KANSAS STATE UNIVERSITY

Agronomy

FIELD RESEARCH 2003

Agronomy Experiment Fields and Department of Agronomy

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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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 was 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. In 2000, most of the field was terminated and a small satellite field was retained to use for variety testing and limited research on corn, soybeans, and grain sorghum.

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 inches 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 from October, 2001 through September, 2002 was almost 17 inches below normal (Table 1). Precipitation was far below normal in June, July, and August, and crop yields were low, especially corn. The last killing frost was on April 4 (normal April 23), and the first killing frost was on October 13 (normal October 15). The frost-free period was 17 days longer than the 170-day average.

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

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Total
October, 2001 - September, 2002												
1.49	0.75	0.12	1.03	0.25	0.84	2.45	5.27	0.52	1.37	2.51	1.75	18.35
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												
-1.31	-1.16	-0.91	0.28	-0.58	-1.39	-0.72	0.53	-4.55	-3.07	-1.48	-2.61	-16.97

PLANTING DATES AND MATURITY GROUP EFFECTS ON SOYBEAN PRODUCTION

L.D. Maddux

Summary

Four soybean varieties of maturity groups II, mid-III, late-III, and mid-IV were planted at 4 dates from mid-April to late June/early July from 2000 to 2002. Yields in 2000 and 2002 were below normal because of below normal rainfall. Yields in 2001 were better because of timely rains in July and August. In 2001, the fuller season varieties had a yield advantage in the first 3 planting dates, while the group III soybeans had a slight yield advantage over the other 2 varieties with the 4th date of planting. Overall, a planting date from about May 1 to about the middle of June was the best. Early planting did not affect yields as much as later planting.

Introduction

The flexibility to plant crops of choice rather than to plant to maintain base acres of a farm program crop encourages crop rotations. Soybean acres continue to increase in Kansas. Soybean tolerance to a wide range in planting dates has helped the widespread acceptance of this crop. Nevertheless, most crops have an optimum planting date that can differ by both region and cultivar. Little current information is available in Kansas concerning soybean planting dates with modern cultivars. The objective of this study is to determine the optimum planting date for soybeans from a wide range of maturities over several environments in Kansas. Six similar studies were located across eastern Kansas in 1999 with 3 western Kansas sites added in 2000. This project is supported by the Kansas Soybean Commission with check-off funds.

Procedures

This study was conducted at the Cornbelt Field, Powhattan, KS, from 1999 - 2002 and included varieties in maturity groups II, mid-III, late-III, and mid-IV. Uniform stands were not obtained in 1999, so the plots were not harvested. Varieties used at this location were: Grp. II - Midland 8250 (1999) and IA 2021 (2000-02); mid-III - Pi 93B54 (1999-01) and Taylor 357RR (2002); late-III - Macon; mid-IV - KS 4694. Macon has been used at all sites. Four planting dates were used beginning in mid-April and spaced on approximately 3-week intervals. Actual planting dates were: (1) - 4/18/00, 5/01/01, 4/26/02; (2) - 5/05/00, 5/14/01, 5/21/02; (3) - 5/25/00, 6/12/01, 6/10/02; (4) - 6/23/00, 7/03/01, 7/01/02. Weeds were controlled by chemical and mechanical means. The last frost in the spring occurred on 4/16/00, 4/12/01, and 4/16/02. The first frost in the fall occurred on 10/04/00, 10/06/01, and 10/16/02. Data collected were grain yield, maturity date, and plant height. Plots were harvested with a plot combine and yields were corrected to 13% moisture.

Results

Planting dates varied from the desired dates from year to year because of weather conditions. Because of weather conditions and other factors, the study was not completed in 1999. In 2000, fairly poor stands were obtained with the 4th date of planting because of dry soil conditions and these results are not reported. The first frost in the fall hastened the maturity of the fourth planting of the mid-IV soybeans even in 2001, when it was later than usual. Maturity was delayed by 20 days (2-yr. average) from the first planting date to the fourth planting date (planted 57 days later, 2-yr. average). There was an average difference of 20 days in maturity between the group II and mid group IV soybeans. A positive interaction of planting date x variety was observed. The fourth planting date delayed the maturity of the Grp. II soybeans more than the other varieties. The maturity of the mid-IV variety was affected less by delaying the planting date than the other varieties.

Soybean plants were shortest when planted early or late. The second and third planting dates were the tallest and similar in height. The grp. II soybeans were shortest and the grp. IV soybeans were tallest, with the mid- and late-III soybeans being intermediate and fairly similar in height.

Shattering had occurred with the Grp. II soybean in the first 2 planting dates (esp. the first planting date) before the plots could be harvested. In 2000, yields of the two earlier planting dates were higher than the third planting date (fourth date of planting was not harvested). This was attributed to the dry weather during the latter part of the growing season. In 2001, when rainfall was received in July and early August, the fuller season soybeans had a yield advantage in the first 3 dates of planting, while the group III soybeans had a slight yield advantage over the other 2 varieties with the 4th date of planting. In 2002, the group II soybean had lower yields at all planting dates which was attributed to a somewhat poor stand obtained with low germination seed. Very little difference was observed between the other 3 varieties in this extremely dry year. Yields were slightly better with the second date of planting followed closely by the third date of planting. The fourth date of planting resulted in the lowest yield, mainly because no late season rainfall was received.

For the years this study was conducted, a planting date from about May 1 to about the middle of June was the best. Earlier planting did not decrease yields as much as later planting.

Table 2. Effects of planting dates and maturity groups on soybean maturity, Powhattan, 1999-2002.

		Days after Sept. 1				
Planting period (data) x maturity/variety		1999	2000	2001	2002	2-yr Avg*
April 17- May 01						
	II Midland 8250/IA 2021		6.0	8.8	12.0	10.4
April 18, 2000	III Pioneer 93B54/Taylor 357		11.5	21.0	26.0	23.5
May 01, 2001	III Macon		14.8	26.0	20.0	23.0
April 26, 2002	IV KS 4694		31.0	35.0	30.3	32.6
May 02-May 14						
	II Midland 8250/IA 2021		7.5	12.3	12.0	12.1
May 05, 2000	III Pioneer 93B54/Taylor 357		13.0	26.8	26.0	26.4
May 14, 2001	III Macon		18.3	29.0	25.0	27.0
May 21, 2002	IV KS 4694		32.3	39.3	32.3	35.8
May 15-June 12						
	II Midland 8250/IA 2021		8.3	21.8	22.0	21.9
May 25, 2000	III Pioneer 93B54/Taylor 357		30.5	34.5	39.0	36.8
June 12, 2001	III Macon		32.0	36.0	31.0	33.5
June 10, 2002	IV KS 4694		36.0	44.8	43.0	43.9
June 13-July 03						
	II Midland 8250/IA 2021		—	34.0	34.3	34.1
June 23, 2000	III Pioneer 93B54/Taylor 357		—	42.0	45.0	43.5
July 03, 2001	III Macon		—	43.8	42.8	43.3
July 01, 2002	IV KS 4694		---	50.0	48.0	49.0
LSD(.05) - Interaction (Date x Maturity)			---	0.9	0.3	0.5
Planting Period (means)						
April 17-May 01			15.8	22.7	22.1	22.4
May 02-May 14			17.8	26.8	23.8	25.3
May 15 -June 12			26.7	34.3	33.8	34.0
June 13-July 03			---	42.4	42.5	42.5
LSD(.05)			1.0	0.3	0.2	0.2
Maturity/Variety (means)						
II Midland 8250/IA 2021				19.2	20.1	19.6
III Pioneer 93B54/Taylor 357				31.1	34.0	32.5
III Macon				33.7	29.7	31.7
IV KS 4694				42.3	38.4	40.3
LSD(.05)				0.5	0.2	0.3

* Avg. of 2001 and 2002.

Table 3. Effects of planting dates and maturity groups on soybean height, Powhattan, 1999-2002.

Planting period (data) x maturity/variety		Height, inches 1999	2000	2001	2002	2-yr Avg*
April 17- May 01						
	II Midland 8250/IA 2021		21.8	20.3	16.3	18.3
April 18, 2000	III Pioneer 93B54/Taylor 357		28.3	26.3	21.0	23.6
May 01, 2001	III Macon		27.5	25.8	22.0	23.9
April 26, 2002	IV KS 4694		31.8	27.3	23.5	25.4
May 02-May 14						
	II Midland 8250/IA 2021		25.0	21.0	19.0	20.0
May 05, 2000	III Pioneer 93B54/Taylor 357		30.0	27.0	21.0	24.0
May 14, 2001	III Macon		30.3	26.5	22.0	24.3
May 21, 2002	IV KS 4694		31.8	29.0	24.0	26.5
May 15-June 12						
	II Midland 8250/IA 2021		24.5	24.0	19.0	21.5
May 25, 2000	III Pioneer 93B54/Taylor 357		26.0	29.5	20.5	25.0
June 12, 2001	III Macon		29.0	29.5	22.5	26.0
June 10, 2002	IV KS 4694		28.8	29.3	25.3	27.3
June 13-July 03						
	II Midland 8250/IA 2021		—	24.3	17.8	21.0
June 23, 2000	III Pioneer 93B54/Taylor 357		—	24.0	17.8	20.9
July 03, 2001	III Macon		—	23.3	21.3	22.3
July 01, 2002	IV KS 4694		---	24.0	22.0	23.0
LSD(.05) - Interaction (Date x Maturity)			---	NS	1.5	2.1
Planting Period (means)						
April 17-May 01			27.3	24.9	20.7	22.8
May 02-May 14			29.3	25.9	21.5	23.7
May 15 -June 12			27.1	28.1	21.8	24.9
June 13-July 03			---	23.9	19.7	21.8
LSD(.05)			1.8	2.0	1.3	1.3
Maturity/Variety (means)						
II Midland 8250/IA 2021			—	22.4	18.0	20.2
III Pioneer 93B54/Taylor 357			—	26.7	20.1	23.4
III Macon			—	26.3	21.9	24.1
IV KS 4694			—	27.4	23.7	25.5
LSD(.05)			—	1.8	0.8	1.1

* Avg. of 2001 and 2002.

Table 4. Effects of planting dates and maturity groups on soybean yield, Powhattan, 1999-2002.

Planting period (data) x maturity/variety		Yield, bu/a 1999	2000	2001	2002	2-yr Avg*
April 17- May 01						
	II Midland 8250/IA 2021		15.0	10.8	6.8	8.8
April 18, 2000	III Pioneer 93B54/Taylor		21.8	25.8	28.0	26.9
May 01, 2001	357		22.0	30.7	28.3	29.5
April 26, 2002	III Macon		19.9	39.8	25.4	32.6
	IV KS 4694					
May 02-May 14						
	II Midland 8250/IA 2021		18.0	13.7	16.2	15.0
May 05, 2000	III Pioneer 93B54/Taylor		18.0	27.0	32.5	29.8
May 14, 2001	357		22.0	32.8	33.4	33.1
May 21, 2002	III Macon		18.7	36.4	32.6	34.5
	IV KS 4694					
May 15-June 12						
	II Midland 8250/IA 2021		16.8	33.4	14.1	23.7
May 25, 2000	III Pioneer 93B54/Taylor		14.1	38.0	30.0	34.0
June 12, 2001	357		18.0	43.4	30.8	37.1
June 10, 2002	III Macon		13.9	44.9	31.1	38.0
	IV KS 4694					
June 13-July 03						
	II Midland 8250/IA 2021		—	24.5	8.9	16.7
June 23, 2000	III Pioneer 93B54/Taylor		—	27.3	19.2	23.2
July 03, 2001	357		—	30.0	22.7	26.4
July 01, 2002	III Macon		—	25.7	19.5	22.6
	IV KS 4694					
LSD(.05) - Interaction (Date x Maturity)			---	7.8	NS	4.4
Planting Period (means)						
April 17-May 01			19.7	26.8	22.1	24.5
May 02-May 14			19.2	27.5	28.7	28.1
May 15 -June 12			15.7	39.9	26.5	33.2
June 13-July 03			---	26.9	17.6	22.2
LSD(.05)			3.8	3.5	3.4	2.8
Maturity/Variety (means)						
II Midland 8250/IA 2021			—	20.6	11.5	16.0
III Pioneer 93B54/Taylor 357			—	29.5	27.4	28.5
III Macon			—	34.2	28.8	31.5
IV KS 4694			—	36.7	27.1	31.9
LSD(.05)			---	3.9	2.7	2.2

* Avg. of 2001 and 2002.

EFFECT OF PLACEMENT OF STARTER FERTILIZERS ON SOYBEANS

L.D. Maddux and S. Staggenborg

Summary

The effect of N and P placement and ratio on soybean production was evaluated at two sites in northeast Kansas in 2001 and 2002. The placement and ratio of N and P resulted in no 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 soybeans.

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 soybeans 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 and 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 at 144,000 seeds/a in 30-inch rows May 16, 2001 and June 3, 2002 at Rossville and May 23, 2001 and May 31, 2002 at Powhattan. Soybean varieties used were Stine 4200-2 (2001) and Pioneer Brand 93B85 (2002) at Rossville and Taylor 394RR (2001) and Taylor 380RR (2002) at Powhattan. The Rossville site was sprinkler irrigated as needed. The plots were harvested using a plot combine.

Results

Yield results are shown in Table 2. Yields were low in 2002 at Powhattan because of hot, dry weather. No significant differences in grain yield were found at either location either year.

Table 2. Effect of N and P placement on soybean yield, Rossville and Powhattan, 2001 and 2002.

		Yield at Rossville		Yield at Powhattan	
Treatment[1]	Placement	2001	2002	2001	2002
		------------bu/a-----------			
Check	---	52.9	50.4	39.0	20.8
8.8-30-0	2x2	45.4	49.3	39.5	18.8
30-30-0	2x2	50.5	55.3	41.9	21.9
10-34-0, 2 gpa	In Furrow	52.8	54.9	38.9	19.4
10-34-0, 4 gpa	In Furrow	52.4	48.1	38.3	21.5
8.8-0-0	2x2	47.5	48.4	37.5	20.7
30-0-0	2x2	50.2	40.0	37.8	22.5
30-30-0	Broadcast	50.5	55.0	37.5	20.4
0-30-0	Broadcast	48.6	54.4	35.7	17.2
LSD(0.05)		NS	NS	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).

GRAIN SORGHUM HERBICIDE PERFORMANCE TEST

L.D. Maddux and S. Staggenborg

Summary

Sixteen herbicide treatments were evaluated. Visual injury was observed with treatments containing Aim, but the sorghum grew out of it and no significant effect on grain yield was observed. Weed populations in this test were low and variable, and few significant differences were observed because of the resulting large LSD's.

Introduction

Chemical weed control and cultivation have been used to reduce weed competition in row crops for many years. This test included 16 herbicide treatments and an untreated control.

Procedures

This test was conducted on a Grundy silty clay loam soil previously cropped to soybeans with a pH of 6.5 and an organic matter content of 3.1 percent. Pioneer Brand 84G62 grain sorghum hybrid was planted May 31 at 65,000 seeds/a in 30-inch rows. Anhydrous ammonia at 90 lbs N/a was applied preplant. Herbicides were applied preemergent (PRE) - June 1 and postemergent (EP) - June 25. The plots were not cultivated. The data reported here are for crop injury ratings made on July 15 – 20 days after EP applications; and weed control ratings made on July 31 – 36 days after EP applications. The growing season was very dry and weed pressure was light and variable. Weeds rated were common cocklebur (cocb), jimsonweed (jiwe), and ground cherry (grch). Plots were harvested on October 14 using a modified John Deere 3300 plot combine.

Results

Because of the dry weather, weed pressure was light and variable. Crop injury was observed with treatments containing Aim, but by 3 weeks after treatment, the amount of injury had decreased and had no significant effect on grain yield (Table 2). Some of the treatments had weed control ratings that would be considered unsatisfactory, but few of the differences in ratings were statistically significant because of the variability of weed pressure in the test area.

Table 2. Effect of herbicides on sorghum injury, weed control, and grain yield, Powhattan, 2002.

Treatment	Rate	Appl Time[1]	Injury 20 DAT	Weed Control, 36 DAT [2] cocb	jiwd	grch	Grain Yield
	prod./a		%	-------------%----------			bu/a
Untreated check	---	---	0.0	0	0	0	64
Dual II Magnum	1.33 pt	PRE	0.0	100	87	83	81
Outlook	15 oz	PRE	0.0	100	88	85	78
Bicep II Magnum	2.1 qt	PRE	0.0	100	87	88	85
Bicep Lite II Magnum	1.5 qt	PRE	0.0	100	80	87	76
Guardsman Max	2.0 qt	PRE	0.0	92	77	82	73
Bullet	3.5 qt	PRE	0.0	67	53	50	80
Dual II Magnum + Peak + Atrazine + COC	1.33 pt 0.5 oz+1.5 pt+1.0qt	PRE EP	0.0	100	90	53	79
Dual II Magnum + Peak + Banvel + NIS	1.33 pt 0.5 oz+0.25 pt+0.25%	PRE EP	1.7	73	47	88	76
Dual II Magnum + Aim + Atrazine + NIS	1.33 pt 0.33 oz+1.5 pt+0.25%	PRE EP	6.7	100	75	82	71
Dual II Magnum + Ally+2,4-D Amine+NIS	1.33 pt 0.05 oz+0.5 pt+0.25%	PRE EP	0.0	100	85	88	85
Paramount +Atra.+COC	5.33 oz+1.5 pt+1.0 qt	EP	0.0	100	97	100	81
Outlook + Aim + Atrazine + NIS	15 oz 0.33 oz+1.5 pt+0.25%	PRE EP	0.0	80	82	83	72
Dual II Magnum + Aim + Atrazine + NIS	1.26 pt 0.5 oz+1.0 qt+0.25%	PRE EP	3.3	87	83	82	79
Dual II Magnum + Aim + Permit + NIS	1.26 pt 0.5 oz+0.68 oz+0.25%	PRE EP	8.3	95	82	97	73
Dual II Magnum + Aim + Atrazine + 2,4-D Amine + NIS	1.26 pt 0.5 oz + 0.5 qt + 0.5 pt + 0.25%	PRE EP	8.3	100	87	88	79
Dual II Magnum + Aim + Peak + NIS	1.26 pt 0.5 oz+0.5 oz+0.25%	PRE EP	8.3	100	93	87	89
LSD(0.05%)			4.5	39	39	31	16

[1] PRE = preemergence; EP = postemergence.
[2] DAT = days after EP application; Injury rated 7/15/02 and weed control rated 7/31/02.

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 Field's 160 acres 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.

2002 Weather Information

Precipitation during 2002 totaled 27.31 in., which was 9.58 in. below the 34-yr average (Table 1). Most of the moisture deficit occurred during the mid to late parts of the growing season. Rainfall during April and May was 2.88 in. above normal. June, July, August, and September rainfall was 9.95 in. below normal.

The coldest temperatures during 2002 occurred the first week of January with three days in single digits and one day with 1^{o}F below zero. Cold temperatures returned during late February- early March with 4 days in single digits and one day with 1^{o}F below zero . The overall coldest temperatures recorded were 1^{o}F below zero on January 3 and March 4. There were 55 days during the summer in which temperatures exceeded 90 degrees. The two hottest days were July 9 and 26, when daily temperatures reached 100^{o}F.

The last freeze in the spring was April 5 (average, April 18) and the first killing frost in the fall was October 14 (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	2002	34-yr. avg.	Month	2002	34-yr. avg.
January	2.23	1.05	July	1.24	3.43
February	0.47	1.30	August	0.93	3.45
March	0.53	2.53	September	1.50	3.88
April	4.83	3.47	October	5.05	3.51
May	6.77	5.25	November	0.30	2.36
June	3.36	5.22	December	0.00	1.43
Annual Total				27.31	36.89

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 2002 to determine the effects of repeated annual 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 2002 crop was the 22nd year for 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 2002. Grain sorghum yields, when averaged across all fertilizer treatments, were 52 bu/a where crop residue has been harvesting each year, 52 bu/a with normal crop residue incorporated, and 51 bu/a with 2X normal crop residue incorporated. The fertilizer treatments (zero, low, normal and high levels of N, P, and K) produced significant yield differences in 2002. Soil test results after 21 years show that soil organic matter and soil exchangeable K 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 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 yield 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 effect. 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 annual 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 plots). 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 (Table 2). Crops planted were soybean, wheat, and grain sorghum/corn in a 3-year rotation. Crop grain and residue yields were measured each year and soil samples (0 to 2-in. depth) were collected and analyzed after year 21 to detect any changes in soil properties.

Results

Grain yields and residue yields for the last 10 years of this 22-year study are summarized in Tables 3 and 4. The residue treatments have not caused differences in either grain or residue yields for any crop in any year since the study was initiated, except for 1987. In 1987, a year when there was hail damage, 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 the residue treatments. Summed over all 22 years, 1980-2002, total grain and residue yields for residue harvesting and 2X normal residue incorporated treatments differ from normal residue incorporated by less than 1.5 percent.

In contrast, the fertilizer treatments have produced significant grain and residue yield differences, averaging 36% and 37%, respectively, for all years. Highest grain and residue yields have been 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 effect on grain and residue yields with crop residue harvesting, soil properties have changed. The effects of the residue and fertilizer treatments on soil properties are shown in Table 5. Soil organic matter and soil exchangeable K have decreased with annual harvesting of crop residue. The harvesting of crop residue has lowered soil exchangeable K by nearly 12%. This is because of the high K content in crop residue and removing it removes large amounts of K. Crop residue harvesting decreased soil organic matter 10%. Doubling crop residue increased soil organic matter 11%. The fertilizer treatments produced the expected increases in P and K. Available P, exchangeable K, and organic matter all increased with increased fertilizer application. Soil pH decreased with increased fertilizer application.

These data suggest that harvesting of crop residues from fields similar to this soil will have little effect on grain or residue yields over the short to moderate-term 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 reaching equilibrium. 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 2. 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 3. Mean effects of crop residue and fertilizer treatments on grain yields, East Central Experiment Field, Ottawa, KS, 1993-2002.

Treatment	Soy ‘93	Corn ‘94	Wht ‘95	Soy ‘96	Corn ‘97	Soy ‘98	Wht ‘99	Corn ‘00	Soy ‘01	GS ‘02	22-yr total
					- - - - - - - - - - bu/a - - - - - - - - - -						
<u>Residue</u>											
Harvested	21	104	21	42	89	47	25	82	34	52	1264
Normal	22	108	19	46	88	47	24	81	36	52	1278
2X normal	21	107	17	48	82	46	22	80	35	51	1261
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
<u>Fertilizer</u>											
Zero	19	89	12	43	46	44	17	46	34	42	1058
Low	20	103	17	43	76	46	22	76	35	46	1227
Normal	22	114	22	47	99	47	26	96	36	57	1345
High	25	120	24	48	123	50	29	106	35	61	1439
LSD 0.05	2	5	2	2	9	2	2	7	NS	6	

Table 4. Mean effects of crop residue and fertilizer treatments on residue yields, East Central Experiment Field, Ottawa, KS, 1993-2002.

