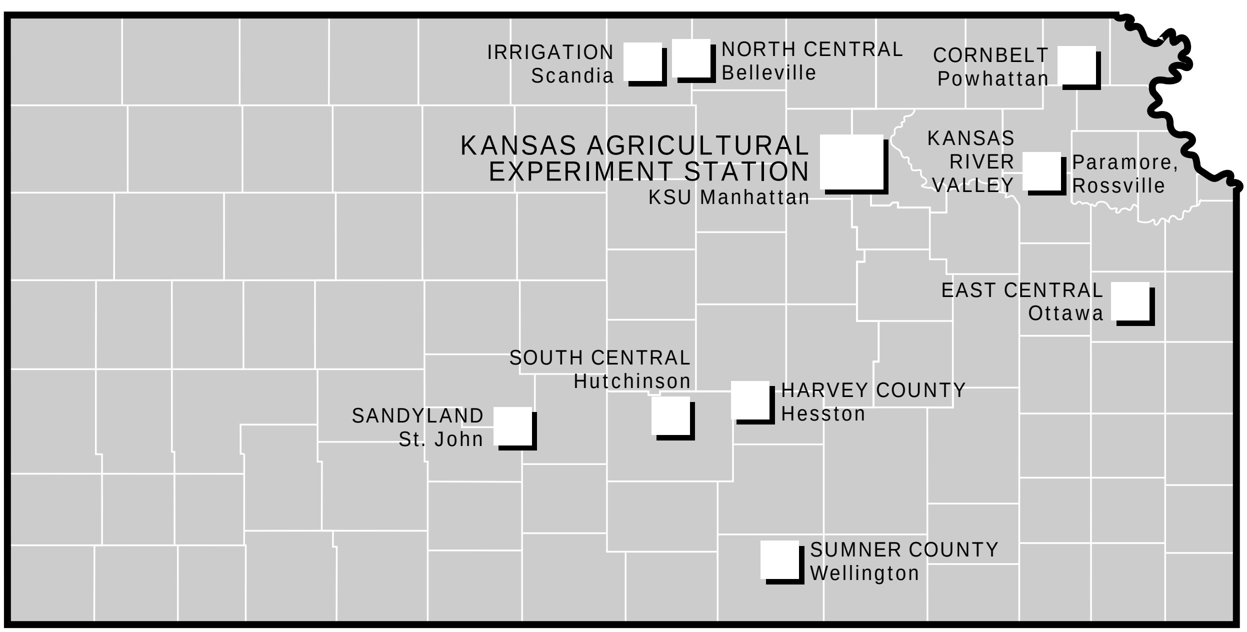
Report of Progress 893
Kansas State University Agricultural Experiment Station and Cooperative Extension Service

FIELD RESEARCH 2002



Agronomy Experiment Fields

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ACKNOWLEDGMENTS

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CORNBELT EXPERIMENT FIELD

Introduction

The Cornbelt Field was established in 1954 through the efforts of local interest groups, Kansas State University, and the state legislature. The objective then was to conduct research on the propagation, culture, and development of small-seeded legumes.

Emphasis since 1960 has been on fertilizer management; row spacings, planting rates and dates; variety testing; control of weeds and insects; cultural practices, including disease and insect-resistant varieties; and cropping systems. Foundation seed of oat, wheat, and soybean cultivars is produced as needed to provide a source of quality seed of public varieties.

Soil Description

The soils on the Experiment Field are silty, windblown, Pleistocene sediments called loess (pronounced luss). Grundy silty clay loam, the dominant soil, has a black silty clay loam surface, usually more than 15 in. thick, and a silty clay subsoil. It typically occupies ridge crests and tablelands of western and southeastern Brown County and is extensive in northeastern Jackson, western Atchison, eastern Jefferson, and western Leavenworth counties in Kansas, as well as in western Richardson County, Nebraska. Grundy soil is similar to the Wymore soil of Nemaha and Marshall counties, Kansas and of Pawnee County, Nebraska. The nearly level slopes have thick surface soil, which thins rapidly as slopes increase. Gradient terraces usually are needed to reduce sheet erosion, which is a serious hazard because the subsoil absorbs water slowly.

Weather

Precipitation during the growing season in 2001 was above normal (Table 1). Precipitation was below normal in April, May, and August, but timely rains in June and July resulted in excellent corn and sorghum yields and fairly good soybean yields. The last killing frost was on April 16 (normal April 23), and the first killing frost was on October 16 (normal October 15). The frost-free period was 6 days longer than the 170-day average.

Table 1. Precipitation at the Cornbelt Experiment Field, (in.).

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
October, 2000 - September, 2001												
1.92	0.53	0.99	1.80	5.31	2.33	2.66	4.34	6.87	6.18	2.10	6.28	41.31
43-Year Average												
2.80	1.91	1.03	0.75	0.83	2.23	3.17	4.74	5.07	4.44	3.99	4.36	35.32
Departure From Normal												
-0.88	-1.38	-0.04	1.05	4.48	0.10	-0.51	-0.40	1.80	1.74	-1.89	1.92	6.08

WHITE FOOD -CORN PERFORMANCE TEST

L.D. Maddux

Summary

The average yield of the 25 hybrids in the test was 167 bu/a, with a range of 149 to 191 bu/a. The LSD(.05) was 22 bu/a (two hybrids must differ in yield by 22 bu/a to be considered significantly different in yielding ability 95% of the time).

Introduction

This test at the Cornbelt Field is one of 14 locations of a regional fee test coordinated by Dr. L. L. Darrah with USDA-ARS at the University of Missouri. The 2001 test included 22 white hybrids and two yellow hybrid checks submitted by 10 commercial seed producers. Ten white hybrids were new to the test in 2001.

Procedures

Anhydrous ammonia at 125 lbs N/a was applied on 30-in. centers April 17. The hybrids were planted May 1 at 24,390 seeds/a in 30-in. rows on a silty clay loam soil following a previous crop of soybean. Bicep II Magnum at 2.1 qt/a plus Roundup Ultra at 1.5 pt/a were applied preemergence the following day. The test was harvested with a John Deere 3300 plot combine.

Results

Yields in this test averaged 167 bu/a, with a range of 149 to 191 bu/a (Table 2). Timely rains in June and July resulted in the good yields. The yellow corn performance test planted April 18 adjacent to this test had an average yield of 180 bu/a, with a range of 152 to 215 bu/a. The yellow check B73xMo17 yielded 168 bu/a and the other yellow check (Pioneer Brand 3394) yielded 158 bu/a.

Table 2 Grain yield, stand, root and stalk lodging, ear height, moisture content, and days from planting to half-silk of the white food-corn hybrids, Powhattan, KS, 2001.

Brand	Hybrid	Yield	Stand	Stalk Lodged	Days to Flower	Moisture
		bu/a	%	%	no.	%
Asgrow	RX776W	167	109	0.5	73	17.6
Garst	8277W	150	102	101	76	18.8
Garst	N0379W	149	90	0.0	75	18.2
Garst	EXP 696W	151	103	0.5	77	18.2
GEI	9856W	168	107	1.6	75	20.1
IFSI	97-1	163	103	1.0	76	19.7
Lfy	(FR828 X Lfy467W)	156	98	0.5	74	20.3
Lfy	(FR828 X Lfy481W)	160	101	1.1	77	21.2
Lfy	(FR828 X Lfy493W)	150	97	2.2	76	21.0
Lfy	(FR828 X Lfy495W)	177	104	4.6	76	20.8
NC+	6990W	159	99	0.5	78	18.7
Pioneer Brand	32K72	163	102	1.5	74	17.3
Pioneer Brand	32Y52	175	107	1.0	75	17.3
Pioneer Brand	33T17	173	99	3.8	72	17.3
Vineyard	V433W	191	109	2.9	74	17.6
Vineyard	V445W	180	101	4.0	75	18.0
Vineyard	Vx7118W	165	101	0.0	72	16.7
Whisnand	50AW	156	102	2.6	76	18.5
Whisnand	100W	172	87	2.0	75	18.2
Zimmerman	1851W	191	106	2.0	76	18.7
Zimmerman	Z62W	166	109	1.4	78	17.2
Zimmerman	E8272	191	95	3.7	78	19.6
Yellow check	B73xMo17	168	100	1.1	74	16.8
Yellow check	Pioneer 3394	158	100	0.5	73	16.8
Mean		167	101	1.7	75	18.5
LSD 0.05		22	NS	NS	2	0.7
CV%		8			1	2.5

EFFECT OF PLACEMENT OF STARTER FERTILIZERS ON SOYBEANS

L.D. Maddux, D.A. Whitney, and S.A. Staggenborg

Summary

The effect of N and P placement and ratio on soybean production was evaluated at two sites in northeast Kansas−−the Rossville Unit, Kansas River Valley Exp. Field and the Cornbelt Exp. Field near Powhattan. The placement and ratio of N and P did not produce significant differences in grain yield at either location.

Introduction

This study was conducted on an irrigated field at the Kansas River Valley Experiment Field, Rossville Unit, and on a dryland field at the Cornbelt Experiment Field near Powhattan. The objective was to evaluate the effect of nitrogen (N) and phosphorus (P) application, ratios, and placement on plant uptake and yield of soybean.

Procedures

The study was conducted for two years on two sites: (1) Cornbelt Experiment Field near Powhattan, on a dryland Grundy silty clay loam site previously cropped to soybean with a pH of 6.4, an organic matter content of 3.2 percent, and a P test level of 12 ppm and (2) Kansas River Valley Experiment Field, Rossville Unit, on an irrigated Eudora silt loam site previously cropped to corn with a pH of 6.4, an organic matter content of 1.6 percent, and a P test level of 21 ppm.

Eight treatments were applied: (1) 0 N, 0 P check; (2) 8.8-30-0, 2x2 placement (10-34-0 applied at 7.6 gpa); (3) 30-30-0, 2x2 (18.0 gpa of 15-15-0 made from 10-34-0 and 28% UAN); (4 & 5) 10-34-0 applied in the seed furrow (IF) at 2 and 4 gpa; (6) 8.8-0-0, 2x2 placement; (7) 30-0-0, 2x2 placement; (8) 30-30-0, broadcast; and (9) 0-30-0 (made from phosphoric acid and water), broadcast.

The treatments were applied and the plots were planted May 16 at Rossville and May 23 at Powhattan. Stine 4200-2 and Taylor 394RR soybean varieties were planted at 144,000 sds/a in 30-in. rows at Rossville and Powhattan, respectively. Trifoliate leaf plant samples were collected for nutrient analyses. The Rossville site was sprinkler irrigated as needed. The plots were harvested using a plot combine October 26 at Rossville and October 12 at Powhattan.

Results

Yield results are shown in Table 3. No significant differences in grain yield were found at either location. We are currently waiting for completion of the soybean plant samples.

Table 3. Effect of N and P placement on soybean yield, Rossville and Powhattan, 2001.

Treatment[1]	Placement	Yield	
		Rossville	Powhattan
		------------bu/a-----------	
Check	---	52.9	39.0
8.8-30-0	2x2	45.4	39.5
30-30-0	2x2	50.5	41.9
10-34-0, 2 gpa	In Furrow	52.8	38.9
10-34-0, 4 gpa	In Furrow	52.4	38.3
8.8-0-0	2x2	47.5	37.5
30-0-0	2x2	50.2	37.8
30-30-0	Broadcast	50.5	37.5
0-30-0	Broadcast	48.6	35.7
LSD(0.05)		NS	NS

[1] 7.6 gpa of 10-34-0 = 8.8-30-0; 18 gpa of 15-15-0 = 30-30-0 (ie. 1:3 and 1:1 ratio N:P starters).

BT AND ROUNDUP READY® CORN HYBRID EVALUATION IN NORTHEAST KANSAS

S.A. Staggenborg, L.D. Maddux, and D.L. Fjell

Summary

Twenty-four corn hybrids (seven Bt, five Roundup Ready®, and 12 conventional hybrids that are of similar genetics or maturities) were evaluated for grain yields and test weights during 2001 at the Cornbelt Experiment Field in Northeast Kansas. Grain yields for the non-Bt hybrids was 164 bu/a whereas grain yields for the Bt hybrids were 173 bu/a. Roundup Ready hybrids averaged 156 bu/a and the conventional counterparts averaged 149 bu/a. Spring rain and cool temperatures delayed early growth, but above average rain during July and August resulted in excellent yields. There were individual instances where the technology-enhanced hybrids yielded more than their conventional counterparts, but in most instances, there were no significant differences between the two hybrids.

Procedures

Corn plots were established at the Cornbelt Experiment Field near Powhattan, KS on May 1, 2001. Corn hybrids from four companies (Monsanto, Garst, Novartis, and Pioneer) were represented in this study. Each company was instructed to enter two or three Bt hybrids and three conventional hybrids adapted to the area. Bt and non-Bt hybrids were not required to be genetic relatives either with or without the Bt trait. Roundup Ready hybrids and their conventional counterparts were acquired from Monsanto as part of a regional study. Hybrids from each company included in the trial are listed in Tables 4 and 5.

Grain weight, test weight and moisture were measured following harvest with a plot combine on October 27, 2000. Grain yields were adjusted to 15.5% moisture.

Results

Spring rain and cool temperatures delayed planting and emergence slightly, but probably had little impact on final yields. Above average rainfall during July resulted in excellent growing conditions, resulting in overall plot yields of 169 bu/a for the Bt/non Bt hybrids and 153 bu/a for the RoundUp Ready and non-RoundUp Ready hybrids.

Despite the excellent growing conditions, few differences between genetically enhanced and conventional pairs occurred (Table 4 and 5). Overall, the Bt hybrids averaged 173 bu/a (58.3 lb/bu test weight) and the non-Bt hybrids averaged 164 bu/a (58.2 lb/bu test weight). Of the seven Bt and non-Bt hybrid pairs that were similar, two grain yield differences occurred. Overall, the Roundup Ready hybrids averaged 156 bu/a (57.7 lb/bu test weight) and the conventional hybrids averaged 149 bu/a (57.8 lb/bu test weight). Of the five Roundup Ready and conventional hybrid pairs, one grain yield difference occurred.

As with grain yields, no consistent relationships between Bt and non-Bt hybrids occurred with test weights.

Table 4. Bt and non-Bt hybrids grown at Cornbelt Experiment Field in 2001.

Company	Hybrid	Type	Yield		Test Weight	
			bu/a		lb/bu	
Garst	8366 BT	Bt	171.3	bcd	57.2	
Garst	8366 IT	Conventional	141.7	e	58.4	
Garst	8484 BT	Bt	163.3	cde	57.6	
Garst	8464IT	Conventional	176.3	bc	58.5	
Garst	9570 BT	Bt	188.5	b	56.9	
Garst	9565 C	Conventional	176.0	bc	58.3	
Novartis	79L3	Bt	158.5	cde	60.3	
Novartis	79L4	Conventional	165.2	bcde	59.3	
Novartis	67T4	Bt	169.0	bcd	58.0	
Novartis	67H6	Conventional	162.3	cde	57.8	
Pioneer	33G30	Bt	149.6	de	59.1	
Pioneer	33G26	Conventional	168.2	bcd	58.0	
Pioneer	31A13	Bt	211.7	a	59.0	
Pioneer	31A12	Conventional	160.7	cde	57.2	
	LSD(0.05)		23.6		NS	
	C.V. (%)		8.3		2.1	
	Orthogonal Contrasts	Group Means				
		Bt	173.1	NS	58.3	NS
		Conventional	164.3		58.2	

Table 5. Roundup Ready and conventional hybrids grown at Cornbelt Experiment Field in 2001.

Hybrid	Type	Yield		Test Weight	Anthesis Date	
		bu/a		lbs/bu		
DKC46-28 RR	Roundup	143.3	bcd	57.9	7/7/01	cd
DKC46-26	Conventional	133.5	d	57.1	7/5/01	d
DKC53-33 RR	Roundup	154.1	abc	57.3	7/6/01	cd
DK537	Conventional	163.7	abc	57.4	7/8/01	abc
DKC57-40 RR	Roundup	168.8	ab	58.0	7/8/01	abc
DKC57-38	Conventional	151.0	bcd	58.3	7/7/01	cd
DKC58-53 RR	Roundup	171.8	a	57.3	7/9/01	ab
DK585	Conventional	136.4	cd	57.6	7/8/01	abc
DKC60-17 RR	Roundup	139.4	d	58.4	7/9/01	ab
DK60-15	Conventional	165.2	bcd	58.1	7/9/01	ab
LSD(0.05)		24.3		NS	2	
C.V. (%)		9.3		1.2	16.1	
	Group Means					
	Roundup	156.2	NS	57.7	7/8/01	NS
	Conventional	149.2		57.8	7/8/01	

THE IMPACT OF PLANTER PERFORMANCE ON CORN PLANT SPACING AND YIELD

S.A. Staggenborg, R.K. Taylor, and L.D. Maddux

Summary

Proper planter adjustment, attachments, and operation play an important role in uniform stand establishment in corn. A study was conducted in 2001 to assess the impact of planter speed and a commercially available seed firmer on corn stand establishment uniformity and yield. Corn was seeded at 23,525 and 27,330 seed/a at speeds of 4, 6 and 8 mph at one location and 30,262 seed/a at speeds of 5, 7, and 9 mph at a second location. Keeton seed firmers were a main treatment at both locations. Plant spacing for each treatment was measured after emergence. Three indices were calculated to evaluate the plant spacing data: miss index, multiple index, and precision index. The miss and multiple indices indicate the number of skips and doubles. Yield was influenced by planter speed at one location, but not the other. The three planter performance indices increased with planter speed.

Introduction

Approximately 90% of the annual management decisions related to corn production are made by the time the crop is planted. Establishing a uniform plant stand at the desired plant population is the goal of the planting operation. Uniformity and rate of emergence of a corn stand are the most common characteristics used by producers to evaluate planter performance. Planter maintenance, adjustment, and attachments can impact planter performance. Operating speed can further influence seed singulation and placement. The objective of this experiment was to evaluate the influence of planter speed and a commercially available seed firmer on corn plant spacing variation and final grain yields.

Procedures

A field study was conducted at the Cornbelt Experiment Field in Brown County, Kansas and at the Paramore Experiment Field in Shawnee County, Kansas. Plots were planted at Cornbelt on April 19 and at Paramore on April 20, 2001. The plots at Cornbelt were rainfed while the Paramore location was furrow irrigated. Corn was planted at the Cornbelt location into soybean stubble at two seeding rates (23,525 and 27,330 seed/a) and three speeds (4, 6, and 8 mph) and at the Paramore location into tilled soil at one seeding rate (30,262 seed/a) and three speeds (5, 7, and 9 mph). Both locations were planted in 30-in. rows with a John Deere 7200 MaxEmerge II planter equipped with a vacuum metering system. Plots were four rows wide and approximately 350 ft long at Cornbelt and 1500 ft long at Paramore. A Keeton seed firmer was a main treatment at both locations. At Cornbelt, the corn hybrid used was Garst 8342 GLS IT and Golden Harvest 2547 was used at Paramore.

Plant spacings were measured for 100 consecutive plants in the center two rows of each plot. Plant spacing distribution was characterized using three indices that use a theoretical plant spacing based on the expected seeding rate. These indices include the miss index, which is an indication of the number of times that the planter produced a skip; the multiple index, which is an indication of the number of times that plants were established in close proximity; and the precision index which is the standard deviation in plant spacing, excluding those counted as misses and multiples, divided by the theoretical plant spacing. Thus, the precision index is the coefficient of variation in plant spacing for the plants that are not skips or doubles.

Grain yields were measured for the entire plot as well as the area where plant spacings were measured. These yields were used to determine the impact of plant spacings, as determined by the planter performance indices, on grain yields.

Results

Early season crop growth was slowed by below average temperatures. However, above average rainfall in July resulted in excellent yields. Corn yields averaged 155 bu/a at Cornbelt and 176 bu/a at Paramore.

At Cornbelt, seed firmer, seeding rate, and planter speed affected most of the indices used to assess planter performance (Table 6). Using seed firmers significantly reduced plant spacing standard deviation and the miss index and significantly increased plant density (Table 6 and 7). The affect of the firmer on the miss index and plant density is particularly interesting. Reducing the number of misses would certainly increase plant density. Since the firmer can not affect the metering system, it must have improved seed-soil contact. Therefore, the reduction in misses due to using the firmer was most likely better emergence. Miss, multiple and precision indices and yield increased as seeding rates increased (Table 7).

At Paramore, using firmers significantly reduced seed spacing standard deviation (Table 8 and 9). Though lower in magnitude and not statistically significant, trends at Paramore followed those for Cornbelt regarding the miss index and plant density (Table 8 and 9).

At both locations, standard deviation, miss index, multiple index, and precision index increased as planter speed increased (Figures 1-4). A polynomial equation best described these relationships, with standard deviation remaining relatively low, between 3 and 4 in., when planter speeds were below 7 mph. It should be noted that the planter used in this experiment was in above average condition and appropriate adjustments had been made prior to planting. Planter age, level of maintenance and level of adjustment can have a major impact on planter performance.

Table 6. Regression coefficients for plant density, standard deviation, miss, multiple, and precision index and yield from a planter speed study at Cornbelt in 2001.

Source	Plant Density	Standard Deviation	Miss Index	Multiple Index	Precision Index	Yield
	plts/a	in	%	%	%	bu/a
Intercept	4900.2*	4.70**	-18.71*	-11.92*	2.66	98.47**
Firmer	958.8**	-0.53*	-3.77**	0.44	-1.61	1.23
Seeding Rate	0.8**	-0.01	0.01**	0.01*	0.01**	0.01**
Speed	-317.3**	0.21**	1.54**	0.83**	2.10**	-1.77**
R^2	0.83	0.41	0.64	0.50	0.71	0.60
C.V. (%)	3.3	13.2	22.0	30.5	6.1	3.0

Table 7. Plant density, standard deviation, miss, multiple and precision indices, and yield at Cornbelt Experiment Field in 2001.

Seed Firmer	Seeding Rate	Plant Density	Standard Deviation	Miss Index	Multiple Index	Precision Index	Yield
	Seed/a	plts/a	in	%	%	%	Bu/a
No		23,330	4.1	14.0	4.9	42.5	154.0
Yes		24,289	3.5	10.2	5.4	40.9	155.2
	23,525	22,288	3.9	10.3	4.3	39.7	149.6
	27,330	25,331	3.7	13.8	6.0	43.7	159.5

Table 8. Regression coefficients for plant density, standard deviation, miss, multiple, and precision indices and yield from a planter speed study at Paramore in 2001.

Source	Plant Density	Standard Deviation	Miss Index	Multiple Index	Precision Index	Yield
	plts/a	in	%	%	%	bu/a
Intercept	30720.0**	2.06**	1.32	-1.14	33.05**	164.27**
Firmer	609.7	-0.34*	-1.47	0.29	-0.32	2.20
Speed	-210.8	0.23**	1.83**	1.72**	1.93**	-1.55
R^2	0.11	0.52	0.58	0.63	0.68	0.05
C.V. (%)	3.5	10.9	19.2	19.6	4.7	6.9

Table 9. Plant density, standard deviation, miss, multiple and precision indices, and yield at Paramore Experiment Field in 2001.

Seed Firmer	Plant Density	Standard Deviation	Miss Index	Multiple Index	Precision Index	Yield
	plts/a	in	%	%	%	Bu/a
No	29,245	3.7	14.1	10.9	46.6	175.1
Yes	29,854	3.3	12.7	11.2	46.3	177.3

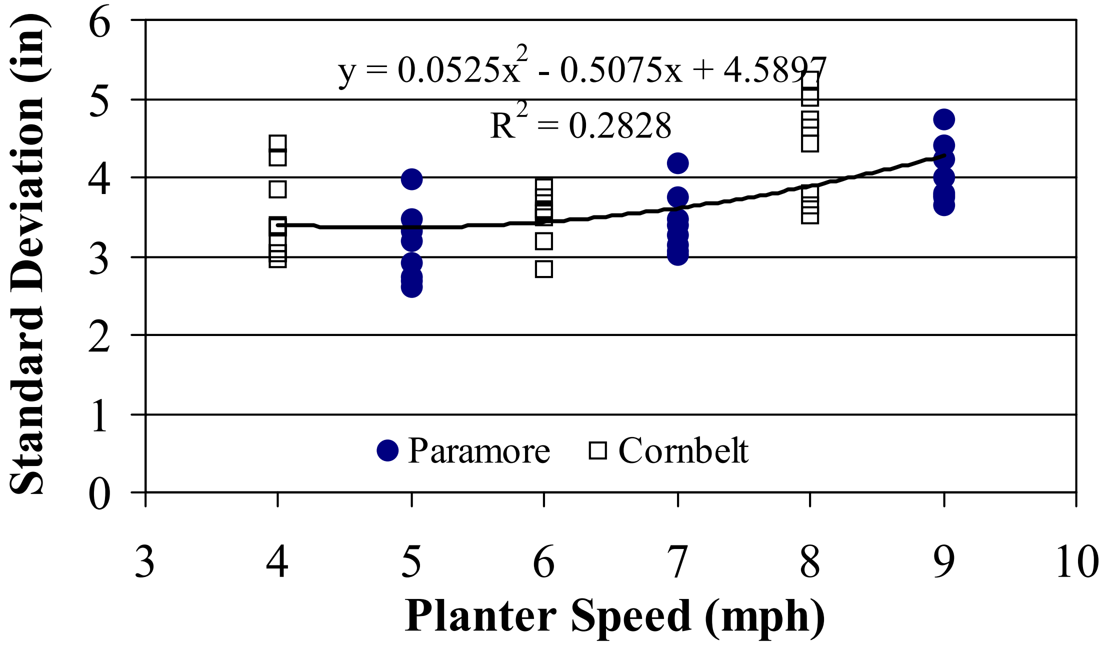

Figure 1. Standard deviation as a function of planter speed at Cornbelt and Paramore Experiment Fields in 2001.

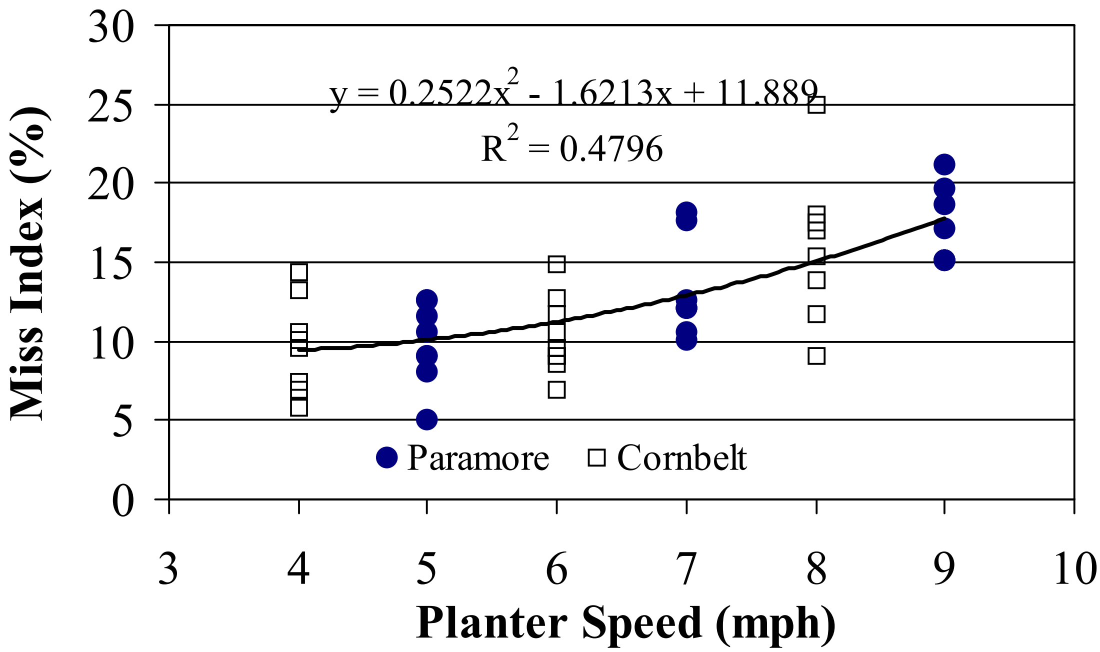

Figure 2. Miss index as a function of planter speed at Cornbelt and Paramore Experiment Fields in 2001.

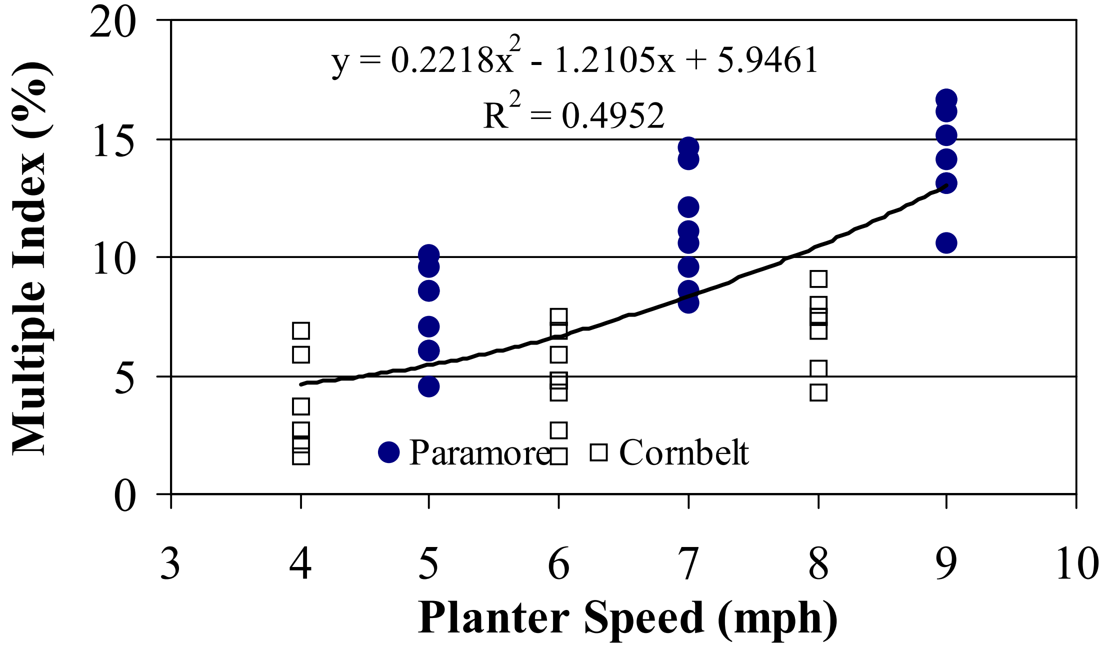

Figure 3. Multiple index as a function of planter speed at Cornbelt and Paramore Experiment Fields in 2001.

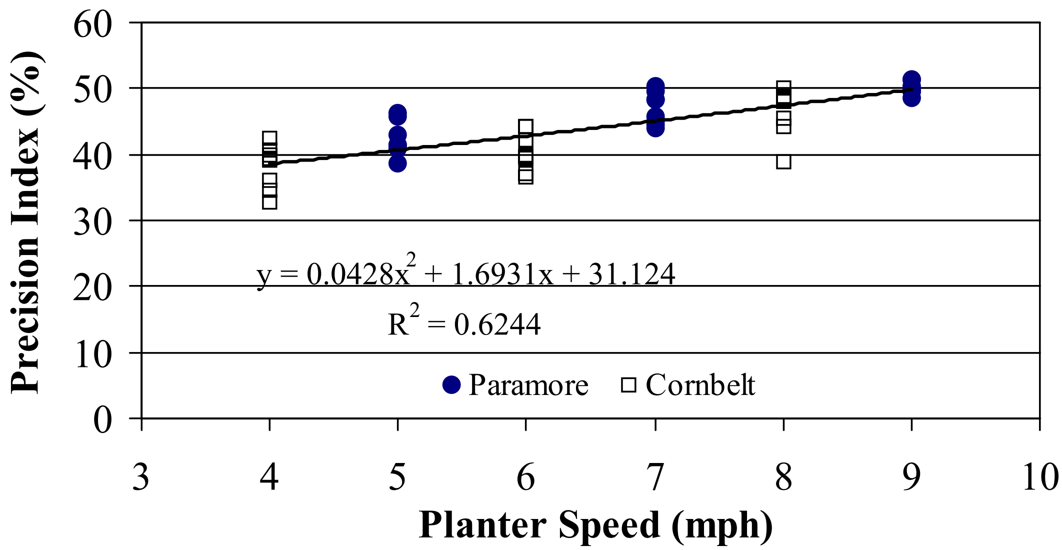

Figure 4. Precision index as a function of planter speed at Cornbelt and Paramore Experiment Fields in 2001.

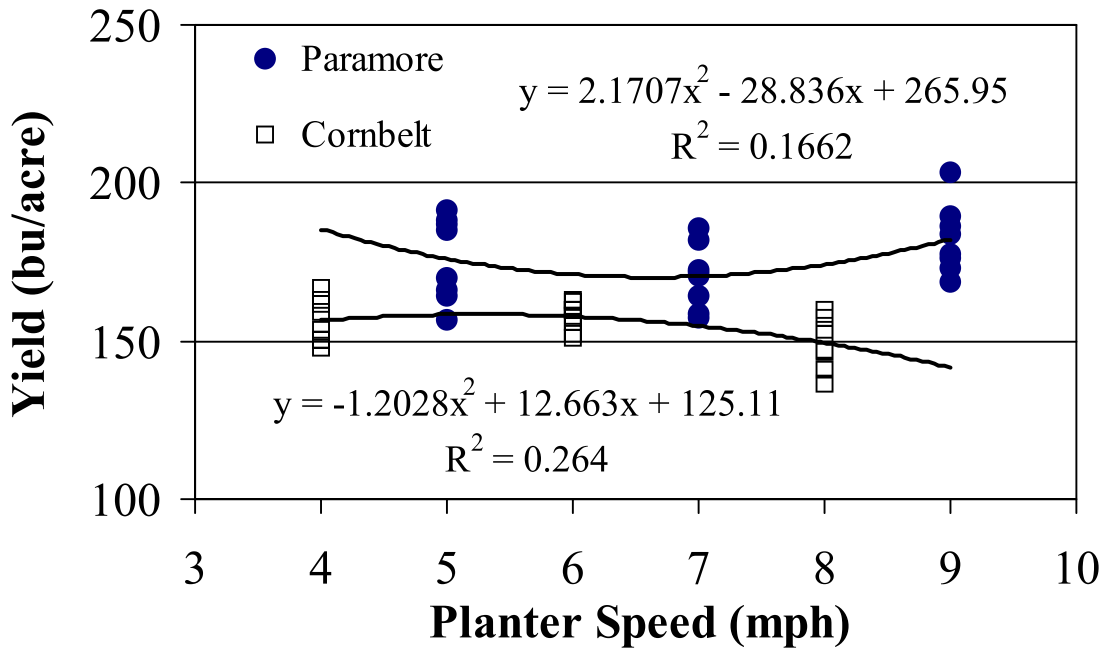

Figure 5. Yield as a function of planter speed at Cornbelt and Paramore Experiment Fields in 2001.

EAST CENTRAL KANSAS EXPERIMENT FIELD

Introduction

The research program at the East Central Kansas Experiment Field is designed to enhance the area's agronomic agriculture. Specific objectives are: (1) to identify the top performing varieties and hybrids of wheat, corn, grain sorghum, and soybean; (2) to determine the amount of tillage necessary for optimum crop production; (3) to evaluate weed control practices using chemical, non-chemical, and combination methods; and (4) to test fertilizer rates and application methods for crop efficiency and environmental effects.

Soil Description

Soils on the 160 acres of fields are Woodson. The terrain is upland, level to gently rolling. The surface soil is a dark, gray-brown, somewhat poorly drained, silt loam to silty clay loam with a slowly permeable, clay subsoil. The soil is derived from old alluvium. Water intake is slow, averaging less than 0.1 in. per hour when saturated. This makes the soil susceptible to runoff and sheet erosion.

2001 Weather Information

Precipitation during 2001 totaled 30.80 in., which was 6.38 in. below the 33-yr average (Table 1). Most of the moisture deficit occurred during the early and the mid to late parts of the growing season. Rainfall during April and May was 3.74 in. below normal. July and August rainfall was 1.56 in. below normal.

The coldest temperatures during 2001 occurred the first two days of January with below zero temperatures. Cold temperatures occurred intermittently during January and February, with 5 days in single digits, and during the last 6 days of December with 3 days in single digits. The overall coldest temperature recorded was 13°F below zero on January 2. There were 41 days during the summer in which temperatures exceeded 90 degrees. The two hottest days were August 21 and 22, when daily temperatures exceeded 100°F. The overall highest temperature was 102°F.

The last freeze of the winter was April 18 (average, April 18) and the first killing frost in the fall was October 27 (average, October 21). The number of frost-free days was 191 compared with the long-term average of 185 days.

Table 1. Precipitation at the East Central Experiment Field, Ottawa, Kansas, inches.

Month	2001	33-yr. avg.	Month	2001	33-yr. avg.
January	1.47	1.01	July	2.66	3.50
February	4.12	1.33	August	2.80	3.52
March	1.80	2.59	September	3.77	3.95
April	0.83	3.43	October	2.31	3.47
May	4.07	5.21	November	0.10	2.42
June	6.02	5.27	December	0.85	1.47
Annual Total				30.80	37.18

EFFECTS OF SUB-SOILING ON YIELD OF CORN AND SOYBEAN

K.A. Janssen

Summary

The effects of sub-soiling, shallower chisel plowing, and no-preplant tillage were evaluated during 1996-2001 for corn and soybean. Corn grain yields for 2001 were severely reduced by moisture stress and ranged from 38 to 50 bu/a. Soybean yields benefitted from later-season rains and ranged from 30.9 to 32.9 bu/a. Under these limited moisture conditions, deep subsoil tillage still did not increase corn or soybean yields. Averaged across all six years, which included both average and below average moisture years, subsoil tillage produced only a slightly higher average yield than no-till and similar yield to chisel plow. Considering the cost of subsoil tillage, these small yield increases do not justify subsoiling.

