Effects of Broadcast and Phosphorus and Potassium Placement on Yield of Corn and Soybean Managed with Tillage or No-Tillage

RFR-A1594

Antonio Mallarino, professor
Department of Agronomy
Bernard Havlovic, farm superintendent (retired)
Daniel Schaben, ag specialist

Introduction

No-tillage systems limit the incorporation of crop residue and fertilizer with soil, which results in wetter and colder soils in early spring and accumulation of organic matter, phosphorus (P), and potassium (K) near the soil surface. Banding of P and K could be more effective than broadcast fertilization by applying nutrients below the soil surface. Therefore, a long-term study was established in 1994 to evaluate P and K fertilizer rates and placement methods for grain yield of corn and soybean managed with no-till and chisel-plow/disk tillage. The study evaluated broadcast, planter-bands, and deep bands until 2001 when the deep-band treatment was discontinued. This report summarizes results since 2002.

Materials and Methods

The study consists of separate P and K trials on areas with Marshall soil. Corn and soybean were planted using a 30-in. row spacing on adjacent areas with identical design so that crops switch sides each year to complete a rotation. The tillage consists of chisel-plowing cornstalks in the fall and disking for both crop residues in the spring. Since 2002, the P and K placement methods have been broadcast and banded with the planter using granulated triple superphosphate and potassium chloride. The broadcast treatments are applied in the fall or spring and planter bands are placed 2 in. below and 2 in. beside the seeds. Fertilizer rates for both placement method are a control, one-half the estimated maintenance rate (28 lb P_2O_5/acre or 35 lb K_2O/acre) and the full rate (56 lb P_2O_5/acre or 70 lb K_2O/acre) applied annually. Other broadcast treatments are twice the maintenance rate applied once before either crop (112 lb P_2O_5/acre or 140 lb K_2O/acre) and these rates applied annually.

Results and Discussion

Tillage effects. Soybean grain yield seldom has been affected by tillage. Corn yield often has been higher with tillage than with no-till in normal or wet years but often has been higher with no-till in drought years. Therefore, long-term averages show little difference between tillage systems. Calculations from data in Tables 1 and 2 show that since 2012, yield differences between the tillage treatments were less than 2 bushels/acre. During the last four years, however, corn yield was 7 bushels/acre lower with no-till.

Phosphorus and potassium effects. Initial soil-test P for the P trial areas was Optimum in 1994. Values for the control plots decreased to Low in 2003 and to Very Low in 2010. Therefore, yield response to P has increased over time. Table 1 and 2 show that in recent years the 56-lb rate applied annually or twice this amount applied every year has maximized corn or soybean yield with either tillage system or placement method. The P application method has not significantly affected grain yield of any crop. Interestingly, as was observed before at this study, the yield difference between the non-fertilized and fertilized treatments was greater for no-till than for plots managed with tillage.

At the K trial site, the initial soil-test K values were in the High interpretation category, and values of the control plots have decreased to between Optimum and High. Therefore, data in Tables 1 and 2 show small yield increases began to be observed in the recent years for corn but not soybean. The K fertilizer placement methods have not differed.

Conclusions

Soybean grain yield has not been different for no-till and chisel-plow/disk systems. Corn yield was not consistently affected by tillage in the early years, but recently has been lower with no-till. Phosphorus fertilization began increasing yield when soil-test values of non-fertilized plots decreased into the Low interpretation category. Initially high soil-test K has decreased to a value borderline between High and Optimum in the non-fertilized plots, so no consistent yield responses to K have been observed. The broadcast and planter-band P or K placement methods have not differed for any crop or tillage system.

Acknowledgements

We appreciate financial support by the International Plant Nutrition Institute, Potash Corp., and seed donation by Monsanto Company.

Table 1. Phosphorus placement and application rate effects on crop yield.

		Placement method and rate (lb P_2O_5/acre)						
			Broadcast				Planter band	
Period	Tillage	Control	28	56	56b	112	28	56
		Corn yield (bu/acre)						
2002-15	Chisel-disk	179	187	189	191	190	185	187
	No-till	174	185	188	187	189	182	185
2012-15	Chisel-disk	182	194	203	201	201	194	197
	No-till	174	189	195	196	202	184	191
		Soybean yield (bu/acre)						
2002-15	Chisel-disk	57.1	60.1	59.6	59.5	61.4	59.6	59.7
	No-till	56.7	60.6	62.2	61.3	61.3	59.2	60.8
2012-15	Chisel-disk	61.5	66.1	64.7	65.5	67.9	65.3	65.7
	No-till	58.1	61.8	65.8	62.6	64.7	59.0	62.7

56b = twice the annual 56 lb-rate applied once for the 2-year rotation.

Table 2. Potassium placement and application rate effects on crop yield.

		Placement method and rate (lb K_2O/acre)						
			Broadcast				Planter band	
Period	Tillage	Control	35	70	70b	140	35	70
		Corn yield (bu/acre)						
2002-15	Chisel-disk	183	185	188	189	190	186	186
	No-till	185	190	189	191	191	192	189
2012-15	Chisel-disk	190	197	199	202	194	200	198
	No-till	194	200	198	198	192	200	198
		Soybean yield (bu/acre)						
2002-15	Chisel-disk	56.4	55.6	55.5	55.9	54.5	56.5	55.6
	No-till	58.4	58.2	58.0	57.1	58.2	59.1	58.8
2012-15	Chisel-disk	61.1	62.2	60.6	61.2	60.7	61.1	60.5
	No-till	60.6	62.5	61.4	60.2	61.1	62.6	63.5

140b = twice the annual 70 lb/acre applied once for the 2-year rotation.