Treatment	Soy '93	Corn '94	Wht '95	Soy '96	Corn '97	Soy '98	Wht 99	Corn '00	Soy '01	GS '02	22-yr total
					- - - - - - - - - - tons/a - - - - - - - - - -						
Residue											
Harvested	0.38	1.63	1.22	0.48	1.46	1.00	0.63	2.85	0.96	1.81	30.17
Normal	0.39	1.73	1.22	0.52	1.49	1.03	0.59	2.74	0.97	1.77	30.52
2X normal	0.39	1.56	1.24	0.54	1.39	1.03	0.51	2.72	0.94	1.77	30.45
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Fertilizer											
Zero	0.34	1.38	0.50	0.46	1.09	0.95	0.34	2.32	0.92	1.59	25.07
Low	0.35	1.46	1.02	0.52	1.35	0.97	0.49	2.79	0.94	1.74	29.22
Normal	0.40	1.91	1.71	0.53	1.57	1.07	0.68	2.88	0.98	1.87	32.45
High	0.45	1.81	1.67	0.54	1.78	1.08	0.80	3.09	0.98	1.95	34.41
LSD 0.05	0.03	0.26	0.16	0.04	0.19	0.06	0.08	0.33	0.04	0.19	

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Table 5. Mean soil test values after 21 years of residue and fertilizer treatments, 0-2 in. soil depth, 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	6.1	23	177	2.91	4.8
Normal	6.1	22	200	3.24	5.0
2X Normal	6.2	28	230	3.61	6.3
LSD 0.05	0.05	4	11	0.15	1.0
Fertilizer					
Zero	6.5	14	162	3.02	5.9
Low	6.2	20	182	3.27	5.0
Medium	6.0	28	223	3.34	4.9
High	5.8	34	242	3.39	5.7
LSD 0.05	0.06	5	13	017	NS

INTEGRATED AGRICULTURAL MANAGEMENT SYSTEMS FOR PROTECTION OF KANSAS SURFACE WATERS
Marais Des Cygnes River Basin

K.A. Janssen and G.M. Pierzynski

Summary

The purpose of this study was to evaluate, in a field-scale setting, effects of different tillage, fertilizer, and herbicide management practices for controlling cropland runoff losses of sediment, nutrients, and herbicides from a terraced Kansas field in the Marais Des Cygnes River Basin. Five years of runoff water collections show that no-till with fertilizer pre-plant deep-banded and herbicide split between early pre-plant and planting is one of the best combinations for balanced protection of water quality.

Introduction

Water quality is an issue that concerns everyone. Total Maximum Daily Loads (TMDLs) are being implemented in Kansas for various contaminants in streams and water bodies. Contaminants of most concern are sediment, nutrients, pesticides, and fecal coliform bacteria. In watersheds with waters not meeting standards, farmers and other land owners will be requested, on a voluntary basis, to reduce contaminant loading by implementing Best Management Practices (BMPs).

Numerous BMPs are available to crop producers to reduce soil erosion and sediment in runoff from cropland. However, no-till has been shown to be one of the most effective BMPs because it targets sediment control at the origination point. Tillage/planting systems such as no-till, however, provide little opportunity for incorporating fertilizer, manure, and herbicides. When surface applied, an increased percentage of these crop inputs contact runoff waters and that results in increased contaminant losses.

Consequently, to attain balanced water quality control, a comprehensive management strategy beyond just no-till is needed. A system of farming is needed that uses combinations of best management practices (BMPs) so that all runoff contaminants are controlled. We refer to such a strategy as "Integrated Agricultural Management Systems."

The purpose of this study was to test, in a field-size setting, effects of different combinations of tillage, fertilizer, and herbicide management practices for balanced water quality protection.

Procedures

The study location was on an approximately 10-acre, parallel-terraced field near Lane in southeast Franklin County, KS. Soils in the field were a mixture of Eram-Lebo with some Dennis-Bates complex (Argiudolls, Hapludolls and Paleudolls). Bray-1 P soil test initially was 13 ppm, which according to K-State recommendations is a low to medium P soil test.

Three combinations of tillage, fertilizer, and herbicide management practices were evaluated starting in 1998. The combinations were: (1) No-till, with fertilizer and herbicides broadcast on the soil surface; (2) No-till, with fertilizer deep-banded (3-5 inch depth) and herbicides split broadcast on the soil surface; and (3) Chisel-disk-field cultivate with fertilizer and herbicides incorporated by tillage. All treatments were replicated twice and were established between terraces to facilitate runoff water collection. The crops grown were grain sorghum and soybean in alternate years in rotation. The rate of fertilizer applied for grain sorghum was 70 lb N, 33 lb P_2O_5, and 11 lb K_2O per acre. 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.

Rainfall amounts were recorded and runoff was collected by instrumentation of all treatment areas between terraces with weirs and automated ISCO samplers. The runoff water collected was analyzed for sediment, nutrients, and herbicide concentrations. Mass losses of contaminants in the runoff were calculated by multiplying the runoff concentrations times runoff volumes

Results

Rainfall and Runoff

Averaged across all runoff sampling dates and years (1998-2002), rainwater that ran off was 3.81 inches or 40% in the no-till system and 2.26 inches or 24% in 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 no-till conserves surface soil moisture which then generates runoff more quickly. Also, each time the soil in the chisel-disk field cultivate system was tilled it loosened and dried the soil, which then increased the soil's capacity to absorb rainwater.

Soil Erosion and Sediment Losses

Even though runoff was less in the chisel-disk field cultivate system, the amount of soil loss was three times greater compared to no-till (Figure 2). With the chisel-disk field cultivate system the 5-yr average soil loss was 0.80 ton/a per growing season and with no-till 0.26 ton/a.

Nutrient and Herbicide Losses

Total P concentrations and losses in the runoff generally paralleled soil losses (Figure 3). This is because sediment P in runoff accounts generally for most total P losses. Soluble P and atrazine losses in the runoff water were highest with surface P fertilizer and herbicide applications in no-till (Figures 4 and 5). Incorporation of P fertilizer and atrazine with tillage decreased losses. Deep-banding fertilizer P in no-till also reduced soluble P losses. Concentrations of soluble P and atrazine in runoff were highest generally during the first couple of runoff events after application (data not shown). This is because that is when the largest portion of these materials are still present on the soil surface and have not yet been absorbed into the soil.

Conclusions

These data confirm that no-till is one of the most effective BMPs for reducing soil erosion and sediment in runoff from crop land. However, if fertilizer and herbicides are surface applied losses of these crop inputs may be increased compared to when incorporated by tillage. Therefore, to assure balanced runoff water protection, it will be important to subsurface apply P fertilizer when planting crops no-till. This could be in the form of pre-plant deep banding (3-5 inch coulter knife depth on 15 in. centers, which was used here), 2x2 inch band placement of fertilizer with the planter, or some combination of these. Steps to reduce herbicide losses when planting crops no-till will also be needed. This might be accomplished partially by timing of the herbicide applications when there is less opportunity for runoff-producing rains (fall or early spring, or as post emergence applications compared to planting-time applications).

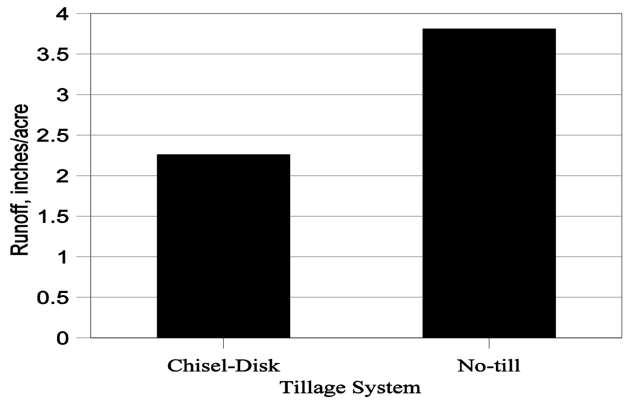

Figure 1. Volume of runoff as influenced by tillage (5-yr growing season avg.).

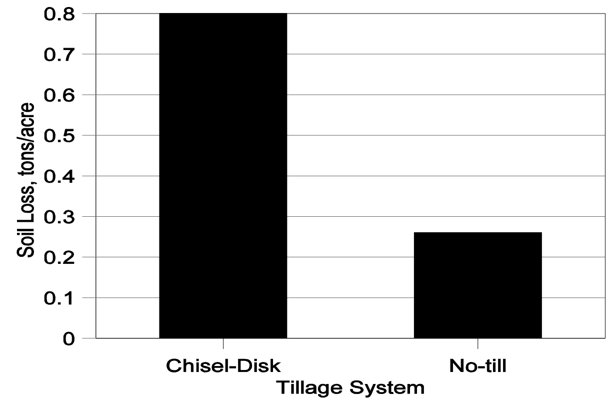

Figure 2. Soil loss as influenced by tillage (5-yr growing season avg.).

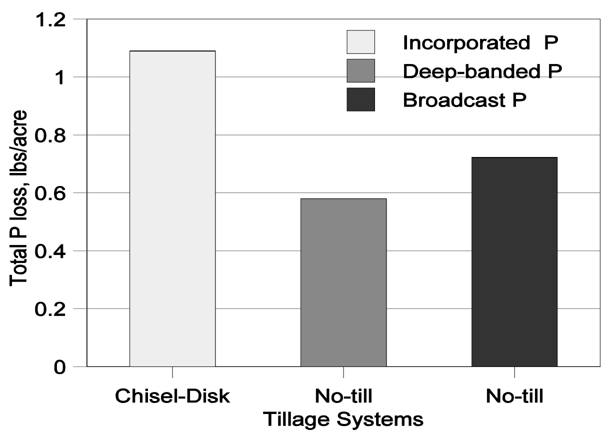

Figure 3. Total P loss as influenced by tillage and P placement (5-yr growing season avg.).

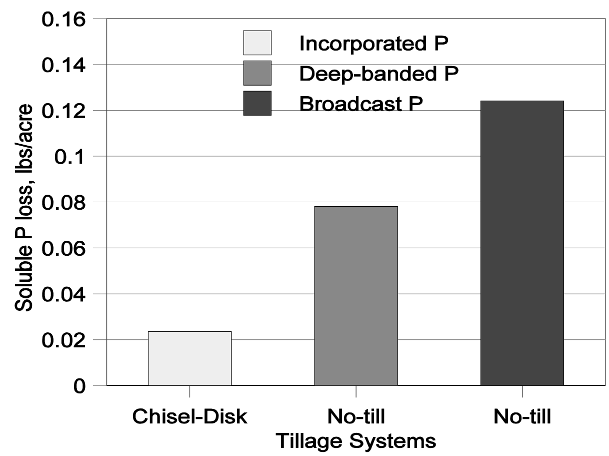

Figure 4. Soluble P loss as influenced by tillage and P placement (5-yr growing season avg.).

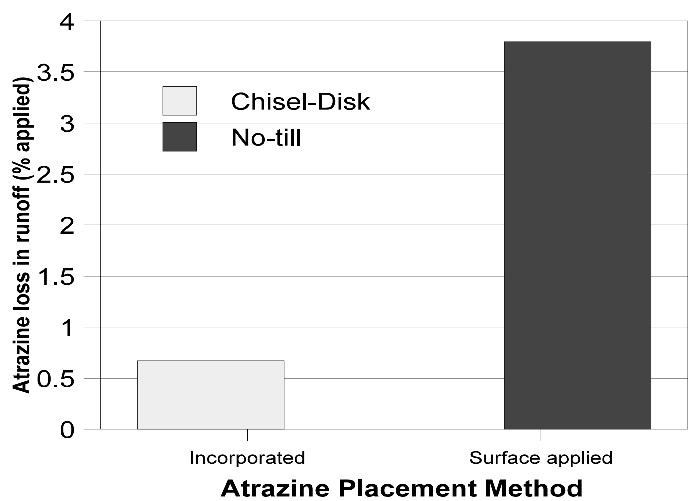

Figure 5. Atrazine loss as influenced by tillage and placement (3-yr growing season avg.) **.**

FORAGE PRODUCTION OF BERMUDAGRASS CULTIVARS IN EASTERN KANSAS

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

Summary

Production in 2002 was higher from experimental lines LCB 84 x 19-16 and LCB 84 x16-66 than for the other cultivars. In turn, ‘Ozarka’, ‘Guymon,’, ‘Greenfield’, ‘Wrangler’, and ‘Midland 99’ produced more than ‘Midland’. One entry, CD 90160, was being reestablished.

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/acre 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 and July 2002. Application of 60 lb/a of N was made in April 2002. Strips 20 x 3 ft were cut on July 3, 2002. Subsamples were collected for determination of moisture.

Results

The spring and early summer of 2002 was favorable for growth. However, regrowth was curtailed after the July 3 harvest because of drought. Soil moisture was not adequate for growth until bermudagrass was nearing fall dormancy.

Plot coverage was not very dense in July 2002 for any of the entries, so ratings were judged on a scale of 1 to 3, with 1 being poor, 2 being fair to good, and 3 being excellent (Table 6). Besides CD 90160, which was being reestablished from sprigs, Ozarka and the original Midland had the poorest plot coverage.

Forage yields in July 2002 were higher ($P<.05$) for the two experimental lines, LCB 84x19-16 and LCB 84x16-66, than for the other entries (Table 7). Midland yielded less than the seven other entries that were harvested.

Total yields for the two years were higher for the two experimental cultivars than for four other entries (Table 7). Midland again produced less forage than the seven other entries that were harvested. The two surviving seed-producing types, Guymon and Wrangler, produced less than the four highest yielding entries, averaging 86% of the average yield of the sprigged types.

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Table 6. Plot Coverage of Bermudagrass Sprigged in 2000, Ottawa Experiment Field, Department of Agronomy.

		Plot Cover†		
Entry	Aug 2000	May 2001	July 2001	July 2002 ‡
CD 90160*	2.8	- -	- -	- -
Greenfield	1.8	1.2	4.2	2
Guymon	3.5	3.0	4.9	2
LCB 84x16-66	2.2	1.0	2.2	2
LCB 84x19-16	3.0	2.0	4.0	2
Midland	2.2	0.1	1.6	1
Midland 99	4.2	1.2	3.9	2
Wrangler	2.0	2.0	4.8	2
Ozarka	1.8	1.0	2.2	1
Average	2.6	1.5	3.5	- -
LSD 0.05	0.7	0.7	0.9	- -

* Plot being reestablished.
† Ratings from 0 to 5, where 5=100% coverage.
‡Ratings from 0 to 3, where 3 represents an “excellent” stand.

Table 7. Forage Yield of Bermudagrass Sprigged in 2000, Ottawa Experiment Field, Department of Agronomy.

		Forage Yield	
Entry	2001	2002	2-Year Total
		- tons per acre @ 12% moisture -	
CD 90160*	- -	- -	- -
Greenfield	3.64	3.46	7.10
Guymon	4.00	3.50	7.51
LCB 84x16-66	5.49	4.53	10.02
LCB 84x19-16	6.27	5.08	11.35
Midland	3.47	1.87	5.34
Midland 99	6.15	2.97	9.12
Wrangler	4.04	3.34	7.39
Ozarka	5.68	3.60	9.29
Average	4.84	3.55	8.39
LSD 0.05	0.99	0.89	1.53

* Plot being reestablished.

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 maximize maturity group differences and yield potential if all other factors are not limiting. Delayed or very late planting dates reduce vegetative growth before flowering, reduce the 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 effects on soybean yield under east-central Kansas conditions from five soybean variety/maturity groups planted at various planting dates.

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 ranged from April 28 through July 24. Seeding rate was 175,000 seeds/a. Planting was with a drill in 7-in. rows. Weeds were controlled with 2 pt/a Treflan and 6.8 oz/a Canopy XL herbicide and hand weeding. At maturity, the center nine rows of each 11-row plot were harvested for yield.

Results

Grain yields 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; in 2001 with the May 6-June 14 planting dates; and in 2002 with the April 21-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, and in 2002 seasonal moisture favored the early planting dates with medium to late maturity groups. Overall highest yield in 1999 was 53.9 bu/a with Hutcheson (MGV) planted May 14. In 2000, highest yield was 30.5 bu/a with Macon (MGIII) planted April 28. In 2001, highest yield was 49.4 bu/a with Hutcheson (MGV) planted May 24 and in 2002 highest yield was 20.3 bu/a with Hutcheson planted May 3. August and September rainfall amounts for 1999, 2000, 2001, and 2002 totaled 11.53, 2.45, 6.57 and 2.43 in., respectively.

Table 8. Effects of Planting Dates and Maturity Groups on Soybean Yield, Ottawa, 1999-2002.

Planting period (date) x Maturity/variety		Yield (bu/a) 1999	2000	2001	2002	4-yr Avg
April 21-May 5						
April 28, 2000	II IA2021	--	18.4	20.0	7.6	--
May 2, 2001	III IA3010	--	28.4	37.0	9.9	--
May 3, 2002	III Macon	--	30.5	37.9	17.5	--
	IV KS4694	--	15.2	43.1	14.3	--
	V Hutcheson	--	14.3	47.9	20.3	--
May 6-May 25						
May 14, 1999	II IA2021	13.8	19.6	24.9	10.7	17.2
May 17, 2000	III I3010	31.4	26.8	44.9	19.0	30.5
May 24, 2001	III Macon	36.7	25.3	43.6	17.0	30.6
May 21,2002	IV KS4694	46.3	15.2	46.1	15.1	30.7
	V Hutcheson	53.9	12.2	49.4	19.1	33.6
May 26-June 14	II IA2021	33.1	19.2	32.7	11.8	24.2
June 8, 1999	III IA3010	41.6	19.1	44.8	16.8	30.6
May 31, 2000	III Macon	44.0	12.1	43.7	19.3	29.8
June 12, 2001	IV KS4694	52.8	12.8	45.3	14.2	31.3
June 7, 2002	V Hutcheson	53.5	14.4	46.7	16.1	32.7
June 15-July 4	II IA2021	34.1	7.6	33.4	12.2	21.8
June 15, 1999	III IA3010	40.2	6.6	36.4	8.2	22.8
June 29, 2000	III Macon	44.2	8.9	39.3	11.2	25.9
June 25, 2001	IV KS4694	45.9	9.5	45.0	11.9	28.1
June 25, 2002	V Hutcheson	53.2	11.4	40.3	14.8	29.9
July 5-July 18	II IA2021	25.3	0.0	27.5	5.8	14.6
July 8, 1999	III IA3010	23.9	0.0	11.9	4.3	10.0
July 17, 2000	III Macon	28.6	0.0	26.8	7.8	15.8
July 9, 2001	IV KS4694	31.0	0.0	33.0	8.2	18.0
July 9, 2002	V Hutcheson	29.2	0.0	34.3	14.6	19.5
July 19-July 28	II IA2021	12.3	--	13.5	0.0	--
July 23, 1999	III IA3010	9.8	--	7.2	0.0	--
July 19, 2001	III Macon	14.4	--	19.7	0.0	--
July 24, 2002	IV KS4694	11.0	--	28.8	0.0	--
	V Hutcheson	2.0	--	25.2	0.0	--
Planting Period (means)						
April 21-May 5		--	21.4a	37.2a	13.9ab	--
May 6-May25		36.4a	19.8a	41.8b	16.2a	28.6
May26-June 14		45.0b	15.5b	42.6b	15.6ab	29.7
June 15-July 4		43.5b	8.8c	38.9a	11.7bc	25.7
July 5-July 18		27.6c	0.0d	26.7c	8.1c	15.6
July 19-July 28		9.9d	--	18.9d	--	--
Maturity/Variety (means)						
II IA2021		23.7a	16.2a	25.3a	9.6a	18.7
III IA3010		29.4b	20.2b	30.4b	11.6b	22.9
III Macon		33.6c	19.2b	35.2c	14.6c	25.6
IV KS4694		37.4d	13.2c	40.2d	12.7b	25.9
V Hutcheson		38.3d	13.1c	40.6d	17.0d	27.2

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

HARVEY COUNTY EXPERIMENT FIELD

Introduction

Research at the Harvey County Experiment Field 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, and is designed to directly benefit the agricultural industry of the area. The focus is primarily on wheat, grain sorghum, and soybean, but research is also conducted on 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, 75 acres immediately west of Hesston on Hickory St., 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 run-off 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.

2001- 2002 Weather Information

Extremely heavy rains fell on exceedingly dry soil about 2 weeks before wheat planting began. Seedbed conditions were good, but lacked consistent moisture at seed depth. However, timely rains in early October insured prompt and complete wheat emergence. After a cool October, temperatures remained well above average during November and December. Fall wheat development was good despite very limited precipitation. Winter precipitation was above normal in January, but below normal during the other winter months. Mean temperatures continued to be well above normal in January, near normal in February, and colder than usual in March. Wheat stands were good, with excellent winter survival. Foliage greened-up again in mid-March after getting burned by zero-degree temperature near the beginning of the month.

Rainfall was somewhat above normal in April, but nearly 2 inches below normal in May. Fortunately, May temperatures also were cooler than usual. June rains were excessive during the last 2 weeks before wheat harvest. Low levels of barley yellow dwarf symptoms were observed. Leaf rust appeared in late May but had little impact on wheat yield.

Soil moisture was generally favorable for row crop planting. However, early-June plantings in some cases were affected by soil crusting following copious rainfall prior to emergence. Mean air temperatures were near normal for that month. Crazy top downy mildew in grain sorghum was evident in certain areas affected by the excessive rainfall. Scattered affected plants remained stunted and did not produce grain. Average maximum air temperatures were below normal in July and August. During this time, temperatures only equaled or exceeded 100 °F on 7 days. However, rainfall was below normal, and drouth stress occurred during these months. Temperatures were above normal and precipitation well below normal in September.

Corn had no significant diseases, but did encounter limited grasshopper activity. In some locations, chinch bugs became a significant threat to grain sorghum by mid-season and required remedial treatment. Stalk rot in certain sorghum hybrids was associated with drouth stress, and resulted in late-season lodging. Bean filling in soybean was curtailed prematurely by drouth stress. While summer drouth affected the performance of all the row crops, limited, but timely rains averted even more deleterious effects on yields.