Introduction

Extensive acreage of upland soils in the east-central part of Kansas have massive clay subsoils. These slowly permeable clay sub-horizons restrict drainage, limit aeration, limit depth of rooting, and limit available soil moisture and storage. As a result, crop yields are limited. Various tillage operations have been used to attempt to improve the physical properties of these soils. Some farmers deep chisel or subsoil their fields every year, others every other year, and some on a less frequent basis. The benefits from these deep tillage operations have not been fully evaluated.

Most years, freeze-and-thaw and wet and dry cycles crack and loosen these soils to a depth of 6 to 8 in. or more. These shrink-swell processes may be sufficient to break up any surface soil compaction that develops from fertilization, planting, spraying, and harvesting. Consequently, the need for deep tillage is being questioned. Another unknown is whether various crops respond differently to deep tillage. This study evaluated various frequencies of subsoil tillage as well as shallower chisel plow and no-till systems for effects on corn and soybean yields.

Procedures

This study was conducted on a Woodson silt loam soil (fine montmorillonitic, thermic, Abruptic Argiaquolls) at the East Central Experiment Field. The tillage treatments established were: no-till; chisel plowing every year at 5-7 in. depth; and deep subsoil tillage at 8-14 in. depth yearly, every other year, and every 3 years. All treatments were replicated four times and were evaluated in two blocks, one for corn and one for soybean. Subsoil and chisel plow treatments for the 2001 growing season were performed on April 9. All plots, except the no-till plots, were field cultivated each year before planting. Also, all corn plots were row-crop cultivated for weed control each year. Corn (Hoegemeyer 2693) was planted on May 7, 2001 and soybean (Midwest Seed 3506) was planted May 14, 2001. A mixture of 28-0-0 and 10-34-0 liquid fertilizer was coulter knifed to provide 111 lb N and 38 lb P_2O_5/a for corn. No fertilizer was applied to soybean.

Results

Corn yields for the 2001 growing season were severely limited by moisture stress during silking and grain fill (Table 2). Corn yields ranged from 38 to 50 bu/a with a test average of 42 bu/a. Soybean yields faired better because of late-season rains. Soybean yields ranged from 30.9 to 32.9 bu/a with a test average of 31.9 bu/a. With both crops there were no statistically significant differences in yield between subsoil tillage, chisel-plow and no-till treatments. Six-year average yields show similar results, with only a slightly lower yield for no-till compared to subsoil and chisel plow treatments. All frequencies of deep subsoil tillage and chisel-plow treatments produced similar yields. These small yield differences are not enough to offset the cost of subsoil tillage.

Table 2. Subsoiling effects on corn and soybean yield, Ottawa, KS.

	Yield			
	Corn		Soybean	
Tillage System and Frequency	2001	6-yr Avg	2001	6-yr Avg
	bu/a			
No-till	50	98	31.6	35.4
Chisel[1] (every year)	39	100	30.9	36.6
Subsoil[2] (every year)	38	103	31.8	37.0
Subsoil[2] (every other year)	42	99	32.9	37.3
Subsoil[2] (every third year)	41	105	32.4	37.9
LSD.05	NS		NS	
CV %				

[1] 5-7 in. depth.
[2] 8-14 in. depth.

EFFECTS OF LONG-TERM CROP RESIDUE HARVESTING ON SOIL PROPERTIES AND CROP YIELD

K.A. Janssen and D.A. Whitney

Summary

Research was continued during 2001 to determine the effects of continuous harvesting of crop residues on crop yields and soil properties in a soybean - wheat - grain sorghum/corn rotation, fertilized with different levels of N, P, and K. The 2001 crop was the 21st year of annual harvesting of crop residues. The residue treatments (residue harvested annually, normal residue incorporated, and 2X normal residue incorporated) resulted in no statistically significant differences in grain or residue yields in 2001. Soybean grain yields, when averaged across all fertilizer treatments, were 34.3 bu/a with crop residue harvesting each year, 35.6 bu/a with normal crop residue incorporated, and 34.8 bu/a with 2X normal crop residue incorporated. The fertilizer treatments (zero, low, normal and high levels of N, P, and K) also produced no significant yield differences in 2001. Soil test results after 16 years show that soil properties are changing with crop residue harvesting. Soil pH, soil exchangeable K, and soil organic matter are declining with repeated harvesting of crop residues.

Introduction

Crop residues are increasingly becoming a source of raw materials for various non-agricultural uses. In Kansas, two companies are currently manufacturing wheatboard from wheat straw. In Iowa, over 50,000 tons of corn residue was harvested during the 1997-1998 crop year for ethanol production. In Minnesota, a company is planning to introduce a BIOFIBER soy-based particle board. Other companies will likely soon join the market for the production of other bio-products (paper). All of this is in addition to the customary on-farm use of crop residues for livestock feed and bedding. These new uses are welcomed new sources of revenue for crop producers. However, crop producers must be aware that crop residues also are needed for soil erosion protection and to replenish organic matter in the soil. Crop residues are the single most important source of carbon replenishment in soils.

Unfortunately, data on the effects of crop residue harvesting on soil properties and crop yields are very limited, especially for long-term, continuous harvesting of crop residues. From past history we know that grain producers have harvested crop residues for livestock feed for years with little noticeable side effects. However, harvesting crop residues for farm use has generally not been on a continuous basis from the same field. Also, some of the crop residues harvested may be returned as animal wastes. With non-agricultural uses, this generally would not be the situation, and there would be increased probability for repeat harvests. Harvesting crop residues continually would remove larger amounts of plant nutrients and return less organic plant material to the soil. The effects of fertilizer management in offsetting these losses are not well understood.

This study was established to determine the effects of long-term repeated harvesting of crop residues and the additions of varying levels of crop residues on crop yields and soil properties in a soybean - wheat - grain sorghum/corn rotation, fertilized with variable rates of nitrogen (N), phosphorus (P) and potassium (K).

Procedures

This study was established in the fall of 1980 on a Woodson silt loam soil (fine montmorillonitic, thermic, Abruptic Argiaquolls) at the East Central Experiment Field. The residue treatments evaluated were: (1) crop residue harvested annually, (2) normal crop residue incorporated, and (3) twice (2X) normal crop residue incorporated (accomplished by adding and spreading evenly the crop residue from the residue harvest treatment). Superimposed over the residue treatments were four levels of fertilizer treatments; zero, low, normal, and high levels of N-P-K fertilizer at rates for each crop as shown in Table 3. The crops planted were soybean, wheat, and grain sorghum/corn in a three-year rotation. Corn was substituted for grain sorghum beginning in 1994. Crop grain and residue yields were measured each year and soil samples (0 to 2-in. depth) were collected and analyzed after the 16th year to detect any changes in soil properties.

Results

Grain yields and residue yields for the last 10 years of this 21-year study are summarized in Tables 4 and 5. The residue treatments did not result in yield differences in either grain or residue for any crop in any year since the study was initiated, except for 1987. In 1987, a year with hail, less residue was measured in the 2X normal residue incorporated treatment than with normal residue incorporated. This may have been the result of uneven hail damage rather than an effect of residue treatment. Summed over all 21 years, 1980-2001, grain and residue yield totals for residue harvesting and 2x normal residue incorporated treatments differ by less than 1.5 percent from normal residue incorporated. In contrast, the fertilizer treatments have produced large grain and residue yield differences, averaging 37% and 38%, respectively, for all years. Highest grain and residue yields were produced with the normal and high fertilizer treatments and the lowest grain and residue yields with the zero and low fertilizer treatments.

Although there has been little difference in grain and residue yields with the removal or addition of crop residue, soil properties have changed. The effects of the residue and fertilizer treatments on soil properties are shown in Table 6. Soil pH, exchangeable K, and soil organic matter have decreased with repeated crop residue harvesting. The harvesting of crop residue has lowered exchangeable K in the soil by nearly 20%. This is because of the high K content in crop residue. Crop residue harvesting decreased soil organic matter 9%. Doubling crop residue increased soil organic matter 12%. The fertilizer treatments produced the expected increases in N, P, and K. Soil pH decreased with fertilizer application. Available P, exchangeable K, and organic matter all increased with increased fertilizer application.

These data suggest that the short-term harvesting of crop residues will have little effect on grain or residue yields and should require no special changes in management practices, except possibly to keep a close watch on soil K test levels. However, in the long term, repeated harvesting of crop residues from the same field could eventually cause problems. This is because very long-term harvesting of crop residues could cause further decreases in soil organic matter to a point where crop yields will be affected. The effects of crop residue harvesting develop slowly and could take many years before affecting yield. With different soils and different environments, the time period for yield limitations to occur could be much different. This soil was initially quite high in soil organic matter and had initially high levels of soil fertility. Soils with lower organic matter and lower fertility may be affected more rapidly by crop residue harvesting.

Table 3. Nitrogen, phosphorus, and potassium fertilizer treatments for crops in rotation, East Central Experiment Field, Ottawa, KS.

	Crop and Fertilizer Rate ($N-P_2O_5-K_2O$)		
Fertilizer Treatments	Soybean	Wheat	Grain Sorghum/Corn
	lb/a		
Zero	0-0-0	0-0-0	0-0-0
Low	0-0-0	40-15-25	40-15-25
Normal	0-0-0	80-30-50	80-30-50
High	0-0-0	120-45-75	120-45-75

Table 4. Mean effects of crop residue and fertilizer treatments on grain yields, East Central Experiment Field, Ottawa, KS, 1992-2001.

Treatment	G.S. ‘92	Soy ‘93	Corn ‘94	Wht ‘95	Soy ‘96	Corn ‘97	Soy ‘98	Wht ‘99	Corn ‘00	Soy ‘01	21-yr total
	bu/a										
Residue											
Harvested	128	21	104	21	42	89	47	25	82	34	1212
Normal	127	22	108	19	46	88	47	24	81	36	1226
2X normal	130	21	107	17	48	82	46	22	80	35	1210
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Fertilizer											
Zero	120	19	89	12	43	46	44	17	46	34	1016
Low	123	20	103	17	43	76	46	22	76	35	1181
Normal	135	22	114	22	47	99	47	26	96	36	1288
High	136	25	120	24	48	123	50	29	106	35	1378
LSD 0.05	7	2	5	2	2	9	2	2	7	NS	

Table 5. Mean effects of crop residue and fertilizer treatments on residue yields, East Central Experiment Field, Ottawa, KS, 1992-2001.

Treatment	G.S. '92	Soy '93	Corn '94	Wht '95	Soy '96	Corn '97	Soy '98	Wht 99	Corn '00	Soy '01	21-yr total
	bu/a										
Residue											
Harvested	1.80	0.38	1.63	1.22	0.48	1.46	1.00	0.63	2.85	0.96	28.36
Normal	1.85	0.39	1.73	1.22	0.52	1.49	1.03	0.59	2.74	0.97	28.75
2X normal	1.92	0.39	1.56	1.24	0.54	1.39	1.03	0.51	2.72	0.94	28.68
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Fertilizer											
Zero	1.83	0.34	1.38	0.50	0.46	1.09	0.95	0.34	2.32	0.92	23.48
Low	1.74	0.35	1.46	1.02	0.52	1.35	0.97	0.49	2.79	0.94	27.48
Normal	1.95	0.40	1.91	1.71	0.53	1.57	1.07	0.68	2.88	0.98	30.58
High	1.90	0.45	1.81	1.67	0.54	1.78	1.08	0.80	3.09	0.98	32.46
LSD 0.05	0.17	0.03	0.26	0.16	0.04	0.19	0.06	0.08	0.33	0.04	

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Table 6. Mean soil test values after 16 years of residue and fertilizer treatments, East Central Experiment Field, Ottawa, KS.

Treatment	Soil pH	Soil Available P	Soil Exchangeable K	Soil Organic Matter	Soil NO_3-N
		ppm	ppm	%	ppm
Residue					
Harvested	6.0	29	163	3.0	33
Normal	6.1	30	201	3.3	27
2X Normal	6.2	37	249	3.7	21
LSD 0.05	0.1	2	20	0.2	NS
Fertilizer					
Zero	6.4	23	147	3.0	27
Low	6.2	26	177	3.3	26
Medium	6.0	36	236	3.5	30
High	5.8	42	259	3.5	26
LSD 0.05	0.1	3	22	0.2	NS

INTEGRATED AGRICULTURAL MANAGEMENT SYSTEMS TO IMPROVE THE QUALITY OF KANSAS SURFACE WATERS

K.A. Janssen and G.M. Pierzynski

Introduction

Total Maximum Daily Loads (TMDLs) are being implemented for various contaminants in Kansas streams and water bodies. The contaminants of most concern are sediment, nutrients, pesticides, and fecal coliform bacteria. Controlling these contaminants will require information concerning runoff losses associated with different land uses and the impact of different management practices on contaminant losses.

Farming systems that greatly reduce tillage and maintain 30% or more crop residue cover after planting significantly reduce soil erosion and sediment in runoff. Tillage/planting systems that greatly restrict tillage, however, provide little opportunity for incorporating fertilizer, manure, and herbicides. When surface applied, these materials enrich the near surface soil and runoff losses increase.

Consequently, a more comprehensive management strategy other than just tillage reduction is needed to provide broad spectrum runoff water protection. A system of farming practices is needed that includes combinations of specific best management practices (BMPs) for controlling all cropland runoff contaminates. We refer to such a strategy as "Integrated Agricultural Management Systems."

The purpose of this study was to evaluate, on a field-scale basis, various combinations of tillage, fertilizer, and herbicide management practices for uniform control of cropland runoff contaminants.

Procedures

Five locations in Kansas were selected for this project. This article presents information and data for the Marais des Cygnes River Basin site located in Franklin Co. near Ottawa, Kansas. This location represents the slowly permeable soils of the east-central part of Kansas with 38-40 in. rainfall per year. The field selected for this study was approximately 10 acres in size, had a slope of 2-5 percent, and had near parallel terraces. Soils in the field are a mixture of Eram-Lebo with some Dennis-Bates complex (Argiudolls, Hapludolls and Paleudolls). Bray 1 P soil test at the start of the study was 13 ppm, which according to K-State recommendations is a low to medium soil test. The tillage, fertilizer, and herbicide treatment combinations evaluated were: (1) No-till, with fertilizer and herbicides broadcast on the soil surface; (2) No-till, with fertilizer deep-banded (3-5 in. depth) and herbicides broadcast on the soil surface; and (3) Chisel-disk-field cultivate with fertilizer and herbicides incorporated by tillage. Each treatment was replicated twice. Crops grown were grain sorghum and soybean in rotation. The rate of fertilizer applied for grain sorghum was 70 lb N, 33 lb P_2O_5, and 11 lb K_2O/a. No fertilizer was applied for soybean. Atrazine (1.5 lb/a ai) and Dual (metolachlor 1.25 lb/a ai) herbicides were applied for weed control in grain sorghum. For soybean, Roundup Ultra (glyphostate 1 lb/a ai) and metolachlor (1.25 lb/a ai) herbicides were applied.

Runoff from natural rainfall was collected with weirs and automated ISCO samplers. Data were collected each year by instrumentation of each of the between terraced treatment areas. The runoff water was analyzed for sediment, nutrient, and herbicide losses. Mass loss was calculated by multiplying the runoff concentrations times runoff volumes.

Results

Rainfall and Runoff

Rainfall amounts for the dates in which we collected runoff totaled 9.46 in. in 1998, 8.02 in. in 1999, 5.00 inches in 2000 and 15.22 in. in 2001. Averaged across all runoff collection dates and years, the amount of rainwater that ran off was 48% with the no-till system and 29% with the chisel-disk-field cultivate system (Figure 1). Part of the reason that runoff was greater in no-till than in the chisel-disk-field cultivate system was that each time the soil was tilled, it loosened and dried the soil, which then increased the soil's capacity to absorb rainwater.

Soil Erosion and Sediment Losses

Averaged across all of the runoff collection dates and years, the amount of soil loss was three times greater with the chisel-disk-field cultivate system than for no-till (Figure 2). Soil losses did not always parallel runoff volumes. Differences in intensity of rainfall and timing of individual rainfall events, plus differences in the amount of canopy cover at the time the rainfall occurred, also influenced soil losses.

Nutrient and Herbicide Losses

Soluble P, atrazine, and metolachlor concentrations and losses in the runoff water were highest with surface application in no-till (Figures 3-10). Incorporation of fertilizer and herbicides with tillage decreased losses. Highest runoff concentrations of soluble P and herbicides occurred during the first couple of runoff events after application. Much of the initial losses were direct losses before these materials were fully absorbed into the soil by rain.

Conclusions

The results of this study verify that no-till systems can greatly reduce soil erosion and sediment in runoff water. However, if fertilizer and herbicides are surface applied, runoff losses of these crop inputs will be increased compared to losses when incorporated by tillage.

Therefore, a necessary requirement for preventing soluble P losses in no-till will be to subsurface apply P fertilizer. This could be in the form of pre-plant deep banding (which was used here), 2x2 in. band placement of fertilizer with the planter, or some combination of these.

Steps to reduce herbicide losses in no-till will also be needed. This might be partially accomplished by timing of the herbicide applications when the potential for runoff is less (fall and early spring applications compared to planting-time applications).

Farming operations that rely on tillage also must be improved to minimize soil erosion. Use of structures (terraces) and grass waterways are a given. Also, the use of tillage implements that are designed to leave more crop residue cover on the soil surface would be beneficial.

Ultimately, the farming practices that are best suited for a particular watershed may depend on what the problems are in the watershed. If the problem is predominantly soil erosion and sediment losses, then the use of no-till should be a priority. If the problem is elevated levels of phosphorus and herbicides, then cropping systems that allow for incorporation of these crop inputs would be most beneficial. If all three contaminates (sediment, nutrients, and herbicides) are problems in the watershed, or no single contaminant is a problem, then a combination of tillage practices (no-till on the most highly erosive land and tilled systems on the least erosive fields) may actually provide the best balance for cropland runoff contaminant control.

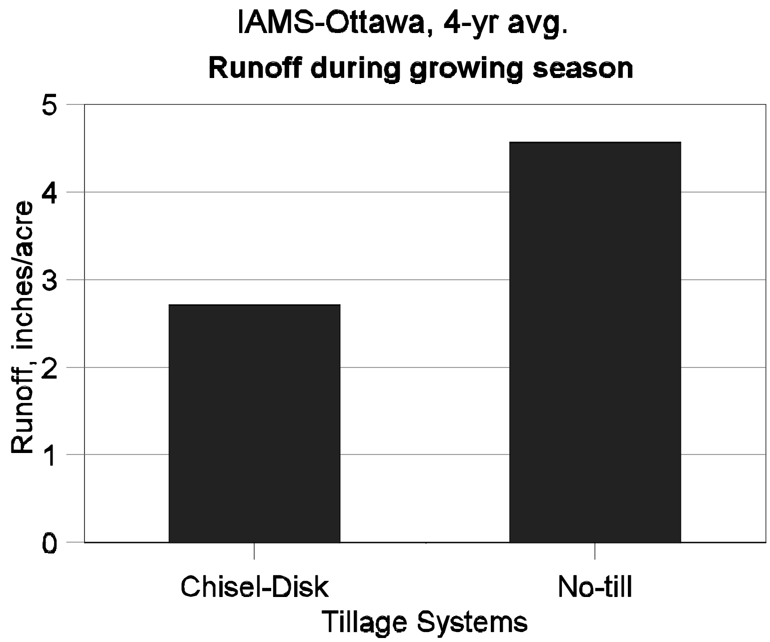

Figure 1. Tillage effects on volume of runoff.

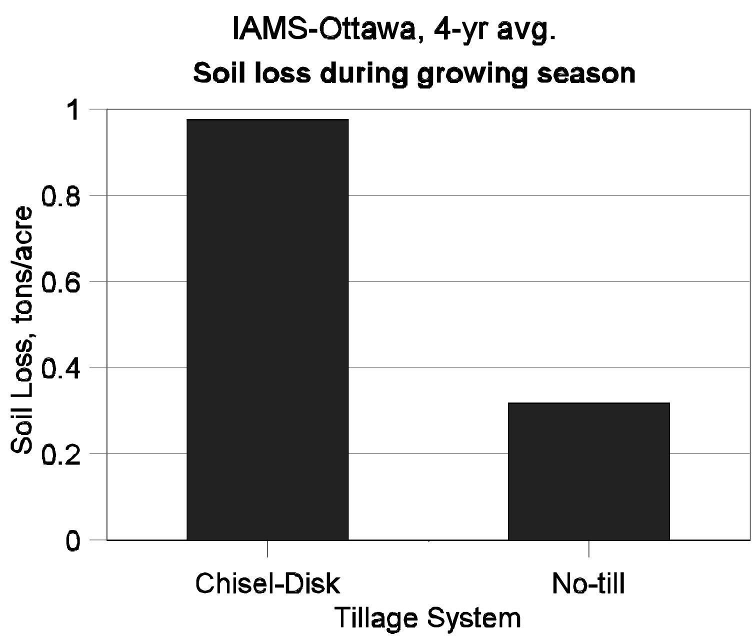

Figure 2. Tillage effects on soil loss in runoff.

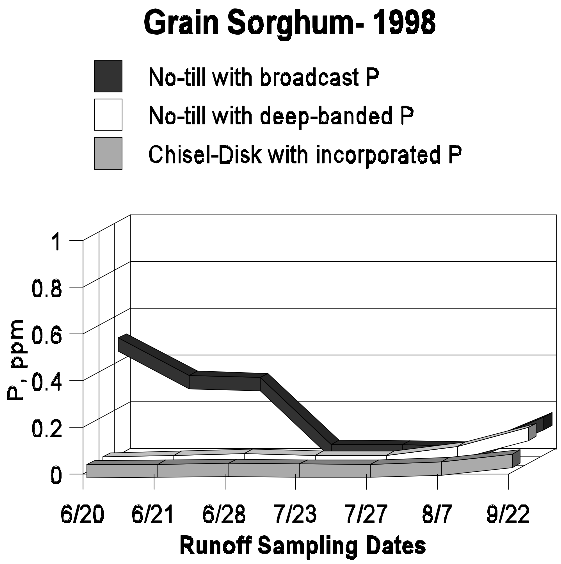

Figure 3. Effects of tillage and P fertilizer placement on soluble P concentrations in runoff, 1998.

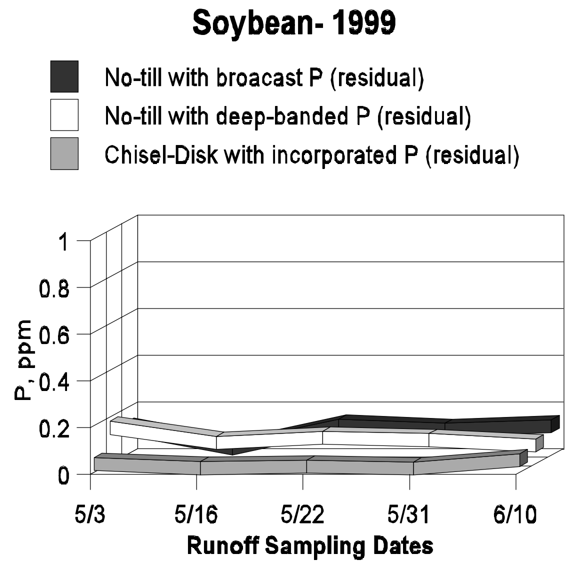

Figure 4. Effects of tillage and residual from P fertilizer placement on soluble P concentrations in runoff, 1999.

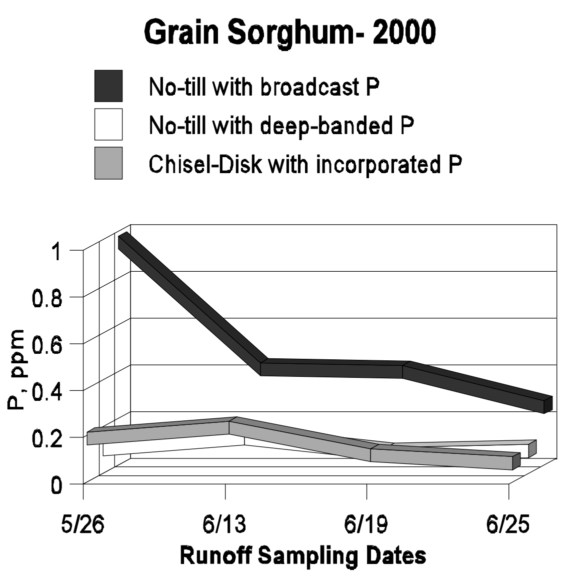

Figure 5. Effects of tillage and P fertilizer placement on soluble P concentrations in runoff, 2000.

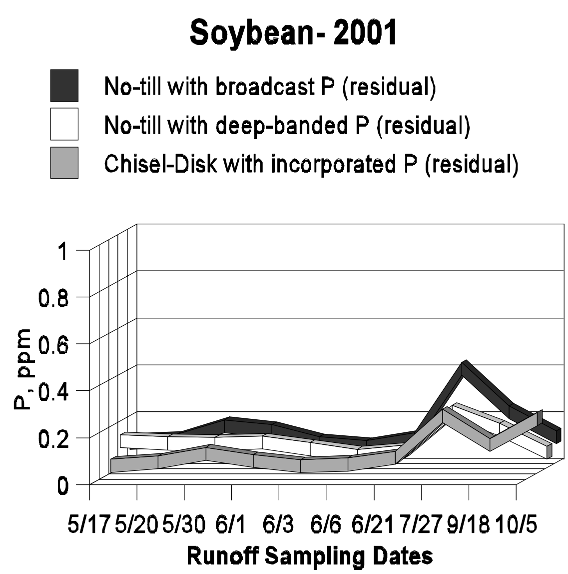

Figure 6. Effects of tillage and P fertilizer placement on soluble P concentrations in runoff, 2001.

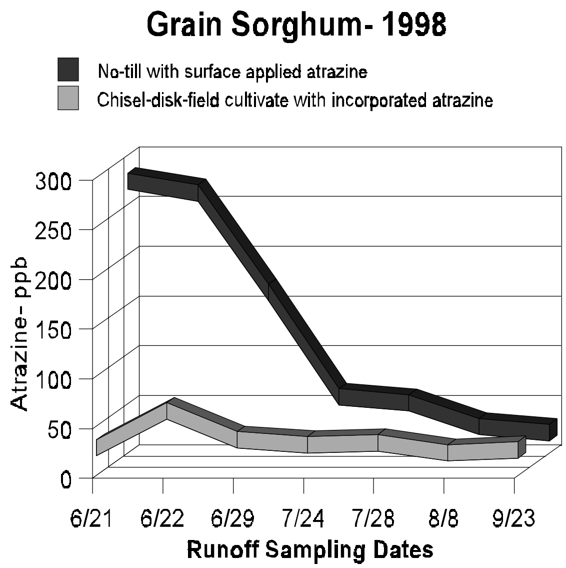

Figure 7. Effects of tillage and atrazine placement on atrazine concentrations in runoff, 1998.

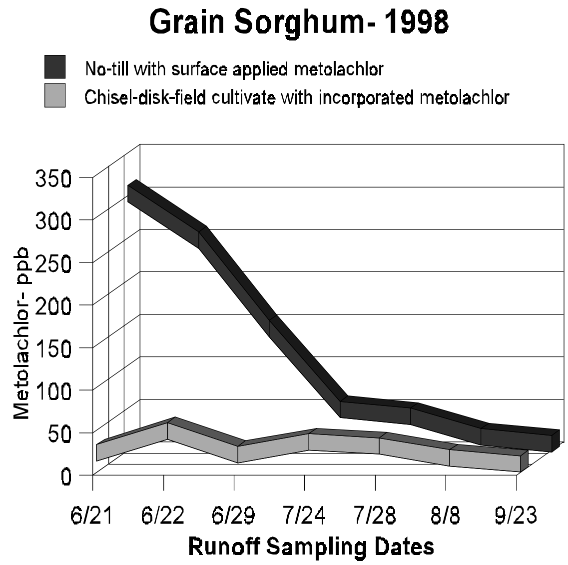

Figure 8. Effects of tillage and metolachlor placement on metolachlor concentrations in runoff, 1998.

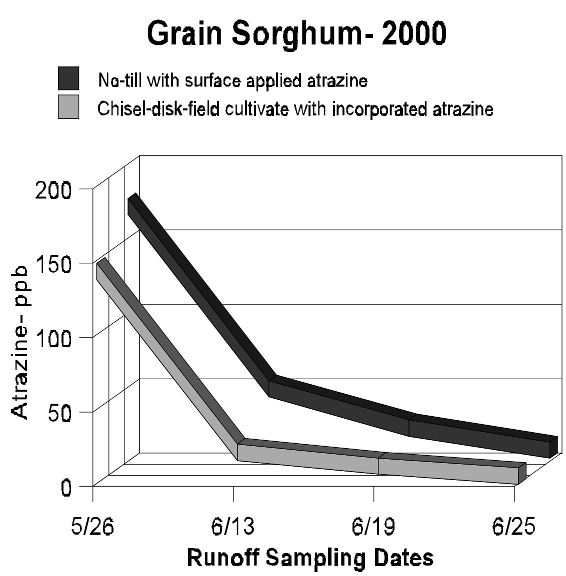

Figure 9. Effects of tillage and atrazine placement on atrazine concentration in runoff, 2000.

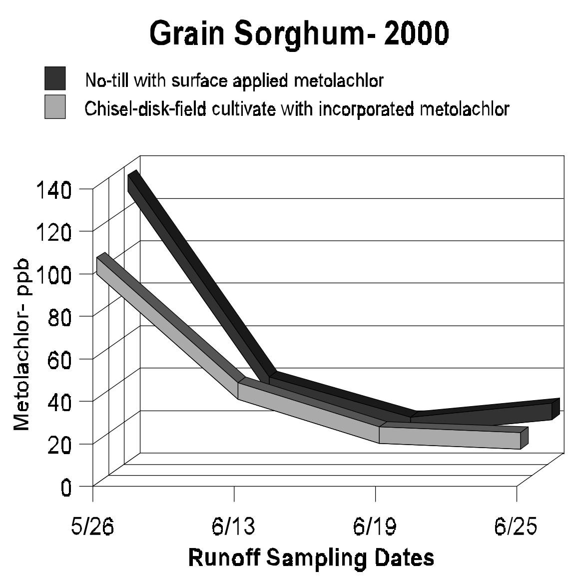

Figure 10. Effects of tillage and metolachlor placement on metolachlor concentration in runoff, 2000.

FORAGE PRODUCTION OF BERMUDAGRASS CULTIVARS IN EASTERN KANSAS

J.L. Moyer, K.A. Janssen, and C.M. Taliaferro[1]

Summary

Total 2001 production was higher from experimental line LCB 84 x 19-16, Midland 99, Ozarka, and LCB 84 x16-66 than for Midland, Greenfield, Guymon, and Wrangler. One entry, CD 90160, did not survive the winter of 2000-2001.

Introduction

Bermudagrass can be a high-producing, warm-season, perennial forage for eastern Kansas when not affected by winterkill. Producers in southeastern Kansas have profited from the use of more winter-hardy varieties that produced more than common bermudas. Further developments in bermudagrass breeding should be monitored to speed adoption of improved, cold-hardy types.

Procedures

Plots were sprigged at 1-ft intervals with plants in peat pots on April 27, 2000 at the East Central Experiment Field, Ottawa, except for entry CD 90160 that was seeded at 8 lb/a of pure, live seed. Plots were 10 x 20 ft each, in four randomized complete blocks. Plots were subsequently sprayed with 1.4 lb/a of S-metolachlor. Plot coverage was assessed in August 2000, and in May and July 2001. Application of 60 lb/a of N was made in April 2001. Strips 20 x 3 ft were cut on July 10, August 15, and November 14, 2001. Subsamples were collected for moisture determination.

Results

Conditions in the winter of 2000-2001 were difficult for bermudagrass because the previous summer was dry and enabled little growth, and winter was more severe than usual. The spring of 2001 was also unusual in that April was drier and warmer than average, and midsummer was also drier than average. In late summer, Ottawa began to receive some moisture that enabled growth for a late-fall cutting after dormancy.

Plot coverage during the dry summer of 2000 was most complete by Midland 99, the new cultivar from Oklahoma State University, and Guymon, a seed-producing type from the same source (Table 7). Poorest coverage was shown by Greenfield and Ozarka.

By spring, 2001, Guymon had good stands remaining whereas CD 90160, an experimental seeded type, and Midand were winterkilled (Table 7). In midsummer, Guymon and Wrangler, both seed-producing types, had excellent stands, and Greenfield had recovered to a large extent. Stands of Midland, Ozarka, and experimental LCB 84x16-66 were only fair by early July, and nonexistent for CD 90160.

Forage yields of the first cutting were higher (P<.05) for the experimental line, LCB 84x19-16, Guymon, and Midland 99 than for five of the other six entries (Table 7). Midland yielded less than six other entries. Second-cut yields were higher for Midland 99 and Ozarka than for the other entries. The three seed-producing types and Greenfield produced less than four other entries.

At the fall dormancy harvest, the experimental LCB 84x16-66 yielded more

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forage and Guymon less than all other entries ($P<.05$, Table 7). Total 2001 forage production was higher for LCB 84x19-16, Midland 99, Ozarka, and LCB 84x16-66 than for Midland, Greenfield, Guymon, and Wrangler. One entry, CD 90160, did not live to produce forage in 2001.

Table 7. Plot coverage and forage yield of bermudagrass sprigged in 2000, Ottawa Experiment Field, Department of Agronomy.

	Plot Cover†			2001 Forage Yield			
Entry	Aug 2000	May 2001	July 2001	July 10	Aug 15	Nov 14	Total
				- tons/a @ 12% moisture -			
CD 90160*	2.8	- -	- -	- -	- -	- -	- -
Greenfield	1.8	1.2	4.2	2.22	0.50	0.92	3.64
Guymon	3.5	3.0	4.9	3.01	0.44	0.56	4.00
LCB 84x16-66	2.2	1.0	2.2	2.04	1.06	2.40	5.49
LCB 84x19-16	3.0	2.0	4.0	3.14	1.10	2.02	6.27
Midland	2.2	0.1	1.6	1.37	0.71	1.40	3.47
Midland 99	4.2	1.2	3.9	2.90	1.75	1.51	6.15
Wrangler	2.0	2.0	4.8	2.87	0.30	0.88	4.04
Ozarka	1.8	1.0	2.2	2.00	1.71	1.98	5.68
Average	2.6	1.5	3.5	2.44	0.94	1.46	4.84
LSD 0.05	0.7	0.7	0.9	0.66	0.34	0.32	0.99

* Plot established from seed.
† Ratings from 0 to 5, where 5=100% coverage.
‡Mostly other grasses.

PLANTING DATE AND MATURITY GROUP EFFECTS ON SOYBEAN PRODUCTION IN EAST-CENTRAL KANSAS

K.A. Janssen and W.B. Gordon

Introduction

Soybean producers in east-central Kansas have a wide window in which they can plant soybean (late April through the middle of July) and a wide range of maturity groups they can plant (II, III, IV, and V). Very early planting of soybean runs the risk of poor stand development and injury by a killing late spring freeze. However, they tend to increase maturity group differences and yield potential if all other factors are not limiting. Delayed or very late plantings reduce vegetative growth before flowering, reduce effects of maturity groups, reduce yield potential, and run the risk of a fall freeze killing the crop before maturity. Other factors associated with planting dates and maturity groups also can affect yield, such as differences in soil and air temperatures that occur with different planting dates, differences in disease and weed pressures, and most importantly, differences in moisture availability during the critical grain fill period. However, selection of soybean maturity groups and time of planting can be helpful to manage situations resulting in planting delays, or to try and match the grain fill period with the most favorable seasonal moisture pattern, spread the harvest load, or shorten time to maturity in order to plant another crop more quickly.

This study evaluates the effects on soybean yield under east-central Kansas conditions from five soybean variety/maturity groups (II, early III, late III, IV, and V) planted at various planting dates (April 21-May 5; May 6-May 25; May 26-June14; June 15-July 4; and July 5-July 28).

Procedures

This experiment was conducted at the East Central Experiment Field near Ottawa on a Woodson soil. The variety/maturity groups planted were IA2021 (II), IA3010 (early III), Macon (late III), KS4694 (IV) and Hutcheson (V). Planting dates ranged from April 28 through July 23. The seeding rate was 175,000 seeds/a. Planting was with a drill in 7-in. rows. Weeds were controlled with Tri-Scept herbicide and hand weeding. At maturity, the center nine rows of each 11-row plot were harvested for yield. All treatments were replicated four times.

Results

Grain yields for the 1999, 2000, and 2001 crop years are shown in Table 8. Averaged across all variety/maturity groups, highest soybean yield in 1999 was produced with the May 26-July 4 plantings, in 2000 with the April 21-May 25 planting dates, and in 2001 with the May 6-June 14 planting dates. Availability of moisture during the pod fill period was the single most important factor affecting yield response to planting dates and maturity groups. In 1999, seasonal moisture favored the medium to late planting dates with the later maturity group soybeans. In 2000, seasonal moisture was most favorable for the early planting dates with the early to medium maturity group soybeans. In 2001 seasonal moisture favored the medium to late planting dates with the later maturity group soybeans. The overall highest yield in 1999 was 53.9 bu/a with Hutcheson (MGV) planted May 14. In 2000 the highest yield was 30.5 bu/a with Macon (MGIII) planted April 28, and in 2001 the highest yield was 49.4 bu/a with Hutcheson (MGV) planted May 24. August and September rainfall amounts for 1999, 2000, and 2001 totaled 11.53, 2.45, and 6.57 in., respectively.

Table 8. Effects of Planting Dates and Maturity Groups on Soybean Yield, Ottawa, 1999-2001.

