

2003

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Recommended Citation

Mallarino, Antonio P. and Van Dee, Kevin, "Phosphorus and Potassium Placement for Corn and Soybeans Managed with No-till and Chisel-Plow Tillage" (2003). *Iowa State Research Farm Progress Reports*. 1535.

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Phosphorus and Potassium Placement for Corn and Soybeans Managed with No-till and Chisel-Plow Tillage

Abstract

This study was initiated in 1994 to evaluate P and K fertilizer placement methods for corn and soybeans managed with no-till and chisel-plow tillage. The study consists of four trials: P for corn, P for soybeans, K for corn, and K for soybeans. Corn and soybeans are grown in a rotation by alternating crops each year between adjacent areas with Mahaska and Nira soils. Treatments are applied for both crops. Cornstalks of plots managed with chisel-plow tillage are chisel plowed in the fall and field cultivated in the spring, whereas soybean residues are field-cultivated in the spring. Crops are planted using 30-inch row spacing, Yetter bubble-type coulters, Yetter 2976 series dry fertilizer coulters, and Martin residue managers.

Keywords

Agronomy

Disciplines

Agricultural Science | Agriculture | Agronomy and Crop Sciences

Phosphorus and Potassium Placement for Corn and Soybeans Managed with No-till and Chisel-Plow Tillage

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Materials and Methods

This study was initiated in 1994 to evaluate P and K fertilizer placement methods for corn and soybeans managed with no-till and chisel-plow tillage. The study consists of four trials: P for corn, P for soybeans, K for corn, and K for soybeans. Corn and soybeans are grown in a rotation by alternating crops each year between adjacent areas with Mahaska and Nira soils. Treatments are applied for both crops. Cornstalks of plots managed with chisel-plow tillage are chisel plowed in the fall and field cultivated in the spring, whereas soybean residues are field-cultivated in the spring. Crops are planted using 30-inch row spacing, Yetter bubble-type coulters, Yetter 2976 series dry fertilizer coulters, and Martin residue managers.

The fertilizer placement methods are: broadcast, deep-banded (both applied in the fall), and planter banded. Deep bands are applied 30 inches apart and 5–7 inches deep, and crop rows are placed on top of the knife tracks. Planter bands are applied about 2 inches below and beside the seeds. Fertilization rates are: check, a coulters-knife check, the average P and K maintenance needs (56 lb P_2O_5 /acre or 70 lb K_2O /acre), and one-half maintenance amounts. The deep-banded treatment was discontinued in 2001, although its residual effect on yield continues to be evaluated.

Results and Discussion

Corn yields were similar for both tillage systems until about 1996. Since then, yields have been higher for the chisel-plow tillage except for 1998. That year, no-till corn that was smaller at the time of a strong windstorm was less affected by green snap. Over all nine years of the study, fertilized no-till crops yielded less than crops managed with chisel-plow tillage (5.5 bushels/acre less for corn and 1.8 bushels/acre less for soybeans).

When fertilizer treatments increased crop yield, there were no significant differences between the fertilizer P or K rates. For this reason, yields for fertilizer treatments shown in Table 1 are the

averages across the rates. Yields for the checks are averages of the check and coulters-knife check because these treatments did not differ consistently.

There has been little and inconsistent response to P fertilization, although the 9-year averages show a small response to banded P. The lack of response can be explained by initially high soil-test P. The P level of nonfertilized plots had decreased to a value borderline between the Low and Optimum categories by fall 2001; therefore, larger responses to P are expected in the future.

Both crops have shown significant yield responses to K fertilization, although corn responses have been greater (about 10 bushels/acre) and more consistent. This large response was not expected because initial soil-test K values were borderline between the Optimum (90–130 ppm) and High (130–170 ppm) categories. Soil-test K of unfertilized plots decreased to the Optimum categories by fall 2001. These results, combined with results of many other field trials, have led to an update of the Iowa State University K recommendations. The new interpretations recommend maintaining a soil-test K range of 130–170 ppm for these crops.

Long-term yield responses to K fertilizer have been slightly more for band placement than for the broadcast placement (2–3 bushels/acre for corn and 1–2 bushels/acre for soybeans). Moreover, there was a small overall advantage for the deep-banded method. The advantage of deep-banded K for no-till corn has been greater at other locations, and has been linked to dry topsoil in late spring and early summer. New recommendations suggest deep banding of K for no-till crops, but recognizes that the yield advantage often will be small and may not offset increased application costs (which was the case at this farm).

The results have confirmed that little or no response to P fertilizer should be expected in soils testing Optimum or higher in soil-test P. However, responses to K fertilizer supported an update of ISU K fertilizer recommendations,

which beginning in 2003 suggest maintaining higher soil-test K values. The results also showed that yields of corn and soybeans are slightly more for chisel-plow tillage compared with no-till. Differences between fertilizer placement methods

have been small, and banding has not consistently reduced this difference. Studies at other Iowa locations have shown more consistent responses of no-till crops to deep-banded K. This experiment will continue.

Table 1. Effects of tillage and phosphorus and potassium fertilizer placement on corn and soybean yields.

Tillage	Year	Phosphorus experiment				Potassium experiment			
		Check	Placement method†			Check	Placement method†		
		Check	Broadcast	Deep-band	Plntr-band	Check	Broadcast	Deep-band	Plntr-band
----- Corn yield (bu/acre) -----									
Chisel	1994–2000	152	153	152	152	151	159	162	158
	2001	117	120	123	115	116	119	124	127
	2002	190	189	184	195	181	188	192	193
	1994–2002	153	153	152	152	150	158	161	159
No-till	1994–2000	149	149	151	152	148	155	159	157
	2001	106	105	112	110	113	120	123	121
	2002	156	160	154	164	156	162	162	172
	1994–2002	145	145	147	149	145	152	155	154
----- Soybean yield (bu/acre) -----									
Chisel	1994–2000	54.8	55.9	55.8	55.5	54.2	56.1	56.3	55.2
	2001	51.9	51.9	52.9	53.2	48.3	52.5	53.7	51.3
	2002	56.9	56.0	55.1	55.4	52.1	57.7	57.5	55.4
	1994–2002	54.7	55.5	55.4	55.3	53.3	55.9	56.1	54.8
No-till	1994–2000	54.3	55.0	54.2	55.9	55.1	55.1	56.3	55.4
	2001	51.6	53.1	52.1	53.1	47.2	51.9	55.6	51.0
	2002	39.8	41.8	44.0	43.0	45.0	44.4	45.5	42.2
	1994–2002	52.4	53.3	52.8	54.2	53.1	53.5	55.0	53.5

†The deep-banded treatment was discontinued in 2001, and residual effects have been evaluated since that year.