Freezing temperatures occurred last in the spring on April 5. First killing temperatures occurred next on October 13. The frost-free season of 191 days was about 23 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
	2001				2002		
October	0.59	0.75	2.94	March	0.51	0.42	2.72
November	0.23	0.23	1.87	April	3.56	4.19	2.94
December	0.11	0.18	1.12	May	3.09	2.94	5.02
				June	8.43	7.43	4.39
	2002			July	1.58	2.12	3.71
January	1.69	1.42	0.69	August	2.41	2.50	3.99
February	0.58	0.39	0.93	September	1.13	1.75	2.93
Twelve-month total					23.91	24.32	33.25
Departure from 25-year Normal at N. Unit					-9.34	-8.93	

[1] Four 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 for a sixth consecutive year. In most seasons, tillage in alternate years did not consistently affect no-till wheat after row crops. However, in 2002, prior tillage for row crop resulted in a 6.6 bu/a increase in yield of no-till wheat after sorghum and soybean, but not after corn. In contrast with most years, crop rotation effects on wheat yield were not significant. Tillage systems did not meaningfully affect yields of row crops in rotation with wheat except for corn, which responded to no-till with a 2.7 bu/a increase. Wheat rotation increased sorghum yields by 6.6 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 May plantings by 23.3 bu/a; however, 6-year average yields continued to favor May planting by 5.6 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 drouth 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.

<u>Wheat after Corn</u>
WC-NTV = No-till after V-blade (V-blade, sweep-treader, mulch treader) for corn
WC-NTNT = No-till after No-till corn

<u>Wheat after Sorghum</u>
WG-NTV = No-till after V-blade (V-blade, sweep-treader, mulch treader) for sorghum
WG-NTNT = No-till after No-till sorghum

<u>Wheat after Soybean</u>
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 with Roundup Ultra + 2,4-D_A + Banvel + Placement Propak (1.5 pt + 1 pt + 4 oz /a + 1% v/v) on July 11. Additional fallow applications of Roundup Ultra + Placement Propak at 1.5 pt/a + 1% and Roundup Ultra + ammonium sulfate at 20 oz + 2.6 lb/a were made on September 6 and October 3, respectively. Variety 2137 was planted October 8 in 8-inch rows at 90 lb/a with a CrustBuster no-till drill equipped with double disk openers. Wheat was fertilized with 71 lb N/a and 35 lb P_2O_5/a as preplant, broadcast ammonium nitrate and in-furrow diammonium phosphate at planting. An additional 50 lb/a of N was broadcast on January 28. WW-NT and WW-C plots were sprayed for cheat control with Maverick 75 DF at 0.66 oz/a + 0.5% nonionic surfactant (NIS) on November 16. WC-NTNT and WG-NTNT were sprayed on the same day for cheat control with Everest 70[1] DF at 0.6 oz/a + 0.5% NIS. No herbicides were used on wheat in the remaining tillage and cropping systems. Wheat was harvested on June 26, 2002.

No-till corn after wheat plots received the same herbicide treatments as WW-NT during the summer plus a mid-November application of AAtrex 90 DF + 2,4-D_{LVE} + crop oil concentrate (COC) at 1.67 lb + 1 pt + 1 qt/a. Preplant weed control was achieved with Roundup Ultra + Banvel + Placement Propak (1 pt + 2 oz/a +1%). Weeds were controlled during the fallow period in CW-V plots with a combination of two tillage operations and two herbicide applications targeting field bindweed. An additional tillage operation was necessary for seedbed preparation. 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 inches from the row at planting. A White no-till planter with double-disk openers on 30-inch centers was used to plant Pioneer 35N05 at approximately 18,700 seeds/a on April 18, 2002. All corn plots were sprayed after planting with Dual II Magnum + AAtrex 4L (1.33 pt + 1.5 pt/a) for preemergence weed control. 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 (1.67 lb + 1 pt + 4 oz + 1 qt/a) in mid-November. $GG\text{-}NT_{May}$ areas received a preplant application of Roundup Ultra + Banvel + Placement Propak (1 pt + 2 oz/a + 1%). $GG\text{-}NT_{June}$ plots were treated with Roundup Ultra + Placement Propak (1 qt/a + 1%) before planting. GW-V plots were managed like CW-V areas during the fallow period

[1]*Everest is labeled for use by wheat growers in the northern plains, but is not sold in Kansas.*

between wheat harvest and planting. However, sorghum required one more tillage operation than corn because of later planting. Between crops, all GG-C plots were tilled once in the fall (chisel) and twice in the spring (mulch treader and sweep-treader). 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-inch rows on May 6, 2002. A second set of continuous sorghum plots was planted on June 22. Post-plant 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 + AAtrex 4L at 1.33 pt + 1.5 pt/a (GG-NT_{May}) or at 1.33 pt + 1 qt/a (GG-C_{May}, GG-NT_{June}, GG-C_{June}) shortly after planting. Sorghum was not row cultivated. May- and June-planted sorghum were harvested on September 6 and November 21, respectively.

Fallow weed control procedures for no-till soybean after wheat were the same as for CW-NT and GW-NT, except that there was no late fall herbicide application for residual weed control. Roundup Ultra + Banvel + Placement Propak (1 pt + 2 oz/a + 1%) controlled emerged weeds just prior to planting. SW-V tillage and herbicide treatments were the same as those indicated for GW-V. After planting, weeds were controlled 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-inch rows on May 6 and harvested on September 25, 2002.

Results

Wheat

An extreme rainfall event near mid-September helped alleviate extremely dry conditions. At planting time, surface soil moisture was generally adequate for wheat germination and emergence. Fall wheat development was acceptable despite very little additional rainfall. Total precipitation for the period from planting until the end of May was 7.9 inches below normal. However, favorable temperatures at important stages of wheat development resulted in very good yields.

Crop residue cover in wheat after corn, sorghum, and soybean averaged 72, 72, and 36%, respectively (Table 2). WW-B, WW-C, and WW-NT averaged 8, 35, and 71% residue cover after planting, respectively. Wheat stands averaged 99% complete and were not affected by tillage or cropping system. Cheat control was excellent. Plant N concentration in wheat at late boot-early heading stage was highest in continuous cropping (2.10%) and in rotations with sorghum (2.02%) or corn (1.93%), but slightly lower following soybean (1.80%). Tillage system did not significantly affect wheat plant N level. Wheat heading date tended to be slightly delayed in continuous NT systems versus V-blade or Chisel systems with tillage in alternate years. Unlike previous years, crop rotation had no significant effect on wheat yields. Wheat in rotation with corn, sorghum, and soybean averaged 49.9, 51.8, and 52.3 bu/a, while continuous wheat yields averaged 52.4 bu/a. Tillage in the preceding year did not affect the yield of wheat after corn, but increased the production of NT wheat after sorghum and soybean by 6.6 bu/a. In continuous wheat, Burn and Chisel systems were, respectively, 12.2 and 7.2 bu/a superior to NT. Test weights were below average and were not significantly affected by tillage or cropping systems.

Row Crops

Corn, sorghum, and soybean following wheat had an average of 45, 40, and 33%, respectively, crop residue cover after planting in V-blade systems (Table 3). Where these row-crops were planted NT after wheat, crop residue cover averaged 78%, with little difference among rotations. The chisel system in continuous sorghum resulted in ground cover comparable to the V-blade system in sorghum after wheat. However, NT sorghum after wheat averaged 12 and 17% more ground cover than May- and June-planted NT continuous sorghum.

Drouth stress caused low yields in all row crops. Tillage systems had no significant effect on row crop stands, maturity, number of ears or heads/plant, or grain test weight. Corn yields averaged 46.3 bu/a. NT increased corn yield by 2.7 bu/a in comparison with the V-blade tillage system. Sorghum and soybean averaged 60.7 and 19.7 bu/a, with no apparent tillage effect. Wheat rotation benefitted May-planted sorghum, increasing flag leaf N by 14%, number of heads/plant by 39%, and grain yield by 13%.

Planting date effect on yield of continuous sorghum was highly significant because of the seasonal weather pattern. June planting shortened the period from planting to half bloom by 19 days, increased the number of heads/plant by 22%, increased leaf N by 7%, and increased yield significantly. Sorghum planted after mid-June produced 74.1 bu/a, 46% more than sorghum planted in early May. However, long-term average yields continued to show an advantage of 5.6 bu/a for May vs June planting.

Table 2. Effects of row crop rotation and tillage on wheat, Harvey County Experiment Field, Hesston, KS, 2002.

Crop Sequence[1]	Tillage System	Crop Residue Cover [2]	Yield[3] 2002	Yield[3] 6-Yr	Test Wt	Stand[4]	Head-ing[5]	Plant N[6]	Cheat Control[7] Jun
		%	bu/a		lb/bu	%	date	%	----%----
Wheat-corn	V-blade	65	49.1	54.0	54.4	100	8	1.90	100
(No-till)	No-till	80	50.6	54.2	55.7	98	10	1.95	100
Wheat-sorghum	V-blade	65	55.6	42.7	56.2	100	9	2.02	100
(No-till)	No-till	80	48.0	40.4	55.2	98	10	2.02	100
Wheat-soybean	V-blade	21	55.1	54.7	56.9	99	7	1.76	100
(No-till)	No-till	52	49.5	58.6	56.2	99	8	1.84	100
Continuous	Burn	8	58.2	48.7	57.1	99	7	2.06	100
wheat	Chisel	35	53.2	44.6	56.0	100	8	2.02	100
	No-till	71	46.0	43.1	54.8	99	11	2.21	100
LSD .05		9	NS	9.7	NS	NS	1.3	0.23	NS
LSD .10		7	6.5	8.1	NS	NS	1.1	0.19	NS
Main effect means: Crop Sequence									
Wheat-corn		72	49.9	54.1	55.0	99	9	1.93	100
Wheat-sorghum		72	51.8	41.5	55.7	99	9	2.02	100
Wheat-soybean		36	52.3	56.6	56.5	99	7	1.80	100
Continuous wheat		53	49.6	43.9	55.4	99	9	2.11	100
LSD .05		7	NS	7.2	NS	NS	0.9	0.16	NS
Rotation Tillage system									
No-till/V-blade		50	53.3	50.4	55.8	99	8	1.89	100
No-till/no-till		70	49.5	51.1	55.7	98	9	1.94	100
LSD .05		5	2.9	NS	NS	0.6	0.6	NS	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 evaluated on March 28. [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 just before harvest.

Table 3. Effects of wheat rotation and reduced tillage on corn, grain sorghum, and soybean, Harvey County Experiment Field, Hesston, KS, 2002.

Crop Sequence	Tillage System	Crop Residue Cover [1]	Yield[2] 2002	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	45	44.9	66.8	55.3	20.0	78	0.96	2.87
	No-till	76	47.6	60.5	55.6	20.3	78	0.96	2.72
LSD .05		12	2.0	NS	NS	NS	NS	NS	NS
Sorghum-wheat	V-blade	40	58.2	89.4	58.2	33.0	73	1.48	2.84
	No-till	78	56.6	92.2	57.9	32.4	74	1.52	2.76
Contin. sorghum (May)	Chisel	37	50.5	73.6	59.0	34.8	75	1.10	2.49
	No-till	67	51.0	72.6	59.3	35.0	76	1.07	2.42
Contin. sorghum (June)	Chisel	35	73.9	65.7	58.7	30.4	56	1.30	2.77
	No-till	61	74.2	69.4	59.0	30.8	56	1.34	2.48
LSD .05[5]		8	9.0	19.9	0.70	2.8	1.8	0.13	0.23
Soybean-wheat	V-blade	33	18.8	27.3	—	—	137	—	—
	No-till	80	20.5	26.9	—	—	138	—	—
LSD .05		16	NS	NS	—	—	NS	—	—
Main effect means for sorghum:									
Crop sequence									
Sorghum-wheat		59	57.4	90.8	58.1	32.7	73	1.50	2.80
Contin. sorghum (May)		52	50.8	73.1	59.1	34.9	75	1.08	2.45
Contin. sorghum (June)		48	74.1	67.5	58.8	30.6	56	1.32	2.62
LSD .05		4	5.2	14.1	0.41	1.6	1.0	0.08	0.13
Tillage system									
V-blade/chisel		37	60.9	76.2	58.6	32.7	68	1.29	2.70
No-till/no-till		69	60.6	78.1	58.7	32.7	68	1.31	2.55
LSD .05		5	NS	NS	NS	NS	NS	NS	0.16

[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, 2001-2002 for corn and 1997-2002 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 SOYBEAN COVER CROP AND NITROGEN RATE ON NO-TILL GRAIN SORGHUM AFTER WHEAT

M.M. Claassen

Summary

Late-maturing Roundup Ready® soybean drilled in wheat stubble at 135,000, 165,000, and 200,000 seeds/a produced an average of 2.25 ton/a of above-ground dry matter and a N yield of 87 lb/a potentially available to the succeeding crop. Soybean cover crop did not affect grain sorghum yield the following growing season, but, when averaged over N rate, resulted in a 0.15% N increase in flag leaves. N fertilizer significantly affected sorghum maturity, heads/plant, leaf N concentration, yield, and bushel weight. Highest overall average yield of 103 bu/a occurred with 60 lb/a of N. Additional N fertilizer did not significantly increase leaf N or bushel weight.

Introduction

Research at the KSU Harvey County Experiment Field over the past 8 years has explored the use of hairy vetch as a winter cover crop following wheat in a winter wheat- sorghum rotation. Results of long-term experiments showed that between September and May, hairy vetch can produce a large amount of dry matter with an N content on the order of 100 lb/a. However, significant disadvantages also exist in the use of hairy vetch as a cover crop. These include the cost and availability of seed; interference with the control of volunteer wheat and winter annual weeds; and the possibility of hairy vetch becoming a weed in wheat after sorghum.

New interest in cover crops has been generated by research in other areas showing the positive effect these crops can have on the overall productivity of no-till systems. In Ohio, use of a late-maturing Roundup Ready soybean has shown promise as a summer cover crop in a rotation from wheat to corn. The current experiment was conducted as a pilot project to assess soybean seeding rate and N rate effects on no-till grain sorghum after wheat.

Procedures

The experiment site was located on a Smolan silt loam soil. Following winter wheat harvest, weeds were controlled with Roundup Ultra + Banvel + Placement Propak (1 qt/a + 2 oz/a + 1% v/v) in early July. Asgrow 6701 RR soybean was no-till drilled in 8-inch rows in randomized strips with four replications at 0, 135,000, 165,000, and 200,000 seeds/a on July 11, 2001. Unreplicated soybean plants from 1-m^2 samples were harvested at the first killing frost on October 16. Whole-plant soybean dry matter yield estimates were obtained and subsamples analyzed for N content. Volunteer wheat was controlled in the fall with Roundup herbicide.

Soybean plants in existing wheat stubble were left undisturbed after maturity. Preplant weed control was accomplished with the application of Roundup Ultra + AAtrex 4L + Dual II Magnum + 2,4-D LV6 + Banvel (1.6 pt/a +1.5 pt/a + 1.33 pt/a + 1.33 oz/a + 2 oz/a) on May 20, 2002. Randomized N rates of 0, 30, 60, and 90 lb/a were broadcast as ammonium nitrate on May 31. Pioneer 8505 grain sorghum with Concep III and Gaucho seed treatments was no-till planted at 42,000 seeds/a in 30-inch rows on June 3, 2002. Sorghum was harvested on September 24.

Results

Soybean stand establishment and crop development were good. Ground cover and volunteer wheat control varied with soybean seeding rate. Although volunteer wheat was suppressed by the soybean cover crop, some wheat growth occurred. Fall application of Roundup herbicide was necessary. Despite the choice of a late maturing soybean, some pod set and minor seed development was noted. At termination by frost on October 16, soybean whole-plant above-ground dry matter yield estimates were 2.3, 2.5, and 2.0 tons/a with seeding rates of 135,000, 265,000 and 200,000/a, respectively. Nitrogen concentrations in soybean plant samples ranged from 1.88% to 2%, with an average of 1.92%. Corresponding N yields of soybeans at these seeding rates were calculated to be 85, 100, and 75 lb/a.

Soybean cover crop increased grain sorghum leaf N concentration, but had no effect on yield nor any of the other variables measured (Table 4). This increase averaged 0.15% N across N rates, and there were no significant differences among soybean seeding rates of 135,000 to 200,000. Nitrogen fertilizer significantly decreased the number of days to half bloom as well as increased the number of sorghum heads/plant, sorghum leaf N concentration, yield, and bushel wt. Highest grain yield occurred with 60 lb/a of N fertilizer. Leaf N and grain test weight also did not increase significantly with additional N fertilizer.

Table 4. Effects of late-maturing soybean cover crop, soybean seeding rate, and nitrogen rate on no-till grain sorghum after wheat, Hesston, KS, 2002.

Cover Crop/ Seeding Rate[1]	N Rate[2]	Grain Yield	Bushel Wt	Stand	Half Bloom[3]	Heads/ Plant	Leaf N[4]
	lb/a	bu/a	lb	1000's/a	days	no.	%
None	0	88.5	59.4	36.8	60	1.0	2.18
	30	97.2	59.8	37.9	59	1.0	2.40
	60	103.8	60.7	36.0	57	1.1	2.47
	90	107.5	61.0	36.3	57	1.2	2.58
Soybean	0	88.7	59.9	36.2	60	1.0	2.24
135,000	30	90.2	59.3	36.2	58	1.0	2.57
	60	98.7	60.7	34.8	57	1.1	2.63
	90	103.1	60.7	37.1	56	1.1	2.74
Soybean	0	81.4	60.4	36.2	59	1.0	2.34
165,000	30	97.3	60.7	37.3	57	1.0	2.57
	60	107.7	60.4	37.0	57	1.1	2.70
	90	97.1	60.5	34.7	56	1.1	2.80
Soybean	0	83.1	59.7	36.5	60	0.9	2.20
200,000	30	104.9	60.7	36.5	57	1.1	2.45
	60	102.5	60.5	36.6	57	1.1	2.80
	90	102.0	60.5	36.3	57	1.1	2.67
LSD .05 across systems		10.3	0.70	NS	1.5	0.10	0.25
Means: Cover Crop/ Seeding Rate							
None		99.2	60.2	36.8	58	1.1	2.41
Soybean/135,000		95.1	60.2	36.1	58	1.0	2.55
Soybean/165,000		95.9	60.5	36.3	57	1.0	2.60
Soybean/200,000		98.1	60.4	36.5	58	1.0	2.53
LSD .05		NS	NS	NS	NS	NS	0.11
N Rate							
0		85.4	59.9	36.4	60	1.0	2.24
30		97.4	60.1	37.0	58	1.0	2.50
60		103.2	60.6	36.1	57	1.1	2.65
90		102.4	60.7	36.1	57	1.1	2.70
LSD .05		5.1	0.33	NS	0.8	0.06	0.13

[1] Asgrow 6701 Roundup Ready soybean drilled in 8-inch rows on July 11, 2001.
[2] N applied as 34-0-0 on May 31, 2002.
[3] Days from planting (June 3, 2002) 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 GRAIN 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. Fertilizer N and hairy vetch raised wheat plant N levels. Without vetch in the rotation, wheat plant N increased only at 90 lb/a. Averaged over N rate, hairy vetch resulted in respective increases of 0.17% N to 0.33% N in disk and no-till systems. Nitrogen rate significantly increased wheat yield, but the residual benefit of the cover crop on wheat grain production was less apparent than in previous years. With vetch/disk, wheat produced 5.7 bu/a more than with vetch/no-till. But, at 0 lb/a of fertilizer N as well as at the average N rate, yields of wheat in hairy vetch systems were not significantly greater than in no-vetch. In wheat after sorghum without vetch, 30 and 60 lb/a of fertilizer N progressively increased yield. However, in wheat after vetch-sorghum, yields at these N rates 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 1996. Sorghum was grown in 1997 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-inch rows into sorghum stubble in the fall of 1997. In the third cycle of the rotation, hairy vetch plots were seeded at 25 lb/a in 8-inch rows 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/a + 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, 2001. 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 was planted in 30-inch rows at approximately 42,000 seeds/a on June 15, 2001. 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. Fertilizer N was broadcast as 34-0-0 on October 20, 2001, at rates equal to those applied to the prior sorghum crop. On the same day, variety 2137 winter wheat was no-till planted in 8-inch rows into sorghum stubble at 120 lb/a with 37 lb/a of P_2O_5 fertilizer banded in the furrow. Wheat was harvested on June 26, 2002.

Results

Hairy vetch terminated near mid-May, 2001, produced an average of 1.42 ton/a of dry matter, yielding 103 lb/a of N potentially available to the sorghum that followed (Table 5). 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 a 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. While 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.

Precipitation total for the period from November 1 through May 31 was nearly 5.5 inches below normal. The residual effect of hairy vetch on wheat in the rotation was evident, but it was not as pronounced as in previous years. Vetch accounted for wheat plant height increases of 3 to 5 inches, but only with zero fertilizer N. Averaged across N rates, vetch treatments were associated with significantly higher wheat plant N levels. Increases ranged from 0.17% N to 0.33% N in disk and no-till systems. Plant N increases following vetch were most notable at 60 and 90 lb/a of fertilizer N. Vetch/disk system resulted in a yield 5.7 bu/a greater than with vetch/no-till. However, at 0 lb/a of N and at the average N rate, wheat yields in vetch systems were not significantly greater than in the no-vetch system.

Without hairy vetch in the rotation, wheat after sorghum responded to N rate with increases in plant height and yield at 30 and 60 lb/a, while plant N increased only at 90 lb/a. Notably, however, the incremental increase in wheat yield at 30 versus 60 lb/a of N was significant in the crop rotation without vetch, but not with vetch included as a prior winter cover crop.

Table 5. Residual effects of hairy vetch cover crop, termination method, and nitrogen rate on no-till wheat after grain sorghum, Hesston, KS, 2002.

