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Corn-Soybean Cropping Sequences in the Kansas River Valley

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Much of the corn in the Kansas River valley is continuous corn. Research in other areas has shown that corn following a previous soybean crop yields more than corn following corn. It is likely that at least some of this yield increase is attributable to nitrogen fixed by the previous soybean crop when N is insufficient on corn following corn. Research has also shown that soybeans grown in a cropping sequence with corn or grain sorghum yield more than continuous soybeans.

Procedure

A study conducted at the Kansas River Valley Experiment Field from 1979 through 1987 was designed to evaluate various corn-soybean cropping sequences and nitrogen rates. The cropping sequences included continuous corn and soybeans, first and second year corn following soybeans, soybeans following 1 year of corn, and soybeans following 2 years of corn. The continuous soybeans and each corn crop received annual applications of nitrogen at 0, 75, 150, and 225 pounds per acre. The soybeans in the cropping sequence received no nitrogen, but were evaluated for their response to possible residual N from the treatments applied to the previous corn crop(s).

The plots were initiated in 1978, so the 1979 data did not include the 3-year cropping sequences. The plots were disked and chiseled in the fall when weather con-

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ditions permitted and were disked in the spring when a preplant, incorporated herbicide was applied. Corn was planted at 26,200 seeds per acre in 30-inch rows and soybeans were planted at 10 seeds per foot of 30-inch row. Corn hybrids planted were: Bo-Jac 56-1979-1982; Bo-Jac 601—1983; and Pioneer Brand 3377-1983-1987. Soybean varieties planted were: Union—1979-1981; Douglas-1982, 1985, 1986; Desoto- 1983- 1984; and Sherman—1987. The nitrogen fertilizer treatments were applied in early April as anhydrous ammonia. Corn was planted in mid-April and soybeans in early May. Fertilizer (130 lbs 8-32-16/a) was banded at planting on all corn and soybean plots. Herbicides were applied preplant, incorporated, and a corn rootworm insecticide was applied in the furrow at planting. Both crops were cultivated and furrowed for

Table 1. Effect of annual cropping sequence and N rate on corn yield.

Cropping Sequence[1]	N Rate	Yield							
		1979	1982	1983	1984	1985	1986	1987	Avg
	lbs/a	— bu/a —							
Soybeans-Corn	0	146	108	93	89	154	125	101	117
	75	149	147	118	168	166	163	126	148
	150	157	146	137	158	180	161	145	155
	225	155	137	127	160	188	149	149	152
Corn-Soybeans-Corn	0	105	124	118	-	124	116	81	111
	75	148	160	118	-	178	157	147	151
	150	159	161	134	-	180	168	157	160
	225	145	141	150	-	169	150	128	147
Soybeans-Corn-Corn	0	-	78	59	58	-	82	48	65
	75	-	132	114	138	-	162	135	136
	150	-	143	133	161	-	169	143	150
	225	-	135	132	149	-	161	141	144
Continuous Corn	0	80	77	63	57	72	66	49	66
	75	125	126	102	134	150	151	110	128
	150	137	142	126	169	170	168	139	150
	225	135	126	120	155	166	154	138	142
LSD (.05)		NS	NS	NS	21	30	21	20	15
Cropping Sequence Means:									
Corn-Soybeans		152	135	119	144	172	149	130	143
Corn-Soybeans-Corn		140	146	130	—	163	148	128	142
Soybeans-Corn-Corn		—	122	109	127	—	143	117	124
Continuous Corn		119	118	102	129	139	135	109	122
LSD (.05)		14	NS	15	NS	24	NS	7	14
Nitrogen Means:									
	0	111	97	83	68	117	97	70	90
	75	141	141	113	147	165	158	130	141
	150	151	148	133	163	177	167	146	154
	225	145	135	132	155	174	153	139	146
LSD (.05)		15	11	14	12	17	10	10	7

[1]Yields are for the final corn in the cropping sequence listed.

irrigation and irrigated as needed. Crops were harvested with a combine adapted for plot harvesting.

In 1979, 1981, and 1982, total dry matter and N content at physiological maturity were measured on the 0 N plots of the corn following soybeans and continuous corn plots in an effort to evaluate the amount of N contributed by the previous soybean crop.

Results

Corn Yields. Yields were depressed by hot weather in 1980 and by hail in 1981, but were good in 1979 and from 1982-87 (Table 1). Because of the poor yields in 1980 and 1981, these years were not included in the average. Corn following soybeans with no applied ni-

Table 2. Effect of annual cropping sequence and N rate on soybean yield.