			Yield bu/a		
Planting period (date) x	Maturity/variety	1999	2000	2001	3-yr Avg
April 21-May 5	II IA2021	--	18.4	20.0	--
April 28, 2000	III IA3010	--	28.4	37.0	--
May 2, 2001	III Macon	--	30.5	37.9	--
	IV KS4694	--	15.2	43.1	--
	V Hutcheson	--	14.3	47.9	--
May 6-May 25	II IA2021	13.8	19.6	24.9	19.4
May 14, 1999	III I3010	31.4	26.8	44.9	34.4
May 17, 2000	III Macon	36.7	25.3	43.6	35.2
May 24, 2001	IV KS4694	46.3	15.2	46.1	35.9
	V Hutcheson	53.9	12.2	49.4	38.5
May 26-June 14	II IA2021	33.1	19.2	32.7	28.3
June 8, 1999	III IA3010	41.6	19.1	44.8	35.2
May 31, 2000	III Macon	44.0	12.1	43.7	33.3
June 12, 2001	IV KS4694	52.8	12.8	45.3	37.0
	V Hutcheson	53.5	14.4	46.7	38.2
June 15-July 4	II IA2021	34.1	7.6	33.4	25.0
June 15, 1999	III IA3010	40.2	6.6	36.4	27.7
June 29, 2000	III Macon	44.2	8.9	39.3	30.8
June 25, 2001	IV KS4694	45.9	9.5	45.0	33.5
	V Hutcheson	53.2	11.4	40.3	35.0
July 5-July 18	II IA2021	25.3	0.0	27.5	17.6
July 8, 1999	III IA3010	23.9	0.0	11.9	11.9
July 17, 2000	III Macon	28.6	0.0	26.8	18.5
July 9, 2001	IV KS4694	31.0	0.0	33.0	21.3
	V Hutcheson	29.2	0.0	34.3	21.2
July 19-July 28	II IA2021	12.3	--	13.5	--
July 23, 1999	III IA3010	9.8	--	7.2	--
July 19, 2001	III Macon	14.4	--	19.7	--
	IV KS4694	11.0	--	28.8	--
	V Hutcheson	2.0	--	25.2	--
Planting Period (means)					
April 21-May 5		--	21.4a	37.2a	--
May 6-May 25		36.4a	19.8a	41.8b	32.7
May 26-June 14		45.0b	15.5b	42.6b	34.4
June 15-July 4		43.5b	8.8c	38.9a	30.4
July 5-July 18		27.6c	0.0d	26.7c	18.1
July 19-July 28		9.9d	--	18.9d	--
Maturity/Variety (means)					
II IA2021		23.7a	16.2a	25.3a	21.7
III IA3010		29.4b	20.2b	30.4b	26.7
III Macon		33.6c	19.2b	35.2c	29.3
IV KS4694		37.4d	13.2c	40.2d	30.3
V Hutcheson		38.3d	13.1c	40.6d	30.7

Means followed by the same letter are not statistically different at the 0.05 level.
This study was supported by the Soybean Checkoff Funds.

HARVEY COUNTY EXPERIMENT FIELD

Introduction

Research at the Harvey County Experiment Field is designed to benefit directly the agricultural industry of the area. The research effort here deals with many aspects of dryland crop production on soils of the Central Loess Plains and Central Outwash Plains of central and south central Kansas. The focus is primarily on wheat, grain sorghum, and soybean, but also includes alternative crops such as corn and sunflower. Investigations include variety and hybrid performance tests, chemical weed control, tillage methods, cropping systems, fertilizer use, and planting practices, as well as disease and insect resistance and control.

Soil Description

The Harvey County Experiment Field consists of two tracts. The headquarters tract consists of 75 acres immediately west of Hesston on Hickory St., and is all Ladysmith silty clay loam with 0-1% slope. The second tract, located 4 miles south and 2 miles west of Hesston, is comprised of 142 acres of Ladysmith, Smolan, Detroit, and Irwin silty clay loams, as well as Geary and Smolan silt loams. All have 0-3% slope. Soils on the two tracts are representative of much of Harvey, Marion, McPherson, Dickinson, and Rice counties, as well as adjacent areas.

These are deep, moderately well to well-drained, upland soils with high fertility and good water-holding capacity. Water runoff is slow to moderate. Permeability of the Ladysmith, Smolan, Detroit, and Irwin series is slow to very slow, whereas permeability of the Geary series is moderate.

2000-2001 Weather Information

Wheat planting was delayed by extremely dry soil conditions. Heavy rainfall occurred within the first week after planting. Stand establishment was generally good, but cold temperatures in November greatly limited wheat development before winter dormancy. Winter precipitation was somewhat above normal in January, well above average in February, but below normal during the other winter months. Mean temperatures were sharply below normal in November and December, just above average in January, and again colder than usual in February and March.

Final wheat stands were somewhat less than desirable in certain instances. April was a bit warmer than normal, while May temperatures were average, and June was cooler than usual.
Total rainfall during March through May was more than 3.6 in. below normal, but June brought above-average precipitation. Moderate SBM symptoms in wheat occurred in late March and early April. Stripe rust began to appear in early May, ultimately affecting the yield and test weight of susceptible varieties. Favorable temperatures and moisture substantially benefitted wheat during grain filling. However, rain during the harvest period contributed to reduced test weight.

Spring conditions were favorable for timely or early planting of row crops. Average maximum and minimum air temperatures were above normal in July and August. During this time, temperatures equaled or exceeded 100 °F on 19 days. Rainfall was below normal, and row crops suffered significant drought stress during the summer months. Some of the highest temperatures coincided with half-silking in corn and half-bloom stage in grain sorghum. Soybean matured unevenly because of drought stress and related factors.

Freezing temperatures occurred last in the spring on April 17. First killing temperatures occurred next on October 16. The frost-free season of 182 days was about 14 days longer than normal.

Table 1. Monthly precipitation totals, inches - Harvey Co. Experiment Field, Hesston, KS.[1]

Month	N Unit	S Unit	Normal	Month	N Unit	S Unit	Normal
	2000				2001		
October	6.60	7.21	2.94	March	1.72	2.26	2.72
November	0.88	1.22	1.87	April	1.28	1.45	2.94
December	0.33	0.31	1.12	May	3.92	4.37	5.02
				June	6.01	7.22	4.39
	2001			July	1.71	1.84	3.71
January	1.13	1.19	0.69	August	1.64	3.22	3.99
February	4.28	4.15	0.93	September	7.89	6.87	2.93
Twelve-month total					37.39	41.31	33.25
Departure from 25-year Normal at N. Unit					4.14	8.06	

[1] Three experiments reported here were conducted at the North Unit: Reduced Tillage and Crop Rotation Systems with Wheat, Grain Sorghum, Corn, and Soybean; Seed Treatment Insecticide Effects on Corn, and Seed Treatment Insecticide Effects on Grain Sorghum All other experiments in this report were conducted at the South Unit.

REDUCED TILLAGE AND CROP ROTATION SYSTEMS WITH WHEAT, GRAIN SORGHUM, CORN, AND SOYBEAN

M.M. Claassen

Summary

Tillage system effects on continuous wheat, continuous grain sorghum, and annual rotations of wheat with row crops were investigated a 5th consecutive year. Prior tillage for row crop did not consistently affect no-till wheat in rotations. Corn and soybean rotations produced highest wheat yields, averaging 47.6 bu/a. This represented an average yield advantage of 9 bu/a over wheat after grain sorghum and continuous wheat. Tillage systems did not meaningfully affect yields of row crops in rotation with wheat except for corn, which was adversely affected by grass weed escapes under no-till. However, wheat rotation increased sorghum yields by 10.8 bu/a in comparison with continuous sorghum. Tillage systems did not significantly affect continuous sorghum nor its response to planting date. Yields from June continuous sorghum plantings exceeded those of the May plantings by 11.8 bu/a.

Introduction

Crop rotations facilitate reduced-tillage practices, while enhancing control of diseases and weeds. Long-term research at Hesston has shown that winter wheat and grain sorghum can be grown successfully in an annual rotation. Although subject to greater impact from drought stress than grain sorghum, corn and soybean also are viable candidates for crop rotations in central Kansas dryland systems that conserve soil moisture. Because of their ability to germinate and grow under cooler conditions, corn and soybean can be planted earlier in the spring and harvested earlier in the fall than sorghum, thereby providing opportunity for soil moisture replenishment as well as a wider window of time within which to plant the succeeding wheat crop. This study was initiated at Hesston on Ladysmith silty clay loam to evaluate the consistency of corn and soybean production versus grain sorghum in an annual rotation with winter wheat and to compare these rotations with monoculture wheat and grain sorghum systems.

Procedures

Three tillage systems were maintained for continuous wheat; two for each row crop (corn, soybean, and grain sorghum) in annual rotation with wheat; and two for continuous grain sorghum. Each system, except no-till, included secondary tillage as needed for weed control and seedbed preparation. Wheat in rotations was planted after each row-crop harvest without prior tillage. The following procedures were used.

Wheat after corn
WC-NTV = No-till after V-blade (V-blade, sweep-treader, mulch treader) for corn
WC-NTNT = No-till after No-till corn

Wheat after sorghum
WG-NTV = No-till after V-blade (V-blade, sweep-treader, mulch treader) for sorghum
WG-NTNT = No-till after No-till sorghum

Wheat after soybean
WS-NTV = No-till after V-blade (V-blade, sweep-treader, mulch treader) for soybean
WS-NTNT = No-till after No-till soybean

Continuous wheat
WW-B = Burn (burn, disk, field cultivate)
WW-C = Chisel (chisel, disk, field cultivate)
WW-NT = No-till

Corn after wheat
CW-V = V-blade (V-blade, sweep-treader, mulch treader)
CW-NT = No-till

Sorghum after wheat
GW-V = V-blade (V-blade, sweep-treader, mulch treader)
GW-NT = No-till

Soybean after wheat
SW-V = V-blade (V-blade, sweep-treader, mulch treader)
SW-NT = No-till

Continuous sorghum
GG-C = Chisel (chisel, sweep-treader, mulch treader)
GG-NT = No-till

Continuous wheat no-till plots were sprayed on July 13 with Landmaster BW + Roundup Ultra + Banvel + Array (54 oz + 1 pt + 4 oz + 1.8 lb/a). A second fallow herbicide application on August 29 consisted of Roundup Ultra + 2,4-D + Array (1.5 pt + 4 oz + 1.35 lb/a). Variety 2137 was planted on October 21 in 8-in. rows at 90 lb/a with a CrustBuster no-till drill equipped with double disk openers. The same equipment was used to overseed variety Jagger at 120 lb/a without tillage in all wheat plots on November 28. Wheat was fertilized with 120 lb N/a and 32 lb P_2O_5/a as preplant, broadcast ammonium nitrate and in-furrow diammonium phosphate at initial planting. WW-NT and WG-NTNT plots were sprayed for cheat control with Olympus 70 WG at 0.62 oz/a + 0.5% nonionic surfactant (NIS) on April 17. Application by Bayer for label registration of Olympus is in process. Olympus is not currently labeled for use by wheat growers in Kansas. All wheat plots except those previously cropped to soybean were sprayed on April 21 with Buctril 2E + MCPA at 1.5 pt + 0.75 pt/a for broadleaf weed control. Wheat was harvested on June 27, 2001.

No-till corn after wheat plots received the same herbicide treatments as WW-NT during the summer plus a late November application of AAtrex 90 DF + 2,4-D $_{LVE}$ + crop oil concentrate (COC) at 1.67 lb + 1 pt + 1 qt/a. Weeds were controlled during the fallow period in CW-V plots with four tillage operations. Corn was fertilized with 111 lb/a N as ammonium nitrate broadcast prior to planting. An additional 14 lb/a N and 37 lb/a P_2O_5 were banded 2 in. from the row at planting. A White no-till planter with double-disk openers on 30-in. centers was used to plant Pioneer 35N05 at approximately 23,000 seeds/a on April 18, 2001. CW-NT plots were treated with Dual II Magnum at 1.66 pt/a and CW-V with Dual II Magnum at 1.33 pt/a + AAtrex 4L at 1.5 pt/a. Row cultivation was not used. Corn was harvested on August 29.

No-till sorghum after wheat plots received the same fallow and preplant herbicide treatments as no-till corn. Continuous NT sorghum plots were treated with AAtrex 90 DF + 2,4-D $_{LVE}$ + Banvel + COC at 1.67 lb + 1 pt + 4 oz + 1 qt/a in early December. GG-NT_{May} areas required no additional herbicide treatment before planting. GG-NT_{June} needed a preplant Roundup Ultra application (1 qt/a) in mid-June.

GW-V plots were managed like CW-V areas during the fallow period between wheat harvest and planting. A sweep-treader was used for the final preplant tillage operation in GW-V. GG-C plots were tilled once each with a chisel (fall) and a sweep-treader between crops. Sorghum was fertilized like corn, but with 116 lb/a total N. ‘Pioneer 8500' treated with Concep III safener and Gaucho insecticide was planted at 42,000 seeds/a in 30-in. rows on May 1, 2001 . A second set of continuous sorghum plots was planted on June 18. Postplant preemergence herbicides for sorghum in rotation with wheat consisted of Dual II Magnum at 1.67 pt/a (GW-NT) or Dual II Magnum at 1.33 pt/a + AAtrex 4L at 1.5 pt/a (GW-V). Continuous sorghum was treated with Dual II Magnum at 1.33 pt/a + AAtrex 4L at 1 pt/a (GG-NT_{May}, GG-NT_{June}, GG-C_{June}) or 1 qt/a (GG-C_{May}) shortly after planting. Sorghum was not row cultivated. May and June-planted sorghum were harvested on August 30 and October 4, respectively.

Fallow weed control procedures for no-till soybean after wheat were the same as for CW-NT and GW-NT during the summer. An application of Sencor 75 DF + 2,4-D $_{LVE}$ + COC at 4 oz + 1 pt + 1 qt/a followed in late November. Roundup Ultra + AMS (1 qt/a + 2.5 lb/a) applied April 25 controlled emerged weeds prior to planting. SW-V tillage procedures were the same as those indicated for GW-V. Weeds were controlled after planting with preemergence Dual II Magnum + Scepter 70 DG (1.33 pt + 2.8 oz/a). 'Iowa 3010' soybean was planted at 7 seeds/ft in 30-in. rows on May 1 and harvested on September 12, 2001.

Results

Wheat

Wheat planting was delayed by extremely dry soil conditions. Heavy rainfall occurred within the first week after planting. Cold temperatures in November greatly limited wheat development before winter dormancy. Stand establishment was generally poor, with the exception of wheat in row crop rotations under continuous no-till. Replanting resulted in the development of good, early-spring stands, with only minor differences among cropping systems. In light of late establishment, wheat benefitted substantially from favorable spring temperatures and moisture during grain filling.

Crop residue cover after planting averaged 75, 74, and 54% in no-till wheat after corn, sorghum, and soybean, respectively (Table 2). In continuous wheat, residue cover ranged from 6% in burned plots to 86% with no-till. Final broadleaf weed control was good to excellent across cropping systems. Cheat infestations in WW-NT and WG-NT were effectively controlled with early-April application of Olympus (experimental herbicide). Heading dates differed slightly among treatments, with wheat after soybean and corn tending to be consistently 1 to 3 days earlier than continuous wheat.

Whole-plant N was greatest in continuous wheat, followed by wheat after corn and wheat after soybean. Lowest plant N was found in wheat after grain sorghum. Wheat in continuous no-till crop rotation systems averaged 0.16% less N than wheat in systems involving V-blade tillage in alternate years. Wheat after corn and soybean produced the highest yields, averaging 9 bu/a more than wheat after sorghum and continuous wheat. There was no apparent effect of prior tillage for row crop on yield of no-till wheat in rotations. And, there was no significant tillage effect on continuous wheat.

Test weights were below average for wheat in all cropping systems, but highest in wheat following sorghum, slightly lower after corn and soybean, and lowest in monoculture wheat. Tillage systems generally had little effect on test weight.

Row Crops

All row crops suffered severe drought stress during the reproductive stages, and yields were well below average. Crop residue cover for row crops following wheat averaged 28% for V-blade and 81% for no-till systems (Table 3). Tillage increased corn stands by 1,800 plants/a and decreased the number of days to half bloom by 2 days, but had no effect on ears per plant. However, corn leaf N concentration and yield was lower in no-till than in the V-blade system, at least in part because of grass weed escapes.

Crop sequence effected sorghum several ways. In comparison with monoculture sorghum (May planting), rotation with wheat increased sorghum stands by 5%, the number of heads/plant by 13%, and yields by 10.8 bu/a. Continuous sorghum planted in June had a 16-day shorter period from planting to half bloom, 1.3 lb/bu higher test weight, and yield that averaged 11.8 bu/a more than when planted in May.

Neither continuous sorghum nor sorghum after wheat was significantly affected by tillage system. However, there was a tendency for higher plant population and lower leaf N with no-till in sorghum after wheat. Although yields of GW-NT and GG-NT_{June} averaged 5 bu/a more than counterpart tillage treatments, these differences were not significant at the 5% probability level. Other parameters in June-planted continuous sorghum were unaffected by tillage.

Soybean yields were very low as a result of drought stress and showed no response to tillage system.

Table 2. Effects of row crop rotation and tillage on wheat, Harvey County Experiment Field, Hesston, KS, 2001.

Crop Sequence[1]	Tillage System	Crop Residue Cover [2]	Yield[3] 2001	Yield[3] 5-Yr	Test Wt	Stand[4] Nov	Stand[4] Apr	Heading[5]	Plant N[6]	Cheat Control[7] Apr	Cheat Control[7] Jun
		%	bu/a		lb/bu	%		date	%	----%----	
Wheat-corn	V-blade	65	48.5	54.9	58.1	62	98	10	2.12	100	100
(No-till)	No-till	85	49.0	54.9	59.0	91	100	10	1.97	99	100
Wheat-sorghum	V-blade	63	41.0	40.1	59.5	46	99	10	1.82	99	99
(No-till)	No-till	84	37.1	38.9	58.9	81	100	12	1.63	77	100
Wheat-soybean	V-blade	48	45.4	54.6	58.3	81	99	10	2.07	100	100
(No-till)	No-till	61	47.7	60.4	58.4	93	99	10	1.90	100	100
Continuous	Burn	6	38.5	46.9	56.1	3	98	11	2.48	100	100
wheat	Chisel	40	39.6	42.9	56.9	2	97	12	2.54	99	100
	No-till	86	36.7	42.6	56.7	31	98	13	2.39	76	100
LSD .05		9	5.0	10.7	0.9	27	3	1.0	0.19	6	NS
Main effect means:											
Crop Sequence											
Wheat-corn		75	48.7	54.9	58.3	76	99	10	2.04	99	100
Wheat-sorghum		74	39.0	39.5	59.2	64	99	11	1.73	88	100
Wheat-soybean		54	46.5	57.5	58.3	87	99	10	1.99	100	100
Continuous wheat		63	38.2	42.7	56.8	17	98	13	2.46	88	100
LSD .05		7	3.6	8.0	0.6	20	NS	0.6	0.15	4	NS
Rotation tillage system											
No-till/V-blade		58	45.0	49.9	58.6	63	99	10	2.00	100	100
No-till/no-till		76	44.6	51.4	58.8	88	99	11	1.84	92	100
LSD .05		6	NS	NS	NS	19	NS	0.6	0.13	4	NS

[1] All wheat planted no-till after row crops. Crop sequence main effect means exclude continuous wheat-burn treatment. Tillage main effect means exclude all continuous wheat treatments.
[2] Crop residue cover estimated by line transect after planting.
[3] Means of four replications adjusted to 12.5% moisture.
[4] Stands existing on November 28, just before overseeding, and final stands on April 20.
[5] Date in May on which 50% heading occurred.
[6] Whole-plant N levels at late boot to early heading.
[7] Visual rating of cheat control before and after application of Olympus herbicide **(Not presently labeled for wheat in Kansas).**

Table 3. Effects of wheat rotation and reduced tillage on corn, grain sorghum, and soybean, Harvey County Experiment Field, Hesston, KS, 2001.

Crop Sequence	Tillage System	Crop Residue Cover [1]	Yield[2] 2001	Yield[2] Mult-Yr	Test Wt	Stand	Maturity[3]	Ears or Heads/ Plant	Leaf N[4]
		%	-----bu/a-----		lb/bu	1000's/a	days		%
Corn-wheat	V-blade	29	44.5	72.2	53.7	24.6	71	0.91	2.45
	No-till	83	31.2	63.6	53.9	22.8	73	0.91	2.04
LSD .05		18	8.2	---	NS	1.1	0.8	NS	NS
Sorghum-wheat	V-blade	29	55.2	95.6	58.0	34.3	72	1.20	2.80
	No-till	83	60.5	99.3	58.3	36.5	72	1.22	2.62
Contin. sorghum	Chisel	38	47.0	78.2	58.1	33.8	74	1.06	2.32
(May)	No-till	73	47.1	76.9	58.2	33.9	74	1.09	2.22
Contin. sorghum	Chisel	–	56.4	64.0	59.3	39.5	57	0.94	2.29
(June)	No-till	–	61.4	68.5	59.5	38.8	58	0.97	2.22
LSD .05[5]		7	7.8	---	0.60	1.5	2.0	0.13	0.18
Soybean-wheat	V-blade	25	12.5	29.0	—	—	131	—	—
	No-till	78	13.6	28.1	---	---	131	—	—
LSD .05		9	NS	---			NS		
Main effect means for sorghum:									
Crop sequence									
Sorghum-wheat		56	57.9	97.5	58.1	35.4	72	1.21	2.71
Contin. sorghum		56	47.1	77.6	58.1	33.8	74	1.07	2.27
(May)		–	58.9	66.2	59.4	39.1	58	0.95	2.25
Contin. sorghum		NS	5.5	---	0.42	1.1	1.4	0.09	0.13
(June)									
LSD .05									
Tillage system									
V-blade/chisel		34	52.9	79.3	58.5	35.8	68	1.07	2.47
No-till/no-till		78	56.3	81.6	58.7	36.4	68	1.09	2.35
LSD .05		4	NS	---	NS	NS	NS	NS	0.11

[1] Crop residue cover estimated by line transect after planting.

[2] Means of four replications adjusted to 12.5% moisture (corn, sorghum) or 13% moisture (soybean). Multiple-year averages: 1997-1999, 2001 for corn and 1997-2001 for sorghum and soybean.

[3] Maturity expressed as follows: corn - days from planting to 50% silking; grain sorghum - number of days from planting to half bloom; soybean - number of days from planting to occurrence of 95% mature pod color.

[4] Corn leaf above upper ear at late silking; sorghum flag leaf at late boot to early heading.

[5] LSD's for comparisons among means for continuous sorghum and sorghum after wheat treatments.

EFFECTS OF NITROGEN RATE AND SEEDING RATE ON NO-TILL WINTER WHEAT AFTER GRAIN SORGHUM

M.M. Claassen

Summary

Wheat following sorghum that had been fertilized with 120 lb/a of nitrogen (N) yielded an average of 2 bu/a more than wheat following sorghum that had received only 60 lb/a of N. The favorable residual effect of higher sorghum N rate was larger at low wheat N rates, but decreased to zero with 120 lb/a of N. Yields increased significantly with each 40 lb/a increment of fertilizer N. When averaged across seeding rates, highest yields of 60 bu/a were obtained with 120 lb/a of N. Plant height and plant N concentration also increased with N rate, while grain test weight improved only slightly at the highest N level. Wheat yields tended to be highest when seeded at 90 or 120 lb/a. A significant interaction occurred between seeding rate and N rate effects on yield, with a larger yield response to seeding rate as N rate increased.

Introduction

Rotation of winter wheat with row crops provides diversification that can aid in the control of diseases and weeds, as well as improve the overall productivity of cropping systems in areas where wheat commonly has been grown. Grain sorghum often is a preferred row crop in these areas because of its drought tolerance. However, sorghum residue may have a detrimental effect on wheat because of allelopathic substances released during decomposition. Research has indicated that negative effects of sorghum on wheat can be diminished or largely overcome by increasing the amount of N fertilizer, as well as the wheat seeding rate. This experiment was established to study wheat responses to these factors and to the residual from N rates on the preceding sorghum crop.

Procedures

The experiment site was located on a Geary silt loam soil with pH 6.4, 2.4% organic matter, 20 lb/a of available phosphorus (P), and 493 lb/a of exchangeable potassium. Grain sorghum had been grown continuously on the site for a period of years before the initiation of this experiment in 1998. A split-plot design was utilized with main plots of 60 and 120 lb/a N rates on the preceding sorghum crop and subplots of 0, 40, 80, and 120 lb/a of N on wheat in a factorial combination with seeding rates of 60, 90, and 120 lb/a. In this second cycle of the sorghum/wheat rotation with its treatment variables, ‘Pioneer 8500' grain sorghum was planted in 30-in. rows on May 10 and harvested on September 4, 2000. Soil was sampled to a depth of 2 ft for residual N shortly after sorghum harvest. Nitrogen rates were applied as ammonium nitrate on September 21. Wheat planting was delayed initially by extremely dry soil conditions and subsequently by mid-October rains. Variety 2137 was planted on October 20, 2000, into undisturbed sorghum stubble with a no-till drill equipped with double-disk openers on 8-in. spacing. P_2O_5 at 37 lb/a was banded in the seed furrow. Whole-plant wheat samples were collected at early bloom stage for determination of N and P concentrations. Wheat was harvested on June 18, 2001. Grain subsamples were analyzed for N content.

Results

In the preceding sorghum crop, stands were approximately 35,500 plants/a, and yields, across previous wheat N rates and seeding rates, averaged 106 and 124 bu/a with 60 and 120 lb/a of N, respectively. Soil nitrate N (0 to 2 ft) after sorghum was low and differed little between treatments, averaging less than 7 lb/a following the two N rates. Rainfall totaled 2.32 in. between N fertilizer application and wheat planting, and an additional 6.43 in. fell during the first 4 weeks after planting. Stand establishment was good, but cold temperatures in November greatly limited wheat development before winter dormancy. However, subsequent spring conditions were favorable for wheat development and grain filling.

Despite little measured difference in residual soil nitrate N following N rates on sorghum, a small residual effect of those treatments was seen in the succeeding wheat crop (Table 4). When averaged over wheat N rates and seeding rates, the high versus low sorghum N rate significantly increased wheat whole-plant nutrient content by 0.04% N and yield by 2 bu/a. These effects were significant at the 12% probability level. A significant interaction between sorghum N rate and wheat N rate occurred in wheat yield, plant height, and grain protein. Following 60 lb/a of N on sorghum, wheat yields increased more with N rate than following 120 lb/a of N. However, yields converged at the highest rates of fertilizer on wheat. Plant heights increased with N rate, but with zero fertilizer N, plant height was greater following 120 lb/a of N than after 60 lb/a of N on sorghum. With zero fertilizer N, grain protein was higher after 60 lb/a versus 120 lb/a N on sorghum, but the highest protein level occurred with 120 lb/a of N following 120 lb/a of N on the preceding crop. No significant interactions occurred between sorghum N rate and wheat seeding rate.

N rate significantly affected each wheat response variable measured. Yields increased with each 40 lb/a increment of fertilizer. Overall average yields of 60 bu/a were obtained with 120 lb/a of N. Plant height and plant N concentration also increased with N rate. Test weight increased slightly with N rate. Plant P concentration was highest at the zero N rate, reflecting the dilution effect of greater plant growth that resulted from fertilizer application. Grain protein decreased at intermediate N rates, but increased with 120 lb/a of N.

Seeding rate main effect was significant, with 90 and 120 lb/a versus 60 lb/a increasing wheat yield by an average of 2 bu/a and resulting in a slight increase in test weight. However, average plant N concentrations and grain protein decreased somewhat with increasing seeding rate. A significant interaction between wheat N rate and seeding rate occurred in grain yield, test weight, and plant N. Yields did not respond to seeding rate at low N rates, but reached a maximum of 61 bu/a with 90 or 120 lb/a of seed and 120 lb/a of N. Higher seeding rates tended to increase test weight slightly as yields declined at the zero N rate. Plant N levels decreased with increasing seeding rate except at the highest N rate.

Table 4. Effects of nitrogen and seeding rate on no-till winter wheat after grain sorghum, Hesston, KS, 2001.

Sorghum N Rate[1]	Wheat N Rate	Seeding Rate	Yield	Bushel Wt	Plant Ht	Plant N[2]	Plant P[2]	Grain Protein[3]
--------------------lb/a	------------------		bu/a	lb	in.	------------------	%------------------	
60	0	60	14.2	60.9	18	1.17	0.29	10.1
		90	13.6	61.3	17	1.10	0.27	10.1
		120	13.2	61.8	16	1.03	0.27	9.9
	40	60	35.3	61.6	24	1.14	0.21	9.3
		90	34.1	61.8	24	1.09	0.21	9.2
		120	37.7	61.7	25	1.07	0.19	9.0
	80	60	52.0	62.0	26	1.43	0.18	9.7
		90	54.5	61.9	27	1.28	0.18	9.4
		120	54.7	62.0	27	1.18	0.17	9.4
	120	60	57.0	61.8	27	1.40	0.18	10.1
		90	60.8	61.8	28	1.43	0.18	10.1
		120	62.0	61.8	29	1.53	0.16	10.0
120	0	60	18.1	61.0	19	1.12	0.26	10.1
		90	18.1	61.3	19	1.09	0.24	9.9
		120	18.1	61.8	19	1.07	0.24	9.6
	40	60	37.5	61.8	24	1.17	0.20	9.4
		90	40.0	61.9	25	1.15	0.19	9.1
		120	38.7	61.9	24	1.16	0.19	9.1
	80	60	52.3	62.0	27	1.43	0.18	9.8
		90	55.3	62.0	27	1.35	0.17	9.7
		120	56.6	62.2	27	1.19	0.17	9.4
	120	60	56.3	61.4	28	1.61	0.18	10.6
		90	60.5	61.8	27	1.50	0.17	10.6
		120	60.9	61.5	28	1.48	0.17	10.6
LSD .05	Means at same Sor. N		2.9	0.32	1.4	0.14	0.021	0.36
	Means at diff. Sor. N		3.8	0.37	1.7	0.15	0.032	0.41
Means: Sorghum N Rate								
60			40.8	61.7	24	1.24	0.21	9.7
120			42.7	61.7	24	1.28	0.20	9.8
LSD .05			NS	NS	NS	NS	NS	NS
LSD .15			1.8	NS	NS	0.04	NS	NS
	N Rate							
	0		15.9	61.3	18	1.10	0.26	9.9
	40		37.2	61.8	24	1.13	0.20	9.2
	80		54.2	62.0	27	1.31	0.18	9.6
	120		59.6	61.7	28	1.49	0.17	10.3
	LSD .05		1.2	0.13	0.6	0.06	0.009	0.15
		Seed Rate						
		60						
		90	40.3	61.6	24	1.31	0.21	9.9
		120	42.1	61.7	24	1.25	0.20	9.8
		LSD .05	42.7	61.8	24	1.21	0.20	9.6
			1.0	0.11	NS	0.05	0.008	0.13

[1] N applied to preceding sorghum crop.
[2] Whole-plant nutrient levels at bloom stage.
[3] Protein calculated as %N x 5.7.

EFFECTS OF TERMINATION METHOD OF HAIRY VETCH WINTER COVER CROP AND NITROGEN RATE ON GRAIN SORGHUM

M.M. Claassen

Summary

Nitrogen response of sorghum grown in the third cycle of a vetch-sorghum-wheat rotation was compared with that of sorghum in a sorghum-wheat rotation at N rates of 0 to 90 lb/a. Vetch was terminated by tillage (disking) or herbicides (no-till). Cold temperatures severely limited vetch fall development, but favorable spring conditions resulted in ample growth and average yields of 1.42 ton/a of dry matter by mid-May. The potential amount of N to be mineralized for use by the sorghum crop was 103 lb/a. On average, sorghum leaf N concentration was near a maximum with an N rate of 30 lb/a. In the absence of fertilizer N, an increase of 0.16% N in sorghum leaves occurred in the vetch versus no-vetch cropping systems. This represented an N contribution equivalent to 19 lb/a of fertilizer N. Leaf N levels in sorghum after vetch were not significantly affected by method of vetch termination or N rate. In sorghum without a cover crop, yield response to fertilizer was limited to the lowest N rates. However, no yield increase occurred with increasing N rate in sorghum after vetch. Vetch termination method had no affect on sorghum yield. The average vetch contribution to sorghum grain production was equivalent to 43 lb/a of fertilizer N.

Introduction

Interest in the use of legume winter cover crops has been rekindled by concerns about soil and water conservation, dependency on commercial fertilizer, and maintenance of soil quality. Hairy vetch is a good candidate for the cover crop role because it can be established in the fall when water use is reduced, it has winterhardiness, and it can fix substantial N. This experiment was conducted to investigate the effects of hairy vetch and N fertilizer rates on the supply of N to the succeeding grain sorghum crop, as well as to assess sorghum yield response when the vetch is terminated by tillage versus by herbicides.

Procedures

The experiment was established on a Geary silt loam soil with the initial planting of hairy vetch following winter wheat in the fall of 1996. Sorghum was grown in 1997 after vetch had been terminated, and the comparison again was made with sorghum in annual rotation with wheat alone. Wheat was planted without tillage into sorghum shortly after harvest and later top-dressed with the same N rates that had been applied to the preceding sorghum crop. After wheat harvest, volunteer wheat and weeds were controlled with Roundup Ultra. The third cycle of these treatment variables was initiated with no-till planting of hairy vetch plots at 25 lb/a in 8-in. rows with a grain drill equipped with double-disk openers on October 4, 2000. One set of vetch plots was terminated by disking on May 9. Hairy vetch in a second set of plots was terminated at that time with Roundup Ultra + 2,4-D_{LVE} + Banvel (1 qt + 1.5 pt +0.25 pt/a). Weeds were controlled with tillage in plots without hairy vetch.

Vetch forage yield was determined by harvesting a 1-m^2 area from each plot on May 9, 2000. Nitrogen fertilizer treatments were broadcast as ammonium nitrate on June 14. All plots received 35 lb/a of P_2O_5, which was banded as 0-46-0 at sorghum planting. Pioneer 8505, treated with Concep III safener and Gaucho insecticide, was planted at approximately 42,000 seeds/a on June 15. Weeds were controlled with a preemergence application of Lasso + AAtrex 4L (2.5 qt + 1 pt/a). Grain sorghum was combine harvested on October 11.

Results

Dry soil delayed vetch emergence. Subsequently, early cold temperatures severely limited vetch fall development, which provided only 17% ground cover by late November. However, favorable spring conditions resulted in ample vetch growth and average yields of 1.42 ton/a of dry matter at early bloom stage near mid-May. N content was 3.65% , so that the average potential amount of N to be mineralized for use by the sorghum crop was 103 lb/a (Table 5).

Disking to terminate hairy vetch growth did not adversely affect soil moisture at the surface because of subsequent rains. Stand establishment was excellent. No-till sorghum after vetch averaged 1,000 plants/a less than sorghum after disked vetch or no vetch. High temperatures and limited rainfall combined to produce considerable drought stress.

Sorghum leaf N concentration tended to be near a maximum with an N rate of 30 lb/a. In the absence of fertilizer N, an increase of 0.16% N in sorghum leaves occurred in the vetch versus no-vetch cropping systems. This represented an N contribution equivalent to 19 lb/a of fertilizer N. Leaf N levels in sorghum after vetch were not significantly affected by method of vetch termination or N rate. Grain sorghum maturity (days to half bloom) increased very slightly in no-till sorghum after vetch versus the other systems. The number of heads per plant reflected the absence of treatment effects and tillering. In sorghum without a cover crop, yield response to fertilizer was limited to the lowest N rates. However, no yield increase occurred with increasing N rate in sorghum after vetch. Vetch termination method had no affect on sorghum yield. The average vetch contribution to sorghum yield was equivalent to 43 lb/a of fertilizer N. Neither cover crop nor N rate affected grain test weight.

Table 5. Effects of hairy vetch cover crop, termination method, and nitrogen rate on grain sorghum after wheat, Hesston, KS, 2001.

Cover Crop/ Termination	N Rate[1]	Vetch Yield[2]		Grain Sorghum					
		Forage	N	Grain Yield	Bushel Wt	Stand	Half[3] Bloom	Heads/ Plant	Leaf N[4]
	lb/a	ton/a	lb	bu/a	lb	1000's/a	days	no.	%
None	0	--	--	83.0	58.8	39.2	54	1.0	2.55
	30	--	--	95.7	59.6	38.4	54	1.0	2.80
	60	--	--	101.7	59.8	37.8	54	1.0	2.83
	90	--	--	101.5	59.9	38.6	53	1.0	2.82
LSD .10				11.8	0.58	NS	NS	NS	0.18
Vetch/Disk	0	1.42	107	100.9	59.4	38.9	54	1.0	2.71
	30	1.30	101	96.3	58.9	38.5	55	1.0	2.79
	60	1.46	108	100.0	59.6	39.1	54	1.0	2.86
	90	1.42	96	99.0	58.7	38.8	54	1.0	2.70
LSD .10		----	----	NS	NS	NS	0.90	NS	NS
Vetch/No-till	0	1.50	106	97.2	59.5	37.5	54	1.0	2.72
	30	1.47	100	101.9	59.6	37.5	54	1.1	2.82
	60	1.50	109	99.6	59.4	37.0	55	1.1	2.89
	90	1.31	99	93.6	58.9	38.5	55	1.0	2.84
LSD .10		----	----	NS	NS	NS	NS	NS	NS
LSD .05 across systems		NS	NS	NS	NS	1.63	0.98	NS	0.23
LSD .10 across systems		NS	NS	NS	NS	----	----	NS	---
Means:									
Cover Crop/Termination									
None									
Vetch/Disk		--	--	95.6	59.5	38.5	54	1.0	2.75
Vetch/No-till		1.40	103	99.1	59.1	38.8	54	1.0	2.76
LSD .05		1.44	104	98.1	59.4	37.6	55	1.0	2.81
		NS	NS	NS	NS	0.82	0.49	NS	NS
N Rate									
0		1.46	106	93.9	59.2	38.5	54	1.0	2.66
30		1.38	101	98.0	59.3	38.1	54	1.0	2.80
60		1.48	108	100.4	59.6	37.9	54	1.0	2.86
90		1.36	97	98.0	59.2	38.6	54	1.0	2.79
LSD .05		NS	NS	NS	NS	NS	NS	NS	0.13

[1] N applied as 34-0-0 on June 14, 2000.
[2] Oven dry weight and N content on May 9, 2001.
[3] Days from planting (June 15, 2001) to half bloom.
[4] Flag leaf at late boot to early heading.