Cover Crop/ Termination[1]	N Rate[2]	Vetch Yield[3] Forage	Vetch Yield[3] N	Sorghum Yield 2001	Wheat Yield	Wheat Bushel Wt	Wheat Stand	Wheat Plant Ht	Wheat Plant N[4]
	lb/a	ton/a	lb	bu/a	bu/a	lb	%	in.	%
None	0	--	--	83.0	8.8	58.7	83	18	1.23
	30	--	--	95.7	26.4	59.5	93	25	0.87
	60	--	--	101.7	38.3	58.9	91	28	1.13
	90	--	--	101.5	34.6	57.1	80	28	1.56
Vetch/Disk	0	1.42	107	100.9	13.9	59.3	84	21	1.17
	30	1.30	101	96.3	31.2	59.4	93	26	1.06
	60	1.46	108	100.0	36.4	58.1	89	28	1.42
	90	1.42	96	99.0	39.3	57.4	87	30	1.82
Vetch/No-till	0	1.50	106	97.2	14.3	59.3	83	23	1.27
	30	1.47	100	101.9	26.4	58.3	86	26	1.25
	60	1.50	109	99.6	29.4	57.3	90	29	1.58
	90	1.31	99	93.6	27.8	56.9	74	29	2.03
LSD .05		NS	NS	NS	9.9	1.8	13	2.0	0.38
LSD .10		NS	NS	NS	8.2	1.5	11	1.6	0.32
Means: Cover Crop/ Termination									
None		--	--	95.6	27.0	58.5	87	25	1.20
Vetch/Disk		1.40	103	99.1	30.2	58.5	88	26	1.37
Vetch/No-till		1.44	104	98.1	24.5	57.9	83	27	1.53
LSD .05		NS	NS	NS	NS	NS	NS	1.0	0.19
LSD .10		NS	NS	NS	4.1	NS	NS	0.8	0.16
N Rate									
0		1.46	106	93.9	12.2	59.1	83	21	1.22
30		1.38	101	98.0	28.0	59.1	91	26	1.06
60		1.48	108	100.4	34.7	58.1	90	28	1.38
90		1.36	97	98.0	33.9	57.1	80	29	1.80
LSD .05		NS	NS	NS	5.7	1.0	7	1.1	0.22
LSD .10		NS	NS	NS	4.8	0.9	6	0.9	0.18

[1] Hairy vetch planted on October 4, 2000, and terminated in the following spring.
[2] N applied as 34-0-0 on June 14, 2000 for sorghum and on October 20, 2001 for wheat.
[3] Oven dry weight and N content on May 9, 2001, just prior to termination.
[4] Whole-plant N concentration at early heading.

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, Gaucho, and Prescribe seed treatments were evaluated on two corn hybrids, Asgrow RX799Bt and Midland 798. With a low level of chinch bug activity, most parameters used to characterize the crop were not affected by treatments. However, all insecticide treatments comparably increased the yield of one hybrid, Asgrow RX799Bt, by an average of 5.8 bu/a. Insecticide seed treatment effects also were evaluated on NC+ 271 and NK KS 560Y grain sorghum, both of which responded similarly in the presence of low chinch bug populations. Significant differences between Cruiser and Gaucho effects were observed in plant populations and in grain yield. Cruiser increased stands by 40% and yields by 11 bu/a, while Gaucho improved stands by 27% and yields by 7.5 bu/a. However, over a 3-year period, these two insecticides had a comparable impact on sorghum yield, with an average annual increase of 8 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, 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. Beginning in 200l, a third treatment, Prescribe, which is a higher rate of Gaucho, and a fourth treatment, a higher rate of Cruiser, were added to the corn investigation. This allowed comparison of both high and low rates of these two insecticide seed treatments.

Procedures

The experiment was conducted on a Ladysmith silty clay loam soil. In 2002, corn followed soybean, and sorghum was grown on an area with a history of continuous sorghum. Corn was fertilized with 90 lb N/a and 37 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, 2002, in 30-inch rows at 20,000 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 16 days after planting (DAP). Corn was combine harvested on August 28.

Grain sorghum was fertilized with 115 lb/a of N. Hybrids NC+ 271 and NK KS 560Y, with and without Cruiser and Gaucho were planted in eight replications on May 7 in 30-inch rows at 46,090 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 20 DAP. Grain sorghum was harvested on September 6, 2002.

Results

Corn

Corn emerged at the end of April and reached silking stage in early July. Several modest rains in July and August allowed corn to survive the drouth-stressed growing season. A low population of chinch bugs was present and was not quantified. Insecticide treatments had no effect on corn stands, plant vigor, number of days to silking, or grain test weight (Table 6). With Cruiser at 5.1 oz/cwt, Asgrow RX799Bt had 6% less lodging than with no treatment. Other treatments did not affect lodging in this hybrid and none of the treatments impacted lodging in Midland 798. All insecticide seed treatments significantly increased yield of Asgrow RX799Bt and were comparable at an average of 5.8 bu/a. None of the seed treatments benefitted Midland 798 yield. The high rate of Cruiser tended (P=0.10) to increase yield of Asgrow RX799Bt more than the low rate; no effect of Gaucho rate was noted in this hybrid. Insecticides had no effect on corn yields in 2001 under the severe drouth; thus, no information on insecticide rate effects was obtained.

Grain Sorghum

More than 1 inch of rain fell within 5 days after planting. Sorghum initiated emergence at 10 DAP. Significant drouth stress during the summer months resulted in relatively low yields. Chinch bug populations were low and were not quantified. Cruiser and Gaucho increased sorghum stands by an average of 40% and 27%, respectively, and differences between these treatments were significant. Both insecticides increased plant vigor slightly at 20 DAP and also improved grain production. Cruiser increased sorghum yield by an average of 11 bu/a, which was significantly more than the 7.5 bu/a gain noted with Gaucho treatments. However, these treatments had nearly equal effects on sorghum yields over the 3-year period of this experiment, with an average increase of 8 bu/a. The number of days to half bloom, heads/plant, lodging, and grain test weight were not affected by the insecticides. Response in these parameters of the two hybrids was similar with both Gaucho and Cruiser treatments.

Table 6. Cruiser, Gaucho, and Prescribe seed insecticide effects on corn, Harvey County Experiment Field, Hesston, KS, 2002.

Hybrid	Treat-ment[1]	Grain Yield[2] 2002	Grain Yield[2] 3-Yr	Bu Wt	Plant Vigor[3]	Stand[4]	Days to Silk[5]	Ears/ Plant	Lodging
		------bu/a-----		lb/bu	score	%			%
Asgrow RX799Bt	None	52	59	54.6	3.3	93	76	0.97	15
Asgrow RX799Bt	Cruiser 1.3	57	62	54.4	3.9	95	75	0.96	14
Asgrow RX799Bt	Cruiser 5.1	62	–	55.1	3.6	93	75	0.96	8
Asgrow RX799Bt	Gaucho	57	65	54.8	3.9	92	75	0.97	10
Asgrow RX799Bt	Prescribe	57	–	54.5	3.5	94	75	0.96	13
Midland 798	None	43	43	54.3	3.9	86	78	0.95	6
Midland 798	Cruiser 1.3	44	57	53.9	4.0	88	78	0.93	5
Midland 798	Cruiser 5.1	46	–	53.9	4.2	89	78	0.96	5
Midland 798	Gaucho	44	58	53.8	3.9	86	78	0.95	5
Midland 798	Prescribe	42	–	53.9	4.0	90	78	0.94	7
LSD .05		5	–	0.64	0.26	5	0.4	NS	6
Main effect means:									
Hybrid									
Asgrow RX799Bt		57	62	54.7	3.6	93	75	0.96	12
Midland 798		44	53	54.0	4.0	88	78	0.95	6
LSD .05		2	–	0.28	0.11	2	0.2	NS	3
Treatment									
None		48	51	54.4	3.6	89	77	0.96	10
Cruiser 1.3		51	60	54.1	3.9	92	76	0.94	9
Cruiser 5.1		54	–	54.5	3.9	91	76	0.96	7
Gaucho		51	62	54.3	3.9	89	76	0.96	8
Prescribe		50	–	54.2	3.8	92	77	0.95	10
LSD .05		4	–	NS	0.18	NS	0.3	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 4: 1 = good; 5 = poor.
[4] Percent of 20,000 target plant population.
[5] Days from planting to 50% silking.

Table 7. Cruiser and Gaucho seed insecticide effects on grain sorghum, Harvey County Experiment Field, Hesston, KS, 2002.

Hybrid	Treatment[1]	Grain Yield[2] 2002	Grain Yield[2] 3-Yr	Bu Wt	Plant Vigor[2]	Stand[3]	Days to Bloom[4]	Heads/ Plant	Lodging
		------bu/a-----		lb/bu	score	%			%
NC+ 271	None	42	65	60.0	1.9	59	75	1.3	1
NC+ 271	Cruiser	53	74	59.5	1.6	80	75	1.3	2
NC+ 271	Gaucho	49	73	60.0	1.8	74	75	1.2	1
NK KS 560Y	None	42	62	59.2	2.0	54	73	1.7	0
NK KS 560Y	Cruiser	53	70	59.7	1.6	78	73	1.6	1
NK KS 560Y	Gaucho	50	69	59.6	1.8	69	73	1.6	1
LSD .05		4	–	NS	0.28	6	0.5	0.14	NS
Main effect means:									
Hybrid									
NC+ 271		48	70	59.8	1.8	71	75	1.3	1
NK KS 560Y		48	67	59.5	1.8	67	73	1.6	1
LSD .05		NS	–	NS	NS	4	0.3	0.08	NS
Treatment									
None		42	63	59.6	2.0	56	74	1.5	1
Cruiser		53	72	59.6	1.6	79	74	1.4	1
Gaucho		49	71	59.8	1.8	72	74	1.4	1
LSD		3		NS	0.20	4	NS	NS	NS

[1] Average of 8 replications adjusted to 56 lb/bu and 12.5% moisture.
[2] Vigor score on May 27: 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 and D.L. Fjell

Summary

Two corn hybrids, NC+ 5790B and NC+ 5878B, respectively representing fixed-ear (D) and flex-ear types (F), were grown in a wheat rotation under minimum-till conditions at plant populations ranging from 14,000 to 26,000 plants/a. Yields were low because of drought stress. Highest yields occurred with 14,000 and 18,000 plants/a, decreasing by 12% at 22,000 and 26,000 plants/a. Number of ears/plant tended to decrease as populations increased. Grain test weight was not affected by plant population. Lodging increased significantly with stand levels in NC+ 5878B (F) but not in NC+ 5790B (D). This was the only hybrid by treatment interaction effect observed.

Introduction

The Kansas Corn Performance Tests historically have been planted at a constant population across all hybrids at a given location. Optimal populations are generally based on current K-State Research and Extension recommendations, as well as consideration of 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.

This experiment 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 Kansas crop 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 5.9, 2.5 % organic matter, and soil tests that were medium in available phosphorus and high in exchangeable potassium. In 2001 winter wheat was grown on the site, which was subsequently maintained with minimum tillage. Corn was fertilized with 125 lb/a of N and 37 lb/a of P_2O_5 as 34-0-0 broadcast on April 16 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 17, 2001. Temik 15G insecticide at 7 lb/a was applied in-furrow at planting. Weeds were controlled with preemergence application of Partner 65 DF + atrazine 90 DF (3.85 lb + 1.1 lb/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 maturity, lodging, ear number, yield and grain test weight. Plots were combine harvested on August 29.

Results

Moisture conditions were quite favorable for corn in the first months after planting. However, the season was characterized by drouth stress. Fewer days with extreme temperatures coupled with several modest, but timely summer rains prevented crop failure and insured low, but meaningful yields.

Length of time to reach half-silking stage increased slightly in both hybrids at the two highest plant populations (Table 8). Corn yields were low and tended to decline at 22,000 and 26,000 plants/a. Highest yields occurred with 18,000 plants/a, but were not significantly better than at 14,000 plants/a. Yields at the two highest populations averaged 12% less than at the lowest populations. NC+ 5790B (D) produced 7.7 bu/a more than 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 tended to decrease as plants/a increased, and this effect was similar in both hybrids. Lodging increased significantly in NC+ 5878B (F) at all populations greater than 14,000 plants/a, reaching a plateau of approximately 28% at 22,000 and 26,000 plants/a. NC+ 5790B (D) had little or no lodging. This was the only measured variable showing a significant hybrid by plant population interaction.

Table 8. Dryland corn hybrid response to plant populations, Harvey County Experiment Field, Hesston, KS, 2002.

Hybrid[1]	Plant Population	Grain Yield[2] 2002	Grain Yield[2] 2001	Bu Wt	Ears /Plant	Days to Silk[3]	Lodging
	no./a	bu/a		lb/bu			%
NC+ 5790B (D)	14,000	66	48	53.3	1.03	75	0
NC+ 5790B (D)	18,000	70	44	52.5	0.98	75	1
NC+ 5790B (D)	22,000	57	40	52.4	0.96	76	2
NC+ 5790B (D)	26,000	64	36	52.1	0.96	77	1
NC+ 5878B (F)	14,000	58	28	55.2	1.01	75	8
NC+ 5878B (F)	18,000	62	24	55.4	0.98	75	18
NC+ 5878B (F)	22,000	52	15	55.1	0.98	76	27
NC+ 5878B (F)	26,000	53	14	55.3	0.94	77	29
LSD .05		6.9	8.4	1.0	0.04	0.5	7
Hybrid*Plant Population[4]		NS	NS	NS	NS	NS	0.003**
Main effect means:							
Hybrid							
NC+ 5790B (D)		64	42	52.5	0.98	76	1
NC+ 5878B (F)		56	20	55.2	0.98	76	20
LSD .05		3.5	4.2	0.5	NS	0.3	4
Plant Population							
14,000		62	38	54.2	1.02	75	4
18,000		66	34	54.0	0.98	75	9
22,000		54	27	53.7	0.97	76	14
26,000		58	25	53.7	0.95	77	15
LSD .05		4.9	5.9	NS	0.03	0.4	5

[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

Twenty herbicide treatments were evaluated for crop tolerance and weed control efficacy in grain sorghum. Weed competition consisted of moderate large crabgrass and sunflower populations as well as dense stands of Palmer amaranth. Full rates of Dual II Magnum, Lasso, and Outlook as well as Bicep II Magnum, Bicep Lite II Magnum, Bullet, and Guardsman preemergence provided excellent control of large crabgrass. Paramount + AAtrex + COC and Guardsman + COC postemergence had very limited activity on large crabgrass up to 2 inches tall. Palmer amaranth control was excellent with full rates of Dual II Magnum, Lasso, and Outlook alone as well as with reduced rates in combination with all subsequent postemergence treatments. Bicep II Magnum and Bullet were the only preemergence treatments with good to excellent control of sunflower. However, postemergence treatments, with the exception of those involving Aim + AAtrex, were effective on sunflower. Outlook at 15 oz/a and Guardsman preemergence caused some stunting and/or unevenness of sorghum plant heights, but did not significantly affect stands. Several postemergence treatments, principally those involving either Banvel or 2,4-D, caused significant sorghum injury. However, symptoms of injury dissipated over time and were not well correlated with yields. While all herbicides greatly improved sorghum production, significant differences in grain yield occurred among treatments.

Introduction

This experiment evaluated grass herbicides, standard premix preemergence treatments, and alternative post emergence herbicides and herbicide combinations that may provide greater flexibility for growers with regard to grain sorghum rotation and cost.

Procedures

Winter wheat was grown on the experiment site in 2001. Soil was a Geary silt loam with pH 6.8 and 2.3% organic matter. A reduced tillage system with v-blade, sweep-treader, and field cultivator was used to control weeds and prepare the seedbed. Fertilizer nitrogen was applied at 99 lb/a as 46-0-0 in early June. Palmer amaranth and large crabgrass seed was broadcast over the area to enhance the uniformity of weed populations. Also, domestic sunflower was planted in four 30-inch rows across all plots. Pioneer 8505 with Concep III safener and Gaucho insecticide seed treatment was planted at approximately 42,000 seeds/a in 30-inch rows on June 3, 2002. Seedbed condition was excellent. All herbicides were broadcast in 20 gal/a of water, with three replications per treatment (Table 9). Preemergence (PRE) applications were made shortly after planting with AI TeeJet 110025-VS nozzles at 29 psi. Postemergence treatments were applied with Turbo Tee 11003 nozzles at 20 psi on June 24 (EPOST) or June 26 (POST). EPOST treatments were applied to 0.5- to 3-inch Palmer amaranth, 4-inch domestic sunflower, and 0.5- to 2-inch large crabgrass in 5- to 8-inch sorghum. POST herbicides were applied to 0.5- to 3-inch Palmer amaranth, 4- to 5-inch sunflower, and 0.5- to 3-inch large crabgrass in 6- to10-inch sorghum. Plots were not cultivated. Crop injury and weed control were rated several times during the growing season. Sorghum was harvested September 24.

Results

Substantial rainfall began within hours after preemergence treatments were applied. Total precipitation for that day was 2.19 inches. An additional 3.55 inches of rain fell 1 week later. Mean air temperatures were near normal and precipitation was well above average in June.

Drouth stress occurred during the summer months, but timely, modest rains averted more deleterious effects on sorghum yields.

Outlook at 15 oz/a preemergence caused some stunting and unevenness of sorghum plant heights. Guardsman preemergence also resulted in minor disuniformity of emergence and plant heights. Sorghum stands were not significantly affected by any of the herbicide treatments. Among postemergence treatments following Dual II Magnum or Lasso preemergence, Peak + Banvel, Ally + 2,4-D LVE, and Yukon caused significant injury in the form of leaning plants or tillers and rolled leaves. Ally + AAtrex + 2,4-D LVE and Permit + 2,4-D LVE caused somewhat less injury. Paramount + AAtrex + COC caused light chlorosis. Sorghum treated with Aim + AAtrex had very minor and inconsistent chlorotic spotting on leaves. All symptoms of injury dissipated over time.

Moderate large crabgrass and sunflower populations developed along with dense stands of Palmer amaranth. Reduced rates (33%) of Dual II Magnum, Lasso, and Outlook were used to minimize preemergence broadleaf weed control in treatments involving subsequent postemergence herbicides. Full rates of Dual II Magnum, Lasso, and Outlook as well as Bicep II Magnum, Bicep Lite II Magnum, Bullet, and Guardsman preemergence provided excellent control of large crabgrass. At reduced rates, Dual II Magnum and Outlook were less effective, but generally gave fair to good large crabgrass control that was significantly better than the reduced rate of Lasso. Paramount + AAtrex + COC postemergence had very limited activity on large crabgrass, and the efficacy of Guardsman postemergence also was low on crabgrass already up to 2 inches in height.

Palmer amaranth control was excellent with full rates of Dual II Magnum, Lasso, and Outlook alone as well as with reduced rates in combination with all subsequent postemergence treatments. Paramount + AAtrex + COC was less effective, but still provided good control. Poor to fair control of Palmer amaranth occurred with reduced rates of Dual II Magnum, Outlook, and Lasso. At these rates, Palmer amaranth control with Outlook and Lasso tended to be slightly better than with Dual II Magnum.

Sunflower control was good to excellent with Bicep II Magnum and Bullet preemergence. All other preemergence treatments were unsatisfactory. On the other hand, most postemergence treatments effectively controlled sunflower. Exceptions were treatments involving Aim + AAtrex, which gave less than 75% control.

All herbicides significantly increased grain sorghum production. Highest yield occurred with Bicep II Magnum. A number of other treatments resulted in comparable yields. Significantly lower yields were obtained with Guardsman preemergence as well as with Dual II Magnum, Outlook, and Lasso alone. Sorghum grain moisture and test weights were not affected by treatments.

Table 9. Weed control in grain sorghum, Harvey County Experiment Field, Hesston, KS, 2002.

Herbicide Treatment[1]	Product			Timing[2]	Injury 7/3	Lacg[3] Control 8/10	Paam[4] Control 8/10	Dosf[5] Control 8/10	Yield
	Form	Rate/a	Unit						
					%	%	%	%	bu/a
1 Dual II Magnum	7.64 EC	0.44	Pt	PRE	0	79	65	0	70
2 Dual II Magnum	7.64 EC	1.33	Pt	PRE	0	97	98	0	85
3 Outlook	6 EC	5	Fl Oz	PRE	0	80	74	0	74
4 Outlook	6 EC	15	Fl Oz	PRE	7	98	99	3	79
5 Lasso	4 EC	1.66	Pt	PRE	0	69	71	0	77
6 Lasso	4 EC	2.5	Qt	PRE	0	94	99	3	86
7 Bicep II Magnum	5.5 SC	2.1	Qt	PRE	0	97	98	87	116
8 Bicep Lite II Magnum	6 F	1.5	Qt	PRE	0	99	100	53	108
9 Guardsman	5 F	2	Qt	PRE	5	100	100	34	91
10 Bullet	4 F	3.5	Qt	PRE	0	91	95	97	110
11 Guardsman +	5 F	1.75	Qt	EPOST	6	22	95	100	105
COC		1	Qt	EPOST					
12 Dual II Magnum	7.64 EC	0.44	Pt	PRE	0	87	100	100	113
Peak +	57 WG	0.5	Oz	POST					
AAtrex +	4 F	1.5	Pt	POST					
COC		1	Qt	POST					
13 Dual II Magnum	7.64 EC	0.44	Pt	PRE	19	79	99	100	111
Peak +	57 WG	0.5	Oz	POST					
Banvel +	4 EC	4	Fl Oz	POST					
NIS		0.25	% V/V	POST					
14 Dual II Magnum	7.64 EC	0.44	Pt	PRE	2	85	99	72	105
Aim +	40 WG	0.33	Oz	POST					
AAtrex +	4 F	1.5	Pt	POST					
NIS		0.25	% V/V	POST					
15 Dual II Magnum	7.64 EC	0.44	Pt	PRE	17	84	100	91	105
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	86	100	100	103
Ally +	60 DF	0.05	Oz	POST					
AAtrex +	4 F	1	Pt	POST					
2,4-D $_{LVE}$ +	6 EC	2.67	Fl Oz	POST					
NIS		0.25	% V/V	POST					
17 Paramount +	75 DF	5.33	Oz	POST	7	37	86	100	105
AAtrex +	4 F	1.5	Pt	POST					
COC		1	Qt	POST					
18 Outlook	6 EC	5	Fl Oz	PRE	0	87	100	59	105
Aim +	40 WG	0.33	Oz	POST					
Aatrex +	4 F	1.5	Pt	POST					
NIS		0.25	% V/V	POST					

Table 9. Weed control in grain sorghum, Harvey County Experiment Field, Hesston, KS, 2002.

Herbicide Treatment[1]	Product			Timing[2]	Injury 7/3	Lacg[3] Control 8/10	Paam[4] Control 8/10	Dosf[5] Control 8/10	Yield
	Form	Rate/a	Unit						
					%	%	%	%	bu/a
19 Lasso	4 EC	1.66	Pt	PRE	12	70	98	100	105
Permit +	75 DF	0.67	Oz	POST					
2,4-D $_{LVE}$ +	6 EC	2.67	Fl Oz	POST					
NIS		0.25	% V/V	POST					
20 Lasso	4 EC	1.66	Pt	PRE	16	64	100	100	105
Yukon +	67.5	5	Oz	POST					
NIS	WG	0.25	% V/V	POST					
21 No Treatment					0	0	0	0	19
LSD .05					3	8	6	19	12

[1] COC = Farmland Crop Oil Plus. NIS = Pen-A-Trate II nonionic surfactant.
[2] PRE= preemergence on June 4; EPOST = early postemergence 21 DAP.; POST = postemergence 23 DAP.
[3] Lacg =large crabgrass.
[4] Paam = Palmer amaranth. Weed population included some redroot pigweeds.
[5] Dosf = domestic sunflower.