Cropping Sequence[1]	N Rate	Yield								
		1979	1980	1982	1983	1984	1985	1986	1987	Avg
	lbs/a	—bu/a—								
Corn -Soybeans	0	60.4	57.3	69.9	60.9	59.8	57.7	74.5	61.0	62.7
	75	60.4	52.7	64.8	61.0	64.2	55.4	67.3	60.3	60.8
	150	57.8	55.3	66.0	61.9	59.1	54.9	71.2	62.1	61.1
	225	58.0	56.7	66.6	58.4	57.9	55.5	66.0	62.5	60.2
Corn -Corn -Soybeans	0	—	59.4	65.5	65.6	65.7	50.6	67.8	67.6	61.6
	75	—	54.1	68.5	64.6	64.1	56.3	61.2	70.8	62.8
	150	—	59.5	69.2	63.0	67.9	53.4	64.4	70.1	62.9
	225	—	56.0	63.3	61.5	67.1	58.5	64.0	65.4	61.5
Continuous Soybeans	0	58.6	54.0	63.2	65.9	45.8	53.9	60.7	68.8	58.9
	75	58.8	50.4	57.2	62.9	47.0	53.3	62.7	68.0	57.5
	150	61.4	54.6	58.8	61.8	44.0	54.5	65.0	63.3	57.9
	225	60.9	48.7	58.9	59.3	35.8	51.4	61.9	60.8	54.7
LSD (.05)		NS	NS	NS	NS	NS	4.6	NS	NS	NS
Cropping Sequence Means:										
Corn-Soybeans		59.1	55.5	66.8	60.5	60.3	55.9	69.8	61.5	61.2
Corn-Corn-Soybeans		—	57.2	66.6	63.6	66.2	54.7	64.3	68.5	62.2
Continuous Soybeans		59.9	51.9	59.5	62.4	43.1	53.3	62.6	65.2	57.2
LSD (.05)		NS	3.5	3.3	NS	5.5	NS	5.3	2.9	1.5
Nitrogen Means:										
	0	58.7	56.9	66.2	64.1	57.1	54.0	67.7	65.8	61.1
	75	60.1	52.4	63.5	62.8	58.4	55.0	63.7	66.4	60.4
	150	58.8	56.5	64.6	62.2	57.0	54.2	66.9	65.2	61.6
	225	59.2	53.8	62.9	59.7	53.6	55.1	64.0	62.9	58.8
LSD (.05)		NS	3.2	NS	2.6	NS	NS	NS	NS	NS

Table 3. Effect of cropping sequence on total dry matter and total N uptake.

Cropping Sequence[1]	Total Dry Matter			Total N Uptake		
	1979	1981	1982	1979	1981	1982
	lbs/a			—bu/a—		
Soybeans-Corn	16408	14528	10303	122.4	151.8	95.1
Corn-Soybeans-Corn	—	11513	11116		111.0	111.5
Soybeans-Corn-Corn	—	10567	8345		103.7	66.8
Continuous Corn	11783	10804	8280	65.3	107.7	66.2
LSD (.05)	909	NS	2021	55.6	NS	19.1

[1]Dry matter and N uptake are for the final corn in the cropping sequence listed.

trogen yielded from 30 to 82 bushels per acre more than continuous corn (51 bu/a avg.). The addition of 75 pounds N per acre decreased this average yield differential to 20 bushels per acre. There was still a slight trend of increased yield for corn following soybeans at the 150 pounds N per acre rate. However, these yield advantages disappeared in second year corn after soybeans. Nitrogen fertilization up to 150 pounds N per acre increased yields in all years, with no significant increase in yield occurring with the next 75 pound N per acre increment (225 lb N/a).

Soybean Yields. Yields were good except in 1981 when hail occurred (Table 2). Soybean yields were not affected by the hot weather in 1980, as corn yields were. Soybeans following corn have yielded more than continuous soybeans by an average of 4.0 bushels per acre (ranging from -3.7 to 17.2 bushels per acre). The yield advantage for soybeans following corn in 1982 and 1984 was attributed partly to a high infestation of eastern black nightshade in the continuous soybeans. This emphasizes the advantage of using a cropping sequence to help control weeds that could become problems in a monoculture system. Granular Lasso was applied over the row from 1983 to 1987 in an effort to control the black nightshade. Good control was obtained in 1983 and 1985 to 1987, but control was poor in 1984. Application of 225 pounds N per acre significantly decreased yields of continuous soybeans in 1984 (caused mainly by more black nightshade), but the same trend was evident in other years.

Nitrogen Uptake. The data collected in 1979, 1981, and 1982 indicate that corn following soybeans with no applied N had more total dry matter and more N uptake than continuous corn. Corn following soybeans ranged from 28.9 pounds more total N uptake than continuous corn per acre in 1982 to 57.1 lb/a in 1979, with 1981 being intermediate. However, the 1981 data were collected from corn that received significant hail damage, and the 1982 data were collected from corn following soybeans, which yielded well but had been heavily defoliated by hail in 1981. If the N uptake figures for these two years are discounted, and the value obtained in 1979 is compared to the 1978 soybean yield, the result is approximately 1 pound of N produced per bushel of previous soybean crop. This agrees closely with values previously reported in the literature.

Summary

Yields of corn following a previous soybean crop averaged 51 bushels per acre higher than yields of continuous corn when no N was applied. This yield advantage decreased as N fertilization rate increased to 150 pounds N per acre. Soybeans following corn yielded an average of 4 bushels per acre higher than continuous soybeans. Nitrogen uptake data suggest that 1 pound of N per bushel of soybeans can be supplied to a subsequent corn crop, when no N fertilizer is applied.

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