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Introduction

No-till management results in little or no incorporation of crop residues and fertilizer into the soil. Subsurface banding phosphorus (P) and potassium (K) fertilizers could be more effective than broadcast fertilization because both nutrients accumulate at or near the soil surface. A long-term study has been conducted at this farm to evaluate P and K fertilizer placement for corn and soybean managed with no-till and chisel-plow tillage.

Materials and Methods

Separate trials for P and K have been conducted with corn-soybean rotations since 1994 on an area with Galva and Primghar soils. Both crops are grown each year on adjacent areas and are planted with a 30-in. row spacing. Tillage for cornstalks consists of chisel-plowing in the fall and field cultivating in the spring, but only field cultivating soybean residue in the spring. The planter has row cleaners and fertilizer attachments. Fertilizer placement methods were broadcast, deep-band, and planter-band until 2001, when deep banding was discontinued. This report includes data collected since 2002 for the broadcast and planter-band methods.

The fertilizers used are triple superphosphate and potassium chloride. The broadcast treatments are applied in the fall, and the planter bands are placed 2 in. below and 2 in. beside the seeds. Fertilizer rates for each 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 maintenance rate (56 lb P_2O_5/acre or 70 lb K_2O/acre) applied annually. Other broadcast treatments are twice the full maintenance rate applied only once before corn or soybean for the two-year rotation (112 lb P_2O_5/acre or 140 lb K_2O/acre) and the same rate applied annually.

Results and Discussion

Tillage effects. Corn yield has been higher with tillage than with no-till since the beginning of the study, but soybean yield has only been slightly higher with tillage or has not differed. In the last four years, the average difference in favor of tillage across all treatments shown in Tables 1 and 2 was 26 bushels/acre for corn and 4 bushels/acre for soybean. The yield difference has been larger with cool and wet spring weather and tended to increase over time.

Fertilizer placement methods and rates. Phosphorus (Table 1) increased grain yield greatly because the initial soil-test P was low, and levels for the control plots had decreased to the Very Low class by the late 1990s. In the early years, there was no difference between the P rates applied, but since the early 2000s the higher rates (56 or 112 lb P_2O_5/acre) have increased yield more than the low rate. Application of 56 lb/acre every year or 112 lb/acre once for the two-year rotation have not differed consistently. The increases have been greater for no-till than with tillage. The 56-lb annual rate had increased soil-test P to the optimum class by the late 1990s and to the lower range of High by 2006. However, there has been no large or consistent differences between the P broadcast and band placement methods. Planter-band P has increased early crop growth significantly more than broadcast P, especially for no-till corn.

Potassium (Table 2) has not increased soybean yield, but has slightly increased corn yield since the middle 2000s, although the different application rates have not differed. The relative increases have been greater for no-till than with tillage. No yield response to K was expected initially because soil-test K was in the High class, but over time levels of the control plots have decreased to the Optimum class where small responses are expected. However, there has been no yield difference between broadcast and planter-band K application for any crop.

The tillage treatments have had little or no effect on soybean yield but corn yield has been higher with tillage. Phosphorus fertilization has increased yield greatly in this initially low-testing soil, but K fertilizer began increasing yield recently once the initially high soil-test K of the control plots decreased into Optimum category. However, the broadcast or planter-band P or K placement methods have not differed consistently for any nutrient or crop.

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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	143	186	197	199	201	193	200
	No-till	113	172	183	184	185	176	184
2012-15	Chisel-disk	150	196	214	212	219	212	218
	No-till	112	182	189	193	199	183	196
		Soybean yield (bu/acre)						
2002-15	Chisel-disk	44.7	56.0	58.0	58.2	58.7	57.2	58.7
	No-till	41.0	54.0	57.0	57.2	57.0	55.0	56.3
2012-15	Chisel-disk	45.4	56.9	59.9	59.9	61.3	58.3	60.3
	No-till	41.0	52.8	56.0	57.3	56.8	54.1	56.4

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	176	181	183	184	186	185	184
	No-till	152	167	168	171	169	166	170
2012-15	Chisel-disk	197	210	209	217	216	214	210
	No-till	152	184	187	191	189	181	190
		Soybean yield (bu/acre)						
2002-15	Chisel-disk	53.5	54.4	54.1	53.4	54.7	54.3	53.8
	No-till	51.4	53.4	53.7	53.3	53.0	52.6	52.7
2012-15	Chisel-disk	58.3	58.6	60.0	57.1	58.5	58.8	59.1
	No-till	54.0	55.0	57.2	55.6	56.1	55.6	54.9

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