HERBICIDES FOR WEED CONTROL IN SOYBEAN

M.M. Claassen

Summary

Twenty-two herbicide treatments were evaluated for crop tolerance and weed control efficacy in soybean. Dense large crabgrass and Palmer amaranth populations developed along with moderate sunflower stands. Large crabgrass control was good to excellent with a number of treatments, but was unsatisfactory with Flexstar + Fusion, Prowl followed by Raptor + Ultra Blazer, and with single applications of Roundup UltraMax or Touchdown. Palmer amaranth control was excellent with most treatments. Late application of Touchdown tended to diminish its efficacy on Palmer amaranth. Poor control of Palmer amaranth occurred with Prowl followed by Raptor + Ultra Blazer. Most treatments were effective on sunflower. However, Prowl followed by Raptor + Ultra Blazer failed to give acceptable sunflower control. Check plot soybean yields were reduced to zero by weed competition. All treatments benefitted soybean production. Drouth effects limited conclusions about yield response to treatments. Crop injury and weed control were not consistently correlated with soybean yield.

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 glyphosate. This experiment was conducted to evaluate various herbicides and herbicide combinations for weed control efficacy as well as soybean tolerance. Treatments in 2002 included Canopy XL preemergence followed by Roundup UltraMax + Synchrony STS postemergence; Boundary (new formulation) preemergence followed by Touchdown or non-glyphosate postemergence herbicides; and Touchdown and Roundup UltraMax application timing.

Procedures

Winter wheat was grown on the experiment site in 2001. The soil was a Smolan silt loam with pH 6.8 and 2.2% organic matter. A reduced tillage system with v-blade, sweep-treader, and field cultivator was used to control weeds and prepare the seedbed. Palmer amaranth and large crabgrass seed was broadcast over the area to enhance the uniformity of weed populations. Also, domestic sunflower was planted across all plots. Asgrow AG3302 Roundup Ready + STS soybean was planted at 104,540 seeds/a in 30-inch rows on June 11, 2002. 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 10). Postemergence treatments were applied with Turbo Tee 11003 nozzles at 20 psi on June 24 (EPOST), July 1 (POST1), July 8 (POST2), and July 15, (POST3 and SEQ). EPOST treatments were applied to 0.5- to 3-inch Palmer amaranth, 4-inch domestic sunflower, and 0.25- to 2-inch large crabgrass in 5-inch soybean with 1 to 2 trifoliate leaves. POST1 herbicides were applied to 2- to14-inch Palmer amaranth, 12-inch sunflower, and 1- to 5-inch large crabgrass in 7-inch soybean. POST2 herbicides were applied to 4- to 28-inch Palmer amaranth, 16-inch sunflower, and 4- to 9-inch large crabgrass in 10-inch soybean. POST3 and SEQ treatments were applied to 19- to 40-inch Palmer amaranth, 28- to 41-inch sunflower, and 12- to 18-inch large crabgrass in 16-inch soybean. Crop injury and weed control were evaluated several times during the growing season. Soybean was harvested September 27.

Results

Substantial rainfall totaling 2.19 inches occurred within 12 hours after planting. As a result, soil crusting was significant. Nevertheless, soybean emerged in 8 days with generally acceptable stands. Precipitation was well above average in June, but below normal in July and August. Drouth stress during the summer months was significant. Limited, but timely rains averted an even more disastrous effect on soybean yields.

Crop injury was observed with six of the treatments. Preemergence Squadron resulted in some soybean stunting. Flexstar + Fusion caused leaf crinkling and/or necrotic spots on soybean leaves. Ultra Blazer caused leaf burn.

Dense large crabgrass and Palmer amaranth stands developed along with moderate sunflower populations. A number of treatments provided good to excellent control of large crabgrass. However, poor control of large crabgrass resulted from Prowl followed by Raptor + Ultra Blazer and from Flexstar + Fusion. Also, in the absence of a preemergence grass herbicide, single application of Touchdown or Roundup UltraMax did not provide complete, season-long control of large crabgrass. Plots receiving early application of either of these two herbicides showed a decline in control late in the season because of subsequently emerging weeds.

Most treatments gave excellent control of Palmer amaranth. Intermediate season-long control was achieved with Flexstar + Fusion and single applications of Touchdown. Late application of Touchdown tended to reduce efficacy. Poor Palmer amaranth control resulted from Prowl followed by Raptor + Ultra Blazer.

Weed competition reduced soybean yields to zero in untreated check plots, and all herbicide treatments significantly benefitted soybean production. Although differences of statistical significance were noted among soybean yields, drouth-induced variability placed limitations on conclusions about treatment effects. Crop injury and/or weed control were not always correlated with yields attributed to herbicide treatments.

Table 10. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 2002.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/9	Lacg[3] Control 9/26	Paam[4] Control 9/26	Dosf[5] Control 7/30	Yield
					%	%	%	%	bu/a
1 Boundary	6.5 EC	2.25	Pt	PRE	0	99	99	85	26
2 Boundary	6.5 EC	1.5	Pt	PRE	20	100	100	99	19
Flexstar +	1.88 L	16	Fl Oz	POST1					
Fusion +	2.56 EC	10	Fl Oz	POST1					
MSO +		1	% V/V	POST1					
UAN		2.5	% V/V	POST1					
3 Boundary	6.5 EC	1.5	Pt	PRE	20	100	100	98	19
Flexstar +	1.88 L	20	Fl Oz	POST1					
Fusion +	2.56 EC	10	Fl Oz	POST1					
MSO +		1	% V/V	POST1					
UAN		2.5	% V/V	POST1					
4 Flexstar +	1.88 L	20	Fl Oz	EPOST	15	63	84	98	20
Fusion +	2.56 EC	10	Fl Oz	EPOST					
MSO +		1	% V/V	EPOST					
UAN		2.5	% V/V	EPOST					
5 Touchdown +	4 L	2	Pt	POST1	0	60	89	100	20
AMS		1.7	Lb	POST1					
6 Boundary	6.5 EC	1.5	Pt	PRE	0	99	100	100	21
Touchdown +	4 L	2	Pt	POST1					
AMS		1.7	Lb	POST1					
7 Touchdown +	4 L	2	Pt	POST2	0	73	88	100	19
AMS		1.7	Lb	POST2					
8 Boundary	6.5 EC	1.5	Pt	PRE	0	99	100	100	17
Touchdown +	4 L	2	Pt	POST2					
AMS		1.7	Lb	POST2					
9 Touchdown +	4 L	2	Pt	POST3	0	85	81	100	19
AMS		1.7	Lb	POST3					
10 Boundary	6.5 EC	1.5	Pt	PRE	0	100	100	100	23
Touchdown +	4 L	2	Pt	POST3					
AMS		1.7	Lb	POST3					
11 Touchdown +	4 L	2	Pt	EPOST	0	100	100	100	17
AMS		1.7	Lb	EPOST					
Touchdown +	4 L	2	Pt	SEQ					
AMS		1.7	Lb	SEQ					
12 Roundup UltraMax +	5 L	26	Fl Oz	EPOST	0	100	100	100	17
AMS		1.7	Lb	EPOST					
Roundup UltraMax +	5 L	26	Fl Oz	SEQ					
AMS		1.7	Lb	SEQ					
13 Canopy XL	56.3 DF	3.5	Oz	PRE	0	85	100	100	25
Touchdown +	4 L	2	Pt	POST1					
AMS		1.7	Lb	POST1					
14 Domain	60 DF	10	Oz	PRE	0	92	100	100	25
Touchdown +	4 L	2	Pt	POST1					
AMS		1.7	Lb	POST1					

Table 10. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 2002.

Herbicide Treatment[1]	Product Form	Rate/a	Unit	Timing[2]	Injury 7/9	Lacg[3] Control 9/26	Paam[4] Control 9/26	Dosf[5] Control 7/30	Yield
					%	%	%	%	bu/a
15 Canopy XL	56.3 DF	4.5	Oz	PRE	0	92	100	100	21
Roundup UltraMax +	5 L	20	Fl Oz	POST1					
Synchrony STS +	42 DF	0.25	Oz	POST1					
AMS		2	Lb	POST1					
16 Authority +	75 DF	2.5	Oz	PRE	0	90	100	100	16
Canopy XL	56.3 DF	2.5	Oz	PRE					
Roundup UltraMax +	5 L	20	Fl Oz	POST1					
Synchrony STS +	42 DF	0.25	Oz	POST1					
AMS		2	Lb	POST1					
17 Roundup UltraMax +	5 L	1.2	Pt	EPOST	0	98	99	100	16
AMS		1.7	Lb	EPOST					
Roundup UltraMax +	5 L	0.8	Pt	SEQ					
AMS		1.7	Lb	SEQ					
18 Roundup UltraMax +	5 L	1.6	Pt	EPOST	0	75	95	100	27
AMS		1.7	Lb	EPOST					
19 Prowl	3.3 EC	2.5	Pt	PRE	0	95	98	100	17
Extreme +	2.16 L	3	Pt	POST1					
NIS +		0.25	% V/V	POST1					
AMS		1.7	Lb	POST1					
20 Squadron	2.33 EC	3	Pt	PRE	11	98	100	100	20
Roundup UltraMax +	5 L	1.2	Pt	POST1					
AMS		1.7	Lb	POST1					
21 Prowl	3.3 EC	2.5	Pt	PRE	10	63	65	67	17
Raptor +	1 L	4	Fl Oz	POST1					
Ultra Blazer +	2 L	8	Fl Oz	POST1					
NIS +		0.25	% V/V	POST1					
AMS		2.5	Lb	POST1					
22 Squadron	2.33 EC	3	Pt	PRE	22	82	100	100	20
Ultra Blazer +	2 L	12	Fl Oz	POST1					
NIS +		0.25	% V/V	POST1					
AMS		2.5	Lb	POST1					
23 No Treatment					0	0	0	0	0
LSD .05					4	8	3	6	7

[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).

[2] PRE= preemergence to soybeans and weeds on June 3; EPOST = postemergence 21 DAP; POST1 = postemergence 28 DAP; POST2 = postemergence 35 DAP; POST3 = postemergence 42 DAP; SEQ = sequential postemergence 42 DAP;

[3] Lacg =large crabgrass.

[4] Paam = Palmer amaranth. Weed population included some redroot pigweeds.

[5] Dosf = domestic sunflower.

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. In 2001, a linear sprinkler system was added on a 32-acre tract 2 miles south of the present Irrigation Field. In 2002 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 type 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 a 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.

2002 Weather Information

The 2002 growing season was characterized by much below normal precipitation. The summer (June, July, August) rainfall total was the lowest since 1934.

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

	Rainfall, in.			Temperature, ^{0}F		Growth Units	
	Scandia 2002	Belleville 2002	Average 30-year	Daily Mean 2002	Avg Mean	2002	Average
April	2.3	2.29	2.3	58	54	359	243
May	5.3	5.72	3.8	63	64	456	449
June	1.5	2.28	4.6	78	73	755	691
July	0.4	0.53	3.4	82	79	839	824
August	2.5	2.65	3.4	79	77	798	798
Sept	1.8	1.25	3.5	71	69	607	577
Total	13.8	14.7	21.0			3814	3582

EFFECTS OF CROPPING SYSTEM AND NITROGEN FERTILIZATION ON SORGHUM PRODUCTION

W.B. Gordon and D.A. Whitney

Summary

The 2002 growing season was characterized by a very hot, dry summer. The summer rainfall total was the lowest since1934. The overall test average was only 53 bu/a. When averaged over all N rates, yields of sorghum grown in rotation with soybeans were 9 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 soybeans 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 only up to 60 lb/a. When averaged over N rate, no-tillage grain sorghum rotated with soybeans 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 21-year soybean yield average was 33 bu/a. Soybean yields in 2002 averaged only 6 bu/a. In 1996, four additional N rates (120, 150, 180, and 210 lb/a) were added to the experiment. When averaged over the period 1996-2002, 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 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 soybeans 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 from 1982. Treatments included cropping system (continuous grain sorghum and grain sorghum rotated with soybeans) and N rates (0, 30, 60, and 90 lb/a). In 1982-1989, 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 60,000 seed/a, and soybeans were planted at 10 seed/ft in 30-in. rows. Soybean yields were not affected by N applied to sorghum and are averaged over all N rates. In 1996, four additional N rates (120, 150, 180, and 210 lb/a were added to the experiment to further define N response.

Results

Summer rainfall averaged only 45% of normal. Temperatures also were above normal in July and August. When averaged over all N rates, grain sorghum rotated with soybeans yielded 9 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 1). Sorghum yields in the rotated system were maximized with an application of 60 lb/a N. When no N was applied, rotated sorghum yielded 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 2). Addition of N alone did not make up yield losses in a continuous sorghum production system. Over the 21-year period (1982-2002), soybean yields averaged 33 bu/a and were not affected by N applied to the previous sorghum crop (Table 3). 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, 1996-2002

	Cropping	Yield							
N Rate	System	1996	1997	1998	1999	2000	2001	2002	Avg
lb/a		---------------------------------bu/a---------------------------------------							
0	Continuous	92	51	55	73	37	59	32	57
	Rotated	120	88	87	112	46	75	43	82
30	Continuous	110	71	75	95	40	75	48	74
	Rotated	137	108	115	119	62	113	56	101
60	Continuous	131	110	118	115	68	96	51	98
	Rotated	164	128	142	127	66	128	59	116
90	Continuous	143	121	126	125	69	116	52	108
	Rotated	163	141	144	126	68	129	60	119
120	Continuous	148	122	128	123	69	117	51	108
	Rotated	162	144	145	128	65	128	59	119
150	Continuous	148	120	127	123	69	116	53	108
	Rotated	162	143	145	129	65	129	61	119
180	Continuous	148	121	128	126	68	117	52	109
	Rotated	162	144	145	129	65	129	59	119
210	Continuous	148	122	128	126	66	116	50	108
	Rotated	162	145	145	129	64	129	59	119
System Means									
	Continuous	134	105	111	113	61	101	48	96
	Rotated	154	130	134	125	63	120	57	112
N Rate Means									
0		106	70	71	92	42	67	38	70
30		124	90	95	107	51	94	46	88
60		148	119	130	121	67	112	55	107
90		153	131	135	126	69	122	56	114
120		155	133	137	126	67	123	55	114
150		155	132	136	126	67	123	57	114
180		155	133	137	127	67	123	56	114
210		155	134	137	127	65	123	55	114
LSD(0.05)		8	6	6	6	8	5	6	

Table 4. Yield of soybeans grown in rotation with grain sorghum, Belleville, 1982-2002

Year	Yield	Year	Yield
	bu/a		bu/a
1982	38	1993	56
1983	15	1994	32
1984	20	1995	41
1985	28	1996	61
1986	48	1997	36
1987	48	1998	38
1988	18	1999	42
1989	25	2000	8
1990	30	2001	31
1991	12	2002	6
1992	58	Average	33

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 inches to the side and 2 inches below the seed at planting, dribble on the soil surface 2 inches 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. Dribble application of 30-30-5 starter fertilizer applied 2 inches to the side of the row also 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 8,400 plants/a compared with the no starter check. Corn yield was 33 bu/a lower when starter fertilizer was applied in-furrow than when applied 2x2. Dribble application of starter fertilizer in a surface band 2 inches 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. Other treatments were added in order to determine if K was responsible for any of the additional yield seen with the starter fertilizers or if N and P were the only elements necessary. Starter that included K improved yields (3-year average) by 12 bu/a.

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 colters 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 inches of soil were 40 and 420 ppm, respectively.

The study consisted of 4 methods of starter fertilizer application: in-furrow with the seed; 2 inches to the side and 2 inches below the seed at planting; dribble in a narrow band on the soil surface 2 inches 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 a 8 inch 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 8,400 plants/a when compared with the no starter check (Table 4). Corn yield was 33 bu/a lower when starter fertilizer was applied in-furrow with the seed than when applied 2 inches beside and 2 inches below the seed. Dribble application of

starter fertilizer in a narrow surface band 2 inches to the side of the seed row resulted in yields equal to the 2x2 applied starter. The band over the row treatment yielded more than the in-furrow treatment but less than the 2x2 or surface band treatments. Grain yield and V6 dry matter accumulation were lower in the starter treatment that only included 5 or 15 lb N/a. Addition of K to the starter mix increased 3-year average grain yields by 12 bu/a (Table 5). When averaged over the 3 years of the experiment, there were no differences in 2x2 placement and dribble on the soil surface.

Table 5. Starter application method and composition effects on corn grain yield, plant population and V6-stage dry whole plant dry matter, North Central Kansas Experiment Field, Scandia, 2002.

Application Method	Starter	Yield, 2002	Yield, 2000-2002	Population	V-6 Dry Matter
	lb/a	bu/a	bu/a	plants/a	lb/a
	Check 0-0-0	175.2	164.4	31,425	385
In-furrow	5-15-5	188.6	172.0	24,822	392
	15-15-5	188.2	177.2	24,710	401
	30-15-5	184.5	174.4	22,754	390
	45-15-5	180.2	171.0	21,650	388
	60-15-5	170.0	162.8	21,122	345
2x2	5-15-5	202.0	193.9	31,422	452
	15-15-5	208.0	196.9	31,368	598
	30-15-5	222.2	215.7	31,480	708
	45-15-5	223.5	214.9	31,422	710
	60-15-5	222.0	214.3	31,458	711
Dribble 2x	5-15-5	200.6	189.8	31,452	445
	15-15-5	205.8	197.8	31,325	571
	30-15-5	218.0	211.9	31,388	700
	45-15-5	220.0	212.5	31,399	709
	60-15-5	221.0	212.7	31,410	710
Row band	5-15-5	195.8	179.4	31,408	448
	15-15-5	198.5	180.2	31,397	586
	30-15-5	212.2	191.5	31,429	678
	45-15-5	212.1	194.6	31,451	688
	60-15-5	213.6	200.6	31,422	689
Method Means					
In-furrow		182.3	171.1	23,012	383
2x2		215.5	206.2	31,430	636
Dribble 2x		213.0	204.9	31,395	627
Row band		206.4	190.1	31,421	617
LSD (0.05)		12.0		791	20
Starter Means					
5-15-5		196.8	183.8	29,776	434
15-15-5		200.1	188.0	29,700	539
30-15-5		209.4	199.1	29,263	619
45-15-5		208.9	198.2	28,981	624
60-15-5		206.2	197.6	28,853	613
LSD (0.05)		10.0		NS	22

Table 6. Starter fertilizer composition effects on corn grain yield, Scandia, KS.

Starter Fertilizer				2000	2001	2002	Average
	N	P_2O_5	K				
		lb/a		- - - - - - - -	- - - bu/a - - -	- - - - - - - -	
1.	15	30	5	170	180	172	174
2.	30	30	0	178	190	186	185
3.	30	15	0	178	192	185	185
4.	30	30	5	190	206	196	197

Means were compared using orthogonal contrasts. Treatment 4 was significantly greater than treatment 2 at the 0.01 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 when planting, which would eliminate trips across the field. Previous research has shown that 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 with 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 bigger 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. Polymer-coated fertilizers for slow release of N have 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 21, 2002 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 V4 stage after plant samples had been taken for dry matter and nutrient analysis.

Results

The 2002 growing season was characterized by a very cool spring followed by a hot, dry summer. Summer (June, July, and August) rainfall averaged only 47% of normal resulting in the driest summer since 1934. Grain yields were very poor. Grain sorghum stands were greatly reduced when uncoated urea was placed in contact with seed as compared to the polymer-coated urea products (Table 7). Grain 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 North Central in which 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 possible in systems where the fertilizer is placed in-furrow in direct contact with the seed.

Table 7. Effects of starter fertilizer rate and nitrogen source on plant population and grain yield of no-tillage grain sorghum at the North Central Kansas Experiment Field, Belleville, KS, 2002.

Starter			Balance		Yield	Yield
N	P_2O_5	Sources	N	Population	2002	2001-2002
lb/a			lb/a	plants/a	bu/a	bu/a
6	30	MAP	114	49,710	62	97
30	30	MAP+CRU I	90	49,618	72	107
60	30	MAP+CRU I	60	49,510	71	105
90	30	MAP+CRU I	30	48,326	68	100
120	30	MAP+CRU I	0	46,711	59	91
30	30	MAP+CRU II	90	47,654	73	107
60	30	MAP+CRU II	60	49,422	71	105
90	30	MAP+CRU II	30	46,111	72	105
120	30	MAP+CRU II	0	45,310	58	121
30	30	MAP+Urea	90	21,718	55	88
60	30	MAP+Urea	60	21,215	45	76
90	30	MAP+Urea	30	20,019	32	67
120	30	MAP+Urea	0	21,122	27	61
60	30	MAP+CRU I	0	46,432	70	102
60	30	MAP+CRU II	0	48,122	72	104
60	0	CRU I	60	48,654	70	102
60	0	CRU II	60	48,888	70	101
60	0	Urea	60	21,354	52	84
0	30	0-0-46	120	49,712	58	93
0	0	Check	0	49,822	42	67
0	0	Check	120	49,811	54	86
LSD(0.5)				1221	6	

USE OF STRIP-TILLAGE FOR CORN PRODUCTION IN KANSAS

W.B. Gordon and R.E. Lamond

Summary

Conservation tillage production systems are being used by an increasing number of producers. Early season plant growth and nutrient uptake can be poorer in no-tillage than in conventional tillage systems. Strip-tillage may offer many of the soil-saving advantages of the no-tillage system while establishing a seed-bed that is similar to conventional tillage. Field studies were conducted at Belleville and Manhattan, KS to compare the effectiveness of strip tillage to no-tillage and to access the effects of fall vs spring applications of N-P-K-S fertilizer on growth nutrient uptake and yield of corn. The 2002 growing season was characterized by rainfall much below normal at both locations. The summer rainfall total at Belleville was the lowest since 1934. Corn yields were severely reduced by the hot, dry conditions. Even though grain yields were low, strip-tillage improved early season growth and nutrient uptake of corn at both locations. Grain yields of strip-tilled corn were significantly greater than no-tillage at Belleville but not at Manhattan. At the Belleville location, strip-tilled corn shortened the time from emergence to mid-silk by 7 days and also reduced grain moisture content at harvest. Strip-tillage appears to be an attractive alternative to no-tillage for Great Plains producers.

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, 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 nutrient uptake by plants. Soils can also be wetter in the early spring with no-tillage systems, which can delay planting. Early season planting is done in order for silking to occur when temperature and rainfall are more favorable. Earliness is an important component in successful dryland corn production in Kansas. Strip-tillage may provide an environment that preserves the soil and nutrient saving advantages of no-tillage while establishing a seed-bed that is similar to conventional tillage. The objectives of this experiment were to compare the effectiveness of strip-tillage to no-tillage and to assess the effects of fall applied, spring applied or split applications of N-P-K-S fertilizer on growth, grain yield, and nutrient uptake of corn grown in strip-till or no-till systems.