RESIDUAL EFFECTS OF HAIRY VETCH WINTER COVER CROP AND NITROGEN RATE ON NO-TILL WINTER WHEAT AFTER SORGHUM

M.M. Claassen

Summary

Wheat production was evaluated in the third cycle of annual wheat-sorghum and wheat-vetch-sorghum rotations. Treatment variables included disk and herbicide termination methods for hairy vetch and N fertilizer rates of 0 to 90 lb/a. Both hairy vetch and N rate significantly increased wheat yield. At 0 lb/a of fertilizer N, the residual effect of hairy vetch increased wheat yields by 27 and 23 bu/a in disk and no-till systems, respectively. These residual vetch benefits were equivalent to 47 and 40 lb/a of fertilizer N, respectively. In wheat after sorghum without vetch, each 30 lb/a increment of fertilizer N significantly increased yield. The trend suggested that yields had not exceeded the maximum at 90 lb/a of fertilizer N. In wheat after vetch-sorghum, yields at 60 and 90 lb/a of N did not differ significantly.

Introduction

Hairy vetch can be planted in September following wheat and used as a winter cover crop ahead of grain sorghum in an annual wheat-sorghum rotation. Soil erosion protection and N contribution to the succeeding crop(s) are potential benefits of including hairy vetch in this cropping system. The amount of N contributed by hairy vetch to grain sorghum has been under investigation. The longer-term benefit of vetch in the rotation is also of interest. This experiment concluded the third cycle of a crop rotation in which the residual effects of vetch as well as N fertilizer rates were measured in terms of N uptake and yield of wheat.

Procedures

The experiment was established on a Geary silt loam soil with the initial planting of hairy vetch following winter wheat in the fall of 1995. Sorghum was grown in 1996 with or without the preceding cover crop and fertilized with N rates of 0, 30, 60, or 90 lb/a. Winter wheat was no-till planted in 8-in. rows into sorghum stubble in the fall of 1996. In the third cycle of the rotation, hairy vetch plots were seeded at 24 lb/a in 8-in. rows on October 8, 1999. One set of vetch plots was terminated by disking on May 8. Hairy vetch in a second set of plots was terminated at that time with Roundup Ultra + 2,4-D_{LVE} + Banvel (1 qt + 1.5 pt/a + 0.25 pt/a).

Vetch forage yield was determined by harvesting a 1-m^2 area from each plot on May 8, 2000. Nitrogen fertilizer treatments were broadcast as ammonium nitrate on May 24. All plots received 35 lb/a of P_2O_5, which was banded as 0-46-0 at sorghum planting. Pioneer 8505 was planted in 30-in. rows at approximately 42,000 seeds/a on June 7, 2000. Weeds were controlled with a preemergence application of Dual II + AAtrex 90 DF (1 qt/a + 0.55 lb/a). Grain sorghum was combine harvested on September 26. Fertilizer N was broadcast as 34-0-0 on October 4, 2000, at rates equal to those applied to the prior sorghum crop. Variety 2137 winter wheat was no-till planted in 8-in. rows into sorghum stubble on October 20 at 120 lb/a with 39 lb/a of P_2O_5 fertilizer banded in the furrow. Wheat was harvested on June 18, 2001.

Results

Hairy vetch terminated near mid-May, 2000, produced an average of 1.97 ton/a of dry matter, yielding 105 lb/a of N potentially available to the sorghum that followed (Table 6). In terms of sorghum leaf N levels, the apparent N contribution by vetch was equivalent to approximately 57 lb/a and >120 lb/a of fertilizer N in no-till and disked plots, respectively. However, in the absence of fertilizer N, sorghum after vetch produced yields not differing significantly from sorghum with no preceding cover crop. And, when averaged over N rates, yields of sorghum after disked vetch were 7 bu/a lower than either no-till sorghum after vetch or sorghum without a cover crop.

Residual vetch effect increased wheat plant height at 0 and 30 lb/a of N but not at higher N rates. Averaged across N rates, vetch treatments increased wheat plant N and grain protein. These increases were most notable at 90 lb/a of N. At 0 lb/a of fertilizer N, the residual effect of hairy vetch increased wheat yields by 27 and 23 bu/a in disk and no-till systems, respectively. These residual vetch benefits were equivalent to 47 and 40 lb/a of fertilizer N, respectively. Averaged over N rates, hairy vetch in these systems accounted for yield increases of 15 and 12 bu/a. In wheat after sorghum without vetch, each 30 lb/a increment of fertilizer N significantly increased yield. The trend suggested that yields had not exceeded the maximum at 90 lb/a of fertilizer N. In wheat after vetch-sorghum, yields also increased with increasing fertilizer N, but failed to differ significantly between rates of 60 and 90 lb/a of N.

Table 6. Residual effects of hairy vetch cover crop, termination method, and nitrogen rate on no-till wheat after grain sorghum, Hesston, KS, 2001.

Cover Crop/ Termination[1]	N Rate[2]	Vetch Yield[3] Forage	Vetch Yield[3] N	Sorghum Yield 2000	Wheat Yield	Wheat Bushel Wt	Wheat Plant Ht	Wheat Plant N[4]	Wheat Grain N[5]
	lb/a	ton/a	lb	bu/a	bu/a	lb	in.	%	%
None	0	--	--	76.1	12.0	62.2	17	0.94	10.0
	30	--	--	82.0	28.3	62.3	22	1.05	9.2
	60	--	--	86.0	46.2	62.2	26	1.07	9.1
	90	--	--	89.3	54.2	61.8	27	1.21	9.5
Vetch/Disk	0	2.19	109	73.8	38.7	62.8	24	1.13	10.1
	30	1.96	110	77.4	48.1	62.0	26	1.05	9.7
	60	2.05	104	79.9	54.6	61.7	27	1.26	10.4
	90	1.76	94	75.6	58.9	60.7	27	1.55	10.8
Vetch/No-till	0	2.26	116	82.2	35.2	63.0	23	1.14	9.9
	30	1.91	108	80.6	45.0	62.5	26	1.08	9.7
	60	1.84	98	85.5	52.0	62.1	27	1.28	10.1
	90	1.80	101	84.0	54.6	61.5	28	1.59	11.0
LSD .05		0.41	NS	9.5	5.5	0.52	1.9	0.25	0.69
Means:									
Cover Crop/Termination									
None									
Vetch/Disk		----	----	83.3	35.2	62.1	23	1.07	9.5
Vetch/No-till		1.99	104	76.7	50.1	61.8	26	1.24	10.3
LSD .05		1.95	106	83.1	46.7	62.3	26	1.27	10.2
		NS	NS	4.7	2.8	0.26	0.9	0.12	0.34
N Rate									
0		2.23	112	77.3	28.7	62.7	21	1.07	10.0
30		1.94	109	80.0	40.5	62.3	25	1.06	9.6
60		1.94	101	83.8	51.0	62.0	27	1.20	9.9
90		1.78	98	83.0	55.9	61.3	27	1.45	10.4
LSD .05		0.29	NS	NS	3.2	0.30	1.1	0.14	0.40

[1] Hairy vetch planted on October 8, 1999, and terminated in the following spring.
[2] N applied as 34-0-0 on May 24, 2000 for sorghum and on October 4, 2000 for wheat.
[3] Oven dry weight and N content just prior to termination.
[4] Whole-plant N concentration at early heading.
[5] Protein calculated as %N x 5.7.

INSECTICIDE SEED TREATMENT EFFECTS ON CORN AND EARLY-PLANTED GRAIN SORGHUM

M.M. Claassen, G.E. Wilde, and K.L. Roozeboom

Summary

The effects of Cruiser (formerly Adage), Gaucho, and Prescribe seed treatments were evaluated on two corn hybrids, Asgrow RX799Bt and Midland 798. Under conditions of insignificant insect activity and severe drought, no benefit from these treatments on corn were measured. Cruiser and Gaucho effects also were monitored on NC+ 271 and NK KS 560Y grain sorghum. Minor benefits from insecticide seed treatments were measured only in NK KS 560Y. Most notably, Cruiser and Gaucho increased stands of this hybrid by 30 to 43% and increased yields by an average of 5.7 bu/a.

Introduction

Wireworms, flea beetles, and chinch bugs are insects that may affect stand establishment or development of corn and early-planted grain sorghum. Limited information is available concerning the response of these crops to insecticide seed treatment in the presence of low levels of these pests. Previous work with Gaucho on grain sorghum at Hesston showed that sorghum hybrids differed in their yield response. In April grain sorghum plantings, the average yield increases with Gaucho were 7 and 13 bu/a in 1996 and 1997, respectively, while in May plantings, corresponding increases were 12 and 14 bu/a. Low levels of chinch bugs were present in these experiments. However, in similar tests at four other locations across the state, little or no impact on sorghum yields was found in the absence of any significant insects. Analogous evaluations had not been done in corn. The experiment reported here was established in 2000 to determine the relative efficacy of Cruiser and Gaucho seed treatments on insects in corn or grain sorghum as well as to assess the impacts these pests may have on yields.

Procedures

The experiment was conducted on a Ladysmith silty clay loam soil. In 2001, corn followed grain sorghum, and sorghum was grown on an area previously cropped to corn. Corn was fertilized with 126 lb N/a and 32 lb P_2O_5/a. Eight replications of two hybrids, Asgrow RX799Bt and Midland 798 with and without Cruiser, Gaucho, and Prescribe were planted on April 18, 2001, in 30-in. rows at 23,000 seeds/a. Weeds were controlled with preemergence application of Dual II Magnum + AAtrex 4L (1.33 pt + 1.5 qt/a). Plant population counts and seedling vigor ratings were obtained at 31days after planting (DAP). Corn was combine harvested on August 29.

Grain sorghum was fertilized the same as corn. Hybrids NC+ 271 and NK KS 560Y with and without Cruiser and Gaucho were planted in eight replications on May 2 in 30-in. rows at 47,000 seeds/a. Weeds were controlled with preemergence application of Dual II Magnum + AAtrex 4L (1.33 pt + 1 qt/a). Stand counts and seedling vigor ratings were made at 17 DAP. Grain sorghum was harvested on September 5, 2001.

Results

Corn

Corn emerged at the end of April and reached silking stage in early July. The beginning of the reproductive stage coincided with the arrival of severe drought stress, which persisted during much of the growing season. No measurable insect populations were observed. Insecticide treatments had no beneficial effect on stands (Table 7). In contrast with results in 2000, none of the insecticides significantly affected early plant vigor, number of days to half-silk stage, number of ears per plant, or lodging. Yields of Asgrow RX799Bt and Midland 798 were extremely low and reflected the absence of any benefit from seed treatments.

Grain Sorghum

More than 2 in. of rain fell withing 5 days after planting. Emergence occurred in the normal time frame for NC+ 271, but was delayed and incomplete for KS 560Y. Sorghum suffered significant drought stress during the summer months. Some of the highest temperatures coincided with half-bloom stage.

Chinch bug populations were low and not quantified. Cruiser and Gaucho had no effect on NC+ 271 in terms of any of the sorghum parameters measured. However, insecticide effects on NK KS 560Y regarding some of these parameters were significant, though small (Table 8). At 17 DAP, Cruiser and Gaucho increased stand percentage of NK KS 560Y by 30% and 43%, respectively. Both insecticides slightly increased early sorghum vigor. Gaucho slightly decreased the number of days to half bloom. In terms of yield benefit, there was no significant difference between the insecticides. Both increased the yield of NK KS 560Y by an average of 5.8 bu/a. Test weight was unaffected by treatment.

Table 7. Cruiser, Gaucho, and Prescribe seed insecticide effects on corn, Harvey County Experiment Field, Hesston, KS, 2001.

Hybrid	Treat-ment[1]	Grain YIeld[2] 2001	Grain YIeld[2] 2000	Bu Wt	Plant Vigor[3]	Stand[4]	Days to Silk[5]	Ears/ Plant	Lodg-ing
		------bu/a-----		lb/bu	score	%			%
Asgrow RX799Bt	None	27	97	51.5	1.3	122	75	0.70	1
Asgrow RX799Bt	Cruiser 1.3	28	102	51.7	1.5	120	75	0.70	1
Asgrow RX799Bt	Cruiser 5.1	28	---	52.2	1.3	122	75	0.68	1
Asgrow RX799Bt	Gaucho	28	108	52.2	1.6	126	76	0.64	0
Asgrow RX799Bt	Pre-scribe	28	---	52.2	1.4	125	76	0.67	0
Midland 798	None	30	57	54.9	1.9	104	78	0.71	1
Midland 798	Cruiser 1.3	32	95	54.7	1.8	110	78	0.70	1
Midland 798	Cruiser 5.1	32	---	54.6	1.6	105	78	0.68	2
Midland 798	Gaucho	31	100	55.3	1.7	103	78	0.72	1
Midland 798	Pre-scribe	31	---	55.1	1.7	104	78	0.72	0
LSD .05		4	7	0.86	0.34	7	0.7	0.057	NS
Main effect means:									
Hybrid									
Asgrow RX799Bt		28	102	52.0	1.4	123	75	0.68	1
Midland 798		31	84	54.9	1.7	105	78	0.70	1
LSD .05		2	4	0.38	0.15	3	0.3	0.026	NS
Treatment									
None		29	77	53.2	1.6	113	77	0.71	1
Cruiser 1.3		30	98	53.2	1.6	115	76	0.70	1
Cruiser 5.1		30	---	53.4	1.4	114	76	0.68	1
Gaucho		30	104	53.8	1.7	115	77	0.68	1
Pre-scribe		29	---	53.6	1.5	115	77	0.69	0
LSD .05		NS	5	NS	NS	NS	0.5	NS	NS

[1] Cruiser rates: 1.3 and 5.1 oz/cwt.
[2] Average of 8 replications adjusted to 56 lb/bu and 15.5% moisture.
[3] Vigor score on May 19: 1 = good; 5 = poor.
[4] Percent of 20,000 target plant population.
[5] Days from planting to 50% silking.

Table 8. Cruiser and Gaucho seed insecticide effects on grain sorghum, Harvey County Experiment Field, Hesston, KS, 2001.

Hybrid	Treatment	Grain Yield[1] 2001	Grain Yield[1] 2000	Bu Wt	Plant Vigor[2]	Stand[3]	Days to Bloom[4]	Head/ Plant	Lodging
		------bu/a-----		lb/bu	score	%			%
NC+ 271	None	54	98	58.1	1.3	103	77	1.0	0
NC+ 271	Cruiser	54	114	57.7	1.2	100	77	1.0	0
NC+ 271	Gaucho	57	113	57.5	1.2	103	76	1.0	0
NK KS 560Y	None	43	102	57.5	3.5	40	77	2.4	0
NK KS 560Y	Cruiser	48	109	58.0	3.0	52	76	2.1	0
NK KS 560Y	Gaucho	49	107	58.0	2.9	57	75	1.9	0
LSD .05		5	4	NS	0.45	7	1.3	0.32	NS
Main effect means:									
Hybrid									
NC+ 271		55	109	57.8	1.2	102	77	1.0	0
NK KS 560Y		46	106	57.9	3.1	50	76	2.1	0
LSD .05		3	2	NS	0.26	4	0.8	0.18	NS
Treatment									
None		48	100	57.8	2.4	71	77	1.7	0
Cruiser		51	112	57.9	2.1	76	76	1.6	0
Gaucho		53	110	57.8	2.0	80	76	1.5	0
LSD		NS	3	NS	0.32	5	0.9	NS	NS

[1] Average of 8 replications adjusted to 56 lb/bu and 12.5% moisture.
[2] Vigor score on May 19: 1 = good; 5 = poor.
[3] Percent of 35,000 plants/a target population.
[4] Days from planting to 50% bloom.

DRYLAND CORN HYBRID AND PLANT POPULATION INTERACTIONS

M.M. Claassen, D.L. Fjell, and K.L. Roozeboom

Summary

Two corn hybrids representing fixed-ear (D) and flex-ear types (F) were grown in a wheat rotation under no-till conditions at plant populations ranging from 14,000 to 26,000 plants/a. Yields were very low because of severe drought stress. Highest yields occurred with the lowest plant population and tended to decrease as plants/a increased, especially at the two highest stand levels. All yield variables except grain test weight and kernel weight decreased with increasing plant population. Number of ears/plant decreased as plants/a increased, but NC+ 5878B (F) was more adversely affected than NC+ 5790B (D) and produced only half the yield. Ears/plant was the only variable showing a significant hybrid by plant population interaction.

Introduction

The Kansas Corn Performance Tests historically have been planted at a constant population across all hybrids at a given location. The populations are optimized based on current KSU Extension recommendations considering soil type, typical rainfall, fertility, and planting date. Seed companies often recommend a specific population range for each hybrid based on in-house research. These recommendations are based on the observed reaction of each hybrid to changes in population. Typically, flex-ear hybrids are characterized as handling low populations better, and not responding well to higher populations. Fixed-ear (determinate) hybrids are characterized as performing best under higher populations. As a result, some seed company representatives have questioned our policy of using a constant population for all hybrids at a given location.

The experiment described here was initiated in 2001 to determine if hybrid types (flex-ear vs. determinate) respond differently to plant population under existing dryland conditions and to provide a basis for either 1) the validation of current performance test practices or 2) additional studies on a broader scale to evaluate hybrid response characteristics.

Procedures

The experiment was conducted on a Smolan silt loam with pH 6.8, 2.1 % organic matter, and soil tests high in available phosphorus and exchangeable potassium. In 2000 winter wheat was grown on the site, which was subsequently maintained without tillage. After wheat harvest, weeds were controlled in mid-July with Landmaster + Banvel (54 + 4 oz/a) and in late August with Roundup Ultra (1 qt/a). Fallow weed control was completed with Atrazine 90 DF + 2,4-D_{LVE} + Banvel + COC (1.67 lb + 1 pt + 4 oz + 1 qt) in early December and Roundup Ultra + 2,4-D_{LVE} + Banvel (32 + 2 + 2 oz/a) just before planting. Corn was fertilized with 125 lb/a of N and 37 lb/a of P_2O_5 as 34-0-0 broadcast in early April and as 18-46-0 banded at planting. The experiment design was a randomized complete block with factorial combinations of two hybrids and four plant populations in four replications. A fixed-ear (D) hybrid, NC+ 5790B, and a flex-ear (F) hybrid, NC+ 5878B, were planted at 31,000 seeds/a into moist soil on April 19, 2001. Temik 15G insecticide at 7 lb/a was applied in-furrow at planting. Weed control was completed with preemergence Dual II Magnum at 1.66 pt/a. Corn emerged at the end of April and was subsequently hand thinned to specified populations of 14,000, 18,000, 22,000 and 26,000 plants/a. Evaluations included yield, ear number, ear weight, kernels/ear, and kernel weight. Plots were combine harvested on August 28.

Results

After an excellent start to the growing season, corn encountered severe drought stress beginning in early July, just after silking was completed. High temperatures and below-normal precipitation characterized the remaining summer months. Length of time to reach half-silking stage increased slightly in both hybrids at the two highest plant populations (Table 9). Corn yields were very low and tended to decline as plant population increased. Highest yields occurred with 14,000 plants/a, but were not significantly better than at 18,000 plants/a. Yields at 22,000 and 26,000 plants/a averaged 27% less than at the lowest populations. NC+ 5790B (D) produced more than twice the yield of NC+ 5878B (F). However, these hybrids had similar yield responses to plant population. Test weight was not affected by plant population. Number of ears/plant decreased as plants/a increased, but NC+ 5878B (F) was more adversely affected than NC+ 5790B (D). This was the only yield variable showing a significant hybrid by plant population interaction. Ear weight followed the pattern of population effects observed with yield. All populations greater than 14,000 plants/a had a significant reduction in average ear weight. The number of kernels/ear was greatest at 14,000 plants/a, decreased by 20% at 18,000 plants/a, and declined by an average of 62% at the two highest populations. Kernel weight was not affected by plant population.

Table 9. Dryland corn hybrid response to plant populations, Harvey County Experiment Field, Hesston, KS, 2001.

Hybrid[1]	Plant Popu-lation	Grain Yield[2]	Bu Wt	Ears/ Plant	Ear Wt	Kernels/ Ear	Kernel Wt	Days to Silk[3]	Lodg-ing
	no./a	bu/a	lb/bu		lb		g/1000		%
NC+ 5790B (D)	14,000	48	52.8	0.99	0.21	525	150	68	2
NC+ 5790B (D)	18,000	44	52.5	0.99	0.15	458	137	68	1
NC+ 5790B (D)	22,000	40	53.0	0.95	0.13	386	141	69	1
NC+ 5790B (D)	26,000	36	52.6	0.87	0.10	312	135	69	1
NC+ 5878B (F)	14,000	28	53.0	0.95	0.15	452	135	69	7
NC+ 5878B (F)	18,000	24	53.8	0.86	0.10	319	121	69	8
NC+ 5878B (F)	22,000	15	53.6	0.51	0.08	259	128	71	3
NC+ 5878B (F)	26,000	14	54.0	0.52	0.08	263	130	71	4
LSD .05		8.4	1.4	0.11	0.029	372	17	0.9	4
Hybrid*Plant Population [4]		NS	NS	0.01*	NS	NS	NS	NS	NS
Main effect means:									
Hybrid									
NC+ 5790B (D)		42	52.7	0.95	0.15	420	140	69	1
NC+ 5878B (F)		20	53.6	0.71	0.10	323	128	70	6
LSD .05		4.2	0.7	0. 06	0.015	33	9	0.4	2
Plant Population									
14,000		38	52.9	0.97	0.18	488	142	69	5
18,000		34	53.2	0.93	0.13	389	129	69	5
22,000		27	53.3	0.73	0.10	322	134	70	2
26,000		25	53.3	0.70	0.09	287	132	70	2
LSD .05		5.9	NS	0.08	0.021	47	NS	0.6	NS

[1] (D) = fixed-ear hybrid ; (F) = flex-ear hybrid.
[2] Average of 4 replications adjusted to 56 lb/bu and 15.5% moisture.
[3] Days from planting to 50% silking.
[4] Probability of significant differential hybrid response to plant population; NS = not significant.

HERBICIDES FOR WEED CONTROL IN GRAIN SORGHUM

M.M. Claassen and D.L. Regehr

Summary

Eighteen herbicide treatments were evaluated for crop tolerance and weed control efficacy in grain sorghum. Weed competition, reduced by limited rainfall after planting, consisted of light to moderate Palmer amaranth and very light large crabgrass populations. All preemergence treatments provided excellent control of these species. Dual II Magnum, used at a low rate so as not to contribute to pigweed control in sequential treatments, provided excellent control of large crabgrass under existing conditions. Superior postemergence control of Palmer amaranth was achieved with Guardsman, Aim + AAtrex, Peak + AAtrex, Ally + 2,4-D, Ally + 2,4-D + AAtrex, and Paramount + AAtrex. Aim, Permit, and Aim + Permit provided poor control of Palmer amaranth. Minor crop injury from Aim and 2,4-D did not result in yield loss. All herbicide treatments significantly increased sorghum yields.

Introduction

Atrazine has been a versatile, cost-effective herbicide for both preemergence and postemergence weed control in grain sorghum for a long period of time. However, off-target movement of atrazine under certain conditions has raised environmental concerns. This experiment was conducted to evaluate standard premix preemergence treatments and alternative postemergence herbicides and herbicide combinations that may provide greater flexibility for growers.

Procedures

Winter wheat was grown on the experiment site in 2000. The soil was a Geary silt loam with pH 6.3 and 2.0% organic matter. Fertilizer nitrogen was applied at 100 lb/a as 46-0-0 in mid-June. Weed seed was broadcast over the area to enhance the uniformity of weed populations. Pioneer 8505 with Concep II safener and Gaucho insecticide seed treatment was planted at approximately 42,000 seeds/a in 30-in. rows on June 25, 2001. Seedbed condition was excellent. All herbicides were broadcast in 20 gal/a of water, with three replications per treatment (Table 10). Preemergence (PRE) applications were made shortly after planting with AI TeeJet 110025-VS nozzles at 29 psi. Postemergence treatments were applied in the same way on July 11 (EPOST) or July 14 (POST). EPOST treatment was applied to 1- to 3-in. Palmer amaranth and 1-in. large crabgrass in 7-in. sorghum. POST herbicides were applied to 2- to 7-in. Palmer amaranth and 1- to 2-in. large crabgrass in 10-in. sorghum. Plots were not cultivated. Crop injury and weed control were rated twice during the growing season. Sorghum was harvested on October 26.

Results

Light rains of 0.16 and 0.05 in. fell at 10 and 20 days after planting. The first significant rainfall (0.74 in.) occurred 21 days after planting and preemergence herbicide applications. Thereafter, an additional 0.89 in. of rain fell during the remainder of July. An extremely dry period of nearly three weeks extended from late July until August 17. High temperatures prevailed throughout most of the growing season and combined with below-normal precipitation in July and August to cause significant drought stress.

Weed competition from overseeding did not materialize because of insufficient rainfall. Indigenous populations of Palmer amaranth were moderate, and those of large crabgrass were very low. Weed control evaluations at 4 and 8 weeks after planting generally showed little change in the efficacy of the respective treatments over time. Despite limited rainfall after planting, all preemergence treatments provided excellent control of Palmer amaranth and large crabgrass. Superior postemergence control of Palmer amaranth was achieved with Guardsman, Aim + AAtrex, Peak + AAtrex, Ally + 2,4-D, Ally + 2,4-D + AAtrex, and Paramount + AAtrex. Aim, Permit, Aim + Permit and Paramount provided poor control of Palmer amaranth. Intermediate control was obtained with Peak alone as well as with Peak and Aim in combination with 2,4-D or Banvel. Large crabgrass control ratings for Paramount alone were significantly lower than with preemergence Dual II Magnum, but higher than previously observed because of low or disuniform weed population.

Minor crop injury occurred primarily with treatments involving Aim and 2,4-D. Aim caused necrotic spot on leaves, and 2,4-D resulted in rolled leaves and leaning tillers. Injury symptoms were not associated with yield loss. All herbicide treatments significantly increased yields. Yield differences among these treatments were not meaningful because of variation associated with drought effects.

Table 10 . Weed control in grain sorghum, Harvey County Experiment Field, Hesston, KS, 2001.

	Herbicide Treatment[1]	Product					Lacg[3]	Paam[4]	
		Form	Rate/a	Unit	Timing[2]	Injury 7/24	Control 7/24	Control 7/24	Yield
						%	%	%	bu/a
1	Bicep Lite II Magnum	6 F	1.5	Qt	PRE	0	99	95	83
2	Bullet	4 F	3	Qt	PRE	0	98	99	89
3	Guardsman +	5 F	1.75	Qt	EPOST	0	97	98	82
	COC		1	Qt	EPOST				
4	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	14	98	72	86
	Aim +	40 WG	0.33	Oz	POST				
	COC		1	Qt	POST				
5	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	0	98	77	88
	Peak	57 WG	0.75	Oz	POST				
	COC		1	Qt	POST				
6	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	0	99	70	88
	Permit	75 DF	0.67	Oz	POST				
	NIS		0.25	% V/V	POST				
7	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	15	97	89	94
	Aim +	40 WG	0.33	Oz	POST				
	AAtrex	4 F	1	Pt	POST				
	COC		1	Qt	POST				
8	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	15	98	96	94
	Aim +	40 WG	0.33	Oz	POST				
	AAtrex	4 F	1.5	Pt	POST				
	COC		1	Qt	POST				
9	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	12	97	83	93
	Aim +	40 WG	0.33	Oz	POST				
	Banvel +	4 EC	4	Fl Oz	POST				
	NIS		0.25	% V/V	POST				
10	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	13	99	77	92
	Aim +	40 WG	0.33	Oz	POST				
	2,4-D $_{Amine}$ +	4 L	8	Fl Oz	POST				
	NIS		0.25	% V/V	POST				
11	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	0	96	97	97
	Peak	57 WG	0.5	Oz	POST				
	AAtrex	4 F	1.5	Pt	POST				
	COC		1	Qt	POST				
12	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	5	94	78	89
	Peak	57 WG	0.5	Oz	POST				
	Banvel +	4 EC	4	Fl Oz	POST				
	NIS		0.25	% V/V	POST				
13	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	15	98	80	94
	Peak	57 WG	0.5	Oz	POST				
	Aim +	40 WG	0.33	Oz	POST				
	COC		1	Qt	POST				
14	Dual II Magnum +	7.64 EC	0.44	Pt	PRE	3	98	67	83
	Permit	75 WG	0.5	Oz	POST				
	Aim	40 WG	0.33	Oz	POST				
	NIS		0.25	% V/V	POST				

Table 10 . Weed control in grain sorghum, Harvey County Experiment Field, Hesston, KS, 2001.

Herbicide Treatment[1]	Product			Timing[2]	Injury 7/24	Lacg[3] Control 7/24	Paam[4] Control 7/24	Yield
	Form	Rate/a	Unit					
					%	%	%	bu/a
15 Dual II Magnum	7.64 EC	0.44	Pt	PRE	12	97	98	88
Ally +	60 DF	0.05	Oz	POST				
2,4-D Amine	4 L	8	Fl Oz	POST				
NIS		0.25	% V/V	POST				
16 Dual II Magnum	7.64 EC	0.44	Pt	PRE	10	96	99	94
Ally +	60 DF	0.05	Oz	POST				
AAtrex	4 F	1	Pt	POST				
2,4-D LVE +	4 SC	4	Fl Oz	POST				
NIS		0.25	% V/V	POST				
17 Paramount +	75 DF	5.33	Oz	POST	0	86	50	81
COC		1	Qt	POST				
18 Paramount +	75 DF	5.33	Oz	POST	0	99	96	94
AAtrex +	4 F	1.5	Pt	POST				
COC		1	Qt	POST				
19 No Treatment					0	0	0	64
LSD .05					3	8	8	16

[1] COC = Farmland Crop Oil Plus. NIS = Pen-A-Trate II nonionic surfactant.
[2] PRE= preemergence on June 25; EPOST = early postemergence 16 DAP.; POST = postemergence 19 DAP.
[3] Lacg =large crabgrass.
[4] Paam = Palmer amaranth. Weed population included some redroot pigweeds.

HERBICIDES FOR WEED CONTROL IN SOYBEAN

M.M. Claassen

Summary

Twenty-seven herbicide treatments were evaluated for crop tolerance and weed control efficacy in soybean. Palmer amaranth and large crabgrass populations initially were light, but moderate infestations developed later as a result of rains that followed postemergence treatments. Best Palmer amaranth control was achieved with Roundup Ultra + Classic after Authority or Canopy XL preemergence; Roundup Ultra + Synchrony STS after Authority + Canopy XL preemergence; sequential Roundup Ultra, Roundup Ultra + Classic, and Roundup Ultra + Synchrony STS; Flexstar + Fusion with or without Boundary preemergence; Touchdown following Boundary or Dual II Magnum preemergence; and postemergence Touchdown + Flexstar and Raptor alone. While various treatments provided good to excellent large crabgrass control, single applications of Roundup Ultra or Touchdown were unsatisfactory. Air induction nozzles performed comparably to extended range flat fan nozzles.

Introduction

Successful soybean production is dependent upon effective weed control. Growers may choose from a number of herbicide options that can accomplish this objective. These options include the use of relatively new herbicides alone or in combination with Roundup. This experiment was conducted to evaluate various herbicides and herbicide combinations for weed control efficacy as well as soybean tolerance. Additionally, two treatments compared nozzle types for efficacy of Roundup application.

Procedures

Winter wheat was grown on the experiment site in 2000. The soil was a Smolan silt loam with pH 6.6 and 1.9% organic matter. To promote uniformity of weed populations, pigweed and crabgrass seed were broadcast and incorporated with the last preplant tillage operation. Asgrow AG3302 Roundup Ready + STS soybean was planted at 105,000 seeds/a in 30-in. rows on June 26, 2001. Seedbed condition was excellent. All herbicide treatments were broadcast in 20 gal/a of water, with three replications per treatment. Preemergence (PRE) applications were made shortly after planting with AI TeeJet 110025-VS nozzles at 29 psi (Table 11). Except for treatment 26, postemergence treatments were applied with the same procedure on July 14 (POST) and on August 3 (SEQ). POST treatments were applied when soybean was approximately 4 in. tall with 1 to 3 trifoliate leaves. Palmer amaranth ranged from 3 to 6 in., and large crabgrass height was 1 to 4 in. SEQ treatments were applied to 15-in. soybean with moderate populations of Palmer amaranth ranging from 1 to 10 in. in height and to moderate-density large crabgrass from 0.05 to 5 in. in height. Crop injury and weed control were evaluated twice during the growing season. Soybean was harvested on October 17.

Results

Only token rains of 0.16 and 0.05 in. fell at 10 and 20 days after planting. The first significant rainfall (0.74 in.) occurred 21 days after planting and preemergence herbicide applications. Thereafter, an additional 0.89 in. of rain fell during the remainder of July. An extremely dry period of nearly three weeks extended from late July until August 17. High temperatures prevailed throughout most of the growing season and combined with below-normal precipitation in July and August to cause significant drought stress.

Weed competition from overseeding did not materialize initially because of insufficient rainfall. Indigenous populations of Palmer amaranth were low, and those of large crabgrass were very low initially. However, significant numbers of weeds emerged after rains that followed postemergence applications. For this reason, some preemergence, and to a greater extent, single postemergence treatments without a residual herbicide showed a decline in weed control in mid-September versus late July.

Superior Palmer amaranth control was achieved with Roundup Ultra + Classic after Authority or Canopy XL preemergence; Roundup Ultra + Synchrony STS after Authority + Canopy XL preemergence; sequential Roundup Ultra, Roundup Ultra + Classic, and Roundup Ultra + Synchrony STS; Flexstar + Fusion with or without Boundary preemergence; Touchdown following Boundary or Dual II Magnum preemergence; and postemergence Touchdown + Flexstar and Raptor alone. A number of treatments provided good to excellent large crabgrass control. However, single application of Roundup Ultra or Touchdown resulted in only 71 to 75% control of large crabgrass. Roundup Ultra applied with air induction nozzles at 29 psi performed similarly to application with extended range flat fan nozzles at 18 psi.

Crop injury from Flexstar was observed in the form of chlorotic and necrotic spots on leaves. Also, Cobra caused notable leaf burn. Injury symptoms had no apparent relationship to crop yield. Soybean responded well to late-season moisture. Yields were considerably higher than with earlier plantings. Most treatments increased soybean yields relative to the untreated check. However, some disuniformity of weed pressure as well as mid-season drought stress contributed to variability that places constraints on yield comparisons.

