilization is recommended) was 91 to 130 ppm (by the ammonium-acetate or Mehlich-3 K tests), but now this range is classified as Low and a higher K fertilization rate is recommended.

Disciplines
Agricultural Science | Agriculture | Agronomy and Crop Sciences

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Introduction

Iowa State University (ISU) interpretations for soil-test potassium (K) and fertilizer recommendations were updated in 2002. However, additional research is needed to confirm or continue improving the recommendations. The most significant change in the recommendations was to increase the soil-test K levels suggested for optimum crop production. The new interpretation classes (Very Low to Very High) and recommendations are explained in the ISU Extension publication Pm-1688, so details are not provided here. For example, the range of soil-test K values previously classified as Optimum (for which maintenance K fertilization is recommended) was 91 to 130 ppm (by the ammonium-acetate or Mehlich-3 K tests), but now this range is classified as Low and a higher K fertilization rate is recommended.

This two-year study was initiated in 2003 to evaluate K fertilization effects on soil-test K and yields of corn and soybeans grown in rotation. Similar treatments were used for two adjacent trials cropped with corn-soybean and soybean-corn sequences. The soil was Mahaska series in both areas. For the first-year crops, treatments were 0, 30, 60, 120, and 180 kg K_2O/acre (0-0-60 fertilizer applied in the fall). After harvesting the first-year crops, plots were divided into two halves and either no K fertilizer or 120 lb K_2O/acre were applied for the second crops. Soil-test K (ammonium-acetate test, 6-in.-depth samples) was measured before applying fertilizer treatments for each crop. Average initial soil-test K was higher (141 ppm) for the corn-soybean trial than for the soybean-corn trial (130 ppm). Cornstalks were chisel plowed in the fall and field cultivated in the spring. Soybean residues were also field cultivated in the spring. Crops were planted using a 30-in. row spacing.

Results and Discussion

Soil-test K results for samples collected before applying fertilizer treatments for the first crops showed moderate variability (Table 1). Values for the corn-soybean site were in the lower range of the current Optimum soil-test interpretation class. Soil-test K values for the soybean-corn site were in the upper range of the Low interpretation class.

Both first-year crops showed moderate grain yield responses to K fertilization. In corn, the 30-lb K_2O rate did not increase yield over the control and the 60-lb rate increased yield by about 10 bushels/acre. The 120-lb and 180-lb rates seemed to have increased yield further by 4 bushels/acre, but this effect was not statistically significant. For soybeans, each of the 30-, 60-, and 120-lb K_2O rates increased yield by about 2 bushels/acre. An apparent small additional yield increase (0.5 bu/acre) from application of the 180-lb rate was not statistically significant.

The results for the first-year crops were within expected crop responses because initial soil-test K values were borderline between the Low and Optimum classes. Current interpretations predict very likely moderate to large crop responses for the Low class and less likely moderate to small responses for the Optimum class. Potassium fertilization based on expected removal with harvest is recommended for the Optimum class. The K fertilization rates currently recommended for the soil-test K values and higher yield levels observed for the first year would have been 60 lb K_2O/acre for corn and 90 lb K_2O/acre for soybean, which are very close to rates that resulted in statistically maximum yields.

Application of the five initial K fertilizer treatments influenced soil-test K measured after harvesting the first crops (Table 1). As expected, the two highest K fertilizer rates built up soil K compared with initial values likely because the K applied was higher than the K removed by the first crops. Growing a second crop without adding K resulted in a small soil-test K decrease.

The grain yield response of the 2004 second-year corn (for the soybeans-corn trial) that received no additional K fertilizer (Table 1) was the expected result for a low-testing soil. There was a very

high yield response (more than 30 bu/acre) up to the highest K rate applied before the previous-year soybean crop. When 120 lb K_2O were applied, however, yields were very high and approximately similar for all previous-year treatments. The results showed that the 180-lb K_2O rate applied before the first-year soybean crop produced the highest yield of both crops of the sequence.

The grain yield response of the 2004 second-year soybean crop (for the corn-soybeans trial) was much smaller than expected (Table 1). All K fertilization rates resulted in a small yield increase (about 2 bu/acre) compared with yields of plots that received no K fertilizer in either of the two years. The results showed that K fertilizer rates of 60 or 120 lb K_2O applied for the first-year corn crop produced the highest yield for both crops of the sequence. A much smaller response of soybean compared with corn in 2004 cannot be explained with certainty. Perhaps it resulted from a combination of higher initial soil-test K for the corn-soybean trial and less K removal with grain harvest of the 2003 corn crop compared with the soybean crop of the same year (data not shown).

Conclusion

The results of this study confirmed that the 2002 decision to increase the suggested soil-test K levels for optimum corn and soybean production was appropriate. Both crops showed small to moderate responses to K fertilization when initial soil-test K levels were in the lower part of the current Optimum interpretation class, which were classified in the High class until 2002. Results also showed the viability of applying the K fertilizer needed for corn and soybean crops once prior to a first crop. Results also demonstrated a need to account for expected K removal with harvest in addition to soil-test K results when deciding about K fertilization.

Table 1. Effects of K fertilization on soil-test K and yields of corn and soybean for two cropping sequences during 2 years.

Corn-soybean sequence						Soybean-corn sequence					
	First year		Second year				First year		Second year		
Initial	Fertilizer	Corn		Soybean yield		Initial	Fertilizer	Soybean		Corn yield	
soil K†	K rate	yield	Soil K	No K	120 K_2O	soil K	K rate	yield	Soil K	No K	120 K_2O
ppm	lb K_2O/a	bu/acre	ppm	bu/acre		ppm	lb K_2O/a	bu/acre	ppm	bu/aacre	
137	0	189.8	130	58.5	62.2	125	0	45.7	127	178.3	210.2
140	30	185.7	135	61.3	62.2	132	30	47.5	127	188.9	216.2
142	60	198.4	144	61.1	60.2	130	60	49.0	130	189.4	218.1
144	120	202.4	145	61.5	61.5	129	120	50.9	135	196.9	213.1
141	180	202.4	151	60.8	59.7	132	180	51.4	148	211.6	227.2

† Soil-test K variation for samples collected from the experimental areas before applying the first K fertilizer treatments.