Procedures

Studies were conducted at the North Agronomy Farm at Manhattan, Kansas and the North Central Kansas Experiment Farm near Belleville to compare strip-tillage and no-tillage systems for dryland corn production. Fertilizer treatments at Manhattan consisted of 30, 60, 90 or 120 lb N/a with 30 lb P_2O_5, 5 lb K_2O and 5 lb S/a. An unfertilized check plot also was included. At Manhattan, strip-tillage was done in soybean stubble in early March. The zone receiving tillage was 5-6 inches in width. Fertilizer was applied in both the strip-tilled and no-tilled plots at planting. Placement was 2 inches to the side and 2 inches below the seed. At the Belleville site, fertility treatment consisted of 40, 80, and 120 lb N/a with 30 lb P_2O_5, 5 lb K_2O, and 5 lb S/a. Strip-tillage was done in wheat stubble in early October. Fall fertilizer in the strip-tillage system was placed 5-6 below the soil surface directly under the row. Another set of plots were strip-tilled in the fall but no fertilizer was applied until planting time in the spring. Spring fertilizer in both the strip-till and no-till plots was applied 2 inches to the side and 2 inches below the seed at planting. Nutrients were supplied as 28% UAN, ammonium polyphosphate (10-34-0), and potassium thiosulfate. Corn was planted in early April at both sites.

Results

Due to the very dry growing season, grain yields at both sites were very low and response to applied N was variable. All fertility treatments improved early season growth, nutrient uptake and grain yield over the unfertilized check plot (Table 8). When averaged over fertilizer treatment at Manhattan, strip-tillage improved early season plant growth and uptake of N, P and K compared to no-tillage. Even though the strip-tillage was done only a month before planting, the tilled zone provided a better environment for plant growth and development than did the no-till plots. There was no significant difference in grain yields between the strip-tillage and no-tillage plots.

At Belleville, strip-tillage improved early season growth, nutrient uptake, and grain yield of corn compared to no-tillage (Table 9). When averaged over fertility treatment, strip-tilled plots reached mid-silk 7 days earlier than no-tillage plots. The early season growth advantage seen in the strip-tilled plots carried over all the way to harvest. Grain moisture in the strip-tilled plots was 2.8 % lower than in no-till plots. In this very dry year, yield advantage may have been the result of the increased rate of development in the strip-till system. The corn plants reached the critical pollination period sooner in the strip-tilled plants while some stored soil water was still available. The soil water reserve was depleted 1 week later when the plants in the no-tillage plots reached mid-silk.

Strip-tillage does provide a better early season environment for plant growth and development, while still preserving a high amount of residue on the soil surface. This system may solve some of the major problems associated with conservation tillage, making it more acceptable to producers.

Table 8. Tillage and nutrient management effects on corn, Manhattan, KS, 2002.

$N-P_2O_5-K_2O-S$	Tillage	V-6 Dry Wt	V-6 Uptake N	P	K	Yield
lb/acre		---lb/acre---				bu/acre
0-0-0-0	Strip-Tillage	273	8	1.4	9	36
30-30-5-5		518	17	1.9	14	59
60-30-5-5		545	18	2.2	14	59
90-30-5-5		518	19	2.0	14	70
120-30-5-5		595	22	2.3	15	66
0-0-0-0	No-Tillage	211	6	0.9	6	22
30-30-5-5		392	13	1.6	11	62
60-30-5-5		434	16	1.6	10	65
90-30-5-5		337	13	1.4	11	58
120-30-5-5		522	20	2.0	13	70
LSD(0.10)		97	4	0.5	4	15
Means						
0-0-0-0		242	7	1.2	8	29
30-30-5-5		455	15	1.8	12	61
60-30-5-5		490	17	1.9	12	62
90-30-5-5		428	15	1.6	13	64
120-30-5-5		558	21	2.1	14	68
LSD(0.10)		68	3	0.3	3	11
Strip-Tillage		490	17	2.0	13	58
No-Tillage		379	13	1.5	10	55
LSD(0.10)		43	2	0.2	2	NS

Table 9. Tillage and nutrient management effects on corn, Belleville, KS, 2002.

N-P_2O_5-K_2O-S	Tillage	V-6 Dry Wt	V-6 Uptake N	P	K	Day to Mid-silk	Moist	Yield
lb/acre		---------------lb/acre----------				days	%	bu/acre
	Strip-Tillage Fall Fertilize							
0-0-0-0		210	6	0.8	5	63	15.8	42.0
40-30-5-5		458	15	1.6	14	58	13.7	49.5
80-30-5-5		465	16	1.7	15	56	13.2	50.3
120-30-5-5		462	16	1.7	14	56	13.6	50.6
	Strip-Tillage Spring Fertilize							
40-30-5-5		461	14	1.8	14	58	13.6	49.9
80-30-5-5		466	15	1.7	14	57	13.5	49.3
120-30-5-5		668	16	1.8	15	58	13.4	50.2
	No-Tillage Spring Fertilize							
0-0-0-0		192	5	0.7	4	67	17.1	35.1
40-30-5-5		321	10	1.1	11	65	16.8	37.9
80-30-5-5		336	11	1.1	10	64	16.4	38.1
120-30-5-5		335	11	1.2	12	64	16.2	36.2
<u>Means</u>								
Strip-Tillage		456	14	1.6	13	58	13.8	48.8
No-Tillage		296	9	1.0	9	65	16.6	36.8
LSD(0.05)		15	2	0.3	2	3	1.8	4.5

NITROGEN AND PHOSPHORUS MANAGEMENT FOR CORN AND SOYBEANS GROWN IN ROTATION

W.B. Gordon

Summary

This 42-year experiment was conducted at the North Central Kansas Experiment Field, located near Scandia, on a Crete silt loam soil. The treatments applied to corn consisted of 6 N rates (40, 80, 160, and 200 lb/a) with or without 30 lb P_2O_5/a. An unfertilized check plot and a P only plot also were included. The soybean crop received no fertilization. Results of this study demonstrate the benefit of phosphorus fertilization even on soils not low in available P. Addition of P fertilizer increased yields, improved N use efficiency, lowered N requirement and hastened maturity of the corn crop.

Introduction

Nitrogen and phosphorus management are critical in crop production for both economic and environmental reasons. Application of N and P has significant economic benefits but can create unwanted water quality problems. Phosphorus fertilization is essential for optimum production of irrigated corn in central Kansas. Phosphorus is vital to plant growth and plays a key role in many plant physiological processes such as energy transfer, photosynthesis, breakdown of sugar and starches, and nutrient transport within the plant, as well as enhancing maturity of crops. Adequate P fertilization can help maximize corn grain yield and increase N use efficiency. A study was initiated in 1960 that assesses the effects of applied N, with or without P, on corn and soybean grown in annual rotation.

Procedures

This 42-year experiment was conducted at the North Central Kansas Experiment Field, located near Scandia, Kansas on a Crete silt loam soil. The experimental area was ridge-tilled and furrow-irrigated. The treatments consisted of 6 N rates (40, 80, 120, 160, and 200 lb/a) with or without 30 lb P_2O_5/a. An unfertilized check plot and a P only plot also were included. The experimental design was a 2 factor randomized complete block, replicated 4 times. The test area was arranged so that 12 corn rows were rotated with 12 adjacent soybean rows every other year. Each crop appears every year. Individual plots are 6 rows, 30 inches wide and 40 feet long. Initial Bray-1 P in the top 6 inches of soil (1959) was 80 ppm. Anhydrous ammonia was used as the N source and was applied 7-14 days before planting each year. Granular triple superphosphate (0-0-46) was used as the P source and was applied 2 inches to the side and 2 inches below the seed at planting.

Results

Averaged over the 42 years of this experiment, plots that received P yielded greater than the no P plots at all levels of N (Figure 1). Addition of P also increased nitrogen use efficiency. Maximum yield in the plots that received P was achieved with 120 lb/a N, while in the no-P plots yields continued to increase with increasing N rate up to the 160 lb/a level. Phosphorus plays an important role in seed development and can hasten crop maturity. Figure 2 shows that application of P significantly reduced grain moisture at harvest. At the 120 lb/a N rate, grain moisture was reduced from nearly 20% without P to less that 15% with P. Maturity differences that were established early in growing season persisted up to harvest (Table 10). Applied P fertilizer reduced the number of thermal units need to go from emergence to mid-silk at all levels of N.

Applied P fertilizer also improved the yield of soybean grown in rotation with corn When averaged over N-rates and years, yield of soybean with P was 61 bu/a and 51 bu/a without P. Soybean yield was not affected by N applied to the previous years's corn crop.

Annual application of 30 lb/a P_2O_5 maintained soil test levels at nearly an even level until 1985. (Figure 3). However, soil test levels have declined in recent years. Corn grain yields were 11% greater for the period 1985-2002 than for 1960-1984. This may indicate that the 30 lb P_2O_5 rate may not be keeping pace with the higher removal rate. Soil test P has declined to half of the original value in the no P plots.

Table 10. Effects of N and P rates on number of thermal units from emergence to mid-silk, 1995-2002.

N-Rate	Without P	With P
lb/acre	Thermal units to midsilk	
0	1386	1290
40	1362	1280
80	1320	1210
120	1318	1208
160	1318	1210
200	1316	1210

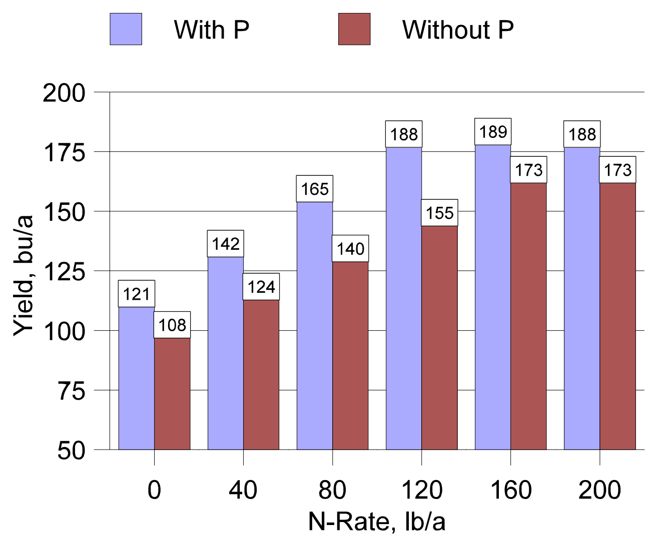

Figure 1. Corn yield as affected by N and P rate, 1960-2002.

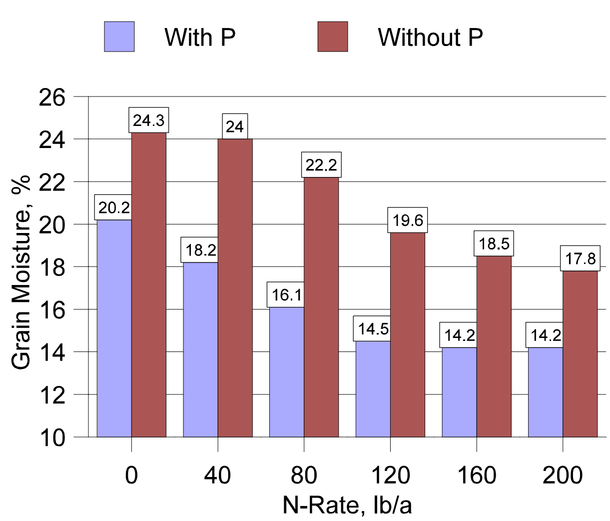

Figure 2. Grain moisture content at harvest as affected by N and P rate, 1960-2002.

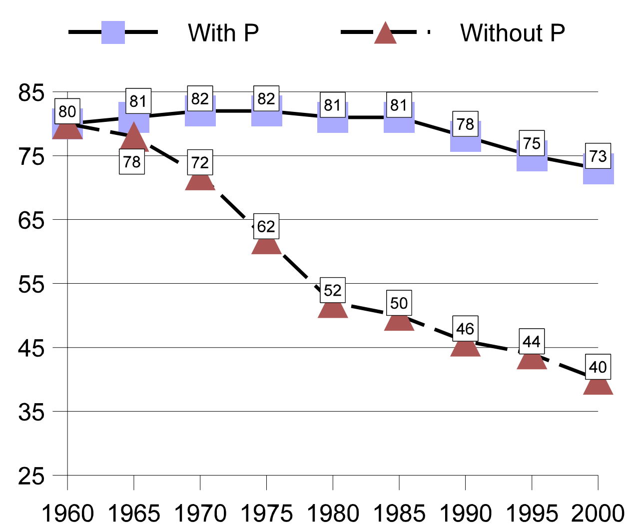

Figure 3. Soil test P changes over time at at 160 lb N/acre with and w/o 30 lb P_2O_5/acre.

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. The 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 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. At the higher fertility rates, grain yield at the higher plant population was 20 bu/a greater than at 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. Applying N fertilizer in four applications was not superior to applying in two applications. Addition of P, K, and S fertilizer resulted in a 99 bu/a yield increase over the N alone treatment. A sound fertility program can increase yields and result in improved profits.

Introduction

With advances in genetic improvement of corn, yield levels continue to raise. Analysis of the KSU Irrigated Corn Hybrid Performance Test data for the years 1968-2000 show that yields have increased by a 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 assess 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 on a Carr sandy loam soil. Analysis by Kansas State University showed that initial soil pH was 6.8; organic matter was 2.0%; Bray 1-P was 20 ppm; exchangeable K was 240 ppm; 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 only 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. N was applied in 2 split applications, (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, V4, V10, and Tassel). A complete list of treatments is given in Table 11. Fertilizer sources used were ammonium nitrate, diammonium phosphate, ammonium sulfate, and potassium chloride. The experiment was fully irrigated, receiving 12 inches of irrigation water during the growing season. Data taken in addition to grain yield included whole plant samples at V6, V10, and tassel; ear leaf samples at silking; grain and stover samples at harvest.

Results

Summer (June, July, and August) rainfall was the lowest since 1934 and totaled only 4.5 inches. However, adequate irrigation water was available and corn grain yields were excellent. Averaged over fertility treatments, there was no significant difference between plant populations, although at the higher rate of P, K, and S, grain yield at the higher plant population was 20 bu/a greater than at the lower population (Table 12). Fertility levels must be adequate in order to take advantage of the added yield potential of modern hybrids at high plant populations. Additional P, K and S increased corn grain yield by 74 bu/a over the treatment receiving only 30 lb/ace P_2O_5. Applying N fertilizer in four applications was not superior to applying in two applications. Additional treatments also were included in the experiment in order to determine which nutrients were providing the most yield increase. Addition of each fertilizer element resulted in economically feasible yield increases. Addition of P, K and S resulted in a 99 bu/a yield increase over the N alone treatment (Table 13). This represents a gross revenue increase of $227.70/a (corn price of $2.30/bu) and a net increase of over $175.00/a. Even at low commodity prices, additional fertilizer inputs are justified. A sound fertility program can increase yields and result in improved profits.

Table 11. Treatments

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

B. Fertility

1. 160 lb/a N, 30 lb P_2O_5 (K-State soil test recommendations for this site call for only 30 lb P_20_5/acre and nothing else). P in first 3 treatments was applied preplant. N was applied as a split application (½ preplant, ½ at V4)
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 (½ preplant ,½ at V4).
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, V4, V8, and tassel).
8. 230 lb/a N, 100 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

Table 12. Effects of Plant Population and Fertilizer Rates and Timing on Ridge-Tilled Irrigated Corn Yields, Scandia, KS 2002.

		Timing of N Application		
		Pre+V4	Pre+V4	Pre+V4+V8+Tassel
		Elements		
		P_2O_5	P_2O_5-K_2O-S	P_2O_5-K_2O-S
		Rates (lb/a)		
		30	100-80-40	100-80-40
Population, plants/acre	**N-Rate, lb/a***	**Yield, bu/acre**		
28,000				
	160	132	183	195
	230	158	224	223
	300	160	225	223
	N-Rate Avg	***150***	***211***	***214***
42,000	160	125	188	192
	230	145	244	245
	300	150	246	248
	N-Rate Avg	***140***	***226***	***228***
Pop Avg	bu/acre			
28,000	192			
42,000	198			
LSD (0.05)	8			
N-Rate Avg	bu/acre			
160	169			
230	207			
300	208			
LSD (0.05)	8			

* N was applied ½ preplant and ½ at V4 or split in 4 applications (preplant, V4, V8, and tassel)

Table 13. Nutrient effects on Corn Grain Yield, Scandia, 2002.

Nutrient and Rate lb/acre	Yield bu/acre	Fertilizer Cost	Net Income Benefit
		-------------- $/acre --------------	
0-0-0-0-0	**81**		
300 N	146	83.00	66.50
300 N+100 P2O5	172	109.00	33.80
300 N+100 P2O5+80 K2O	222	122.00	102.00
300 N+100 P2O5+80 K2O+40 S	245	135.00	39.90

*Net income benefit is calculated by subtracting cost of the element from yield increase due to addition of that element x $2.30 (current cash corn price). Total cost of N-P-K-S fertilizer was $135.00/acre.

COMPARISON BETWEEN GRAIN SORGHUM AND CORN GROWN IN A DRYLAND ENVIRONMENT

W.B. Gordon and S. Staggenborg

Summary

This 3-year 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. 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 and 2002 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 Crop 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 years, hybrid and N rate, grain sorghum at Belleville yielded 37 bu/a greater than corn. Even at Manhattan in a higher rainfall zone, grain sorghum yielded 12 bu/a more than corn when averaged over years, N rate and hybrid.

Introduction

Dryland corn acres continue to expand in north-central Kansas and south-central Nebraska. Government loan programs favor corn over grain sorghum. Sorghum is better adapted to drier environments than corn. Sorghum has the ability to remain dormant during drought and then resume growth; its leaves roll as they wilt, thus less surface area is exposed for transpiration; sorghum plants also exhibit a low transpiration ratio (lb of water required to produce a lb of plant biomass); and sorghum has a large number of fibrous roots that effectively extract moisture from the soil. It has been estimated that the absorption 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 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 April 25 at Manhattan. Seeding rate 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 2002 was characterized by a very cool, wet spring followed by a very hot, dry period. Summer rainfall was the lowest since 1934 at the Belleville location. Corn yield was reduced by dry conditions at pollination in late June.

August was very dry at both locations. When averaged over N rates at Belleville, the corn hybrid NC+ 5018 yielded 25 bu/a and Pioneer 34K77 yielded 32 bu/a (Table 14). Average sorghum yield was 50 bu/a. Yields of both corn and grain sorghum were so low that little response to N was seen (Table 15). When averaged over N rates and hybrids, corn at Manhattan yielded 50 bu/a and sorghum yielded 58 bu/a. When averaged over the 3-years of the experiment, grain sorghum out yielded corn by 37 bu/a at Belleville and 12 bu/a at Manhattan. The ability of sorghum to avoid short term drought and still yield was illustrated by this experiment.

Table 14. Nitrogen rate effects on yield of grain sorghum and corn hybrids, Belleville.

N-Rate	Grain Sorghum Hybrid				Corn Hybrid			
	NC+ 7R83		Dekalb 47		NC+5018		Pioneer 34K77	
	2002	2000-2002	2002	2000-2002	2002	2000-2002	2002	2000-2002
lb/a	--bu/a--							
0	40	68	40	67	10	24	30	49
40	45	73	58	77	14	25	32	56
80	48	77	56	83	12	25	34	57
120	48	77	57	84	15	27	32	57
160	47	77	56	84	12	25	32	57
Avg	46	75	53	79	13	25	32	55
LSD (0.05)	NS	NS	6		NS		NS	

Table 15. Nitrogen rate effects on yield of grain sorghum and corn hybrids, Manhattan.

	Grain Sorghum Hybrid				Corn Hybrid			
	P 8500 (2000) NC+7R37 (2001-2002)		P 84G62		NC+5081		P 34K77	
N-Rate	2002	2000-2002	2002	2000-2002	2002	2000-2002	2002	2000-2002
lb/a	--bu/a--							
0	39	50	51	59	36	41	40	55
40	55	55	71	69	49	48	46	50
80	54	57	65	71	52	44	56	58
120	44	55	83	80	51	48	58	60
160	42	56	74	76	52	46	59	59
Avg	47	55	69	71	48	45	52	56
LSD (0.05)	NS		NS		12		10	

KANSAS RIVER VALLEY EXPERIMENT FIELD

Introduction

The Kansas River Valley Experiment Field was established to study how to effectively manage and use irrigation resources 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. 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 soils are subject to wind erosion. Most soils are deep, but texture and surface drainage vary widely.

Weather Information

The frost-free season was 195 days at the Paramore Unit and 191 days at the Rossville Unit (173 days average). The last 32° F frosts in the spring were on April 5 at the Rossville Unit and on April 4 at the Paramore Unit (average, April 21). The first frost in the fall was on October 13 at the Rossville Unit and on October 16 at the Paramore Unit (average, October 11). Precipitation was below normal at both fields (Table 1). Irrigated corn and soybean yields were generally good.

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

Month	Rossville Unit		Paramore Unit	
	2001-2002	30-Yr. Avg.	2001-2002	30-Yr. Avg.
	Inches		Inches	
Oct.	2.14	0.95	1.90	0.95
Nov.	0.52	0.89	1.30	1.04
Dec.	0.11	2.42	0.00	2.46
Jan.	1.31	3.18	1.51	3.08
Feb.	0.57	4.88	0.58	4.45
Mar.	0.55	5.46	0.58	5.54
Apr.	3.57	3.67	3.58	3.59
May	3.88	3.44	3.58	3.89
June	0.96	4.64	0.96	3.81
July	0.64	2.97	0.92	3.06
Aug.	3.64	1.90	3.26	1.93
Sep.	2.53	1.24	1.59	1.43
Total	20.42	35.64	19.76	35.23

PLANTING DATES AND MATURITY GROUP EFFECTS ON SOYBEAN PRODUCTION

L.D. Maddux

Summary

Four soybean varieties of maturity groups II, mid-III, late-III, and mid-IV were planted at 4 dates from mid-April to late June/early July from 1999 to 2002. No significant yield differences among soybean varieties were observed. In 1999, there were no significant differences in yield due to planting date, but in 2000 yields of the first two planting dates were higher than the last two planting dates. At least part of this yield difference was attributed to poor stands attained at the 3rd and 4th planting dates because of dry weather. It appears from this study that maturity group does not affect yield of irrigated soybeans greatly with the earlier plantings, but if the planting date is delayed much beyond June 1, then the mid-III to late-III soybean maturities are the best choice.