Table 11. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 2001.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/24	Lacg[3] Control 9/17	Paam[4] Control 9/17	Yield
					%	%	%	bu/a
1 Dual II Magnum +	7.64 EC	1.33	Pt	PRE	0	95	77	32
Scepter	70 DG	2.8	Oz	PRE				
2 Pursuit Plus	2.9 EC	2.5	Pt	Pre	0	96	80	31
3 Authority	75 DF	3.0	Oz	Pre	0	79	100	44
Roundup Ultra +	4 L	1.5	Pt	POST				
Classic +	25 DF	0.33	Oz	POST				
COC +		1	%V/V	POST				
AMS		2	Lb	POST				
4 Canopy XL	56.3 DF	4	Oz	PRE	0	78	100	35
Roundup Ultra +	4 L	1.5	Pt	POST				
Classic +	25 DF	0.33	Oz	POST				
COC +		1	% V/V	POST				
AMS		2	Lb	POST				
5 Authority +	75 DF	2.5	Oz	PRE	0	79	100	43
Canopy XL	56.3 DF	2.5	Oz	PRE				
Roundup Ultra +	4 L	1.5	Pt	POST				
Synchrony STS +	42 DF	0.25	Oz	POST				
COC +		1	% V/V	POST				
AMS		2	Lb	POST				
6 Roundup Ultra +	4 L	1.5	Pt	POST	0	96	100	46
Classic +	25 DF	0.33	Oz	POST				
COC +		1	% V/V	POST				
AMS		2	Lb	POST				
Roundup Ultra +	4 L	1.5	Pt	SEQ				
Classic +	25 DF	0.33	Oz	SEQ				
COC +		1	% V/V	SEQ				
AMS		2	Lb	SEQ				
7 Roundup Ultra +	4 L	1.5	Pt	POST	0	96	100	41
Synchrony STS +	42 DF	0.25	Oz	POST				
COC +		1	% V/V	POST				
AMS		2	Lb	POST				
Roundup Ultra +	4 L	1.5	Pt	SEQ				
Synchrony STS +	42 DF	0.25	Oz	SEQ				
COC +		1	% V/V	SEQ				
AMS		2	Lb	SEQ				
8 Roundup Ultra +	4 L	1.5	Pt	POST	0	88	98	41
AMS		2	Lb	POST				
Roundup Ultra +	4 L	1.5	Pt	SEQ				
AMS		2	Lb	SEQ				
9 Roundup Ultra +	4L	2	Pt	POST	0	75	71	35
AMS		2	Lb	POST				
10 Boundary	7.8 EC	1.5	Pt	PRE	0	94	78	33
11 Boundary +	7.8 EC	1.5	Pt	PRE	0	94	81	39
Canopy XL +	56.3 DF	2	Oz	PRE				
Authority	75 DF	2	Oz	PRE				
12 Boundary +	7.8 EC	1.5	Pt	PRE	0	96	77	41
FirstRate	84 WG	0.37	Oz	PRE				
13 Boundary	7.8 EC	1.25	Pt	PRE	15	99	99	39
Flexstar +	1.88 L	1.25	Pt	POST				
Fusion +	2.56 EC	8	Fl Oz	POST				
MSO +		1	% V/V	POST				
UAN		2.5	% V/V	POST				

Table 11. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 2001.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/24	Lacg[3] Control 9/17	Paam[4] Control 9/17	Yield
					%	%	%	bu/a
14 Boundary	7.8 EC	1.75	Pt	PRE	0	95	74	34
15 Boundary	7.8 EC	1.75	Pt	PRE	15	94	100	39
Flexstar +	1.88 L	1.25	Pt	POST				
MSO +		1	% V/V	POST				
UAN		2.5	% V/V	POST				
16 Flexstar +	1.88 L	1.25	Pt	POST	16	99	99	42
Fusion +	2.56 EC	10	Fl Oz	POST				
MSO +		1	% V/V	POST				
UAN		2.5	% V/V	POST				
17 Boundary	7.8 EC	1.25	Pt	PRE	0	97	97	38
Touchdown +	4 L	2	Pt	POST				
AMS		1.7	Lb	POST				
18 Prowl	4 EC	3	Pt	PRE	0	85	73	41
Touchdown +	4 L	2	Pt	POST				
AMS		1.7	Lb	POST				
19 Dual II Magnum	7.64 EC	1.33	Pt	PRE	0	96	95	41
Touchdown +	4 L	2	Pt	POST				
AMS		1.7	Lb	POST				
20 Touchdown +	4 L	2	Pt	POST	0	71	69	36
AMS		1.7	Lb	POST				
21 Touchdown +	4 L	2	Pt	POST	6	90	99	38
Flexstar +	1.88 L	12	Fl Oz	POST				
AMS		1.7	Lb	POST				
22 Roundup Ultra Max	5 L	1.6	Pt	POST	0	73	69	26
AMS		1.7	Lb	POST				
23 Pursuit +	70 DG	1.4	Oz	POST	0	95	86	36
MSO +		1	% V/V	POST				
UAN		2.5	% V/V	POST				
24 Raptor +	1 L	5	Fl Oz	POST	0	98	97	33
MSO +		1	% V/V	POST				
UAN		2.5	% V/V	POST				
25 Select +	2 EC	6	Fl Oz	POST	17	78	72	31
Cobra +	2 EC	8	Fl Oz	POST				
COC		1	% V/V	POST				
26 Roundup Ultra XR8003 Flat Fan	4 L	1.5	Pt	POST	0	72	72	28
27 Roundup Ultra AI 110025	4 L	1.5	Pt	POST	0	74	71	28
28 Hand Weed					0	96	96	30
Dual II Magnum	7.64 EC	1.57	Pt	PRE				
29 No Treatment					0	0	0	24
LSD .05					2	4	6	13

[1] COC = Farmland Crop Oil Plus; AMS = sprayable ammonium sulfate. MSO = Destiny methylated seed oil; NIS = Pen-A-Trate II nonionic surfactant; UAN = urea ammonium nitrate fertilizer (28% N).
Treatments 26 and 27 compare applications with extended range flat fan versus air induction nozzles at 18 and 29 psi, respectively.
[2] PRE= preemergence to soybeans and weeds on June 26; POST = postemergence 18 DAP;
SEQ = postemergence 38 DAP;
[3] Lacg =large crabgrass.
[4] Paam = Palmer amaranth. Weed population included some redroot pigweeds.

HERBICIDES FOR WEED CONTROL IN SUNFLOWER

M.M. Claassen and D.E. Peterson

Summary

Preplant incorporated Treflan and preemergence Lasso, Spartan + Lasso or Spartan + Prowl best controlled light to moderate densities of Palmer amaranth. No Spartan rate effect was evident, but 5 oz/a tended to give more consistent control of Palmer amaranth than 3 or 4 oz/a. All treatments controlled existing very low populations of large crabgrass. No crop injury was observed. Yield differences among treatments were not significant.

Introduction

Sunflower growers have had very few herbicide options for their weed control program. Spartan is a new herbicide being developed by FMC for preemergence weed control in sunflower. Spartan has not yet received a federal label for use on sunflower, but has gained a Section 18 registration for use on sunflower in Kansas for the 2002 growing season. However, some concerns have been raised about crop safety with Spartan. This experiment was initiated to evaluate Spartan alone and in combination with other herbicides for weed control efficacy and crop response.

Procedures

Winter wheat was grown on the experiment site in 2000. The soil was a Geary silt loam with 1.6 % organic matter and pH 6.5. Sunflower was fertilized with 100 lb N/a broadcast as 46-0-0 in mid-June. Weed seed was broadcast over the area to enhance the uniformity of weed populations. Mycogen 8488NS was planted at approximately 25,500 seeds/a in 30-in. rows on June 25, 2001. Seedbed condition was excellent. All herbicides were broadcast in 20 gal/a of water, with three replications per treatment (Table 12). Preplant incorporated (PPI) Treflan was applied just before planting and incorporated by double pass with a field cultivator. Preemergence (PRE) treatments, made shortly after planting, and Treflan were applied with AI 110025 nozzles at 29 psi. Postemergence treatments (POST) were applied with XR 8003 flat fan nozzles at 18 psi on July 25 to large crabgrass from 4 to 8 in. in height with very light density. Plots were not cultivated. Crop injury was evaluated 16 days after planting (DAP). Weed control was rated at 30 DAP and at the end of the season. Baythroid at 2.4 fluid oz/a was applied on August 14 and repeated on August 27 for head moth control. Sunflower was harvested on October 12, 2001.

Results

Absence of meaningful rainfall after planting resulted in only light to moderate density of Palmer amaranth. Highest level of Palmer amaranth control occurred with preplant incorporated Treflan and preemergence application of Lasso, Spartan + Lasso, or Spartan + Prowl. Preemergence Spartan as well as Prowl provided intermediate control. There appeared to be no Spartan rate effect, but Palmer amaranth control was less consistent at 3 and 4 oz/a than at 5 oz/a. All treatments controlled existing very-low populations of large crabgrass.

Herbicides caused no visual sunflower injury and did not affect half-bloom date, which averaged 52 DAP. Treatments had no effect on stands, which averaged 24,240 plants/a, and no effect on lodging, with a mean of 39%. Yields were variable because of drought stress, but averaged 1890 lb/a without significant differences among treatments.

Table 12. Weed control in sunflower, Harvey County Experiment Field, Hesston, KS, 2001.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/11	Paam[3] Control 7/25	Lacg[4] Control 10/12	Lodg-ing	Yield
					%	%	%	%	lb/a
1 Treflan	4 EC	1.5	Pt	PPI	0	100	100	39	1933
2 Prowl	3.3 EC	3	Pt	PRE	0	88	97	34	2269
3 Lasso	4 EC	2.5	Qt	PRE	0	91	99	52	1901
4 Spartan	75 DF	3	Oz	PRE	0	87	92	58	1589
5 Spartan	75 DF	4	Oz	PRE	0	89	97	41	1420
6 Spartan	75 DF	5	Oz	PRE	0	85	97	46	1725
7 Spartan Prowl	75 DF 3.3 EC	3 3	Oz Pt	PRE PRE	0	96	99	35	1586
8 Spartan Lasso	75 DF 4 EC	3 2	Oz Qt	PRE PRE	0	90	99	32	1880
9 Spartan Poast COC	75 DF 1.53 EC	3 1.5 2	Oz Pt Pt	PRE POST POST	0	75	95	22	1622
10 Spartan Poast COC	75 DF 1.53 EC	4 1.5 2	Oz Pt Pt	PRE POST POST	0	82	97	39	1960
11 Spartan Poast COC	75 DF 1.53 EC	5 1.5 2	Oz Pt Pt	PRE POST POST	0	93	99	36	1943
12 Hand Weed					0	100	100	48	1845
13 No Treatment					0	0	0	35	2068
LSD .05					NS	10	22	NS	NS

[1] **Note: Lasso currently is not labeled for sunflower**. COC = Farmland Crop Oil Plus.
[2] PPI = preplant incorporated with field cultivator on June 25. PRE = preemergence to sunflower and weeds on June 26; POST = postemergence on July 25.
[3] Paam = Palmer amaranth.
[4] Lacg = large crabgrass.

IRRIGATION AND NORTH CENTRAL KANSAS EXPERIMENT FIELDS

Introduction

The 1952 Kansas legislature provided a special appropriation to establish the Irrigation Experiment Field in order to serve expanding irrigation development in north-central Kansas. The original 35-acre field was located 9 miles northwest of Concordia. In 1958, the field was relocated to its present site on a 160-acre tract near Scandia in the Kansas-Bostwick Irrigation District. Water is supplied by the Miller Canal and stored in Lovewell Reservoir in Jewell County, Kansas and Harlen County Reservoir at Republican City, Nebraska. A 5-acre site in the Republican River Valley on the Mike Brazon Farm is also utilized for irrigated crop research. In 2001, a linear sprinkler system was added on a 32-acre tract 2 miles south of the present Irrigation Field. In 2001 there were 125,000 acres of irrigated cropland in north-central Kansas. Current research on the field focuses on managing irrigation water and fertilizer in reduced tillage and crop rotation systems.

The 40-acre North Central Kansas Experiment Field, located 2 miles west of Belleville, was established on its present site in 1942. The field provides information on factors that allow full development and wise use of natural resources in north-central Kansas. Current research emphasis is on fertilizer management for reduced tillage crop production and management systems for dryland, corn, sorghum, and soybean production.

Soil Description

The predominate soil on both fields is a Crete silt loam. The Crete series consists of deep, well-drained soils that have a loamy surface underlain by a clayey subsoil. These soils developed in loesses on nearly level to gently undulating uplands. The Crete soils have slow to medium runoff and slow internal drainage and permeability. Natural fertility is high. Available water holding capacity is approximately 0.19 in. of water per in. of soil.

2001 Weather Information

The 2001 growing season was characterized by above normal rainfall in April, May and early June, then very hot and dry conditions prevailed throughout the remainder of June and most of July. Timely rains were received in late July. August also was drier than normal.

Table 1. Climatic data for the North Central Kansas Experiment Fields

	Rainfall, in.		Temperature ^{0}F			Growth Units	
Month	Scandia 2001	Average	Belleville 2001	Daily Mean 2001	Average Mean	2001	Average
April	3.3	2.4	3.3	57	53	326	242
May	9.2	3.7	5.9	64	64	443	427
June	3.0	4.8	4.6	72	74	620	718
July	5.9	3.3	6.0	82	79	867	835
August	1.0	3.3	2.7	77	77	752	748
Sept.	4.9	3.5	4.9	66	67	492	518
Total	27.3	21.0	27.4	70	69	3499	3487

EFFECTS OF CROPPING SYSTEM AND NITROGEN FERTILIZATION ON NO-TILLAGE GRAIN SORGHUM PRODUCTION

W.B. Gordon, D.A. Whitney, and D.L. Fjell

Summary

The 2001 growing season was characterized by a much wetter than normal spring and a very hot, dry period from mid-June until late July. Timely rains were received in late July just at heading time and sorghum yields were very good. The overall test average was 111 bu/a. When averaged over all N rates, yields of sorghum grown in rotation with soybean were 19 bu/a greater than continuous grain sorghum.

When averaged over nitrogen (N) rates, 1982-1995 yields were 23 bu/a greater in sorghum rotated with soybean than in continuous sorghum. When no N was applied, rotated sorghum yielded 32 bu/a greater than continuous sorghum. In the continuous system, grain sorghum yield continued to increase with increasing N rate up to 90 lb/a. In the soybean rotation, sorghum yields increased with increasing N rate up to 60 lb/a. When averaged over N rate, no-tillage grain sorghum rotated with soybean reached mid-bloom 7 days sooner than continuous grain sorghum. Two knife-applied N sources (anhydrous ammonia and 28% UAN) were evaluated during 1982-1989. No grain sorghum yield differences resulted from N source. The 20-year soybean yield average was 34 bu/a. Soybean yields were not affected by N applied to previous grain sorghum crop. In 1996, four additional N rates (120, 150, 180, and 210 lb/a) were added to the experiment. When averaged over the period 1996-2001, yields were greater in the rotated system than in the continuous sorghum at all levels of N. Addition of N did not compensate for the rotational effect. Yields in the continuous system continued to increase with increasing N rate up to 90 lb/a. Yields in the rotated system were maximized with application of 60 lb/a N.

Introduction

Crop rotations were necessary to maintain soil productivity before the advent of chemical fertilizers. Biological fixation of atmospheric N is a major source of N for plants in natural systems. Biological fixation through legume-*Rhizobium* associations is utilized extensively in agricultural systems. Using a legume in a crop rotation system can reduce the N requirement for the following non-legume crop. Other benefits of legume rotations include breaking disease and insect cycles, helping weed control programs, and decreasing the toxic effects of crop residues. This study evaluates N rates for continuous grain sorghum and grain sorghum grown in annual rotation with soybean in a no-tillage production system.

Procedures

This study was established in 1980 at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Data are reported starting in 1982. Treatments included cropping system (continuous grain sorghum and grain sorghum rotated with soybean) and N rates (0, 30, 60, and 90 lb/a). In 1982-1989, the two N sources anhydrous ammonia and urea-ammonium nitrate solution (28% UAN) were evaluated. Both N sources were knife applied in the middle of rows from the previous year's crop. After 1989, anhydrous ammonia was used as the sole N source. In each year, N was knife applied 7-14 days prior to planting. Grain sorghum was planted at the rate of 60,000 seed/a, and soybean was planted at the rate of 10 seed/ft in 30-in. rows. Soybean yields were not affected by N applied to the previous sorghum crop and, therefore, are averaged over all N rates. In 1996, four additional N rates (120, 150, 180, and 210 lb/a) were added to the experiment in order to further define N response.

Results

Although most of the summer was drier than normal, timely rains were received just before heading and yields were very good. When averaged over all N rates, grain sorghum rotated with soybean yielded 19 bu/a greater than continuous grain sorghum.

In the continuous grain sorghum system, grain yields (1982-1995) continued to increase with increasing N rate up to 90 lb/a (Table 2). Sorghum yields in the rotated system were maximized with an application of 60 lb/a N. When no N was applied, rotated sorghum yields were 32 bu/a greater than continuous sorghum. When four additional N rates were added, yields were greater in the soybean rotation than in the continuous system at all levels of N (Table 3). Addition of N alone did not make up yield losses in a continuous sorghum production system. Over the 20-year period (1982-2001), soybean yields averaged 34 bu/a and were not affected by N applied to the previous sorghum crop (Table 4). Two knife-applied N sources, anhydrous ammonia and 28% UAN, were evaluated from 1982-1989. When averaged over cropping system and N rate, yields were 60 and 59 bu/a for anhydrous ammonia and UAN, respectively. When averaged over N rates, the number of days from emergence to mid-bloom was 7 days shorter in the rotated system than in the continuous system (Table 2).

Table 2. Long-term effects of cropping system and nitrogen rate on grain sorghum yields and number of days from emergence to mid-bloom North Central Expt. Field, Belleville.

N Rate	Cropping System	Grain Yield 1982-1995	Days to Mid-bloom 1992-1995
		lb/a	bu/a
0	Continuous	43	64
	Rotated	75	56
30	Continuous	59	61
	Rotated	84	55
60	Continuous	70	59
	Rotated	92	53
90	Continuous	80	58
	Rotated	92	53
System Means			
	Continuous	63	61
	Rotated	86	54
N Rate Means			
0		59	60
30		72	58
60		81	56
90		86	56
LSD(0.05)		9	1

Table 3. Effects of cropping system and N rate on grain sorghum yields, Belleville, 1996-2001

N	Cropping	Yield						
Rate	System	1996	1997	1998	1999	2000	2001	Avg.
		- - - - - - - - - - - - - - - - - - bu/a - - - - - - - - - - - - - - - - - -						
0	Continuous	92	51	55	73	37	59	61
	Rotated	120	88	87	112	46	75	88
30	Continuous	110	71	75	95	40	75	78
	Rotated	137	108	115	119	62	113	109
60	Continuous	131	110	118	115	68	96	106
	Rotated	164	128	142	127	66	128	126
90	Continuous	143	121	126	125	69	116	117
	Rotated	163	141	144	126	68	129	129
120	Continuous	148	122	128	123	69	117	118
	Rotated	162	144	145	128	65	128	129
150	Continuous	148	120	127	123	69	116	117
	Rotated	162	143	145	129	65	129	129
180	Continuous	148	121	128	126	68	117	118
	Rotated	162	144	145	129	65	129	129
210	Continuous	148	122	128	126	66	116	118
	Rotated	162	145	145	129	64	129	129
System Means								
	Continuous	134	105	111	113	61	101	104
	Rotated	154	130	134	125	63	120	121
N Rate Means								
0		106	70	71	92	42	67	75
30		124	90	95	107	51	94	94
60		148	119	130	121	67	112	116
90		153	131	135	126	69	122	123
120		155	133	137	126	67	123	124
150		155	132	136	126	67	123	123
180		155	133	137	127	67	123	124
210		155	134	137	127	65	123	124
LSD(0.05)		8	6	6	6	8	5	

Table 4. Yield of soybean grown in rotation with grain sorghum, Belleville, 1982-2001

Year	Yield	Year	Yield
	bu/a		bu/a
1982	38	1992	58
1983	15	1993	56
1984	20	1994	32
1985	28	1995	41
1986	48	1996	61
1987	48	1997	36
1988	18	1998	38
1989	25	1999	42
1990	30	2000	8
1991	12	2001	31

STARTER FERTILIZER APPLICATION EFFECTS ON REDUCED AND NO-TILLAGE GRAIN SORGHUM PRODUCTION

W.B. Gordon and D.A. Whitney

Summary

This experiment was conducted at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Soil test P was in the "high" range. Treatments consisted of tillage systems and starter fertilizer placement and composition. Tillage systems consisted of no-tillage and minimum tillage (spring disc and harrow treatment). Methods of starter fertilizer application included placement 2 in. to the side and 2 in. below the seed at planting (2x2) and dribbled in a band on the soil surface 2 in. beside the seed row. Liquid starter fertilizer treatments consisted of N and P_2O_5 combinations giving 15, 30 ,and 45 lb N/a and 30 lb P_2O_5/a. Starter treatments containing either 30 lb N or 30 lb P_2O_5/a applied alone and a no starter check also were included. In both tillage systems, yields were maximized by application of starter fertilizer containing either 30 or 45 lb N/a with 30 lb P_2O_5/a. In 2001, there were no differences between 2x2 and band dribbled starter fertilizer. In previous years, subsurface placed starter fertilizer had proven to be more efficient than placing fertilizer in a surface band. Rainfall in May and June was much above normal. The ideal soil moisture condition was probably responsible for the improved effectiveness of surface applied starter. When averaged over tillage treatment, starter fertilizer containing 30 lb N and 30 lb P_2O_5/a decreased time from emergence to mid-bloom by more than 13 days compared to the no-starter check treatment. Tillage and method of starter application did not affect sorghum tissue nutrient concentration. Tissue P concentration was greater when more N was applied in the starter. Grain moisture at harvest was lower in the higher N starters that also included P.

Introduction

Conservation tillage production systems are being used by an increasing number of producers in the central Great Plains because of several inherent advantages. These include reduction of soil erosion losses, increased soil water use efficiency, and improved soil quality. However, early-season plant growth can be poorer in reduced tillage systems than in conventional systems. The large amount of surface residue present in a no-tillage system can reduce seed zone temperatures. Lower than optimum soil temperature can reduce the rate of root growth and P uptake by plants. Starter fertilizers can be applied to place nutrient elements within the rooting zone of young seedlings for better availability, which will hasten maturity and avoid late-season damage by low temperatures. Some experiments that have evaluated crop response to N and P starter fertilizers have demonstrated improved early growth and increased yield and attributed those responses to the P component of the combination. Other studies have indicated that N is the most critical element in the N-P starter on soils not low in P. Many producers do not favor 2x2 placement of starter fertilizer due to high initial cost of application equipment and problems associated with knife applications in high residue situations. This research is aimed at minimizing fertility problems that arise with reduced tillage systems thus making conservation tillage more attractive to producers.

Procedures

The experiment was conducted at the North Central Kansas Experiment Field on a Crete silt loam soil. Analysis by the KSU Soil

Testing Lab showed that initial soil pH was 6.2, organic mater was 2.2%, Bray P-1 was 45 ppm and exchangeable K was 320 ppm in the top 6 in. of soil. Treatments consisted of two tillage systems (no-tillage and minimum tillage). The minimum tillage treatment received one discing and harrowing operation in the spring 3 weeks prior to planting. Starter fertilizer was placed either 2 in. to the side and 2 in. below the seed at planting (2x2) or dribbled in a band on the soil surface 2 in. beside the seed at planting. Starter fertilizer treatments consisted of N and P_2O_5 combinations giving 15, 30, or 45 lb N/a with 30 lb P_2O_5/a. Treatments consisting of either 30 lb N/a or 30 lb P_2O_5/a applied alone and a no starter check also were included. Starter combinations were made using 10-34-0 and 28% UAN. After planting, knife applications of 28% UAN were made to bring N applied to each plot to a total of 140 lb/a. Grain sorghum (NC+ 7R83) was planted at the rate of 60,000 seed/a on May 22, 2001. At the V-6 stage of growth, 20 plants were randomly selected from the 1st or 4th row of each plot and analyzed for dry weight and N and P concentration. At first bloom 20 flag leaves/plot were harvested and analyzed for N and P concentration. Starting on September 8, 10 sorghum heads were randomly selected from the 1st or 4th rows of each plot, thrashed and grain moisture content measured. Plots were harvested on October 12, 2001.

Results

Surface dribble applied starter fertilizer had not been as effective as 2x2 placed fertilizer in the previous 2 years of the experiment; however, there was no difference in starter placement methods in 2001 (Table 5). The very wet spring probably increased the efficiency of the surface banded fertilizer. When averaged over the period 1999-2001, yield of 2x2 placed starter fertilizer was only 6 bu/a greater than the surface dribble treatment. The greatest yields occurred with applications of starter fertilizer containing either 30 or 45 lb N/a with 30 lb P_2O_5/a. All starter treatments increased grain yield over the no-starter check plots. The higher N starters were also the most efficient in reducing the number of days from emergence to mid-bloom. The N alone or the P alone treatments did not yield as well as starters that contained both N and P. The treatment containing 15 lb N/a with 30 lb P_2O_5/a also was not as effective as starters containing more N. Use of starter fertilizer resulted in greater yields in both tillage systems. All starter fertilizer treatments increased V-6 stage whole plant dry matter over the no starter check. The starters containing either 30 or 45 lb/a N with 30 lb/a P_2O_5 resulted in the greatest V-6 whole plant dry matter accumulation. Grain yield, days from emergence to mid-bloom, and V-6 stage whole plant dry matter were not affected by tillage system. Grain sorghum tissue nutrient concentrations were not affected by tillage or by starter application method (Table 6). Tissue P concentrations increased with increasing amount of N in the starter. Grain moisture in the 30-30 starter treatment was lower at all sample dates compared to the no starter check, the P alone treatment or the treatment that included only 15 lb N (Figure 1).

Table 5. Tillage system and starter fertilizer placement and composition effects on grain sorghum yield, number of days from emergence to mid-bloom, and V-6 stage whole plant dry matter accumulation, Belleville 2001.

Tillage	Placement	Starter N	Starter P_2O_5	Yield 2001	Yield 1999-2001	Days to Mid-bloom	V-6 Dry Matter
		- - lb/a - -		- - - - - bu/a - - - - -			
Reduced		0	0	112	93	66	481
	2x2	0	30	120	101	61	827
		30	0	125	108	60	890
		15	30	129	114	58	870
		30	30	145	124	53	1125
		45	30	145	125	52	1103
	Dribble	0	30	119	100	61	700
		30	0	126	106	60	758
		15	30	133	110	57	910
		30	30	146	116	53	1098
		45	30	148	119	52	1111
No-Tillage		0	0	116	92	67	486
	2x2	0	30	124	107	61	749
		30	0	129	114	58	749
		15	30	137	118	58	950
		30	30	148	129	53	1143
		45	30	150	129	52	1152
	Dribble	0	30	124	101	61	770
		30	0	129	109	60	836
		15	30	137	111	57	952
		30	30	150	119	53	1104
		45	30	149	120	52	1068
Tillage Means	Reduced Till			134	113	57	939
	No-Till			138	116	56	947
	LSD(0.05)			NS		NS	NS
Placement Means	2x2			135	117	57	957
	Dribble			136	111	57	931
	LSD(0.05)			NS		NS	NS
Starter Means	0-30			122	103	61	761
	30-0			127	110	60	808
	15-30			134	113	58	921
	30-30			147	122	53	1118
	45-30			148	123	52	1109
	LSD(0.05)			5		2	56

Table 6. Tillage system and starter fertilizer placement and composition effects on V-6 stage whole plant N and P concentrations and flag leaf N and P concentrations of grain sorghum , Belleville 2001.

Tillage	Placement	Starter N	Starter P_2O_5	V-6 N	V-6 P	Leaf N	Leaf P
		- - - - lb/a - - - -		- - - - - - - - - - - % - - - - - - - - - - -			
Reduced		0	0	2.20	0.239	2.37	0.282
	2x2	0	30	2.98	0.288	2.50	0.318
		30	0	3.31	0.224	2.77	0.310
		15	30	3.14	0.300	2.75	0.326
		30	30	3.47	0.311	2.88	0.336
		45	30	3.49	0.316	2.91	0.339
	Dribble	0	30	2.90	0.253	2.48	0.315
		30	0	3.31	0.232	2.74	0.307
		15	30	3.28	0.291	2.76	0.324
		30	30	3.34	0.313	2.89	0.335
		45	30	3.31	0.298	2.89	0.339
No-Tillage		0	0	2.21	0.241	2.39	0.275
	2x2	0	30	2.96	0.265	2.49	0.319
		30	0	3.36	0.282	2.76	0.311
		15	30	3.28	0.314	2.78	0.328
		30	30	3.44	0.325	2.91	0.339
		45	30	3.59	0.329	2.89	0.341
	Dribble	0	30	3.03	0.285	2.49	0.319
		30	0	3.27	0.270	2.79	0.316
		15	30	3.37	0.300	2.65	0.326
		30	30	3.37	0.327	2.82	0.338
		45	30	3.36	0.328	2.89	0.342
Tillage Means	Reduced Till			3.25	0.278	2.76	0.325
	No-Till			3.30	0.303	2.75	0.328
	LSD(0.05)			NS	NS	NS	NS
Placement Means	2x2			3.30	0.291	2.76	0.327
	Dribble			3.26	0.290	2.74	0.326
	LSD(0.05)			NS	NS	NS	NS
Starter Means	0-30			2.97	0.263	2.49	0.318
	30-0			3.32	0.252	2.77	0.311
	15-30			3.27	0.301	2.73	0.326
	30-30			3.40	0.319	2.88	0.337
	45-30			3.44	0.318	2.90	0.340
	LSD(0.05)			0.19	0.017	0.10	0.007

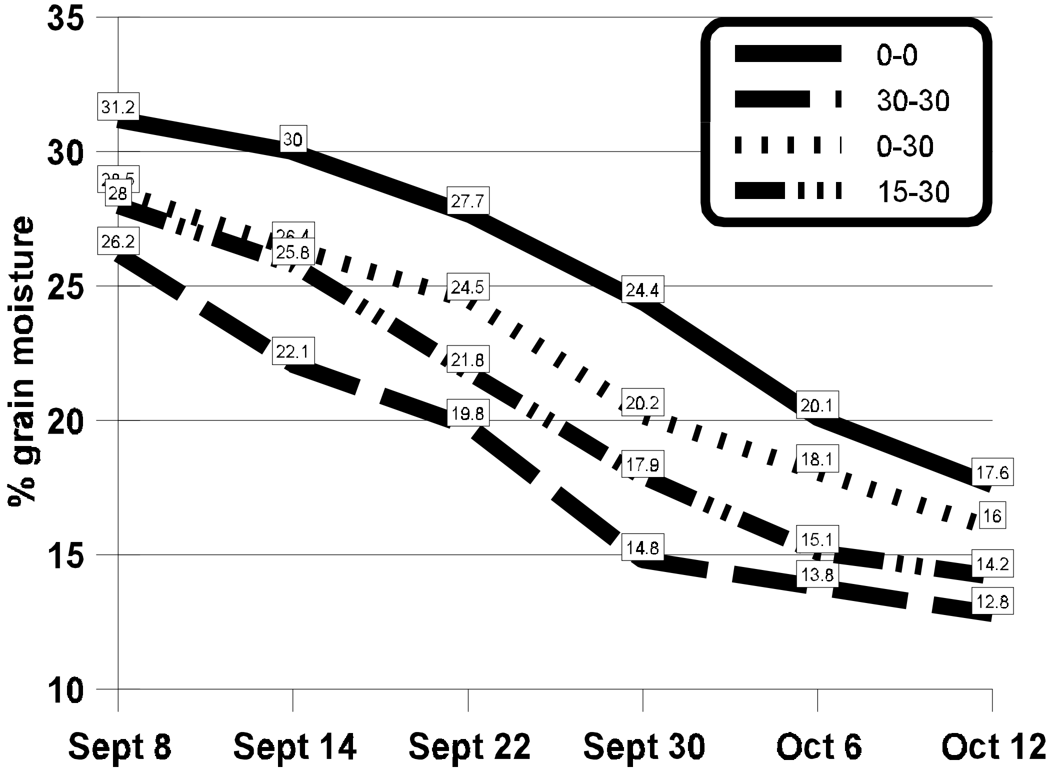

Figure 1. Effect of starter fertilizer composition on grain moisture dry-down for 2x2 placement (values averaged over tillage system), Belleville, KS, 2001.

EFFECTS OF APPLICATION METHOD AND COMPOSITION OF STARTER FERTILIZER ON IRRIGATED RIDGE-TILLED CORN

W.B. Gordon and D.A. Whitney

Summary

Field studies were conducted at the North Central Kansas Experiment Field, located near Scandia, on a Crete silt loam soil. The study consisted of 4 methods of starter fertilizer application (in-furrow with the seed, 2 in. to the side and 2 in. below the seed at planting, dribble on the soil surface 2 in. to the side of the seed, and banded over the row on the soil surface) and 5 starter fertilizer combinations. The starters consisted of combinations that included either 5, 15, 30, 45, or 60 lb/a N with 15 lb/a P_2O_5 and 5 lb/a K_2O. A no-starter check plot also was included in the experiment. Additional treatments included 2x2 starter with and without potassium. In addition, dribble application of 30-30-5 starter fertilizer applied 2 in. to the side of the row was compared to dribble directly over the row. Nitrogen was balanced so that all plots received 220 lb/a N, regardless of starter treatment. Starter fertilizer combinations were made using liquid 10-34-0 ammonium polyphosphate, 28% UAN, and potassium thiosulfate (KTS). When starter fertilizer was applied in-furrow with the seed, plant populations were reduced by over 6,600 plants/a when compared with the no starter check. Corn yield was 41 bu/a lower when starter fertilizer was applied in-furrow than when applied 2x2. Dribble application of starter fertilizer in a surface band 2 in. to the side of the seed row resulted in yields equal to 2x2 applied starter. Grain yield and V-6 dry matter were lower in the starter treatments that only included 5 or 15 lb N/a. Starter that included K improved yields (2-year average) by 14 bu/a. Dribbling directly over the row was as effective as dribbling 2 in.to the side of the row.

Introduction

Use of conservation tillage including ridge-tillage has increased greatly in recent years because of its effectiveness in conserving soil and water. In a ridge-tillage system, tillage at planting time is confined to a narrow strip on top of the ridge. The large amount of residue left on the soil surface can interfere with nutrient availability and crop uptake. Liquid starter fertilizer applications have proven effective in enhancing nutrient uptake, even on soils that are not low in available nutrients. Many producers favor in-furrow or surface starter applications because of the low initial cost of planter-mounted equipment and problems associated with knives and coulters in high-residue environments. However, injury can be severe when fertilizer containing N and K is placed in contact with seed. Surface applications may not be effective in high residue situations. The objective of this research was to determine corn response to starter combinations using 4 different application methods.

Procedures

Irrigated ridge-tilled experiments were conducted at the North Central Kansas Experiment Field on a Crete silt loam soil. Analysis by the KSU Soil Testing Laboratory showed that initial soil pH was 6.2; organic matter content was 2.4%; and Bray-1 P and exchangeable K in the top 6 in.of soil were 40 and 420 ppm, respectively. The study consisted of 4 methods of starter fertilizer application methods (in-furrow with the seed, 2 in. to the side and 2 in. below the seed at planting, dribble in a narrow band on the soil surface 2 in. to the side of the seed row, and banded over the row on the soil surface). In the row-banded treatment, fertilizer was sprayed on the soil surface in an 8- in. band centered on the seed row immediately after planting. Starter consisted of combinations that included either 5, 15, 30, 45, or 60 lb N/a with 15 lb P_2O_5/a and 5 lb K_2O/a. A no-starter check also was included. Nitrogen as 28% UAN was balanced so all plots received 220 lb/a, regardless of starter treatment. Additional treatments consisted of 2x2 placed starter with and without K. Dribbling starter fertilizer (30-30-5 rate) also was compared to the same starter rate dribbled directly over the row. Starter fertilizer combinations were made using liquid 10-34-0 ammonium polyphosphate, 28% UAN, and KTS.

Results

When starter fertilizer was applied in-furrow with the seed, plant populations were reduced by over 6,600 plants/a when compared with the no starter check (Table 7). Corn yield was 41 bu/a lower when starter fertilizer was applied in-furrow with the seed than when applied 2 in. beside and 2 in. below the seed. Dribble application of starter fertilizer in a narrow surface band 2 in. to the side of the seed row resulted in yields equal to the 2x2 applied starter. In this year, surface band application was equal to sub-surface starter placement. The band over the row treatment resulted in yields greater than the in-furrow treatment but less than the 2x2 or surface band treatments. Grain yield and V-6 dry matter accumulation was lower in the starter treatment that only included 5 or 15 lb N/a. Addition of K to the starter mix increased 2-year average grain yields by 14 bu/a (Table 8). Using single degree of freedom contrasts, the dribble 2 in. to the side of the row treatment was compared to dribbling directly over the row. In 2001, there were no differences in these two treatments (dribble over the row, 237 bu/a verses dribble 2 in. to the side of the row, 235 bu/a).

Table 7. Starter application method and composition effects on corn grain yield, plant population and V-6 stage whole plant dry matter, North Central Kansas Experiment Field, Scandia, 2001.

Application Method	Starter	Yield 2001	Yield 2000-2001	Population	V-6 Dry Matter
	lb/a	bu/a	bu/a	plants/a	lb/a
	Check 0-0-0	181.2	159.0	31,585	409
In-furrow	5-15-5	187.8	163.7	24,878	414
	15-15-5	187.0	171.7	25,042	430
	30-15-5	185.5	166.3	23,928	397
	45-15-5	185.0	166.4	26,598	409
	60-15-5	179.7	159.2	23,833	348
2x2	5-15-5	210.6	189.9	31,438	585
	15-15-5	211.1	191.4	31,634	654
	30-15-5	237.6	212.5	31,571	742
	45-15-5	236.4	210.6	31,575	753
	60-15-5	236.1	210.5	31,496	745
Dribble 2x	5-15-5	201.8	184.5	31,597	569
	15-15-5	212.5	193.8	31,507	623
	30-15-5	237.5	208.9	31,472	731
	45-15-5	235.5	208.7	31,624	745
	60-15-5	234.2	208.5	31,422	740
Row band	5-15-5	192.9	171.2	31,470	553
	15-15-5	198.5	176.5	31,630	593
	30-15-5	207.9	181.2	31,502	679
	45-15-5	206.6	185.9	31,530	689
	60-15-5	208.4	194.2	31,478	683
Method Means					
In-furrow		185.0	165.5	24,856	400
2x2		226.3	201.5	31,542	696
Dribble 2x		224.3	200.9	31,524	681
Row band		202.8	181.8	31,522	639
LSD (0.05)		11.5		720	21
Starter Means					
5-15-5		198.3	177.4	29,846	530
15-15-5		202.3	183.4	29,953	575
30-15-5		217.1	192.2	29,619	637
45-15-5		215.9	192.9	30,331	649
60-15-5		214.6	193.1	29,557	629
LSD (0.05)		10.9		NS	24

Table 8. Starter fertilizer composition effects on corn grain yield, 2000 and 2001, Scandia, KS.

	Starter			Yield		
	N	P_20_5	K	2000	2001	Average
	---- lb/a ----			---------- bu/a ----------		
1.	15	30	5	170	180	175
2.	30	30	0	178	190	184
3.	30	15	0	178	192	185
4.	30	30	5	190	206	198

Means were compared using orthogonal contrasts. Treatment 4 was significantly greater than treatment 2 at the 0.05 level of significance.

CONTROLLED-RELEASE NITROGEN FERTILIZER IN STARTER FOR GRAIN SORGHUM PRODUCTION

W.B. Gordon and D.A. Whitney

Summary

No-tillage planting systems have generated interest in methods that allow total fertilizer application at planting to eliminate trips across the field. Previous research also has shown increasing the nitrogen (N) in starter fertilizer has been beneficial for no-tillage grain sorghum. Putting N and/or potassium (K) in direct seed contact, especially urea, may cause seedling injury, so products that slow N release, such as polymer-coated urea, may be effective. Two polymer-coated urea products were examined in this study, Type I (CRU I) and Type II (CRU II). The CRU II product has a thicker coating than the CRU I and the N is released at a slower rate. The polymer coated urea product CRU I at rates of 30 and 60 lb N/a added to mono ammonium phosphate (MAP) as a direct seed-applied starter increased yields over MAP alone or MAP plus un-coated urea. The CRU II material added to MAP increased yields over the MAP alone at rates up to 90 lb/a. Uncoated urea reduced plant populations and yields at all rates of N.