Introduction

The flexibility to plant crops of choice rather than to plant to maintain base acres of a farm program crop encourages crop rotations. Soybean acres continue to increase in Kansas. Soybean tolerance to a wide range in planting dates has helped the widespread acceptance of this crop. Nevertheless, most crops have an optimum planting date that can differ by both region and cultivar. Little current information is available in Kansas concerning soybean planting dates with modern cultivars. The objective of this study is to determine the optimum planting date for soybeans from a wide range of maturities over several environments in Kansas. Six similar studies were located across eastern Kansas in 1999 with 3 western Kansas sites added in 2000. This project is supported by the Kansas Soybean Commission with check-off funds.

Procedures

This study was conducted at the Paramore Unit, Kansas River Valley Exp. Field from 1999 - 2002 and included varieties in maturity groups II, mid-III, late-III, and mid-IV. Varieties used at this location were: Grp. II - Midland 8250 (1999) and IA 2021 (2000-02); mid-III - Pi 93B54 (1999-01) and Taylor 357RR (2002); late-III - Macon; mid-IV - KS 4694. Macon has been used at all sites. Four planting dates were used beginning in mid-April and spaced on approximately 3 week intervals. Actual planting dates were: (1) - 4/21/99, 4/18/00, 4/27/01, 4/17/02; (2) - 5/13/99, 5/5/00, 5/10/01, 5/14/02; (3) - 6/4/99, 5/25/00, 6/11/01, 6/09/02; (4) - 7/2/99, 6/23/00, 6/29/01, 6/26/02. Weeds were controlled by chemical and mechanical means. The last frost in the spring occurred on 3/29/99, 4/14/00, 4/16/01, and 4/14/02. The first frost in the fall occurred on 10/4/99, 10/8/00, 10/26/01, and 10/16/02. Data collected were grain yield, maturity date, and plant height. Plots were harvested with a plot combine and yields were corrected to 13% moisture.

Results

Planting dates varied from the desired dates from year to year because of weather conditions. Fairly poor stands were obtained with the third and fourth plantings in 2000 because of dry soil conditions. The first frost in the fall hastened the maturity of the fourth planting of the mid-IV soybeans even in 2001, when it was later than usual. Maturity was delayed by 18 days (average) from the first planting date to the fourth planting date (57 days later planting, average). There was a difference of 19 days in average maturity between the group II and mid-group IV soybean (Table 2).

A positive interaction of planting date x variety was observed. The fourth planting date delayed the maturity of the Grp. II soybeans more than the other varieties. The maturity of the mid-IV variety was affected less by delayed planting date than the other varieties.

Soybean plants were generally shortest when planted in late June/early July (Table 3). The second and third planting dates were the tallest and similar in height, with the early planting date being slightly shorter. The Grp. II soybeans were shortest and the Grp. IV soybeans were tallest, with the mid- and late-III soybeans being intermediate and similar in height.

No significant yield differences were observed in 1999; however, in 2000, yields of the two earlier planting dates were higher than the last two planting dates (Table 4). The poor stands obtained at the third and fourth planting dates likely had a large influence on the lower yields. In 2002, Grp. II soybean had lower yields at all planting dates, which was attributed to a somewhat poor stands obtained with low germination seed. Also, some shattering had occurred with the Grp. II soybean in the first 2 planting dates (esp. the first planting date) before the plots could be harvested. The Grp. II soybeans would have been closer to the yield of the other varieties if they had been timely harvested. It appears from this study that maturity group does not affect yield of irrigated soybeans greatly with the earlier plantings, but if the planting date is delayed beyond about June 1, then the mid-III to late-III soybean maturities are the best choice.

Table 2. Effects of planting dates and maturity groups on maturity date, Topeka, 1999-2002.

		Maturity (Days after Sept. 1)				
Planting period (date) x maturity/variety		1999	2000	2001	2002	4-yr Avg
April 17- May 01						
April 21, 1999	II Midland 8250/IA 2021	7.0	6.0	9.0	14.0	9.0
April 18, 2000	III Pioneer 93B54/Taylor 357	15.0	17.0	22.3	26.0	19.3
April 27, 2001	III Macon	17.0	13.0	25.0	20.0	20.3
April 17, 2002	IV KS 4694	36.0	23.5	39.8	30.3	32.6
May 02-May 14						
May 13, 1999	II Midland 8250/IA 2021	13.0	9.0	10.8	12.0	12.2
May 05, 2000	III Pioneer 93B54/Taylor 357	25.5	17.3	26.8	26.0	23.6
May 10, 2001	III Macon	28.5	19.0	29.0	25.0	25.9
May 14, 2002	IV KS 4694	39.0	21.5	42.3	32.3	33.9
May 25-June 12						
June 04, 1999	II Midland 8250/IA 2021	25.5	9.0	24.3	22.0	20.4
May 25, 2000	III Pioneer 93B54/Taylor 357	34.0	23.3	35.3	39.0	31.6
June 11, 2001	III Macon	36.0	22.5	38.5	31.0	32.3
June 09, 2002	IV KS 4694	42.0	31.3	45.8	43.0	39.6
June 23-July 03						
July 02, 1999	II Midland 8250/IA 2021	38.8	23.8	34.0	34.3	32.9
June 23, 2000	III Pioneer 93B54/Taylor 357	43.0	33.0	42.0	45.0	38.8
June 29, 2001	III Macon	43.0	32.3	43.3	42.8	38.6
June 26, 2002	IV KS 4694	43.0	36.0	50.0	48.0	42.8
Interaction (Date x Maturity) - LSD(.05)		0.4	2.4	1.1	0.4	0.7
Planting Period (means)						
April 17-May 01		18.8	14.9	24.0	23.5	20.3
May 02-May 14		26.5	16.7	27.2	25.3	23.9
May 25 -June 12		34.4	21.5	35.9	32.1	31.0
June 23-July 03		41.9	31.3	42.3	37.5	38.3
LSD(.05)		0.2	1.4	0.7	0.2	0.3
Maturity/Variety (means)						
II Midland 8250/IA 2021		21.1	11.9	19.5	22.0	18.6
III Pioneer 93B54/Taylor 357		29.4	22.6	31.6	29.8	28.3
III Macon		31.1	21.7	33.9	30.3	29.3
IV KS 4694		40.0	28.1	44.4	36.4	37.2
LSD(.05)		0.2	1.2	0.5	0.2	0.4

* Significant at the 10% level of probability.

Table 3. Effects of planting dates and maturity groups on soybean plant height, Topeka, 1999-2002.

Planting period (date) x maturity/variety		Plant Height, inches 1999	2000	2001	2002	4-yr Avg
April 17- May 01						
April 21, 1999	II Midland 8250/IA 2021	28.3	27.8	31.5	21.3	27.2
April 18, 2000	III Pioneer 93B54/Taylor 357	32.3	38.0	37.0	29.5	34.2
April 27, 2001	III Macon	30.5	34.3	36.3	25.3	31.6
April 17, 2002	IV KS 4694	32.0	44.0	38.3	31.5	36.4
May 02-May 14						
May 13, 1999	II Midland 8250/IA 2021	31.8	34.8	31.3	25.3	30.8
May 05, 2000	III Pioneer 93B54/Taylor 357	35.8	42.3	34.0	33.3	36.3
May 10, 2001	III Macon	35.3	39.0	35.0	32.0	35.3
May 14, 2002	IV KS 4694	38.0	46.3	40.0	36.5	40.2
May 25-June 12						
June 04, 1999	II Midland 8250/IA 2021	31.0	29.5	33.0	29.5	30.8
May 25, 2000	III Pioneer 93B54/Taylor 357	34.8	31.8	41.5	29.8	34.4
June 11, 2001	III Macon	34.3	30.5	41.5	35.3	35.4
June 09, 2002	IV KS 4694	37.5	35.3	47.5	39.3	39.9
June 23-July 03						
July 02, 1999	II Midland 8250/IA 2021	23.5	24.3	31.5	27.8	26.8
June 23, 2000	III Pioneer 93B54/Taylor 357	25.3	27.0	35.8	28.8	29.2
June 29, 2001	III Macon	22.8	26.5	34.8	34.8	29.7
June 26, 2002	IV KS 4694	28.5	33.5	40.3	37.8	35.0
Interaction (Date x Maturity) - LSD(.05)		NS	NS	NS	NS	NS
Planting Period (means)						
April 17-May 01		30.8	36.0	35.8	26.9	32.3
May 02-May 14		35.2	40.6	35.1	31.8	35.6
May 25 -June 12		34.4	31.8	40.9	33.4	35.1
June 23-July 03		25.0	27.8	35.6	32.3	30.2
LSD(.05)		2.3	2.0	4.4	3.7	1.6
Maturity/Variety (means)						
II Midland 8250/IA 2021		28.6	29.1	31.8	25.9	28.9
III Pioneer 93B54/Taylor 357		32.0	34.8	37.1	30.3	33.5
III Macon		30.7	32.6	36.9	31.8	33.0
IV KS 4694		34.0	39.8	41.5	36.3	37.9
LSD(.05)		1.4	2.3	3.2	2.4	1.2

* Significant at the 10% level of probability.

Table 4. Effects of planting dates and maturity groups on soybean yield, Topeka, 1999-2002.

		Yield, bu/a				
Planting period (date) x maturity/variety		1999	2000	2001	2002	3-yr Avg
April 17- May 01						
April 21, 1999	II Midland 8250/IA 2021	52.1	39.8	25.2	28.2	35.2
April 18, 2000	III Pioneer 93B54/Taylor 357	39.4	49.3	53.7	56.4	49.8
April 27, 2001	III Macon	53.1	45.3	57.4	57.6	56.0
April 17, 2002	IV KS 4694	53.4	37.3	52.8	58.8	55.0
May 02-May 14						
May 13, 1999	II Midland 8250/IA 2021	44.6	46.3	37.6	35.1	39.1
May 05, 2000	III Pioneer 93B54/Taylor 357	49.0	45.2	61.2	66.1	58.8
May 10, 2001	III Macon	40.9	43.9	62.2	56.8	53.3
May 14, 2002	IV KS 4694	36.1	31.2	51.5	62.3	49.9
May 25-June 12						
June 04, 1999	II Midland 8250/IA 2021	47.0	---	57.6	43.0	49.2
May 25, 2000	III Pioneer 93B54/Taylor 357	38.8	—	65.1	55.7	53.2
June 11, 2001	III Macon	49.3	—	56.6	55.8	53.9
June 09, 2002	IV KS 4694	41.3	---	50.5	51.0	47.6
June 23-July 03						
July 02, 1999	II Midland 8250/IA 2021	52.0	—	50.7	26.9	43.2
June 23, 2000	III Pioneer 93B54/Taylor 357	44.2	—	54.0	42.0	46.7
June 29, 2001	III Macon	49.3	—	55.9	43.3	49.5
June 26, 2002	IV KS 4694	40.8	---	50.8	42.2	44.6
Interaction (Date x Maturity) - LSD(.05)		NS	NS	6.3	9.0	5.0
Planting Period (means)						
April 17-May 01		49.5	42.9	47.3	50.2	49.0
May 02-May 14		42.6	41.7	53.1	55.1	50.3
May 25 -June 12		44.1	---	57.5	51.4	51.0
June 23-July 03		46.6	---	52.9	38.6	46.0
LSD(.05)		NS	---	5.2	7.1	NS
Maturity/Variety (means)						
II Midland 8250/IA 2021		48.9	---	42.8	33.3	41.7
III Pioneer 93B54/Taylor 357		42.8	---	58.5	55.0	52.1
III Macon		48.2	---	58.0	53.4	53.2
IV KS 4694		42.9	—	51.4	53.6	49.3
LSD(.05)		NS		3.2	4.5	2.5

SUMMARY OF NITROGEN RATES ON CORN IN TWO ROTATION STUDIES

L.D. Maddux

Summary

Two studies evaluating N rates on corn following soybeans are summarized. Study 1 compared N rates on continuous corn and corn following soybeans with a complete set of data each year from 1979 - 96. Study 2 evaluated N, P, and K treatments applied to corn following soybeans in alternate (odd) years from 1983 - 2001. In both studies, little N response was obtained above 160 lbs N/a. In Study 1, continuous corn yielded 10-12 bu/a less than the corn/soybean rotation, even at the high N rate.

Introduction

When these studies were started, much of the corn in the Kansas River Valley was continuous corn. Research in other areas indicated that corn/soybean rotations benefitted both crops. These studies were designed to evaluate the effect of corn/soybean rotation and N rates.

Procedures

Study 1 evaluated N rates on corn/soybean rotations from 1978-1996. Nitrogen rates of 0, 75, 150, and 225 lbs N/a were used. For this summary, the continuous corn and the corn/soybean rotation plots were used. A corn/corn/soybean rotation was also included in the study but is not reported in this summary because results indicated second year corn following soybeans responds to N rate similar to continuous corn. A starter fertilizer including 130 lbs/a of 8-32-16 was applied as a 2x2 band at planting.

Study 2 included in this summary was initiated in 1972 at the Topeka Unit to evaluate the effects of nitrogen (N), phosphorus (P), and potassium (K) on irrigated soybeans. From 1983-2001, the study was changed to a corn/soybean rotation with corn planted in odd years. Nitrogen rates at the start of the study were 40, 80, 160, and 240 lb N/a. In 1997, the 40 lb N/a rate was changed to 120 lb N/a. This study summarizes these N rates over the plots receiving like amounts of P and K. No starter was used on this study. Both studies were planted to adapted corn hybrids in mid-April at 26,200 seed/a, except Study 2 was planted at 30,000 seed/a from 1998-2001. Herbicides were applied preplant, incorporated each year. The plots were cultivated, furrowed, and furrow irrigated as needed. A plot combine was used for harvesting grain yields.

Results

The 0 N plots in Study 1 showed a 55 bu/a yield advantage for the corn/soybean rotation compared to continuous corn (Table 5). Additional N on continuous corn reduced this yield advantage to 10-12 bu/a, but could not completely compensate for the rotation advantage. Average corn yields in Study 2 from 1983 through 1995 (7-years) and for 1997- 2001 (3 years) are shown in Table 6. Corn has been grown in odd years in this study and soybean grown in even years. No continuous corn was included in this study. However, in both studies, the yield response to N rate reached a plateau at about 160 lb N/a. Application of N above this rate did not result in additional economic yield on a corn/soybean rotation.

Table 5. Long term effects of cropping sequence and N rate on corn yields, Topeka, 1979-1996.

Crop	N Rate	5 Year Yield Averages[1], bu/a			Yield
Sequence	Lbs N/a	1979-85	1986-90	1991-96	15 yr Avg.
Continuous	0	70	57	74	69
	75	127	140	129	128
	150	149	155	166	158
	225	140	157	159	152
Corn-Soybean	0	118	110	143	124
	75	150	155	175	160
	150	156	163	185	168
	225	153	160	179	164
Interaction LSD(.05) or (.10)*		24*	11	14	14
CROPPING SEQUENCE MEANS:					
Continuous		122	127	132	127
Corn-Soybean		144	147	170	154
LSD(0.05)		12	5	7	7
N RATE MEANS:					
	0	94	84	108	96
	75	138	147	152	144
	150	152	159	176	163
	225	147	158	169	158
LSD(0.05)		17	8	10	10

[1] 1980, 1981, and 1994 not included in averages because of weather events resulting in low and variable yields.

Table 6. Effect of N rates on corn yield in a corn/soybean cropping sequence, Topeka, 1983-2001.

N Rate	1983-95 (7 yr avg)	1997-2001 (3 yr avg)	1983-2001 (10 yr avg)
lbs N/a	--bu/a--		
0	86	97	89
40	138	---	---
80	151	165	155
120	---	170	---
160	181	193	185
240	182	198	187
LSD(.10)	10	24	13

CORN HERBICIDE PERFORMANCE TEST

L.D. Maddux

Summary

This study was conducted at the Rossville Unit. Timeliness of application is a major factor in determining effective postemergence weed control. The complete postemergence treatments gave excellent control of large crabgrass, Palmer amaranth, and common sunflower this year because of timely rainfall and lack of rainfall for germination of new weeds. Most herbicide treatments used gave good to excellent control on weeds in this test.

Introduction

Chemical weed control and cultivation have been used to control weeds in row crops to reduce weed competition, which can reduce yields. Results of 17 selected treatments from a weed control test that included 34 preemergence and/or postemergence herbicide treatments 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 soybeans. The test site had a pH of 6.9 and an organic matter content of 1.1%. Garst 8342 IT hybrid corn was planted April 24 at 30,000 seeds/a in 30-inch rows. Anhydrous ammonia at 150 lb N/a was applied preplant, and 120 lb/a of 10-34-0 fertilizer was banded at planting. Herbicides were broadcast in 15 gal water/a, with 8003XR flat fan nozzles at 17 psi with 3 replications per treatment. Preemergence (PRE) applications were made April 25. Spike (SP) treatments were applied May 10 to 1-2 leaf corn, large crabgrass and palmer amaranth seedlings, and common sunflower up to 1 inch. Early postemergence (EP) treatments were applied May 29 to 5 leaf corn, 1-2 inch large crabgrass, 1-4 inch Palmer amaranth, and 2-8 inch common sunflower. The mid-postemergence (MP) treatments were applied June 7 to 6 leaf corn, 1-2 inch large crabgrass (when present), 1-4 inch Palmer amaranth, and 2-8 inch common sunflower. Populations of all 3 weed species were moderate to heavy. However, crabgrass and Palmer amaranth populations were generally fairly light at postemergence in plots receiving a preemergence treatment. Plots were not cultivated. Crop injury and weed control ratings reported were made June 11 and July 16, respectively. The first significant rainfall after PRE herbicide application was on May 5 (1.17 inches). The first sprinkler irrigation occurred on June 21. The test was harvested September 23 using a modified John Deere 3300 plot combine.

Results

Light rains of 0.08 and 0.23 inch occurred 2 and 3 days after planting with a significant rainfall of 1.17 inch occurring 11 days after planting. Very little crop injury was observed (Table 7). Weed control was relatively good for all treatments, except for Topnotch + Hornet, which rated lower in large crabgrass and common sunflower control. This treatment has usually resulted in excellent control of this weed spectrum, but did not this year. Weed control with the complete postemergence treatments were good to excellent, except that Celebrity Plus was a little weak on large crabgrass. However, when evaluating these materials, it needs to be noted that the application was timely (small, actively growing weeds) and little rainfall was obtained after application to germinate new weeds. The large LSD of 40 bu/a indicates that yields from this site were extremely variable and decisions on what herbicide to use should be based more on the weed control ratings, not the grain yield.

Table 7. Effects of pre- and post-emergence herbicides on injury, weed control, and grain yield of corn, Kansas River Valley Experiment Field, Rossville, KS, 2002

Treatment	Rate	Appl Time[2]	Corn Injury[1]	Weed Control[1,3]			Grain Yield
				Lacg	Paam	Cosf	
	product/a		---%---	----------%------------			bu/a
Untreated check		---	0.0	0	0	0	100
Dual II Magnum +	0.33 pt	PRE	0.0	82	100	100	206
Hornet + Callisto + Atrazine	3.0 oz + 1.0 oz + 4.0 oz	MP					
Atrazine +	1.5 qt	PRE	0.0	83	100	100	180
Lightning + Distinct	1.28 oz + 4.0 oz	MP					
Dual II Magnum +	1.33 pt	PRE	0.0	93	95	97	150
Callisto	3.0 oz	MP					
Dual II Magnum +	1.33 pt	PRE	0.0	82	100	100	181
Callisto + Atrazine	3.0 oz + 0.25 qt	MP					
Outlook +	1.25 pt	PRE	5.0	83	100	98	138
Marksman	3.5 pt	MP					
Topnotch +	2.5 qt	PRE	0.0	67	100	80	153
Hornet	3.0 oz	MP					
Prowl H2O + Marksman	3.0 pt + 3.5 pt	SP	0.0	98	100	100	197
Prowl EC + Marksman	2.6 pt + 3.5 pt	SP	0.0	97	100	100	190
Dual II Magnum + Marksman	1.33 pt + 3.5 pt	SP	0.0	97	100	100	211
Option + Distinct	1.5 oz + 2.0 oz	EP	0.0	87	97	100	160
Celebrity Plus	4.7 oz	EP	0.0	77	100	100	158
Callisto+ Steadfast+ Atrazine	3.0 oz+ 0.75 oz+ 0.25 qt	EP	0.0	92	100	100	187
Callisto + Accent + Atrazine	3.0 oz+ 0.5 oz+ 0.25 qt	EP	0.0	98	100	100	179
Steadfast + Hornet + Atrazine	0.75 oz + 3.0 oz + 0.5 qt	EP	1.7	92	100	100	178
Accent Gold + Atrazine	2.9 oz + 0.5 qt	EP	1.7	82	97	100	182
Steadfast + Distinct	0.75 oz + 2.0 oz	EP	1.7	85	98	100	163
Steadfast+ Callisto+ Atrrazine	0.75 oz+ 2.0 oz+ 0.75 qt	EP	0.0	85	100	100	183
LSD(.10)			1.9	6	3	5	40

[1] Corn injury - 6/11/02; weed control - 7/16/02.
[2] PRE = preemergence; SP = spike; EP = early postemergence; MP = mid-postemergence. EP & MP treatments had surfactants added (NIS, COC, UAN, &/or AMS) according to label recommendations.
[3] Lacg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower.

Prowl H2O is a new formulation of Prowl expected to be labeled for use for the 2004 growing season.

SOYBEAN HERBICIDE PERFORMANCE TEST

L.D. Maddux

Summary

This study was conducted at the Rossville Unit. The combination of a preemergence application of Boundary + a postemergence application of Touchdown resulted in better weed control than Boundary, PRE or one application of Touchdown, postemergence, regardless of timing of application. One application of glyphosate, alone was not sufficient for satisfactory weed control; a 2-pass program of glyphosate was required. A preemergence treatment containing sulfentratzone (Authority) resulted in excellent control of ivyleaf morningglory. This study emphasizes the fact that a proper application of a preemergence herbicide, even at a reduced rate, followed by a postemergence application of glyphosate, can be an effective weed control program and give the producer more flexibility in timing of the glyphosate application.