Introduction

No-tillage planting of row crops has generated considerable interest in use of starter fertilizer. However, planters equipped with separate coulter knives to place the fertilizer to the side and below the seed are not common in 12 row and larger planters, raising questions about putting fertilizer in the seed furrow as an alternative. Research at the North Central Kansas Experiment Field has shown a greater response to 30-30-0 starter placed to the side and below the seed compared to a 10-30-0 starter similarly placed. Fertilizer rate and source must be limited when placed in direct seed contact to avoid germination injury. This is especially true for P and K. In-furrow products with slower nutrient release may decrease seedling injury. Polymer-coated fertilizers for slow release of N have, in fact, been found to reduce the germination injury problem.

This research was initiated to study the effects on germination and production of grain sorghum from applying a controlled released urea in direct seed contact.

Procedures

The study was initiated at the North Central Kansas Experiment Field near Belleville on a Crete silt loam soil. Soil pH was 6.0; organic matter was 2.4%; and Bray-1 P was 41 ppm. The grain sorghum hybrid Pioneer 8505 was planted without tillage into soybean stubble on May 23, 2001 at the rate of 54,000 seed/a. Starter fertilizer was applied in direct seed contact using 11-52-0 at 58 lb/a (a 6-30-0 starter rate) as the base for all starter treatments, except for the N alone check treatments. Treatments with additional N in the starter were formulated using two controlled-release polymer coated urea products, CRU I and CRU II from Agrium. The Type II product has a thicker polymer coat than Type I and therefore gives a slower N release. The polymer-coated urea products were compared with uncoated urea. Additional N was applied to grain sorghum plots at the V-4 stage after plant samples had been taken for dry matter and nutrient analysis.

Results

The 2001 growing season was characterized by a very cool, wet spring followed by a hot, dry period from mid-June until mid-July. Timely rains were received in late July and early August resulting in excellent dryland grain sorghum yields. Grain sorghum stands were greatly reduced when uncoated urea was placed in contact with seed as compared to the polymer-coated urea products (Table 9). Yields also were reduced in treatments receiving uncoated urea, regardless of N rate. Yield declined in the CRU II plus MAP plots when N rate exceeded 90 lb/a. Grain yields were increased significantly by the 30-30-0 and 60-30-0 CRU plus MAP starters compared to no starter or MAP alone. The yield increase from more N in the starter is consistent with previous research at the North Central Experiment Field, where a 2x2-placed starter band of a 30-30-0 starter rate was significantly greater than the traditional 10-30-0 starter.

Our results suggest that in a no-tillage sorghum system, increasing the N in the starter can increase yield compared to a traditional starter or no starter. However, germination injury can occur if the starter is placed in direct seed contact. The polymer-coated urea for controlled N release used in this study reduced stand loss and made use of higher N starters than possible in systems where the fertilizer is placed in-furrow in direct contact with the seed.

Table 9. Effects of starter fertilizer rate and nitrogen source on plant population, V-4 stage whole plant dry matter, and grain yield of no-tillage grain sorghum, North Central Kansas Experiment Field, Belleville, KS, 2001.

N	P_2O_5	Sources	Balance N	Population	V-4 Dry Matter	Yield
- - - - lb/a - - - -			lb/a	plants/a	lb/a	bu/a
6	30	MAP	114	48715	359	131
30	30	MAP+CRU I	90	48569	383	142
60	30	MAP+CRU I	60	48206	366	139
90	30	MAP+CRU I	30	47408	335	131
120	30	MAP+CRU I	0	45738	278	122
30	30	MAP+CRU II	90	47916	379	141
60	30	MAP+CRU II	60	48061	359	138
90	30	MAP+CRU II	30	46754	335	137
120	30	MAP+CRU II	0	45447	296	126
30	30	MAP+Urea	90	25918	149	120
60	30	MAP+Urea	60	25047	97	106
90	30	MAP+Urea	30	23595	89	101
120	30	MAP+Urea	0	22070	76	94
60	30	MAP+CRU I	0	47915	370	134
60	30	MAP+CRU II	0	47771	371	136
60	0	CRU I	60	48206	367	133
60	0	CRU II	60	48642	383	131
60	0	Urea	60	24611	125	115
0	30	0-0-46	120	48497	286	127
0	0	Check	0	48569	183	92
0	0	Check	120	48279	192	118
LSD(0.5)				1557	54	8

MAXIMIZING IRRIGATED CORN YIELDS IN THE GREAT PLAINS

W.B. Gordon

Summary

This experiment was conducted on a producer's field in the Republican River Valley, located near the North Central Kansas Experiment Field at Scandia, KS. Soil was a Carr sandy loam. Treatments consisted of 2 plant populations (28,000 and 42,000 plants/a) and 9 fertility treatments. Fertility treatments consisted of 3 nitrogen rates (160, 230, and 300 lb/a). The N rates were applied in combination with: (1) current soil test recommendations for P, K, and S (at this site, was 30 lb P_2O_5/a), (2) 100 lb P_2O_5 + 80 lb K_2O + 40 lb S/a preplant with N applied in 2 split applications, and (3) the higher rates of P, K, and S applied preplant with the N applied in 4 split applications. Additional treatments were also included in order to determine which elements were providing the most yield increase. When averaged over fertility treatments, grain yield at 42,000 plants/a was 15 bu/a greater than at 28,000 plants/a. Additional P, K, and S increased corn yield by 35 bu/a over yields with P alone at the lower rate. When averaged over all other treatments, yield was increased by 24 bu/a when N rates were increased from 160 to 230 lb/a. Increasing population did not improve yield when additional P, K, and S were not applied. Addition of P, K, and S resulted in a 78 bu/a yield increase over the N alone treatment.

Introduction

With advances in genetic improvement of corn, yields continue to rise. Analysis of the KSU Irrigated Corn Hybrid Performance Test data for the years 1968-2000 show that yields have increased by an average of over 2 bu/year. New hybrids suffer less yield reduction under conditions of drought stress, insect infestations, and high plant population. Newer hybrids have the ability to increase yields in response to higher plant populations. For many reasons, both environmental and agronomic, reduced tillage production systems are growing in use by producers. Resent research from the Midwest indicates that in reduced tillage systems, K responses can be achieved even though soil test levels are adequate. This research was designed to address whether current soil test recommendations are adequate for new high-yield corn hybrids in reduced tillage production systems.

Procedures

This experiment was conducted on a producer's field located near the North Central Kansas Experiment Field, at Scandia, KS. Soil was a Carr sandy loam. Analysis by the KSU Soil Testing Laboratory showed that initial soil pH was 6.8; organic matter was 2.0%; Bray 1-P was 20 ppm; exchangeable K was 240 ppm; and S was 6 ppm. Treatments included 2 plant populations (28,000 and 42,000 plants/a) and 9 fertility treatments. Fertility treatments consisted of 3 nitrogen rates (160, 230, and 300 lb/a). The N rates were applied in combination with: (1) current soil test recommendations for P, K and S (this would consist of 30 lb/a P_2O_5 at this site), (2)100 lb/a P_2O_5+80 lb/a K_2O+40 lb/a S applied preplant with N applied in 2 split applications, or (3) 100 lb/a P_2O_5+ 80 lb/a K_2O+40 lb/a S applied preplant with N applied in 4 split applications (preplant, V-4, V-10, and Tassel). Additional treatments were included in order to determine which elements were responsible for yield increases. N applied alone was compared to N and P; N, P, and K; and N, P, K and S. A complete list of treatments is given in Table 10. Fertilizer sources used were ammonium nitrate, diammonium phosphate, ammonium sulfate, and potassium chloride. The experiment was fully irrigated, receiving 12 in. of irrigation water during the growing season. Data taken in addition to grain yield included whole plant samples at V-6, V-10, and tassel, ear leaf samples at silking, and grain and stover samples at harvest.

Results

The spring of 2001 was much wetter than normal. Nearly 10 in. of rain fell in May. This wet period was followed by an extremely hot, dry period. No rain fell from June 8 until July 15. August also was drier than normal. In spite of the poor rainfall distribution, corn grain yields were excellent. When averaged over fertility treatments, grain yield at 42,000 plants/a was 15 bu/a greater than at 28,000 plants/a (Table 11). Even at the currently low commodity prices ($1.92/bu of corn), this represents a net income increase of $13.20/a. Addition of additional P, and K and S increased corn grain yield by 35 bu/a over yields with P alone at the lower rate. When averaged over all other treatments, yield was increased by 24 bu/a when N rates were increase from 160 to 230 lb/a. Applying fertilizer in 4 applications was not superior to applying in 2 applications**.** Increasing population did not improve yields when additional P, K, and S were not applied. When only 160 lb N/a was applied with 30 lb P_2O_5/a, yields were 8 bu/a less at the 42,000 plants/a compared with the lower population. Fertility levels must be adequate in order to take advantage of the added yield potential of modern hybrids at high plant populations. Additional treatments were added in 2001 in order to determine which elements were providing the most yield increase (Table 12). Addition of each fertilizer element resulted in economically feasible yield increases. Addition of P, K and S resulted in a 78 bu/a yield increase over the N alone treatment. This represents a gross revenue increase of nearly $150/a and a net increase of over $100.00/a. Even at very low commodity prices additional fertilizer inputs are justified. A sound fertility program can increase yields and improve profits.

Table 10.Treatments

A. Population
- 28,000 plants/a
- 42,000 plants/a

B. Fertility
1. 160 lb/a N, 30 lb P_2O_5 (KSU soil test recommendations for this site call for 30 lb P_20_5/a and nothing else). P in first 3 treatments was applied preplant. N was applied as a split application (1/2 preplant, 1/2 at V-4)
2. 230 lb/a N, 30 lb P_2O_5
3. 300 lb/a N, 30 lb P_2O_5
4. 160 lb/a N, 100 lb/a P_2O_5, 80 lb/a K_2O, 40 lb/a S (for treatment 4,5 and 6 , P, K, and S were applied preplant. N was applied as a split application (1/2 preplant ,1/2 at V-4).
5. 230 lb/a N, 100 lb/a P_2O_5, 80 lb/a K_2O, 40 lb/a S
6. 300 lb/a N, 100 lb/a P_2O_5, 80 lb/a K_2O, 40 lb/a S
7. 160 lb/a N, 100 lb/a P_2O_5, 80 lb/a K_2O, 40 lb/a S (for treatment 7,8, and 9, P, K and S were applied preplant. N was applied as 4 split applications (preplant, V-4, V-8, and tassel).
8. 230 lb/a N, 10 0 lb/a P_2O_5, 80 lb/a K_2O_5, 40 lb/a S
9. 300 lb/a N , 100 lb/a P_2O_5, 80 lb/a K_2O_5, 40 lb/a S
10. 300 lb/a N
11. 300 lb N, 100 lb P_2O_5/a
12. 300 lb N, 100 lb P_2O_5, 80 lb K_2O/a
13. 300 lb N, 100 lb P_2O_5, 80 lb K_2O, 40 lb S/a

Table 11. Effects of Plant Population and Fertilizer Rates and Timing on Ridge-Tilled Irrigated Corn Yields, Scandia, KS 2001.

		Timing of N Application		
		Pre+V-4	Pre+V-4	Pre+V-4 +V-8 +Tassel
		Elements		
		P_2O_5	P-K-S	P-K-S
		Rates		
		30	100-80-40	100-80-40
		lb/a		
Population	N-Rate	Yield		
plants/a	lb/a*	bu/a		
28,000				
	160	166	190	194
	230	183	204	206
	300	186	205	209
	N-Rate Avg	178	199	203
42,000	160	158	199	205
	230	186	236	235
	300	190	235	236
	N-Rate Avg	178	223	225
Pop Avg	bu/a			
28,000	194			
42,000	209			
LSD (0.05)	7			
N-Rate Avg	bu/a			
160	185			
230	209			
300	210			
LSD (0.05)	6			

* N was applied ½ preplant and ½ at V-4 or split in 4 applications (preplant, V-4, V-8, and tassel)

Table 12. Nutrient effects on corn grain yield and net income, Scandia, 2001.

Nutrient and Rate	Yield	Net Income Benefit*
lb/a	bu/a	$/a
0-0-0-0-0	78	
300 N	155	$117.84
300 N+100 P_2O_5	186	$37.82
300 N+100 P_2O_5+80 K_2O	219	$51.75
300 N+100 P_2O_5+80 K_2O+40 S	233	$14.08

*Net income benefit is calculated by subtracting cost of the element from yield increase due to addition of that element x $1.92 (current cash corn price). Total cost of N-P-K-S fertilizer was $74.00/a.

SOYBEAN PRODUCTION PRACTICES IN NORTH CENTRAL KANSAS

W.B. Gordon, S.A. Staggenborg, and D.L. Fjell

Summary

During 1997-1999, 18 soybean varieties in Maturity Groups (MG) I-IV were grown in rotation with grain sorghum. Yields of late MG II soybeans were equal to yields of MG III and superior to yields of MG IV. Yields of MG I soybeans were not as good as MG III soybeans. Early MG II and late MG II soybeans matured 26 and 18 days earlier, respectively, than MG IV soybean, thus allowing for earlier harvest and a longer fall period of soil water recharge. Total water use was 2.7 in.greater in MG IV soybeans than in MG I soybeans. In 1999-2001, soybeans in MG I-IV were planted at four different planting dates. The very dry growing season in 2000 reduced yields to below 5 bu/a so averages for this experiment include only 1999 and 2001 data. When averaged over planting dates, yields of MG II soybean was as good as MG III soybean and better than MG IV soybean. Yields declined for all soybean MGs when planting was delayed until mid-June. Plant height decreased as planting date was pushed back later in the growing season.

Introduction

Present farm legislation gives farmers the flexibility to plant the most profitable crop rather than plant to maintain base acres of a farm program crop. This encourages crop rotations. Opportunities exist for expanding soybean acres in central Kansas. Grain sorghum is grown on a large number of dryland acres in central Kansas. A dryland grain sorghum-soybean rotational study was established at the North Central Kansas Experiment Field at Belleville in 1981. Results show that yield of grain sorghum grown in annual rotation with soybean was 25% greater than yield of continuous sorghum. Nitrogen fertilizer required to achieve maximum yield was reduced by 30 lb/a through rotation with soybean. Soybean yield averaged over the period 1982-2001 was 35 bu/a. Soybean yield ranged from a low of 8 bu/a to a high of 61 bu/a. Large year to year variation in yield may discourage soybean production in areas receiving 24-28 in.of rain. The traditional MGs of soybeans grown in the area (late MG III and early MG IV) can use significant amounts of water in August and early September. Earlier maturing soybeans (late MG I through early MG III) use the maximum amount of water earlier in the growing season when it is more likely to be available, thus potentially providing greater year-to-year yield stability and leaving a longer period for soil water recharge for the following crop. This research was designed to investigate the yield potential, seed quality, and water use of soybeans in different MGs.

Soybeans also have an optimum planting date that can differ by both region and cultivar. Several studies in the Midwest have included combinations of planting dates, row widths, and cultivars. In many of these studies, planting date was the variable having the greatest impact on yield. Little current information is available concerning soybean planting dates in Kansas. In 1999, studies were initiated to investigate planting dates and MG effects on soybean production.

Procedures

This research was conducted at the North Central Kansas Experiment Field located near Belleville on a Crete silt loam soil. The first study included 18 soybean varieties ranging in maturity from late MG I to early MG IV that were grown in annual rotation with grain sorghum. Soybeans were planted in mid-May each year during the period 1997-1999 at the rate of 10 seed/ft into grain sorghum stubble without additional tillage. Gravimetric soil water measurements to a depth of 36 in. were made at planting and again at maturity.

In the second experiment, soybeans in four MGs were planted at four different dates. Varieties used were Pioneer 9172 (MG I), IA 2021 (MG II), Macon (MG III), and Midland 8410 (MG IV). Each variety was planted at the rate of 10 seed/ft Planting dates in 1999 were May 1, May 28, June 8, and June 25. In 2001 soybeans were planted on April 30, May 22, June 11, and June 22. Due to the very hot, dry conditions that prevailed for most of the summer of 2000, soybean yields were very low and variable, so data from that year will not be reported.

Results

When averaged over the period 1997-1999, soybeans in late MG II yielded as well as soybeans in MG III and better than soybeans in MG IV (Table 13). Early and late MG II soybeans matured 26 and 18 days earlier than MG IV soybeans, respectively (Table 14). Earlier harvest allows producers to spread out the work load and rotate to wheat following fall soybean harvest in a timely manner. Soybeans in late MG II used 1.4 in. less water during the growing season than soybeans in MG IV. Soybeans in MG I were shorter in height than soybeans in later MGs. Short stature limits potential pod sites and reduces seed yield. Seed quality was generally poorer in early maturing soybeans than in later groups. Seed of early-season varieties mature during a time when temperatures are still very warm, whereas seed of later maturing groups mature in late September when temperatures are cooler. When averaged over the 3 years of this experiment, seed yields were stable from late MG II to mid MG III. Yields were poorer in earlier or later MGs.

In the second study, yields in 2001 were greatest for late April and May planting dates (Table 15). Yields declined when planting date was delayed until June. Yield of MG II soybean was as high as MG III soybean and greater than soybean in MG IV. The 2-year average yields (Table 16) followed the same trends. Plant height declined as planting date was delayed (Figure 2). The number of days from emergence to maturity also declined as planting was delayed later in the season (Figure 3).

Table 13. Seed yield of soybean groups, North Central Kansas Experiment Field, Belleville, KS, 1997-1999.

Maturity Group	1997	1998	1999	Average
	---------------------------------bu/a---------------------------------------			
Late I	29	40	33	34
Early II	35	44	36	38
Late II	42	43	43	43
Early III	42	44	45	44
Mid III	45	44	43	44
Early IV	31	35	37	34
LSD (0.05)	2	3	3	3

Table 14. Maturity, plant height, water use, and seed germination of soybean groups, North Central Kansas Experiment Field, Belleville, KS, 1997-1999.

Maturity Group	Days to Maturity	Plant Height	Total Seasonal Water Use	Seed Germination
		in.	in.	%
Late I	106	28	13.5	65
Early II	114	34	14.0	79
Late II	122	35	14.8	80
Early III	128	35	15.3	91
Mid III	132	36	15.6	92
Early IV	140	39	16.2	86

Table 15. Planting date and maturity group effects on soybean yield, Belleville, KS, 2001.

Maturity	Planting Date				
Group	April 30	May 22	June 11	June 22	Group Avg
	------------------------------------bu/a--				
I	35	29	25	26	29
II	36	45	24	28	33
III	35	44	27	27	33
IV	32	34	26	22	29
Date Avg	35	38	26	26	-----

Table 16. Planting date and maturity group effects on soybean yield, Belleville, KS (2-year average).

Maturity	Planting Date				
Group	Late April	Mid-May	Early June	Late June	Group Avg
	------------------------------------bu/a--				
I	43	40	33	21	34
II	48	51	36	25	40
III	49	52	37	25	41
IV	44	44	31	17	34
Date Avg	46	47	34	22	-----

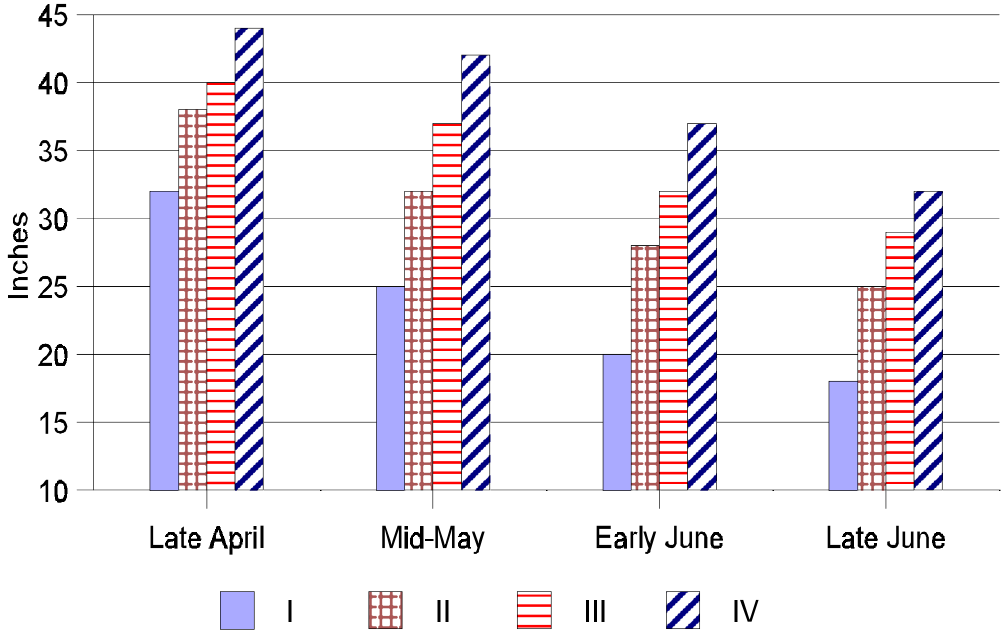

Figure 2. Planting date and maturity group effects on plant height, Belleville 2001.

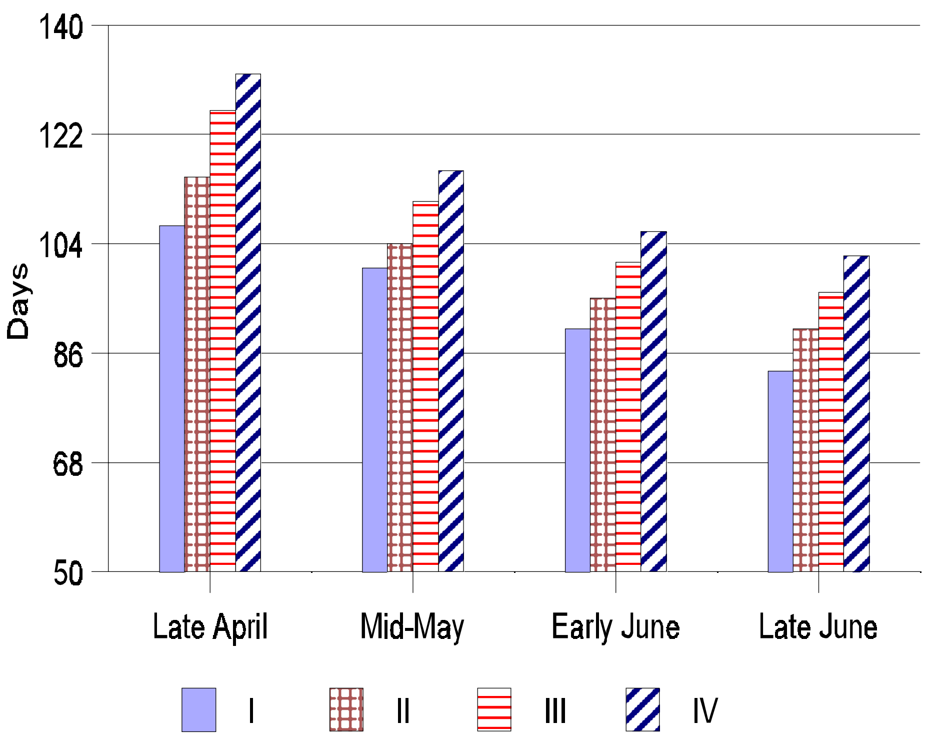

Figure 3. Planting date and maturity effects on days from emergence to maturity, Belleville, 2001.

COMPARISON BETWEEN GRAIN SORGHUM AND CORN GROWN IN A DRYLAND ENVIRONMENT

W.B. Gordon and S.A. Staggenborg

Summary

This experiment was conducted at the North Central Kansas Experiment Field near Belleville, KS on a Crete silt loam soil and at the North Agronomy Farm at Manhattan, KS on a Reading silt loam soil. The test directly compares grain sorghum and corn planted in the same environment. Treatment consisted of two grain sorghum hybrids (Dekalb 47 and NC+7R83 at Belleville and Pioneer 8505 and Pioneer 84G62 in 2000 and NC+7R37 and Pioneer 84G62 in 2001 at Manhattan) and two corn hybrids (NC+5018 and Pioneer 34K77 at both locations). Hybrids were chosen on the basis of past performance in the KSU Hybrid Performance Tests. Additional treatments consisted of nitrogen (N) rates (0, 40, 80, 120, and 160 lb/a). Nitrogen as ammonium nitrate was side dressed after planting. Corn and grain sorghum were planted at optimum dates based on past research. When averaged over hybrid and N rate, grain sorghum at Belleville yielded 56 bu/a greater than corn. At Manhattan, grain sorghum yielded 48 bu/a more than corn.

Introduction

Dryland corn acres continue to expand in north-central Kansas and south-central Nebraska. Government loan programs favor corn over grain sorghum, although sorghum is adapted to drier environments. Sorghum has the ability to remain dormant during drought and then resume growth. Sorghum leaves roll as they wilt; therefore, less surface area is exposed for transpiration. Sorghum plants exhibit a low transpiration ratio (pounds of water required to produce a pound of plant biomass). Sorghum has a large number of fibrous roots that effectively extract moisture from the soil. It has been estimated that the adsorption area of the root system of a sorghum plant is twice that of corn. This large absorption capacity and relatively small leaf area are major factors in sorghum drought resistance. Because sorghum is more drought tolerant, it is most often planted on less productive soils. In contrast, dryland corn is planted on the most productive acres. Comparisons of yield potential of corn and sorghum are limited because of the difference in productivity of the soils on which the crops are planted. This experiment directly compares corn and grain sorghum grown in the same environment.

Procedures

At Belleville, both corn and grain sorghum were planted into wheat stubble without tillage**.** At Manhattan the previous crop was grain sorghum. Corn (NC+5018 and Pioneer 34K77) was planted on April 22 at Belleville and on April 25 at Manhattan. Seeding rates at both locations was 24,000 seed/a. Grain sorghum was planted on May 22 at Belleville and June 3 at Manhattan. Sorghum hybrids used were NC+7R83 and Dekalb 47 at Belleville and NC+7R37 and Pioneer 84G62 at Manhattan. Seeding rate was 60,000 plants/a. Corn and grain sorghum hybrids were selected based on their superior performance in previous KSU Performance Tests. The experiment also included N rates. Nitrogen rates of 40, 80, 120, and 240 lb/a were applied as ammonium nitrate after planting. A no N check also was included.

Results

Weather in 2001 was characterized by a very cool, wet spring followed by a very hot, dry period from mid-June to late July. Corn yield was reduced by dry conditions at pollination in late June. Timely rains were received in late July, prior to sorghum heading. August was very dry. Corn yields at both locations were low. When averaged over N rates at Belleville , the corn hybrid NC+ 5018 yielded 50 bu/a and Pioneer 34K77 yielded 100 bu/a. Both sorghum hybrids yielded over 130 bu/a. Nitrogen applied at 40 lb/a optimized grain yield in both corn and sorghum at this site**.** When averaged over N rates and hybrids, corn at Manhattan yielded 63 bu/a and sorghum yielded 111 bu/a. Grain sorghum responded to addition of 80 lb/a of N. Yields were so low in corn that no response to N was seen. The ability of sorghum to avoid short-term drought and still yield was illustrated by this experiment in 2001.

Table 17. Nitrogen rate effects on yield of grain sorghum and corn hybrids, Belleville.

	Grain Sorghum Hybrid				Corn Hybrid			
	NC+ 7R83		Dekalb 47		NC+5018		Pioneer 34K77	
N-Rate	2000	2001	2000	2001	2000	2001	2000	2001
lb/a	----------	----------	----------	----------bu/a	----------	----------	----------	----------
0	43	122	44	117	12	51	30	90
40	43	131	45	127	12	48	34	102
80	48	136	59	134	13	50	36	100
120	49	135	60	134	15	50	35	104
160	46	139	60	136	15	49	36	103
Avg	46	133	53	130	13	50	34	100
LSD (0.05)	NS	NS	8	8	NS	NS	NS	NS

Table 18. Grain yields for grain sorghum and corn in Manhattan in 2000 and 2001.

Crop		N Rate	2000	2001
		lb/a	bu/a	bu/a
Grain Sorghum	Hybrid	0	13.0	96.2
	P8505 (2000)	40	12.5	97.4
	7R37 (2001)	80	22.2	95.5
		120	21.6	99.2
		160	20.4	105.7
		200	23.3	104.1
	P 84G62	0	21.6	105.0
		40	22.5	112.6
		80	17.7	130.7
		120	25.9	132.0
		160	26.6	126.8
		200	24.8	124.7
Corn	NC+ 5081	0	30.6	56.4
		40	37.1	57.0
		80	36.1	42.6
		120	33.9	60.6
		160	39.4	46.0
		200	40.0	53.8
	P 34K77	0	36.1	88.4
		40	33.7	70.0
		80	45.4	72.0
		120	52.5	68.7
		160	50.6	66.3
		200	54.6	73.0
Crop X N	Grain Sorghum	0	17.3	100.6
		40	17.5	105.0
		80	19.9	113.1
		120	23.7	115.6
		160	23.5	116.2
		200	24.1	114.4
	Corn	0	33.4	72.4
		40	35.4	63.5
		80	40.8	57.3
		120	43.2	64.7
		160	45.0	56.2
		200	47.3	63.4
LSD(0.05)			NS	9.9
Hybrid Means		P8505/ NC+ 7R37	18.8	99.7
		84G62	23.2	122.0
		NC+ 5018	36.2	52.7
		P 34K77	45.5	73.1
LSD(0.05)			NS	20.5

SOYBEAN INOCULANT EVALUATION

S.A. Staggenborg, W.B. Gordon, and C.W. Rice

Summary

Inoculation with *Bradyrhizobium* is necessary when planting soybean in fields that have not produced soybean for several years. A study was conducted to evaluate several commercially available soybean inoculants in two dryland fields and one irrigated field with these fields having various levels of soybean history. In the two fields that had not been in soybean for over 5 years, inoculants increased yields from 10 to 44% compared to the untreated control. A recently introduced pre-inoculant treatment performed at similar levels as their conventional inoculant counterparts. In the fields where soybean had not been grown during the past 2 years, inoculants did not influence yields.

Introduction

Soybean is not native to the United States; therefore, when soybean is planted in fields that have not been in soybean for an extended period of time, *Bradyrhizobium* applied to the seed coat at planting can improve yields. Commercial inoculants vary in the type of bacteria strains, carrier, and other characteristics. The objective of this study was to evaluate the performance of selected commercial soybean inoculants on soybean yield in Kansas.

Procedures

There were between 13 and six treatments (Table 20) used to assess impact of seed applied *Bradyrhizobium japonicum* on soybean yields. We used an irrigated field at the North Central and Irrigation Experiment Field near Scandia, KS; and used dryland fields in Geary County, KS, and at the North Agronomy Farm, Manhattan, KS. Soybean variety, soybean history and soil fertility levels are listed in Table 19. All inoculant treatments were applied at planting, with exception of pre-inoculants. Pre-inoculants were applied to the seed between 4 and 35 days prior to planting. All equipment was flushed with ethanol between treatments to avoid cross contamination.

A randomized complete block design with four replications was used at all three locations. In Geary County and at Manhattan, plots were planted May 16, 2001. The Geary County site was in a creek bottom field containing a Muir silty clay loam. In Manhattan, an upland site containing a Wymore silty clay loam was used. In Republic County, plots were planted May 17, 2001 in a field containing a Crete silt loam with furrow irrigation.

Grain yields were determined on September 27, 2001 at Scandia, on September 29, 2001 in Geary County, and September 31, 2001 at Manhattan. Yield was determined by harvesting the middle two rows of each plot. Grain yields were adjusted to 13% moisture. Stand counts were taken at harvest at Scandia. Analysis of variance was used to determine treatment differences.

Results

The average yields at Scandia were 67 bu/a, 55 bu/a in Geary County and 24 bu/a in Manhattan, which were reduced due to hail and low fertility levels.

The importance of inoculants in a crop rotation that has not recently included soybean is illustrated by the low yields of the untreated control compared to the inoculant treatments at Scandia and Manhattan. At the two higher yielding sites, there were few differences among inoculants. Soybean had been grown at the Geary County site within the past two years, and as a result, there were no yield differences among the treatments.

Table 19. Field information for soybean inoculant study for 2001.

Location	Soybean History	pH	Bray 1 P	Organic Matter	Planting Date	Variety
			(ppm)	(%)		
Scandia	+9	6.3	14.9	2.1	17 May	DK 3151RR
Geary Co.	2	--	--	--	16 May	IA 3010
Manhattan	5	5.7	7.0	1.7	16 May	IA 3010

Table 20. Soybean density and yield with inoculant treatments for three locations in 2001.

Company	Treatment	Scandia Plant Density	Scandia	Geary Co.	Manhattan
			Yield		
		Plants/ft	- - - - - - - bu/a - - - - - - -		
	Control	6.8	49.6	55.1	24.2
MicroBio	Pre-Inoculant	6.0	68.8		
MicroBio	Microfix	7.2	68.0		
MicroBio	Experimental	6.2	69.6		
MicroBio	HiStick 2	5.9	68.5		
Liphatech	Exp High rate	5.3	67.1		
Liphatech	Exp Low rate	6.8	68.0		
Liphatech	Cell Tech 2000	5.4	66.9	57.2	27.9
Liphatech	CT 2000 + Exp High rate	6.0	66.9		
Liphatech	CT 2000 + Exp High rate	7.2	66.3		
Urbana	Nod+	4.8	68.8	54.9	20.6
Urbana	MegaPrep	6.4	71.2	55.4	24.0
Urbana	Experimental 41	6.0	69.6	52.2	25.8
Urbana	Pre-Inoculant	5.2	68.2	57.7	21.9
LSD $_{(0.05)}$		NS	4.2	NS	2.5
C.V. (%)		13.4	4.4	8.8	5.7

KANSAS RIVER VALLEY EXPERIMENT FIELD

Introduction

The Kansas River Valley Experiment Field was established to study how to manage and use irrigation resources effectively for crop production in the Kansas River Valley. The Paramore Unit consists of 80 acres located 3.5 miles east of Silver Lake on US 24, then 1 mile south of Kiro, and 1.5 miles east on 17th street. The Rossville Unit consists of 80 acres located 1 mile east of Rossville or 4 miles west of Silver Lake on US 24.

Soil Description

Soils on the two fields are predominately in the Eudora series. Small areas of soils in the Sarpy, Kimo, and Wabash series also occur. The soils are well drained, except for small areas of Kimo and Wabash soils in low areas. Soil texture varies from silt loam to sandy loam, and the soils are subject to wind erosion. Most soils are deep, but texture and surface drainage vary widely.

2001 Weather Information

The frost-free season was 193 days at the Paramore Unit and 183 days at the Rossville Unit (ong-term average = 173 days). The last 32° F frosts in the spring were on April 16 at the Rossville and Paramore Units (ong-term average, April 21) and the first frost in the fall was on October 16 at the Rossville Unit and on October 26 at the Paramore Unit (long-term average, October 11). Precipitation was slightly above normal at the Rossville Unit and below normal at the Paramore Unit (Table 1). Irrigated corn yields were good and soybean yields were about normal.

Table 1. Precipitation at the Kansas River Valley Experiment Field.

Month	Rossville Unit		Paramore Unit	
	2000-2001	30-Yr. Avg.	2000-2001	30-Yr. Avg.
	- - - - - in. - - - - -		- - - - - in. - - - - -	
Oct.	3.24	0.95	3.06	0.95
Nov.	0.67	0.89	0.86	1.04
Dec.	0.49	2.42	0.35	2.46
Jan.	0.87	3.18	1.19	3.08
Feb.	3.17	4.88	2.75	4.45
Mar.	1.75	5.46	3.52	5.54
Apr.	2.95	3.67	2.52	3.59
May	4.16	3.44	1.58	3.89
June	5.37	4.64	4.59	3.81
July	4.40	2.97	2.24	3.06
Aug.	3.79	1.90	2.95	1.93
Sep.	5.63	1.24	1.63	1.43
Total	36.49	35.64	27.24	35.23

SOYBEAN CYST NEMATODE STUDY

L.D. Maddux

Summary

This study was conducted at the Rossville Unit where soybean cyst nematode races 4 and14 have been a problem for several years. Two nematicides and four resistant soybean varieties were evaluated. No significant effects on soybean height, yield, or nematode egg counts were observed. A long-term study indicates that good varietal resistance can result in lower nematode egg counts but this has not generally resulted in yield increases.

Introduction

Soybean cyst nematode infests many fields in the Kansas River Valley. In the Rossville area, cyst nematode infestations are commonly Race 4/14. Good varietal resistance to Race 4 is not currently available in varieties adapted to this area. This test evaluated a susceptible variety with and without nematicide treatments and three soybean varieties with some resistance to Race 14.

Procedures

The site selected was in soybeans in 2000. A composite soil sample of the area indicated an initial infestation of 1,680 eggs per 100 cm^3. Eight treatments were included: a susceptible variety, Flyer; Flyer plus a biological nematicide, Deny (Stine Biological Products, Adel, IA) at 8 and 16 oz/a applied in the seed furrow; Flyer plus a chemical nematicide, Temik 15G (Aventis CropScience, Research Triangle Park, NC) at 5.0 lb/a applied in the seed furrow; K1370, a newly developed KSU variety with resistance from Pi88788, which has resistance to Races 3 and 14, and some resistance to Race 4; Stine 4200-2, which has Peking resistance; and Stine 4212-4 and Garst 445, which have resistance to Races 3/14**.** Treflan at 1.0 qt/a plus Canopy XL at 6.4 oz/a were incorporated May 8 with a field cultivator**.** The plots were planted May 16 at 144,000 seeds/a in 30-in. rows. Plots were harvested October 26 using a modified John Deere 3300 combine. Nematode egg counts were made from soil samples taken in the fall after harvest from all plots.

Results

No significant differences were noted in soybean plant height, grain yield, or the number of eggs per 100 cm^3 (Table 2). The K1370 variety had the lowest yield because of a poor stand resulting from poor quality seed that was available in this new variety in 2001. The fall egg counts were extremely variable. The counts per plot varied from 272 to 30,464 eggs per 100 cm^3. However, the variability between plots receiving the same treatment was also great. In the long-term soybean cyst nematode studies (9 years), conducted by Tim Todd of KSU Plant Pathology, there is some population suppression obtained from planting the common PI88788-derived varieties, but not as good as can be expected with Hartwig. In the fall of 2001, egg counts in no. per 100 cm^3 were: Flyer - 2,697; Delsoy 4210 (PI88788) - 713; Delsoy 4500 (Peking) - 1,516; and Hartwig (PI437654) - 122. However, there was still no yield advantage observed in this long-term test. Growers with Races 4/14 should watch for the availability of "Cyst-X" labeled varieties, as these contain the Hartwig (PI437654) type of resistance.

Table 2. Treatment effects on soybean height, yield, and soybean cyst nematode egg counts, Rossville, 2001.

Treatments	Plant Height	Yield	Egg Counts
	in.	bu/a	no./100 cm^3
Flyer	37	41.7	4019
Flyer + Deny, 8 oz/a	41	42.1	4216
Flyer + Deny, 16 oz/a	35	40.6	11152
Flyer + Temik, 5.0 lb/a	41	42.1	9078
K1370	37	32.1	2652
Stine 4200-2	40	44.7	3944
Stine 4212-4	41	43.6	3672
Garst 445	36	50.1	11594
LSD(.05)	NS	NS	NS

CORN HERBICIDE PERFORMANCE TEST

L.D. Maddux

Summary

This study was conducted at the Rossville Unit. PRE and PRE + EP or MP treatments were generally superior to EP only treatments. A major reason for these results was that the EP only treatments were applied too late to prevent weed competition from decreasing yields. Timeliness of application is a major factor in determining effective weed control. In this study, broadleaf weed control with the EP only treatments was about equivalent to that obtained with the PRE and PRE + EP or MP treatments, but weed competition resulted in the EP only treatments having much lower grain yields.

Introduction

Chemical weed control and cultivation have been used to control weeds in row crops to reduce weed competition that can reduce yields. Results of selected treatments from a weed control test that included preemergence and postemergence herbicides are presented in this paper. The major weeds evaluated in these tests were large crabgrass (Lacg), Palmer amaranth (Paam), and common sunflower (Cosf).

Procedures

This test was conducted on a Eudora silt loam soil previously cropped to soybean. The test site had a pH of 7.0 and an organic matter content of 1.3%. Garst 8543 IT was planted April 26 at 30,000 seeds/a in 30-in. rows. Anhydrous ammonia at 150 lbs N/a was applied preplant, and 10-34-0 fertilizer was banded at planting at 120 lb/a. Herbicides were applied as follows: preemergent (PRE) - April 26; early postemergent (EP) - May 27; and midpostemergent (MP) - June 7 (Table 3). Plots were not cultivated. The crop injury and weed control ratings reported were made June 14. The first significant rainfall after PRE herbicide application was on May 3 (1.25 in.). The test was harvested October 8 using a modified John Deere 3300 plot combine.

Results

Very little crop injury was observed (Table 3). The EP treatment of Aim + Atrazine resulted in the most injury. Weed control with all the PRE, PRE + MP or PRE + EP treatments was good. Large crabgrass (lacg) control was relatively poor with the all EP application treatments (late season ratings were lower than those reported). Treatments containing Basis Gold had particularly low Lacg ratings. The EP only treatments should have been applied earlier. Too much weed competition had occurred by the time applications were made; lacg was 1-3 in., paam - 2-8 in., and cosf - 2-8 in. in height at EP application, with a moderate to heavy infestation of all three. The use of a PRE application resulted in decreased size and stand and less competition. The yields reflect the greater competition, with all EP only treatments yielding much less than the PRE and PRE + EP or MP treatments.

Table 3. Effects of pre- and postemergence herbicides on weed control and grain yield of corn, Kansas River Valley Experiment Field, Rossville, KS, 2001.

Treatment	Rate	Appl Time[2]	Corn Injury[1]	Weed Control[1,3]			Grain Yield
				Lgcg	Paam	Cosf	
	product/a		---%---	----------%------------			bu/a
Untreated check		---	0.0	0	0	0	8
Bicep II Magnum	2.1 qt	PRE	0.0	88	100	90	185
Guardsman Max	4.0 pt	PRE	0.0	90	100	100	189
Axiom + Atrazine 4L	12 oz + 1.33 qt	PRE	0.0	98	100	95	163
Epic + Atrazine 4L	8.0 oz + 1.0 qt	PRE	0.0	95	100	98	176
Define + Atrazine 4L	14 oz + 1.33 qt	PRE	0.0	98	100	100	187
Degree Xtra	3.75 qt	PRE	0.0	98	100	98	134
Fultime + Hornet	3.0 qt + 3.0 oz	PRE	0.0	95	98	97	160
Fultime +	3.0 qt	PRE	3.3	98	100	100	174
Hornet + Atrazine DF	3.0 oz + 1.0 lb	MP					
Outlook +	18 oz	PRE	0.0	87	100	100	159
Marksman	3.5 pt	EP					
Outlook +	18 oz	PRE	1.7	90	97	98	155
Clarity	0.55 pt	EP					
Outlook +	18 oz	PRE	1.7	90	100	100	152
Distinct	6.0 oz	EP					
Axiom +	12 oz	PRE	0.0	98	100	97	165
Distinct	6.0 oz	EP					
Dual II Magnum +	1.33 pt	PRE	1.7	98	100	100	165
Northstar	5.0 oz	EP					
Dual II Magnum +	1.33 pt	PRE	3.3	95	98	100	140
Spirit	1.0 oz	EP					
Dual II Magnum +	1.33 pt	PRE	10.0	93	100	77	156
Aim + Atrazine 4L	0.33 oz + 1.0 qt	EP					
Leadoff +	2.0 pt	PRE	0.0	98	100	100	191
Basis Gold + Clarity	14 oz + 4.0 oz	EP					
Balance Pro +	0.5 oz	PRE	0.0	87	100	100	158
Basis Gold + Clarity	14 oz + 4.0 oz	EP					
Leadoff +	2.0 pt	PRE	0.0	95	100	100	186
Steadfast + Clarity	0.75 oz + 4.0 oz	EP					
Lightning + Distinct	1.28 oz + 4.0 oz	EP	1.7	88	100	100	101
Lightning + Marksman	1.28 oz + 2.5 pt	EP	3.3	78	100	100	104
Lightning + Clarity + Outlook	1.28 oz + 8.0 oz + 12 oz	EP	0.0	98	93	100	139
Basis Gold + Clarity	14 oz + 4.0 oz	EP	1.7	75	98	100	104
Basis Gold + Callisto	14 oz + 2.0 oz	EP	1.7	72	100	100	132
Basis Gold + Distinct	14 oz + 2.0 oz	EP	0.0	73	100	100	114
Steadfast + Clarity	0.75 oz + 4.0 oz	EP	1.7	73	53	100	96
LSD(.10)			3.5	7	15	14	50

[1] Corn injury and weed control rated - 6/14/01.
[2] PRE = preemergence; EP = early postemergence; MP = mid-postemergence; LP = late postemergence.
[3] Lgcg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower .
[4] EP & MP treatments had surfactants added (NIS, COC, UAN, &/or AMS) according to label recommendations.

MACRONUTRIENT FERTILITY EFFECTS ON IRRIGATED CORN IN A CORN/SOYBEAN ROTATION

L.D. Maddux

Summary

A corn-soybean cropping sequence was evaluated from 1983 - 2001 (corn planted in odd years) for the effects of N, P, and K fertilization. Corn yield increased with increasing N rates up to 160 lbs N/a. A significant yield increase to P fertilization was observed in only 1 year. An average 6 bu/a corn yield increase was observed from 1983-95 with K fertilization.

Introduction

A study was initiated in 1972 at the Topeka Unit to evaluate the effects of nitrogen (N), phosphorus (P), and potassium (K) on irrigated soybeans. In 1983, the study was changed to a corn/soybean rotation with corn planted in odd years. Study objectives are to evaluate the effects of applications of N, P, and K made to a corn crop on (a) grain yields of corn and the following soybean crop and (2) soil test values.

Procedures

The initial soil test in March, 1972 on this silt loam soil was 47 lbs/a of available P and 312 lbs/a of exchangeable K in the top 6 in. of the soil profile. Rates of P were 50 and 100 lbs P_2O_5/a (1972 - 1975) and 30 and 60 lbs P_2O_5/a (1976 - 2001), except in 1997 when a starter of 120 lbs/a of 10-34-0 (12 lbs N/a + 41 lbs P_2O_5/a) was applied to all plots (also applied to soybean in 1998). Rates of K were 100 lbs K_2O/a (1972 - 1975), 60 lbs K_2O/a (1976 to 1995), and 150 lbs K_2O/a (1997 - 2001). N Rates included a factorial arrangement of 0, 40, and 160 lbs of preplant N/a (with single treatments of 80 and 240 lbs N/a). The 40 lbs N/a rate was changed to 120 lbs N/a in 1997. N, P, and K treatments were applied every year to soybean (1972 - 1982) and every other year (odd years) to corn (1983 - 1995, 1999 and 2001).

Corn hybrids planted were BoJac 603 - 1983, Pioneer 3377 - 1985, 1987, 1989; Jacques 7820 - 1991 and 1993; Mycogen 7250CB - 1995; DeKalb 626 - 1997, 1999; and Golden Harvest 2547 in 2001. Corn was planted in mid-April. Herbicides were applied preplant, and incorporated each year. The plots were cultivated, furrowed, and furrow irrigated as needed. A plot combine was used for harvesting grain.

Results

Average corn yields for the 13-year period from 1983 through 1995 (7-years) and yields for 1997, 1999, and 2001 are shown in Table 4. A good N response was obtained with 160 lbs N/a. Fertilization at 240 lbs N/a did not significantly increase corn yield. In 1997, corn yield with 120 lbs N/a was equal to that with 160 lbs N/a and only 6 and 4 bu/a less in 1999 and 2001, respectively. Corn yield showed a significant response to P fertilization only in 1985 and 1993 (yearly data not shown) while the 7-year average showed no significant difference in yield. K fertilization showed a significant yield increase in 1985, 1989, and 1993 (yearly data not shown) and the 7-year average showed a 6 bu/a yield increase. No P response was observed in 1997, when starter fertilizer was applied to all plots, nor in 1999 or 2001, after the 2 years of starter application. No significant response to K fertilization was observed in 1997, 1999, or 2001, although there was a trend to increased yield with K fertilization in 1999 and 2001.

Table 4. Effects of nitrogen, phosphorus, and potassium applications on corn yields in a corn-soybean cropping sequence, Topeka.

Fertilizer Applied[1]			Corn Yield			
N	P_2O_5[2]	K_2O	1983 - 1995	1997	1999	2001
--------lbs/a--------			---------- bu/a ----------			
0	0	0	87	93	88	119
0	0	60/150	86	95	106	123
0	30	0	93	101	115	124
0	30	60/150	86	87	90	115
0	60	0	84	86	76	110
0	60	60/150	92	89	79	115
40/120	0	0	129	200	202	183
40/120	0	60/150	126	181	195	173
40/120	30	0	123	189	188	168
40/120	30	60/150	138	208	181	192
40/120	60	0	117	195	159	183
40/120	60	60/150	132	190	213	182
160	0	0	171	203	171	171
160	0	60/150	177	177	206	168
160	30	0	168	184	189	174
160	30	60/150	181	205	209	190
160	60	0	167	191	199	205
160	60	60/150	178	204	203	198
80	30	60/150	151	187	177	167
240	30	60/150	182	206	219	192
LSD(.05)			15	27	46	26
NITROGEN MEANS:						
0			88	92	92	118
40/120			127	194	190	180
160			174	194	196	184
LSD(.05)			8	19	19	13
PHOSPHORUS MEANS:						
	0		129	158	161	156
	30		131	162	162	160
	60		128	159	155	166
LSD(.05)			NS	NS	NS	NS
POTASSIUM MEANS:						
		0	127	160	154	160
		60/150	133	159	165	162
LSD(.05)			6	NS	NS	NS

[1] Fertilizer applied to corn in odd years 1983 - 2001 and to soybeans for 11 years prior to 1983 (the first number of two is the rate applied to corn from 1983 - 1995).

[2] P treatments not applied in 1997. Starter fertilizer of 10 gal/a of 10-34-0 was applied to all treatments in 1997 & 1998 (corn & soybeans). N & K treatments were applied to corn in 1997.

EVALUATING TWIN ROW CORN PLANTING SYSTEMS

S.A. Staggenborg and L.D. Maddux

Summary

A study was conducted under dryland and irrigated conditions to evaluate three row spacing configurations (30 in., 20 in., and twin row) at two plant density levels. Low corn yields as a result of high temperature and drought stress resulted in no differences between the row spacings or the plant density treatments at either location.

Introduction

Corn row spacing and configurations continue to be of interest in Kansas. Recently, the concept of twin row configurations has gained new interest as more precise seeding methods have been developed. Twin rows configuration consists of two rows planted close together (7.5 in.) and centered on a standard 30 in. spacing. This configuration allows for some row crop equipment to be used, especially standard corn harvesting equipment. Previous narrow row corn research indicated that in most parts of Kansas, row spacing narrower than 30 in. will not consistently increase corn yields.

Procedures

Three row spacing configurations were tested under dryland at Manhattan, KS on a Wymore silty clay loam and under irrigation at Rossville, KS on a Eudora silt loam. The row spacing configurations consisted of 30 in., 20 in. and twin row. The twin row configuration has two rows that are spaced 7.5 in. apart, each set of twin rows are spaced 30 in. apart.
All plots were planted with John Deere 71-Flex planter units mounted on a two-bar planter. This configuration allowed for all possible row spacings to be planted in one pass through each plot by simply moving individual planter units to the appropriate location for each configuration. A randomized complete block design with four replications was used at each location.

The corn hybrid Pioneer 34K77 was used at both locations in 2001. Plots were planted in Manhattan on April 11, 2001, and on May 2, 2001 at Rossville. Plant populations of 24,000 and 28,000 plants/a were established at Manhattan and 26,000 and 30,000 plants/a were established at Rossville. All plots were over-planted and hand thinned to the desired population. Plant establishment at Rossville was not high enough to attain 30,000 plants/a, so the higher target population plots were not thinned. Anhydrous ammonia was applied on April 17, 2001 at a rate of 125 lb N/a. Roundup Ultra (1.5 pts/a) and Bicep Magnum (2.1 qt/a) were applied on May 2, 2001. Grain yield was determined by hand harvesting 30 row-ft from the center 5-ft of each plot.

Results

Corn yields were lower than expected in 2001 due to extreme heat and dry conditions in early July. Hail in mid-June and low soil phosphorous levels further impacted the Manhattan location. Due to lower than expected yields, row spacing and plant density treatments had no impact on corn yields (Table 5).

Table 5. Yield and ear number for three row configurations and two plant population treatments at Manhattan and Rossville, KS in 2001.

		Manhattan		Rossville	
Row Spacing	Target Population	Yield	Ear Number	Yield	Ear Number
		bu/a	Ears/plt	bu/a	Ears/plt
30 in.	Low	38.8	0.9	144.5	1.0
20 in.	Low	46.4	0.9	143.5	1.0
Twin-row	Low	41.4	0.9	130.9	1.0
30 in.	High	31.0	0.8	131.2	1.0
20 in.	High	44.0	0.9	121.4	1.0
Twin-row	High	43.1	0.9	135.5	1.0
		NS	NS	NS	NS
Population Means					
Low		42.2	0.9	139.6	1.0
High		39.4	0.9	129.3	1.0
LSD(0.05)		NS	NS	NS	NS
Row Spacing Means					
30 in.		34.8	0.8	137.8	1.0
20 in.		45.2	0.9	132.4	1.0
Twin-row		42.3	1.0	133.1	1.0
LSD(0.05)		NS	NS	NS	NS

SANDYLAND EXPERIMENT FIELD

Introduction

The Sandyland Experiment Field was established in 1952 to address the problems of dryland agriculture on the sandy soils of the Great Bend Prairie of south-central Kansas. In 1966, an irrigated quarter was added to demonstrate how producers might use water resources more efficiently and determine proper management practices for, and adaptability of, crops under irrigation on sandy soils.

Research at the field has help define adapted varieties/hybrids of wheat, soybean, alfalfa, grain sorghum, and corn. As irrigated crop production grew in importance, research determined proper management strategies for irrigation, fertilizer, pest control, and related cultural practices. Presently, research focuses on variety/hybrid evaluation, evaluation of new pesticides for the area, practicality of dryland crop rotations, corn nitrogen fertilizer requirements, re-examining accepted cultural practices for corn and grain sorghum, and the long-term effects of cropping systems on yield, soil conditions, and residue cover. In 1999, a project was initiated to examine cotton production variables and agronomic potential in the area and work was begun examining the long-term feasibility of dryland soybean production. Winter forage studies for cattle were expanded in 2000. These studies were initiated in 1999 and involved planting of wheat, rye, and triticale.

Soil Description

Soil surface horizons range from Pratt, Carwile, and Naron loamy fine sands to Farnum, Naron, and Tabler fine sandy loams. Subsoils are much more varied, ranging from loamy fine sand to clay. These soils are productive under dryland conditions with intensive management and favorable precipitation patterns. Conservation tillage practices are essential for the long-term production and profitability of dryland summer row crops. Under irrigation, these soils are extremely productive, and high quality corn, soybean, and alfalfa are important cash crops.

2001 Weather Information

The growing season was characterized by extremely hot conditions from mid-June through September. Growing season length exceeded the long-term average of 185 days by 8 days. Precipitation was right on the long-term average of 26.2 in. (Table 1). Rainfall from March through September was 107% of normal, although the distribution was skewed (Figure 1). Without an extremely wet period during mid-July, rainfall for July and August was only 1.1 in. (Figure 2). Wheat yields in 2001 were average overall, with many fields negatively affected by severe weather that produced high winds and hail. The mid-July moisture did save much of the grain sorghum crop and resulted in average yields. The moisture was too late to help much of the dryland corn and overall dryland corn yields were well below average. Lack of moisture from September through December (56% of the long-term average), combined with warm conditions, resulted in extremely variable wheat emergence and poor early growth.

Table 1. Precipitation at the Sandyland Experiment Field, St. John, 20-year average, 2000, 2001.

Month	20-Year Average	2000	20001
	- - - - - - - -	in.	- - - - - - - -
January	0.8	1.3	2.7
February	1.0	2.5	2.3
March	2.4	7.7	1.7
April	2.4	0.6	1.5
May	3.9	4.1	6.7
June	3.9	3.6	2.7
July	3.2	5.2	4.6
August	2.4	0.05	1.1
September	2.2	0.8	3.4
October	2.0	4.6	0.0
November	1.0	0.5	0.0
December	0.95	0.6	0.05
Annual Total	26.2	31.3	26.7

DRYLAND NO-TILL CROP ROTATIONS ON SANDY SOILS

V.L. Martin, K.A. McVay, and D.L. Fjell

Introduction

There is increased interest in no-till cropping systems in South-central Kansas, particularly under dryland conditions. The major benefits of no-till adoption include saving soil moisture, decreasing moisture loss from evaporation, decreasing soil erosion, and increasing soil organic matter. However, continuous cropping systems such as continuous wheat or other cropping systems consisting only of grass crops are often unsuccessful because of residue management, disease pressure, insect pressure, and weed pressure and other problems.

If no-tillage can be successfully adopted on the sandy soils of SC Kansas, there are many potential benefits to area producers, including increased crop yields, better time management, and decreased inputs of fertilizer and pesticides. The objective of this study is to determine the agronomic and economic feasibility of long-term no-tillage crop production by evaluating the practicality of three and four-year crop rotations that include a broadleaf crop. An additional objective is to determine best management practices for these rotations.

Procedures

The study was initiated in 2000. All crops will be planted without tillage. Rotational crops are Cotton (Ct), Corn (C), wheat (W), grain sorghum (GS), soybean (S) and sunflower (Sf).

The rotations are:

(1) Ct - C - W
(2) GS - S - W
(3) GS - Sf - W
(4) C - S - W
(5) GS - C - S - W

Fertility will be maintained with the following yield goals:

Cotton - 1.5 bales/a
Corn - 120 bu/a
Wheat - 50 bu/a
Grain sorghum - 100 bu/a
Soybean - 25 bushels/a
Sunflower - 1500 lbs/a.

Rotations were started at all points in the rotation resulting in a total of 16 plots per replication with three replications. Each plot is 30 X 180 ft with a 5-ft border between each plot.

Results

Weed control was the major problem in 2001 and resulted in very poor yields. The lack of adequate weed control was primarily due to excessive rains in May resulting in herbicide movement below the germination zone. Also, poor conditions for cotton growth and emergence allowed weeds to outcompete the cotton. Average yields were: Cotton - 0.5 bales/a, Corn - 40 bu/a, Wheat - 30 bu/a, Grain Sorghum - 41 bu/a, Soybean - 9 bu/a, and Sunflower - 240 lbs/a. Wheat yields were negatively impacted by two hail storms, late planting, and a lack of tillering. Sunflower yield was impacted by head moth, stem borer, crabgrass pressure, and a lack of moisture. Corn and grain sorghum yields were severely impacted by heat and moisture stress, as well as crabgrass pressure.

CROP PERFORMANCE TESTING AND NEW PROJECTS

V.L. Martin

During the 2001 cropping season, performance tests were conducted on dryland wheat corn, cotton, and grain sorghum, as well as irrigated wheat, soybean, grain sorghum, cotton, and full and short season corn hybrids. Information from statewide crop performance tests are summarized in the respective crop performance test publications, which are available at local county extension offices or online at http://www.ksu.edu./kscpt.

In 1999, a cotton research program was established to evaluate the long-term feasibility of cotton production in the Great Bend Prairie. After the 2001 cropping season, the program was discontinued due to lack of interest in the area and lack of irrigated acreage. Sunflower production research is replacing the cotton research and will include examination of cultural practices and insect control.

The sorghum breeding program implemented a breeding site at Sandyland to assist the program in developing grain sorghum hybrids better adapted to the extreme heat and drought stress typical of the region. This project is scheduled to continue into the foreseeable future.

During the fall of 1999, in conjunction with animal science, a long-term, on- and off-site study was initiated to evaluate the forage production potential of different varieties of wheat, rye, Triticale, and blends of the aforementioned crops. In addition, a grazing study using cattle was begun with the goal of determining weight gain under different fall-seeded small grains. This project is continuing and is being expanded to include summer forage production, novel forages, and intensive study of forage potential of winter cereal pasture.

In 2000, the Sandyland Field had to close its irrigated quarter as K-State lost the lease. During 2001, Kansas State University obtained a supplemental water right to conduct subsurface drip irrigation (SDI) studies on the present leased quarter. A well was installed during the fall of 2001 and development of the site (installing laterals, driplines, and controls) will continue during the spring of 2002. Initial work includes evaluation of dripline spacing, rates of irrigation, suitability of traditional crops for SDI, and longevity of the SDI system in the area.

SOUTH CENTRAL KANSAS EXPERIMENT FIELD

Hutchinson and Sumner County

Hutchinson Location

Introduction

The South Central Kansas Experiment Field was established in 1951 on the US Coast Guard Radio Receiving Station located southwest of Hutchinson. The first research data were collected with the harvest of 1952. Prior to this, data for south-central Kansas were collected at three locations (Kingman, Wichita, and Hutchinson). The current South Central Field location is approximately 3/4 miles south and east of the old Hutchinson location on the Walter Pierce farm.

Research at the South Central Kansas Experiment Field is designed to help area agriculture develop to its full potential using sound environmental practices. The principal objective is achieved through investigations of fertilizer use, weed and insect control, tillage methods, seeding techniques, cover crop and crop rotation, variety improvement, and selection of hybrids and varieties adapted to the area. Experiments deal with problems related to production of wheat, grain and forage sorghum, oat, alfalfa, corn, soybean, rapeseed/canola, and sunflower, s well as soil tilth. Breeder and foundation seed of wheat and oat varieties are produced to improve seed stocks available to farmers. A large portion of the research program at the field is dedicated to wheat breeding and germplasm development.

Soil Description

The soil survey for the South Central Field has approximately 120 acres classified as nearly level to gently sloping Clark/Ost loams with calcareous subsoils. This soil requires adequate inputs of phosphate and nitrogen fertilizers for maximum crop production. The Clark soils are well drained and have good water-holding capacity. They are more calcareous at the surface and less clayey in the subsurface than the Ost. The Ost soils are shallower than the Clark, having an average surface layer of only 9 in. Both soils are excellent for wheat and grain sorghum production. Large areas of these soils are found in southwest and southeast Reno County and in western Kingman County. The Clark soils are associated with the Ladysmith and Kaski soils common in Harvey County but are less clayey and contain more calcium carbonate. Approximately 30 acres of Ost Natrustolls Complex, with associated alkali slick spots, occur on the north edge of the Field. This soil requires special management and timely tillage, because it puddles when wet and forms a hard crust when dry. A 10-acre depression on the south edge of the Field is a Tabler-Natrustolls Complex (Tabler slick spot complex). This area is unsuited for cultivated crop production and has been seeded to switchgrass. Small pockets of the Tabler-Natrustolls are found throughout the Field.

1999-2001 Weather Information

Precipitation in 1999 totaled 30.7 in., 0.87 in. above the 30-year average of 29.83 in. In 2000 the Field rain gauge measured 33.4 in. of precipitation, 3.4 in. above the 30-year (most recent) average of 30.0 in. The year 2001 proved to be quite different from the previous five years in that total precipitation was below normal. The first two months of the year were as much as 1.81 in. above normal in February. However, the only other month that had above normal rainfall was September

(0.05 in.). Thus, precipitation for the year totaled only 22.96 in., 7.01 in. below the 30-year average. Even with the below normal precipitation, rainfall was recorded in every month of the year (Table 1). The lack of moisture that started in March continued into mid-September. However, even though totals were below normal, timely rains in April, May and early June allowed the wheat to develop and fill grain under nearly ideal conditions. Wheat yields for 2001 were slightly above normal, as the crop was harvested before the heat of late June and July. This heat adversely affected the summer annuals, as will be discussed later. The mid-September rainfall (2.74 in.) along with the 1.10 in. received on October 4 allowed for planting of wheat for the 2002 harvest year in soils with good surface moisture. With limited rainfall in November and December, the wheat went into the winter under moisture stress. Winter temperatures were above normal, which allowed the wheat to continue to grow and use the limited soil moisture. The 2002 year has started out dry as well.

The summer annuals (grain sorghum, sunflower, and soybean) benefitted from the late spring rains. However, they were not ready for July, which recorded 18 days of temperatures above 100° F. These temperatures caused poor head extension in grain sorghum, poor pod set and shriveled seed in soybean, and poor head development in sunflowers. A frost-free growing season of 182 days (April 17 - October 16, 2001) was recorded. This is 1 day less than the average frost-free season of 183 days (April 19 - October 17).

Table 1. Precipitation at South Central Kansas Experiment Field, Hutchinson 10 SW 143930.

Month	Rainfall (in.)	30-yr Avg* (in.)	Month	Rainfall (in.)	30-yr Avg (in.)
2000			April	1.81	2.83
September	0.60	3.18	May	4.05	4.15
October	6.92	2.38	June	3.40	3.98
November	1.00	1.51	July	1.25	3.61
December	0.35	1.00	August	1.25	2.98
2001			September	3.06	3.01
January	1.33	0.68	October	1.15	2.43
February	2.89	1.08	November	0.11	1.54
March	2.50	2.69	December	0.16	1.00
			2001 Total	22.96	29.98

* Most recent 30 years.

CROPS PERFORMANCE TESTS AT THE SOUTH CENTRAL FIELD

W.F. Heer and K.L. Roozeboom

Introduction

Performance tests for winter wheat, grain sorghum, alfalfa, canola, and sunflower were conducted at the South Central Kansas Experiment Field. Results of these tests can be found in the following publications, which are available at the local county extension office or online at http;//www.ksu.edu/kscpt.

2001 Kansas Performance Tests with Winter Wheat Varieties. KAES Report of Progress 879.
2001 National Winter Variety Trial. Department of Agronomy Report.
2001 Kansas Performance Tests with Grain Sorghum Hybrids. KAES Report of Progress 883.
2001 Kansas Performance Tests with Sunflower Hybrids. KAES Report of Progress 888.
2001 Kansas Performance Tests with Alfalfa Varieties. KAES Report of Progress 887.

EFFECTS OF NITROGEN RATE AND PREVIOUS CROP ON GRAIN YIELD IN CONTINUOUS WHEAT AND ALTERNATIVE CROP ROTATIONS IN SOUTH CENTRAL KANSAS

W.F. Heer

Summary

The predominant cropping systems in south-central Kansas have been continuous wheat and wheat-grain sorghum-fallow. With continuous wheat, tillage is preformed to control diseases and weeds. In the wheat-sorghum-fallow system, only two crops are produced every three years. Other crops (corn, soybean, sunflower, winter cover crops and canola) can be placed in the above cropping systems. Winter wheat was planted in rotations following these crops and yields were compared to continuous winter wheat under conventional (CT) and no-till (NT) practices. Initially, the CT continuous wheat yields were greater than those from the other systems. However, over time, wheat yields following soybean have increased, reflecting the effects of reduced weed and disease pressure and increased soil nitrogen. However, continuous CT winter wheat outyielded NT winter wheat regardless of the previous crop.

Introduction

In south-central Kansas, continuous hard red winter wheat and winter wheat - grain sorghum - fallow are the predominate cropping systems. The summer-fallow period following sorghum is required because the sorghum crop is harvested in late fall, after the optimum planting date for wheat in this region. Average annual rainfall is only 29 in./yr, with 60 to 70% occurring between March and July. Therefore, soil moisture is often insufficient for optimum wheat growth in the fall. No-tillage (NT) systems can increase soil moisture by increasing infiltration and decreasing evaporation. However, higher grain yields associated with increased soil water in NT have not always been observed. Cropping systems with winter wheat following one of several alternative crops would provide improved weed control through additional herbicide options and reduce disease incidence by interrupting disease cycles, as well as allowing producers several options under the 1995 Farm Bill. However, fertilizer nitrogen (N) requirement for many crops is often greater under NT than CT. Increased immobilization and denitrification of inorganic soil N and decreased mineralization of organic soil N have been related to the increased N requirements under NT. Therefore, evaluation of N rates on hard red winter wheat in continuous wheat and in cropping systems involving "alternative" crops for the area have been evaluated at the South Central Field. The continuous winter wheat study was established in 1979, and restructured to include a tillage factor in 1987. The first of the alternative cropping systems where wheat follows short season corn was established in 1986 and modified in 1996 to a wheat-cover crop-grain sorghum rotation. The second, established in 1990, has winter wheat following soybean. Both cropping systems use NT seeding into the previous crop's residue. All three systems have the same N rate treatments.

Procedures

The research was conducted at the KSU South Central Experiment Field, Hutchinson. Soil was an Ost loam. The sites had been in wheat previous to starting the cropping systems. The research was replicated five times using a randomized block design with a split-plot arrangement. The main plot was crop and the subplot six N levels (0, 25, 50, 75, 100, and 125 lbs/a). Nitrogen treatments were broadcast applied as NH_4NO_3 prior to planting. Phosphate was applied in the row at planting. All crops were produced each year of the study. Crops are planted at the normal time for the area. Plots are harvested at maturity, and - grain yield, moisture, and test weight are determined.

Continuous Wheat

These plots were established in 1979. The conventional tillage treatments are plowed immediately after harvest then worked with a disk as necessary to control weed growth. The fertilizer rates are applied with a Barber metered screw spreader prior to the last tillage (field cultivation) on the CT and seeding of the NT plots. The plots are cross seeded in mid-October to winter wheat. As a result of an infestation of cheat in the 1993 crop, the plots were planted to oats in the spring of 1994. The fertility rates were maintained, and the oats were harvested in July. Winter wheat has been planted in mid-October each year in the plots since the fall of 1994. New herbicides have aided in the control of cheat in the no-till treatments.

Wheat after Corn/Grain Sorghum Fallow

In this cropping system, winter wheat was planted after a short-season corn had been harvested in late August to early September . This early harvest of short-season corn allows the soil profile water to be recharged by normal late summer and early fall rains prior to planting of winter wheat in mid-October. Fertilizer rates are applied with the Barber metered screw spreader in the same manner as for the continuous wheat. In 1996, the corn crop in this rotation was dropped and three legumes (winter pea, hairy vetch, and yellow sweet clover) were added as winter cover crops. Thus, the rotation became a wheat-cover crop-grain sorghum-fallow rotation. The cover crops replaced the 25, 75, and 125 N treatments in the grain sorghum portion of the rotation. Yield data can be found in Field Research 2000, KSU Report of Progress 854.

Wheat after Soybean

Winter wheat is planted after soybean has been harvested in early to mid-September in this cropping system. As with the continuous wheat plots, these plots are planted to winter wheat in mid- October. Fertilizer rates are applied with the Barber metered screw spreader in the same manner as for continuous wheat. Since 1999, a group III soybean has been used. This delayed harvest to October 5, 1999, effectively eliminating the potential recharge time as the wheat was planted October 12, 1999. The wet fall of 2000 allowed for good wheat growth that year.

Wheat after Grain Sorghum in a Cover Crop/Fallow - Grain Sorghum - Wheat

Winter wheat is planted into grain sorghum stubble left from the previous fall harvest. Thus, the soil profile water has had 11 months to be recharged prior to planting of winter wheat in mid- October. Nitrogen fertilizer is applied at a uniform rate of 75 lbs/a with the Barber metered screw spreader in the same manner as for continuous wheat.

Winter wheat is also planted after canola and sunflower to evaluate the effects of these two crops on the yield of winter wheat. Uniform nitrogen fertility is used, therefore, the data is not presented.

Results

Continuous Wheat

Continuous winter wheat grain yield data from the plots are summarized by tillage and N rate in Table 2. Data for years prior to 1996 can be found in Field Research 2000, KSU Report of Progress 854. Conditions in 1996 and 1997 proved to be excellent for winter wheat production in spite of the dry fall of 1995 and the late spring freezes in both years. Excellent moisture and temperatures during the grain filling period resulted in decreased grain yield differences between the conventional and no-till treatments within N rates. Conditions in the springs of 1998 and 1999 were excellent for grain filling in wheat. However, the differences in yield between conventional and no-till wheat still expressed themselves (Table 2). In 2000 the differences were wider up to the 100 lb/a N rate. At that point yield differences were similar to those of previous years. The wet winter and late spring of the 2001 harvest year allowed for excellent tillering and grain fill. However, the excess dry matter produced in the 100 and 125 lb/a N rates resulted in decreased grain yields for those treatments.

Wheat after Soybean

Wheat yields after soybean also reflect the differences in N-rate. The effects of residual N from soybean production in the previous year can be seen when comparing wheat yields from this cropping system with those in which wheat followed corn. This is especially true for the 0 to 75 lb N rates in 1993 and the 0 to 125 lb rate in 1994 (Table 3). Yields in 1995 reflect the added N from the previous soybean crop with yield by N-rate increases similar to those of 1994. The 1996 yields with spring wheat reflect a lack of response to nitrogen fertilizer. Yields for 1997 and 1998 both level off after the first four increments of N. As with wheat in the other rotations in 1999, the ideal moisture and temperature conditions allowed wheat yields after soybean to express the differences in N rate up to the 100 lb N/a rate. In the past, those differences stopped at the 75 lb N/a treatment. When compared to yields in the continuous wheat, the rotational wheat is starting to reflect the presence of the third crop (grain sorghum) in the rotation. Wheat yields were lower in 2000 than in 1999. This is attributed to the lack of moisture in April and May and the hot days at the end of May. This heat caused the plants to mature early and also caused low test weights. As the rotation continues to cycle, the differences at each N-rate will probably stabilize after four to five cycles, with a potential to reduce fertilizer N applications by 25 to 50 lbs/a where wheat follows soybean.

Wheat after Grain Sorghum/Cover Crop

The first year that wheat was harvested after a cover crop, grain sorghum planting was 1997. Data for the 1997-2000 wheat yields are in Table 4. Over these four years there does not appear to be a definite effect of the cover crop (CC) on yield. This is most likely due to the variance in CC growth within a given year. In years like 1998 and 1999, where sufficient moisture and warm winter temperatures produced good CC growth, the additional N from the CC appears to carry through to the wheat yields.

Other Observations

Nitrogen application significantly increased grain N contents in all crops. Grain phosphate levels were not affected by increased N rate.

Loss of the wheat crop after corn can occur in years when fall and winter moisture is limited. This loss has not occurred in continuous winter wheat regardless of tillage or in the wheat after soybean. Corn has the potential to produce grain in favorable years (cool and moist) and silage in nonfavorable years (hot and dry). In extremely dry summers, extremely low grain sorghum yields can occur. The major weed control problem in the wheat after corn system is with the grasses. This was expected, and work is being done to determine the best herbicides and application timing to control grasses.

Soybean and Grain Sorghum in Rotations

Soybean was added to intensify the cropping system in south-central Kansas. It also has the ability, being a legume, to add nitrogen to the soil system. For this reason, the nitrogen rates are not applied during the time when soybean is planted in the plots for the rotation. This gives the following crops the opportunity to utilize the added N and to check the yields against the yields for the crop in other production systems. Yield data for soybean following grain sorghum in the rotation are given in Table 5. Soybean yields are affected more by the weather for a given year than by the previous crop. In three out of the five years there was no effect of the N rates applied to the wheat and grain sorghum crops in the rotation. In the two years that N application rate did affect yield, it was only at the lower N rates. Yield data for the grain sorghum after wheat in the soybean-wheat-grain sorghum rotation are in Table 6. As with the soybean, weather is the main factor affecting yield. The addition of a cash crop (soybean), which intensifies the rotation, will reduce grain sorghum yield in the rotation - soybean-wheat-grain sorghum vs wheat-cover crop-grain sorghum. More uniform yields are obtained in the soybean-wheat-grain sorghum rotation (Table 6) than in the wheat-cover crop-grain sorghum rotation (Table 7).

These rotations are being continued, along with a wheat-cover crop (winter pea)-grain sorghum rotation with various N rates (data presented in Report of Progress 854, 2000), a date of planting and date of termination cover crop rotation study with small grains (oat)-grain sorghum, and the grazing study being conducted with Jim and Lisa French.

Table 2. Wheat yields by tillage and nitrogen rate in a continuous wheat cropping system, Hutchinson.

	Yield bu/a											
	Year											
	1996		1997		1998		1999		2000		2001	
N Rate[1]	CT[2]	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT
0	46	23	47	27	52	19	49	36	34	15	50	11
25	49	27	56	45	61	37	67	51	46	28	53	26
50	49	29	53	49	61	46	76	61	52	28	54	35
75	49	29	50	46	64	53	69	64	50	34	58	36
100	46	28	51	44	55	52	66	61	35	33	54	34
125	45	25	48	42	56	50	64	58	31	32	56	36
LSD* (0.01)	NS	NS	8	8	5	5	13	13	14	14	10	10

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.
[1] Nitrogen rate in lb/a.
[2] CT conventional NT no-tillage.

Table 3. Wheat yields after soybean in a soybean-wheat-grain sorghum rotation with nitrogen rates, Hutchinson.

	Yield										
N-Rate	1991	1992	1993	1994	1995	1996[1]	1997	1998	1999	2000	2001
lb/a	bu/a										
0	51	31	24	23	19	35	13	21	31	26	12
25	55	36	34	37	26	36	29	34	46	37	16
50	55	37	41	47	34	36	40	46	59	46	17
75	52	37	46	49	37	36	44	54	66	54	17
100	51	35	45	50	39	36	45	55	69	55	20
125	54	36	46	52	37	36	47	57	68	50	21
$LSD_{(0.01)}$	NS	4	6	2	1	1	4	3	7	5	7
$CV_{(\%)}$	7	6	9	5	7	2	9	4	5	7	23

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.
[1] Spring wheat yields.

Table 4. Wheat yields after grain sorghum in a wheat-cover crop-grain sorghum rotation with nitrogen rates, Hutchinson.

	Yield				
N Rate	1997	1998	1999	2000	2001
lb/a	- - - - - - - - - - - - - - - - - - bu/a - - - - - - - - - - - - - - - - - -				
0	17	25	26	4	45
HV[1]	43	50	39	16	45
50	59	52	50	21	41
WP[1]	43	51	66	21	41
100	52	56	69	26	39
SC[1]	53	54	70	22	42
$LSD_{(0.01)}$	21*	12	5	5	5
$CV_{(\%)}$	26	14	6	16	6

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.
[1] HV hairy vetch, WP winter pea, SC sweet clover.

Table 5. Soybean yields after grain sorghum in soybean-wheat-grain sorghum rotation with nitrogen rates, Hutchinson.

	Yield					
N Rate[1]	1996	1997	1998	1999	2000	2001
lb/a	- - - - - - - - - - - - - - - - - - bu/a - - - - - - - - - - - - - - - - - -					
0	16	26	22	33	25	7
25	17	29	23	35	21	8
50	18	30	23	36	23	9
75	20	29	24	36	24	8
100	22	31	25	37	21	9
125	20	25	24	34	22	8
$LSD_{(0.01)}$	3	7	NS	NS	NS	NS
CV $_{(\%)}$	10	12	6	12	15	13

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.

[1] N rates are not applied to the soybean plots in the rotation.

Table 6. Grain sorghum yields after cover crop in cover crop-grain sorghum-wheat rotation with nitrogen rates, Hutchinson.

	Yield					
N Rate	1996	1997	1998	1999	2000	2001
lb/a	- - - - - - - - - - - - - - - - - - bu/a - - - - - - - - - - - - - - - - - -					
0	73	26	69	81	68	17
HV[1]	99	36	70	106	54	17
50	111	52	73	109	66	13
WP[1]	93	35	72	95	51	19
100	109	54	67	103	45	12
SC[1]	94	21	72	92	51	19
$LSD_{(0.01)}$	13	14	NS	21	16	6
CV $_{(\%)}$	8	22	13	12	16	21

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.

[1] HV hairy vetch, WP winter pea, SC sweet clover.

Table 7. Grain sorghum yields after wheat in a soybean-wheat-grain sorghum rotation with nitrogen rates, Hutchinson.

	Yield					
N Rate	1996	1997	1998	1999	2000	2001
lb/a	- - - - - - - - - - - - - - - - - - bu/a - - - - - - - - - - - - - - - - - -					
0	32	13	57	52	55	15
HV[1]	76	29	63	67	56	15
50	93	40	61	82	54	13
WP[1]	107	41	60	84	49	9
100	106	65	55	77	50	7
SC[1]	101	54	55	82	49	7
$LSD_{(0.01)}$	8	13	NS	13	NS	NS
CV $_{(\%)}$	5	18	10	9	10	58

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.

[1] HV hairy vetch, WP winter pea, SC sweet clover.

EFFECTS OF TERMINATION DATE OF AUSTRIAN WINTER PEA WINTER COVER CROP AND NITROGEN RATES ON GRAIN SORGHUM AND WHEAT YIELDS

W.F. Heer and R.R. Janke

Summary

Effects of the cover crop most likely were not expressed in the first year (1996) grain sorghum harvest (Table 8). Limited growth of the cover crop (winter pea) due to weather conditions produced limited amounts of organic nitrogen. Therefore, the effects of the cover crop when compared to fertilizer N were limited and varied. The wheat crop for 1998 was harvested in June. The winter pea plots were then planted and terminated the following spring, prior to the planting of the 1999 grain sorghum plots. The N rate treatments were applied and the grain sorghum planted on June 11, 1999. Winter wheat was again planted on the plots in October of 2000 and harvested in June of 2001. Yield data for the grain sorghum and winter wheat is presented in Table 8.

Introduction

There has been renewed interest in the use of winter cover crops as a means of soil and water conservation, a substitute for commercial fertilizer, and the maintenance of soil quality. One winter cover crop that may be a good candidate is winter pea. Winter pea is established in the fall, over-winters, then after producing sufficient spring foliage is returned to the soil prior to planting of a summer annual. As a legume, there is potential for winter pea to add nitrogen to the soil system. With this in mind, research projects were established at the South Central Experiment Field to evaluate the effect of winter pea and its ability to supply N to the succeeding grain sorghum crop when compared to commercial fertilizer N in a winter wheat-winter pea-grain sorghum rotation.

Procedures

The research is being conducted at the KSU South Central Experiment Field, Hutchinson. Soil in the experimental area is an Ost loam. The site had been in wheat prior to starting the cover crop cropping system. Study design is a randomized block with four replications. Cover crop treatments consisted of fall planted winter pea with projected termination dates in April and May, and no cover crop (fallow). Winter pea is planted into wheat stubble in early September at a rate of 35 lb/a in 10-in. rows with a double disk opener grain drill. Prior to termination of the cover crop, above ground biomass samples are taken from a 1-m^2 area. These samples are used to determine forage yield (winter pea and other), and forage nitrogen and phosphate content for the winter pea portion. Fertilizer treatments consist of four fertilizer N levels (0, 30, 60, and 90 lb N/a). Nitrogen treatments are broadcast applied as NH_4NO_3 (34-0-0) prior to planting of grain sorghum. Phosphate is applied at a rate of 40 lbs P_2O_5 in the row at planting. Grain sorghum plots are harvested to determine grain yield, moisture, and test weight, and grain nitrogen and phosphate content. The sorghum plots are fallowed until the plot area is planted to wheat in the fall of the following year. The fertilizer treatments are also applied prior to planting of wheat.

Results

<u>Winter Pea/Grain Sorghum</u>

Winter pea cover crop and grain sorghum results were summarized in the Field Research 2000 Report of Progress 854, pages 139-142. The grain sorghum yields were similar to the wheat yields in the long-term N rate study. The first increment of N resulted in the greatest change in yield and the yields tended to peak at the 60 lb/a N rate treatment regardless of the presence or lack of winter pea.

Winter Wheat

The fall of 2000 was wet, following a very hot, dry August and September. Thus, the planting of wheat was delayed until November 24, 2000. With the wet fall, the temperatures were also warm allowing the wheat to tiller into late December. January and February both had above normal precipitation, which carried the wheat through a dry March. April, May and June were slightly below normal in both precipitation and temperature. The wheat plots were harvested on June 29, 2001. Wheat yields reflect the presence of the winter pea treatments, as well as the reduced yields in the grain sorghum for the no-pea treatment plots. Test weight of the grain was not affected by pea or fertilizer treatment, but was influenced by the rainfall at harvest time. This is also true for the percent nitrogen in the seed at harvest. A concern with the rotation is weed pressure. The April termination pea plus 90 lbs/a N treatment had significantly more weeds than any of the other treatments. Except for this treatment, there were no differences noted for weed pressure. Grain yield data are presented in Table 8.

As this rotation continues and the soil system adjusts, it will reveal the true effects of the winter cover crop in the rotation. It is important to remember that in the dry (normal) years the soil water (precipitation) during the growing season most likely will not be as favorable as it was in 1999, and the water use by the cover crop will be the main influence on the yield of the succeeding crop.

Table 8. Winter pea cover crop and termination date effects on winter wheat after grain sorghum in a winter wheat-winter pea cover crop-grain sorghum rotation, KSU South Central Field, Hutchinson KS, 2001.

Termination		Grain			Plant	
Date	N Rate[1]	Yield	N	P	Height	Weeds
	lb/a	bu/a	%		in.	rating[2]
April[3] N/pea	0	37	2.32	0.38	26	3
	30	40	2.43	0.36	28	5
	60	39	2.30	0.38	30	4
	90	37	2.24	0.38	30	7
April[3] /pea	0	39	2.38	0.35	26	3
	30	42	2.33	0.37	27	4
	60	36	2.22	0.40	29	7
	90	37	2.18	0.37	28	10
May[4] N/pea	0	38	2.30	0.37	26	3
	30	38	2.32	0.37	26	5
	60	34	2.42	0.35	30	7
	90	38	2.24	0.35	30	8
May[4] /pea	0	42	2.37	0.40	26	4
	30	37	2.38	0.38	28	6
	60	35	2.38	0.37	29	9
	90	37	2.34	0.38	28	10
LSD (P=0.05)		5	0.18	0.03	2	3

[1] Nitrogen applied as 34-0-0 prior to planting winter wheat.
[2] Visual rating on a scale of 1= few to 10=most
[3] Early April termination.
[4] Early May termination.

SOUTH CENTRAL KANSAS EXPERIMENT FIELD

Hutchinson and Sumner County

Sumner County Locations

Introduction

Kansas State University Department of Agronomy has been doing research in the south central region of Kansas for several years. In 1999 the Department started using the Wellington Area Test Farm as a research site. This is a 50-acre block owned by the First National Bank of Wellington. At the same time, the Department started placing research plots on farmer-owned land south of Argonia. The soils at the Wellington location are Bethany silt loam (Bb). These soils have a 1 to 3 percent slope, and well drained, but slowly permeable soils that are formed on old alluvium and loess. Other Bethany silt loam (Ba) soils are similar to the Bb soil, but have slopes in the 0 to 1 percent range. The other soil at the Wellington site is a Tabler silty clay loam (Ta), 0 to 1 percent slope. These soils are moderately well drained, but very slowly permeable. These factors make them less than ideal for research. The soils at the Argonia locations are primarily Bethany silt loams.

Research at these locations consist of variety tests with corn, grain sorghum, soybean, and cotton. Other research includes soybean date of planting by maturity group, grain sorghum planting rate, and cotton herbicide and date of planting studies. The wheat breeding program has been installing various wheat plots in this area of the state on farmer-owned land but these results are not reported here.

VARIETY PERFORMANCE TEST

W.F. Heer and S.R. Duncan

Summary

The results for the soybean variety tests conducted at the Argonia location in 2000 and 2001 can be found in the 2001 Kansas Performance Test with Soybean Varieties Report of Progress 886. Available online at http://www.ksu.edu/kscpt, or at local county extension office. The results for the supplemental corn test at Argonia and the sunflower test at Wellington are in Tables 9 and 10 of this report. Yields for both tests were affected by the extremely high temperatures of July. The sunflower test was also affected by lack of moisture. The Wellington location receive 0.27 in. of rain in July, whereas the Argonia location received approximately 5.25 in. The corn was silking during the heat and did not have good ear set. Stand reductions were a result of the heavy rainfall shortly after planting.

Table 9. Supplementary corn variety performance test - Sumner County, Argonia KS, 2001.

		Yield	Percent	Test Wt	Moist	Half Silk	Lodging	Stand
Brand	Name	bu/a	of Ave.	lb/bu	%	Days[1]	%	%
Asgrow	RX740	11.9	94.3	54.5	9.8	62	6	83
Croplan Gen	818	14.6	115.7	50.7	11.6	62	10	79
DeKalb	DKC57-38	10.5	83.3	51.3	10.1	60	9	83
Midland	786	6.3	49.7	50.9	17.4	64	26	86
Midland	798	11.4	90.8	51.1	10.4	68	34	85
Midwest Seed	G7950	10.7	84.7	53.1	10.3	63	10	94
Mycogen	2784	19.4	154.1	51.9	9.8	63	1	89
NK	N 67-T4	15.2	120.6	53.2	9.6	60	6	95
Pioneer	34B97	11.7	92.5	50.7	9.4	64	5	69
Mat Chk	S C4111	13.6	108.2	50.5	9.8	60	7	87
Mat Chk	M H2530	14.6	115.8	51.8	9.5	63	8	75
Mat Chk	F P3162	11.5	90.9	53.4	10.2	58	3	78
LSD* (0.05)		6.0		1.5	6.4	1.8	16	21

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.

[1] Days after planting.

Table 10. Sunflowers, KSU Wellington Area Test Farm, Sumner County, 2001.

Brand	Name	Plant Height	Lodging	Yield	Dropped Heads
		in.	%	lb/a	#
Dekalb	DK 3900	39.25	3.50	82.50	1.00
Dekalb	DKF 31-01 NS	32.50	1.75	34.75	1.25
Dekalb	DKF 36-40 NS	36.50	0.00	51.75	13.00
Kaystar	9404	41.50	18.25	85.00	10.25
Kaystar	9501	38.75	0.50	71.25	23.00
Monsanto	Ex 3804 NS	37.75	2.75	48.25	3.25
Pioneer Hi-Bred Int. Inc	63A70	38.25	7.50	67.25	7.50
Pioneer Hi-Bred Int. Inc	63M80	37.00	0.50	71.75	2.25
Pioneer Hi-Bred Int. Inc	63M91	42.25	16.00	65.25	6.25
Triumph Seed Co. Inc.	658	39.00	8.00	59.25	2.25
Triumph Seed Co. Inc.	665	38.00	6.25	79.75	4.75
LSD* (0.05)		6.02	15.38	20.83	18.28

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.

SOYBEAN DATE OF PLANTING BY MATURITY GROUP

W.F. Heer and S.R. Duncan

Summary

Four soybean varieties each from a different maturity group (MG) were planted at four dates in both Sumner County and at the South Central Field, Hutchinson. Averaged over groups the yields were highest for MG II and III varieties for the late April and early May planting date in 1999 and 2000. Due to the extreme temperatures of July 2001, the late June and July planting date had higher yields than the early plantings.

Introduction

The planting window for soybean in the south-central region of Kansas is quite wide and the large selection of varieties in various maturity groups can increase that window. If growing conditions are favorable, early planting of a early maturing (MG II) bean can produce yields that exceed those of late planted beans regardless of their maturity group. Thus, selection of maturity group by planting date can allow the farmer considerable flexibility in their schedule for spring planting of various crops. Several factors influence the selection of maturity group and variety. These factors include soil type and moisture, potential rainfall and the possibility of a killing freeze in the fall before the crop is mature.

Procedures

The experiments were conducted at the South Central Field, Hutchinson in all three years (1999-2001). In Sumner county they were conducted on the Wellington Area Test Farm in 1999 and on land belonging to Jeff Tracy in 2000, and in 2001 on land belonging to Mark Tracy, both located south of Argonia. Varieties planted were Midland 8280 (MG II), Macon (MG III), Midland 8410 (MG IV), and Pioneer (MG V). A seeding rate of 160,000 plants/a in 30- in. rows was used. Planting dates for year by location are given in Table 11. At seeding plots received 16 lb/a N and 40 lb/a P_2O_5 in a 2 by 2 placement. At maturity the center two (30 ft x 5 ft) were harvested for yield assessment. All treatments were replicated four times at all locations.

Results

Yield data by year, location, maturity group, and planting date are given in Table 11. In 1999 and 2000 the early planted MG II beans had higher yields than the other maturity groups. At later planting dates (June and July) the later maturity groups started to narrow the yield gap between the early and late groups. At Argonia in 2000, the June 8 and July 5 beans did not mature before fall rains set in and continued until such time that the beans for these two planting dates were frozen and shattered to the point that a meaningful harvest was unattainable. The July 6, 2001 planting at Hutchinson did not survive the extreme heat and dry weather of July. This same heat hit the Argonia location, but that location received approximately 5.25 in. of rainfall during the same period. At the Argonia location the rainfall and heat caused a reversal of the yields observed the previous years. In 2001 at Argonia, the late planted beans had higher yields as did the late maturity groups (Table 11).

Table 11. Soybean yields by date of planting and maturity group, Reno County (KSU SCEF, Hutchinson) and Sumner County (Wellington 1999, Argonia 2000-01).

1999									
Hutchinson					Wellington				
	Yield bu/a					Yield bu/a			
DOP[1]	II[2]	III	IV	V	DOP	II	III	IV	V
May 4	41	39	33	22	May 7	19	20	21	8
May 26	22	12	18	11	June 7	19	19	19	17
July 6	21	23	24	15	July 7	17	18	17	15
July 6	22	25	25	16	July 7	18	19	18	16
LSD* (0.05)	6	6	6	6		4	4	4	4
2000									
April 25	35	44	35	12	April 29	26	26	24	8
May 16	33	30	26	7	May 17	25	21	20	5
June 6	14	8	10	4	June 8	---	---	---	---
June 19	7	6	8	3	July 5	---	---	---	---
LSD (0.05)	5	5	5	5		NS	NS	NS	NS
2001									
April 20	4	3	4	5	April 23	8	6	7	7
May 9	2	1	2	2	May 11	6	7	8	9
June 11	2	4	3	4	June 13	7	7	7	10
July 6	---	---	---	---	July 5	11	15	22	22
LSD (0.05)	NS	NS	NS	NS		3	3	3	3

* Unless two yields in the same column differ by at least the least significant difference (LSD), little confidence can be placed in one being greater than the other.

[1] Date Of Planting

[2] Maturity Group II Midland 8280, III Macon, IV Midland 8410, V Pioneer 95B33

COTTON RESPONSE TO PLANTING DATE IN A SHORT SEASON ENVIRONMENT

S.R. Duncan, S.A. Staggenborg and W.F. Heer

Summary

Kansas cotton farmers have relied on information from Oklahoma for common agronomic practices, including optimum planting time. This study was initiated in 2000 to measure yield and quality response of cotton to different planting dates at two rainfed sites in Kansas. Cotton on the Kansas-Oklahoma border counties returned the greatest yields when planted April 27 to May 2. At the northern sites, cotton responded positively to a wider range of planting dates, from early May to mid-June. The responses were similar to traditional Oklahoma planting date recommendations. Cotton planted from mid- to late June produced fiber with discount level micronaire. Fiber length and strength were reduced as planting date was delayed at the location that was under severe temperature and moisture stress. South-central Kansas cotton growers would realize greater yields and quality if their cotton is planted by May 10, where cotton growers in more northern and western regions of the state should plant from May 5 through early June.

Introduction

Kansas was considered to have too short a growing season to consistently produce profitable cotton yields. However, cotton acres stripped in Kansas have grown from 1,200 in 1994 to 44,000 in 2001. The 1996 Farm Bill allowed flexibility for southern Kansas farmers to diversify their cropping options and still participate in government programs. Cotton fits well into the wheat - grain sorghum rotations commonly found in south-central Kansas and north-central Oklahoma. Profits made by early adapters of cotton increased interest, and consequently acreage. The peak rainfall months, May, June and July, are also critical vegetative and early reproductive (through early bloom to mid-bloom) periods of cotton development. Favored planting dates have traditionally been from mid-May to early June, similar to those recommended for the High Plains cotton growing areas of Oklahoma and Texas. Cotton planted earlier than traditional dates may be able to set fruit and develop fiber under reduced period(s) of moisture and temperature stress, resulting in lint yield and quality increases with corresponding increases in net returns to producers. The objectives of this study were to determine the optimum cotton-planting window in Kansas, and measure the effects of planting date on cotton lint yield and quality.

Procedures

Dates of planting (DOP) effects were evaluated in cotton plots planted in the Wellington and Hutchinson, KS areas during the 2000 and 2001 growing seasons. The 2000 Wellington plots were located on a farmer-owned field, and in 2001, on the South Central Experiment Field (SCEF) satellite farm near Wellington. The plots at Hutchinson were planted at the Kansas State University SCEF. In 2000, plots were planted at Wellington on May 2, 18, June 20, and July 11; and at Hutchinson on May 5, 25, June 16, and July 6. Plots were planted in 2001 on April 27, and June 12; and April 30, May 21, June 11, and July 6 at Wellington and Hutchinson, respectively. Paymaster 2280BG/-RR was the variety planted both years. Starter fertilizer [15 lb/a nitrogen (N) and 40 lb/a phosphate (P) acre] was applied in a 2x2 band both years. Thirty-five lb/a N was top-dressed both years (dry urea in 2000 and liquid urea ammonium nitrate in 2001) to bring total N applied to 50 lb/a. There were 4 plots (30 in. rows, 50 ft in length) per date at each location. A preemergent herbicide combination of 1.3 pt/a Dual II Magnum® plus 3 pt/a Cotoran® plus 0.6 oz/a Staple® was applied after planting for weed control. If necessary, Roundup Ultra® at 1.5 pt/a was applied according to label instructions, or hand weeding was used for late season weed control. The center two rows were machine harvested to determine yield. A sub-sample was taken from each plot for fiber quality analysis.

Results

The 2000 project review led to the decision to increase planting dates in 2001 to six, at approximately 14-day intervals. However, planting equipment constraints and untimely rainfall resulted in only two dates being planted at Wellington and larger than desired intervals between plantings at Hutchinson.

In 2000, lint yield decreased for each delay in planting date at Wellington (Table 12). The 2000 studies did not go under heat and moisture stress until mid-August (Figure 1), at which point the May 2 and May 18 cotton was well into bloom and fruiting. However, the June 20 plantings were just beginning to bloom at this most critical period of water use for the crop. Bolls/a and boll weight decreased with delayed DOP, but the differences were significant only when comparing the bolls/a from the first two DOP to those from DOP 3 (Table 12), with corresponding reductions in lint yield. Lint quality was generally adversely affected by the delay in seeding (Table 13). When cotton was planted later in the season, fiber development occured during a period of high heat unit (GDD_{60}) accumulation with high nighttime temperatures (Figure 1). Micronaire in these plots increased significantly when cotton was planted later in the season and increased to discount levels at the June 20 planting date. Fiber length decreased slightly in later plantings, too, probably as the result of moisture stress.

Yields and yield determining factors from the Hutchinson sites are reported in Table 12. As planting date was delayed from early May to July 2000, at the SCEF, lint yields decreased. Precipitation received was near the long-term average until after the June 16 plots were planted (Figure 2), then ceased until late July. Just as the first planting date began fruiting heavily, several timely rains fell on the plots. The volume of rainfall received was evidently sufficient to produce excellent rainfed cotton lint yields in the first planting date. After the late July rains, however, no other significant rainfall events occurred until after the season was finished. During the same period of no rainfall, GDD_{60} accumulation was well above the long-term average. The May 25 planted cotton plants developed similar bolls/plant and bolls/a as the earliest planted cotton, but the boll weights were less than half of the May 5 planted bolls. Consequently, lint yields were reduced 46%. Plant populations from the June 16 planted cotton were good (55,590/a), but the entire fruiting and fiber development process was completed during the period of high temperatures and minimal rainfall, resulting in reduced bolls/plant, bolls/a, and boll weight compared to DOP 1. Planting date 3 bolls/plant and bolls/a were also lower than DOP 2, but boll weight was similar. Fiber quality measurements from the Hutchinson sites are summarized in Table 13. Similarly to Wellington in 2000, micronaire increased as planting date was delayed. At Hutchinson, however, the second DOP cotton produced premium micronaire fiber vs. DOP 1 results at Wellington. Fiber from the DOP 3 cotton fiber had discount level micronaire readings, similar to the Wellington site. Fiber from DOP 1 cotton was longer than that of DOP 2 and 3, that were similar in length. No differences were noted in any of the other fiber quality measurements.

Even with only two DOP and a 45-day interval, lint yields at Wellington showed no response to planting date in 2001 (Table 12). Plant populations in the April 27 planting were reduced as the result of a heavy rain prior to seedling emergence. However, since April 27 plants had nearly twice as many bolls as June 12 plants, the number of bolls/a was similar between planting dates (Table 12). The soil moisture level was good for both dates, but no significant precipitation fell for 75 days (Figure 1) after the June 12 planting, a period which spanned the major fruiting and fiber filling period for both planting dates.

Both DOP 1 and DOP 2 cotton seedlings were stressed by cool, wet weather during emergence at Hutchinson in 2001 (Figure 2). This did not result in plant death, but the seedlings recovered slowly from the shock. The cool wet period in late May and early June, which slowed emergence of the second planting date, stymied growth of DOP 1 plants for a second time and evidently damaged early squares, since first bolls were not set until the fourth reproductive branch. Rainfall and heat units were such that DOP 2 and 3 produced similar yields, boll numbers, and boll weights (Table 12). Though no differences existed between DOP for any measured yield factor, early plantings appeared to be at a disadvantage compared to mid-May to mid-June plantings in 2001.

In the southern tier of Kansas counties, late April or early May plantings of cotton will apparently produce greater lint yields and better fiber quality than cotton planted from mid-May to mid-June. After two years, our results indicated that in the northern cotton producing areas of Kansas, optimum planting dates range from early May to mid-June. Late May to early June plantings of rainfed cotton produced consistent lint yields, but not enough for positive net returns to producers at current prices.

Table 12. Lint yield, bolls/plant, bolls/a and boll weight for different planting dates from cotton grown near Wellington and Hutchinson, KS in 2000-01.

2000					2001				
Planting Date	Lint Yield	Boll Number		Boll Wt.	Planting Date	Lint Yield	Boll Number		Boll Wt.
	lb/a	plant	- a -	- g -		lb/a	plant	- a -	- g -
Wellington									
May 2	506	5.2	159,865	1.48	April 27	314	4.0	104,287	1.36
May 18	383	4.0	135,472	1.29	June 12	243	1.9	95,997	1.13
June 20	212	2.9	90,605	1.13					
July 13	---	---	---	---					
$LSD_{(0.05)}$[1]	53	0.9	39,394	0.35		277	2.7	66,823	0.55
Mean	367	4.0	128,647	1.30		278	3.0	100,142	1.25
C.V.	6.4	10.0	13.6	12.0		44.2	40.1	29.7	19.7
Hutchinson									
May 5	619	5.3	284,108	1.07	April 30	219	1.3	94,671	1.27
May 25	337	5.0	299,015	0.52	May 21	335	1.7	129,518	1.22
June 16	73	1.4	77,827	0.47	June 11	336	1.9	129,591	1.19
July 10	---	---	---	---	July 6	---	---	---	---
$LSD_{(0.05)}$	150	2.1	137,203	0.27		151	0.7	61,477	0.59
Mean	343	3.9	220,317	0.69		297	1.6	117,927	1.22
C.V.	19.4	23.4	27.5	17.5		29.4	24.9	30.1	28.0

[1] Calculated LSD's, means and C.V.'s included only results from dates with lint yields.

Table 13. Fiber quality[1] for different planting dates from cotton grown near Wellington and Hutchinson, KS, 2000.

Planting Date	Mic.	Length	Unif.	Strength	Elong.	Rd	+b	Color Grade
		- in. -	%	- g/tex -				
Wellington								
May 2	4.0	1.05	80.0	28.8	5.9	64.8	7.5	61-4, 51-3
May 18	4.6	1.02	80.9	26.9	5.6	67.1	8.0	51-3, 61-3
June 20	5.1	1.02	82.1	28.3	5.9	66.9	8.2	51-3, 52-1
$LSD_{(0.05)}$	0.6	0.04	1.1	2.1	0.2	11.6	1.2	
Mean	4.6	1.03	81.0	28.0	5.8	66.2	7.9	
C.V.	5.7	1.55	0.6	3.3	1.8	7.8	6.6	
Hutchinson								
May 5	3.9	1.04	80.7	27.2	6.0	62.4	7.9	61-4, 51-3
May 25	4.3	0.98	79.7	24.5	6.0	61.8	7.9	51-3, 61-3
June 16	5.1	0.97	79.6	24.5	5.7	59.8	7.3	51-3, 52-1
$LSD_{(0.05)}$	0.7	0.03	1.8	2.9	0.3	6.9	0.8	
Mean	4.4	1.0	80.0	25.4	5.9	61.3	7.7	
C.V.	7.2	1.2	1.0	6.4	2.9	5.0	4.5	

[1] Fiber quality dates were determined from replications 2 and 3 in both studies.

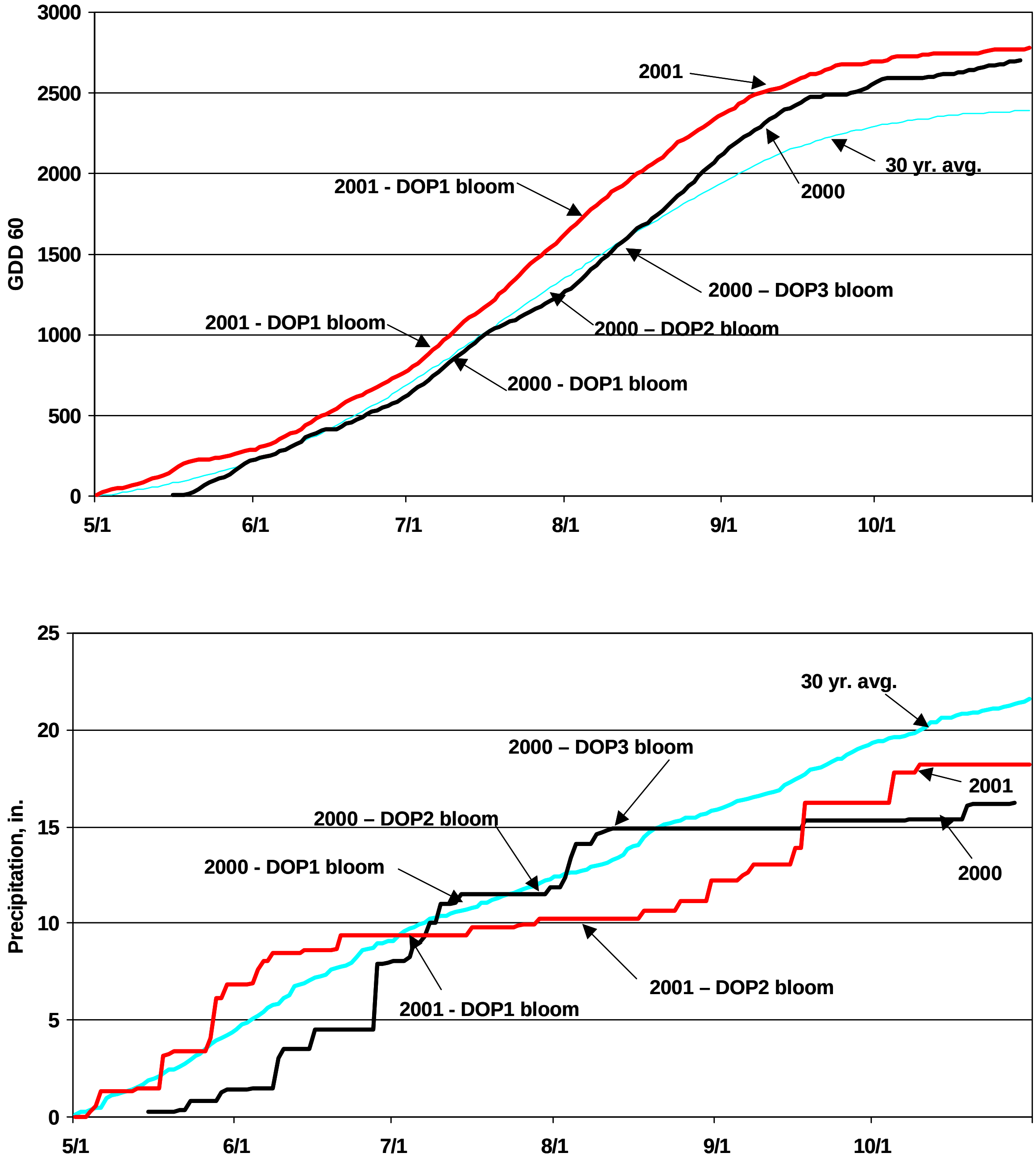

Figure 1. Long-term May 1 to October 31 normal, 2000 and 2001 cotton growing degree days and precipitation for Wellington, KS.

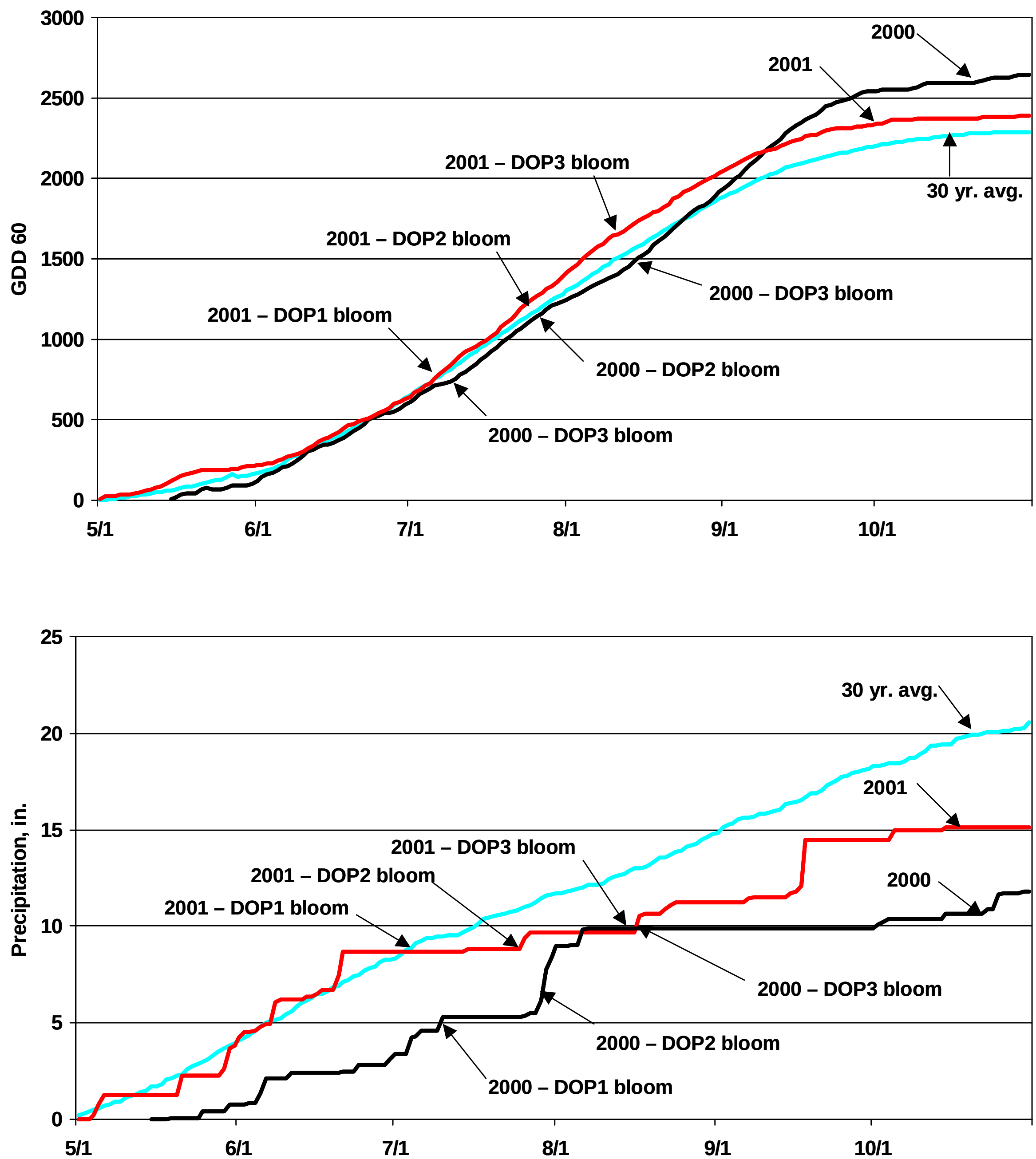

Figure 2. Long-term May 1 to October 31 normal, 2000 and 2001 cotton growing degree days and precipitation for the South Central Experiment Field near Hutchinson, KS.

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