Introduction

Chemical weed control and cultivation have been used to control weeds in row crops to reduce weed competition, which can reduce yields. Results of 16 selected treatments from a weed control test that included 27 preemergence and/or postemergence herbicide treatments are presented in this paper. The weeds evaluated in these tests were large crabgrass (lacg), Palmer amaranth (paam), common sunflower (cosf), and ivyleaf morningglory (ilmg)

Procedures

This test was conducted on a Eudora silt loam soil previously cropped to corn. The test site had a pH of 6.9 and an organic matter content of 1.2%. Stine 4402-4 RR/STS soybean was planted May 18 at 144,000 seeds/a in 30-inch rows and 10-34-0 fertilizer was banded at 120 lb/a. Herbicides were broadcast in 15 gal water/a, with 8003XR flat fan nozzles at 17 psi with 3 replications per treatment. Preemergence (PRE) applications were made May 19. P3 (3 wks after planting) treatments were applied June 15 to 3 trifoliate soybean, 1-2 inch large crabgrass, 2-4 inch Palmer amaranth seedlings, 4-8 inch common sunflower, and 1-2inch ivyleaf morningglory. P4 (4 wks after planting) and MP (mid-postemergence) treatments were applied June 19 to 3-4 trifoliate soybean, 1-3 inch large crabgrass, 4-8 inch Palmer amaranth, 4-8 inch common sunflower, and 1-3 inch ivyleaf morningglory. P5 (5 wks after planting) treatments were applied June 24 to 4 trifoliate soybean, 2-4 inch large crabgrass, 4-10 inch Palmer amaranth, 6-14 inch common sunflower, and 1-4 inch ivyleaf morningglory. P6 (6 wks after planting) treatments were applied July 3 to 5 trifoliate soybean, 2-6 inch large crabgrass, 12-16 inch Palmer amaranth, 12-16 inch common sunflower, and 2-4 inch ivyleaf morningglory. Populations of large crabgrass, Palmer amaranth, and common sunflower were heavy, while populations of ivyleaf morningglory were light to moderate and variable. Plots were not cultivated. Weed control ratings reported were made August 12. The first significant rainfall after PRE herbicide application was on May 24 (0.49 inch). The first sprinkler irrigation occurred on June 21. The test was harvested November 8 using a modified John Deere 3300 plot combine.

Results

No crop injury was observed with these treatments. In the first set of treatments, Boundary was applied PRE at a low rate, and then Touchdown was applied at 4, 5, and 6 weeks after planting (P4, P5, P6) either alone or following Boundary in an effort to evaluate the effect of different timings of application of glyphosate, with and without a low rate PRE herbicide. Treatments with Touchdown and Roundup Ultra Max applied at 3 and 6 weeks after planting were also compared to these treatments, as were other combinations of PRE + Post herbicides. The low rate of Boundary alone resulted in fair control of lacg and paam, poorer control of cosf, and little control of ilmg. Touchdown alone at P4 and P5 resulted in fair to poor control of lacg and paam and little or no control of ilmg. Delaying application of Touchdown alone to P6 resulted in better weed control, but not much difference in yield. One treatment of Touchdown gave excellent control of cosf regardless of timing. This is because most sunflowers germinate in a short period of time and don't usually germinate later in the growing season. The combination of Boundary PRE + Touchdown resulted in better weed control and grain yield than Boundary or Touchdown alone. Boundary + Touchdown at P5 tended to give the highest yield, but yields in this test were quite variable, as indicated by the high LSD(.05) of 18.4 bu/a. The 2-pass program of Roundup Ultra Max gave a little better control of lacg and paam than that of Touchdown, although in other tests, there have been no differences, or results tended to be better for Touchdown.

The other treatments including reduced PRE herbicide rates + glyphosate or glyphosate + another postemergence herbicide gave good to excellent control of lacg, paam, and cosf. Sulfentrazone (Authority) has good activity on morningglory as does Canopy XL (sulfentrazone + chlorimuron) and resulted in excellent ilmg control. Even the reduced rates of Authority + FirstRate (3.5 + 0.4 oz) followed by Glyphomax Plus, resulted in equivalent weed control and grain yield as the full rates (5.33 and 0.6 oz). This emphasizes that a program of a reduced rate of the proper PRE herbicide followed by glyphosate can be an effective weed control program and give a producer more flexibility in timing of the glyphosate application. Yields in this test were fairly variable as indicated by the large LSD of 18.4 bu/a. Herbicide use decisions from this data should be determined more by the weed control ratings than by yield.

Table 8. Effects of glyphosate timing on injury, weed control, and grain yield of soybean, Kansas River Valley Experiment Field, Rossville, KS, 2002

Treatment[1]	Rate	Appl Time[2]	Weed Control[3], 8/12				Grain Yield
			lacg	paam	cosf	ilmg	
	product/a		----------------%--------------				bu/a
Untreated check		---	0.0	0.0	0.0	0.0	1.6
Boundary	1.5 pt	PRE	82	88	67	20	11.8
Touchdown	1.0 qt	P4	77	77	100	0	14.8
Boundary + Touchdown	1.5 pt + 1.0qt	PRE+ P4	93	88	100	23	26.6
Touchdown	1.0 qt	P5	77	80	98	27	9.8
Boundary + Touchdown	1.5 pt + 1.0qt	PRE+ P5	95	87	100	67	35.9
Touchdown	1.0 qt	P6	93	88	100	23	18.1
Boundary + Touchdown	1.5 pt + 1.0qt	PRE+ P6	98	100	100	33	26.3
Touchdown + Touchdown	1.0 qt + 1.0 qt	P3+ P6	82	87	100	90	32.8
Roundup Ultra Max + Roundup Ultra Max	26 oz + 26 oz	P3+ P6	92	95	100	83	41.5
Canopy XL + Touchdown	3.5 oz + 1.0 qt	PRE+ P4	90	90	100	92	35.0
Domain + Touchdown	10 oz + 1.0 qt	PRE+ P4	90	90	100	53	40.2
Python + Pendimax + Glyphomax Plus	0.8 oz + 2.0 pt + 1.5 pt	PRE+ MP	88	88	100	63	32.5
Authority + FirstRate + Glyphomax Plus	5.3 oz + 0.6 oz + 2.0 pt	PRE+ MP	93	98	100	100	41.0
Authority + FirstRate + Glyphomax Plus	3.6 oz + 0.4 oz + 2.0 pt	PRE+ MP	90	93	100	100	41.5
Pendimax + Authority + FirstRate + Glyphomax Plus (if needed)	2.0 + 3.6 + 0.4 + 2.0 pt	PRE+ MP	93	95	100	100	42.7
Canopy XL + Roundup Ultra Max + Synchrony STS	4.5 oz + 20 oz + 0.25 oz	PRE+ MP	98	95	100	100	50.1
LSD(.10)			9	13	10	34	18.4

[1] Touchdown, Roundup Ultra Max, and Glyphomax Plus treatments included recommended rate of AMS
[2] PRE = preemergence; P3, P4, P5, P6 = 3, 4, 5, 6 weeks after planting; MP = mid postemergence (Timing = P4).
[3] Lacg = large crabgrass; Paam = palmer amaranth; Cosf = common sunflower; ilmg = ivyleaf morningglory.

NORTHWEST RESEARCH—EXTENSION CENTER

Introduction

The Colby Branch Experiment Station was authorized by the State Legislature in 1913 and established in 1914 on land purchased by the Thomas County Commissioners and deeded to the state for experimental purposes. ". . . the Colby Station has been a center for studies and services aimed primarily at advancing and developing the agricultural interests in northwest Kansas."[1] Topics of interest in early years included methods of dryland farming, irrigating small acreages, and dairying, with emphasis on crop improvement and soil management. Since the 1950s, emphasis was given to studies in soil and weed management, irrigation, soil fertility, sheep production, variety testing, and crop improvement. Production of foundation wheat seed provides a quality source of public varieties. The integration of research and extension functions was formalized by renaming the station as Northwest Research-Extension Center (NWREC) in 1987.

Soil Description

The thick fertile silt-loam soils on the NWREC site are typical of those on several million acres of the High Plains of western Kansas, eastern Colorado, and western Nebraska. The predominant soil type is Keith silt loam, which has a buried soil on the station acreage. In addition, Ulysses silt loam, Richfield silty clay loam, and Goshen silt loam occur in lesser amounts.[1] These soils have developed in wind-blown silts, called loess, on uplands; have relatively slow runoff and high capacity for available water; and have high base saturation throughout the profile. The surface organic matter of these soils typically exceeds 1%, with surface pH exceeding 7.0, with pH exceeding 8.0 at localities throughout the region. Depth to free calcium carbonate (lime) is 16 to 19 inches for the Richfield and Keith series. Reduced tillage and mineral fertilizers can lower the pH in the surface soil layer.

Weather Information

Water typically limits crop productivity in rain-fed, semi-arid cropping regions. The atmospheric potential for evaporation from an open pan (Figure 1) is often three to four times greater than precipitation (Figure 2) in a year's time. The timing of precipitation can make the difference between crop harvest and crop failure. During the 2001 crop season, precipitation and pan evaporation (April through September) were similar to conditions during the 1970's and 1980's. The 2000 growing season was drier than normal, particularly during late summer. The 2002 growing season exhibited severe drought during spring and early summer, resulting in crop failure for most dryland crops, despite late-summer rainfall.

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[1]Kansas Agricultural Experiment Station Bulletin 636. 1980. The Colby Branch Experiment Station and Agriculture in Northwestern Kansas, with Special Mention of Soils.

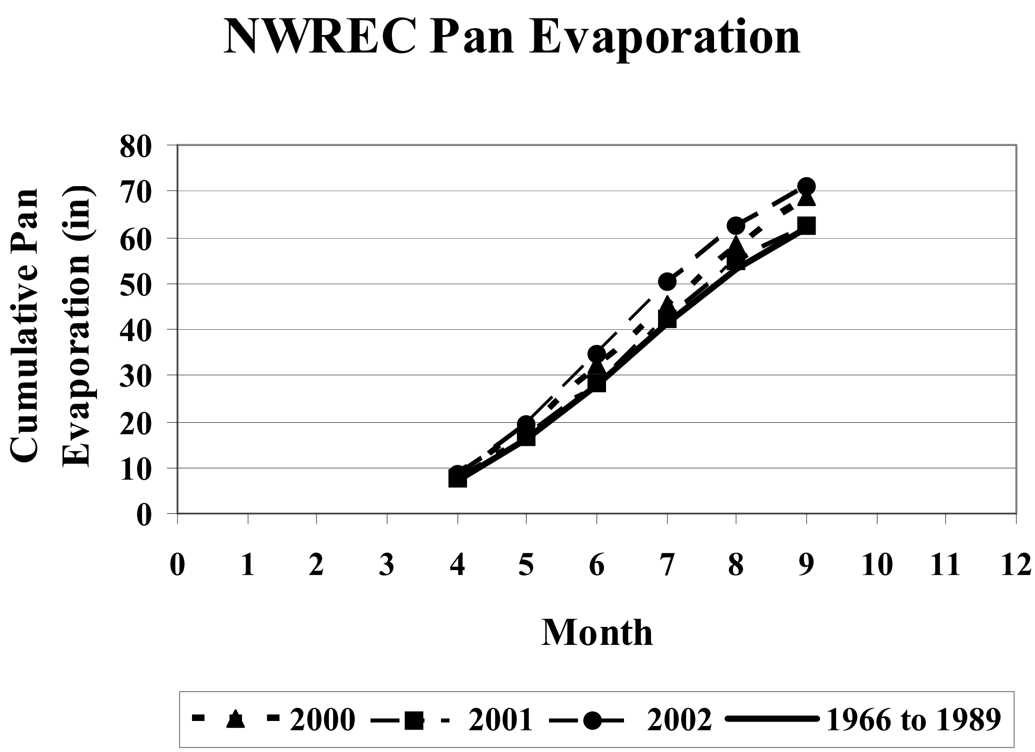

Figure 1. Cumulative pan evaporation, monthly, from April through September, for 2000, 2001 and 2002 at Colby, KS. The 24-year average (1966 to 1989) is shown for reference.

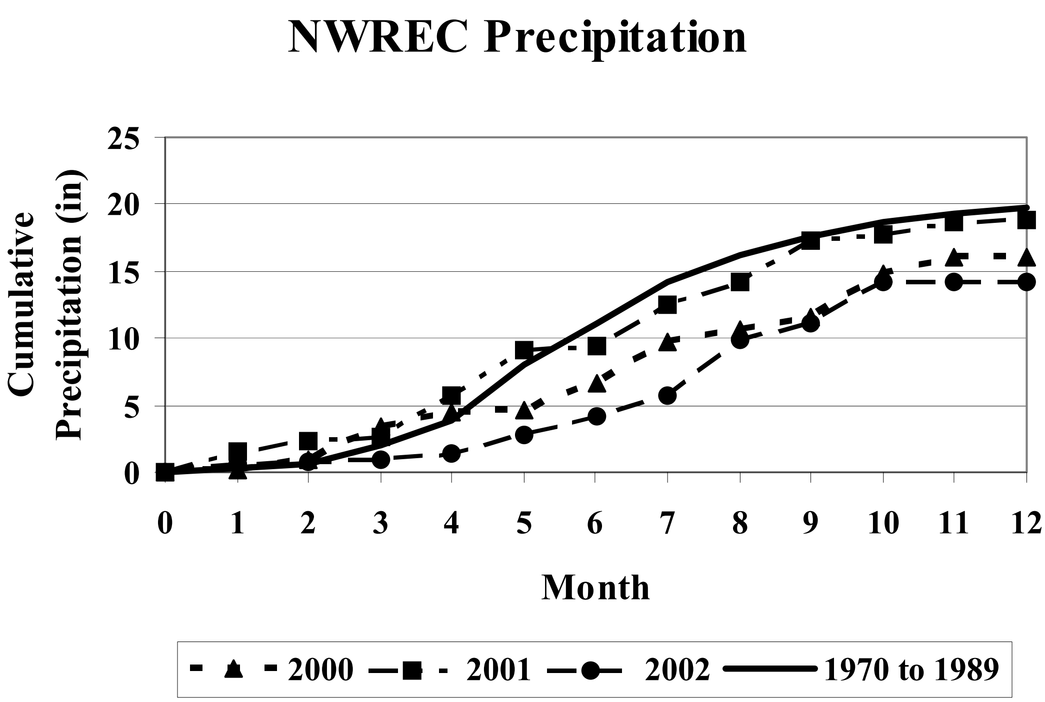

Figure 2. Cumulative precipitation, by month, for 2000, 2001 and 2002 at Colby, KS. The 20- year average (1970 to 1989) is shown for reference.

CROP SEQUENCE EFFECTS ON LAND PRODUCTIVITY, WATER USE AND SOIL QUALITY IN SEMI-ARID CROPPING SYSTEMS

R. Aiken

Summary

Intensive crop sequences add feed grain (corn, grain sorghum) and oilseed (sunflower, soybean, canola) crops to winter wheat-fallow sequences to reduce evaporative losses in fallow periods and increase land productivity. Cropping sequences cover 3-year cycles of wheat, feed grain (corn or grain sorghum), and oilseed (sunflower, soybean, canola) or fallow; as well as wheat-fallow (2-year cycle) and wheat-corn-sunflower-fallow (4-year cycle). Though crop sequence effects are just becoming established, some emerging trends indicate the following:

- Land productivity varies with rainfall among years.
- Wheat productivity benefits from summer fallow.
- Grain sorghum productivity exceeds corn when limited by water.
- Stand establishment, timing, and amounts of water limit oilseed productivity.

Annualized productivity, averaged over 2001 and 2002 growing seasons, indicates highest land productivity for wheat-fallow and wheat-sorghum-fallow sequences. These sequences, common in western Kansas, appear to sustain land productivity while permitting more intensive cropping with an oilseed crop when sufficient moisture is available.

Introduction

Available water frequently limits productivity in semi-arid cropping systems. The wheat-fallow system accumulates water over a 2-year period, producing a single wheat crop. Tillage, providing weed control, often leaves the soil exposed to evaporative and erosive forces. Frequently, more precipitation is lost to evaporation than used by a growing wheat crop. More intensive crop sequences use feed grains (corn, grain sorghum) and oilseeds (sunflower, soybean, canola) to reduce evaporative losses in fallow periods and increase land productivity. The objective of this study is to compare seed yield, water use, and soil quality factors for 10 cropping sequences.

Procedures

Cropping sequences cover 3-year cycles of wheat, feed grain (corn or grain sorghum), and oilseed (sunflower, soybean, canola) or fallow; as well as wheat-fallow (2-year cycle) and wheat-corn-sunflower-fallow (4-year cycle). Each phase of a sequence is present each year in triplicate sets of plots. Thus, cropping sequences represent 1:2, 2:3, 3:4 and 3:3 (crop harvest**:**years in cycle) cropping intensities.

Crop management is intended to minimize evaporative loss of water, maximize grain productivity, and maximize soil water recharge. Full-season, adapted-feed-grain cultivars are planted at conventional periods; short-season oilseed cultivars are planted early in continuous cropping sequences to permit wheat planting following harvest. Cultural practices are summarized in Table 1.

Crop water use is measured by precipitation and change in soil profile water content from emergence to flowering to harvest (physiological maturity). Leaf area at flowering is measured by Li-Cor 2000 plant canopy analyzer. Yield components (stand, mid-vegetative and harvest; flowering units, seed weight) and above-ground biomass are hand-sampled at maturity. Seed yield is also measured by machine-harvest, using a plot combine (platform or corn header). For conditions with poor stands, yield potential is estimated from hand-harvested samples. Yields are adjusted to standard moisture contents. Annualized grain yield, computed as the average yield (lbs/a) among all phases (including fallow) of a given sequence, provides a uniform measure of land productivity.

Results

The study was established in 2000, planted into uniform wheat stubble harvested in 1999. Thus, the 2002 harvest was the first year reflecting crop sequence effects for 3-year cycles. Crop yields and annualized grain yield (AGY) are presented for each sequence, by year, in Table 2. Though crop sequence effects are just becoming established, the following trends were observed during these drought years:

- Land productivity varies with rainfall among years.
- Wheat productivity benefits from summer fallow.
- Grain sorghum productivity exceeds corn when limited by water.
- Stand establishment, timing, and amounts of water limit oilseed productivity.
- Timing of precipitation affects herbicide activity; drought can reduce the effective control of weeds by pre-emergent and contact herbicides.

Crop sequences are known to alter soil quality factors, as well as soil water status; so these preliminary observations require confirmation from long-term data that include a broad range of weather conditions.

Annualized productivity, averaged over 2001 and 2002 growing seasons (when effects of fallow are present), indicate highest land productivity for wheat-fallow and wheat-sorghum-fallow sequences (Figure 3). Adding an oilseed crop reduced AGY by lowering wheat yields, particularly in the severe drought of 2002. The wheat-fallow and wheat-sorghum-fallow sequence, common in western Kansas, appear to sustain land productivity while permitting more intensive cropping with an oilseed when sufficient moisture is available.

Modifications of crop culture for a second 3-year cycle will likely include:

- Replacing corn with grain sorghum in the 4-year cycle to improve productivity
- Delaying planting and selecting adapted cultivars of sunflower and soybean to improve yield potential and avoid pest damage
- Seeding canola after rainfall events for improved stand establishment
- Utilizing Raptor (immidazolinone) herbicide for post-emergent weed control in oilseed crops.

The study is expected to continue for a minimum of four 3-year cycles to establish long-term crop sequence effects in this environment.

Table 1. Typical crop cultural practices for crop sequence study, Colby, KS, 2000-2002.

Crop	Cultivar	Seeding	Fertilizer	Pesticide/Weed Control	Yield Basis
Wheat	Jagger	60#/a	70#N, 30#P	Starane 0.5 pt./a	13%
Corn	CA 6920 Bt	16,000 seeds/a	70#N, 30#P	Roundup UM 24 oz/a Dual II Mag 1.5 pt./a Aatrex 4L 16 oz/a	15.5%
Grain Sorghum	CA 737	3.5 #/a	70#N, 30#P	Roundup UM 24 oz/a[1] Dual II Mag 1.5 pt./a	12.5%
Canola	Hyola	5#/a	60#N	Treflan 1.5 pt./a Roundup Ultra 16 oz/a[1]	10%
Soybean	IA 1008	175,000 seeds/a	90#N, 30#P	Command 4EC 2 pt./a Dual II Mag 1.33 pt./a	13%
Sunflower	SF 187	18,000 seeds/a	70#N, 30#P	Lorsban 15 2#/a Roundup RT 24 oz/a Prowl 3.3EC 3.5 pt./a	10%
Fallow, No-till	----	----	----	4X Roundup Ultra 16 oz/a[2] Aatrex 4L 16 oz/a 2,4-D 1.5 qt./a	---
Fallow, Red. Till	----	----	----	4X Undercut with Sweep Plow	---

[1]When weeds were present prior to planting.
[2]Ammonium sulfate was added (17 lb/100 gal first application, 10 lb/100 gal later applications) to Roundup Ultra fallow applications, but not in tank mixes.

Table 2. Crop sequence effects on grain yields and land productivity, Colby, KS, 2000-2002.

	Crop and Land Productivity (lb/a)			
Rotation[1]	Wheat Phase	Feed Grain Phase	Oilseed Phase	Annualized Grain Yield
		2000		
WW-C-Can	1012	1801	237	1017
WW-C-Soy	1012	1801	0	938
WW-C-Sun	1012	1801	1229	1347
WW-C-Fal	1012	1801	------	938
WW-GS-Can	1012	3500	237	1583
WW-GS-Soy	1012	3500	0	1504
WW-GS-Sun	1012	3500	1229	1913
WW-GS-Fal	1012	3500	------	1504
WW-Fal	968	------	------	484
WW-C-Sun-Fal	1021	2076	1174	1068
		2001		
WW-C-Can	2775	1480	547	1601
WW-C-Soy	2690	1480	755	1642
WW-C-Sun	2446	1480	400	1442
WW-C-Fal	4465	1480	------	1982
WW-GS-Can	2775	4761	547	2694
WW-GS-Soy	2690	4761	806	2752
WW-GS-Sun	2446	4761	714	2640
WW-GS-Fal	4465	4761	------	3075
WW-Fal	4484	------	------	2442
WW-C-Sun-Fal	4601	1309	568	1619
		2002		
WW-C-Can	513	0	0	171
WW-C-Soy	300	0	250	183
WW-C-Sun	312	0	0	104
WW-C-Fal	1728	0	------	576
WW-GS-Can	942	406	0	450
WW-GS-Soy	461	851	249	552
WW-GS-Sun	556	268	0	243
WW-GS-Fal	1995	1413	------	1136
WW-Fal	3833	------	------	1916
WW-C-Sun-Fal	2381	0	0	595

[1]WW = Winter Wheat (13% moisture basis), C = Corn (15.5% moisture basis), Can = Canola (10% moisture basis), Soy = Soybean (13% moisture basis), Sun = Sunflower (10% moisture basis, Fal = Fallow, GS = Grain Sorghum (12.5% moisture basis).

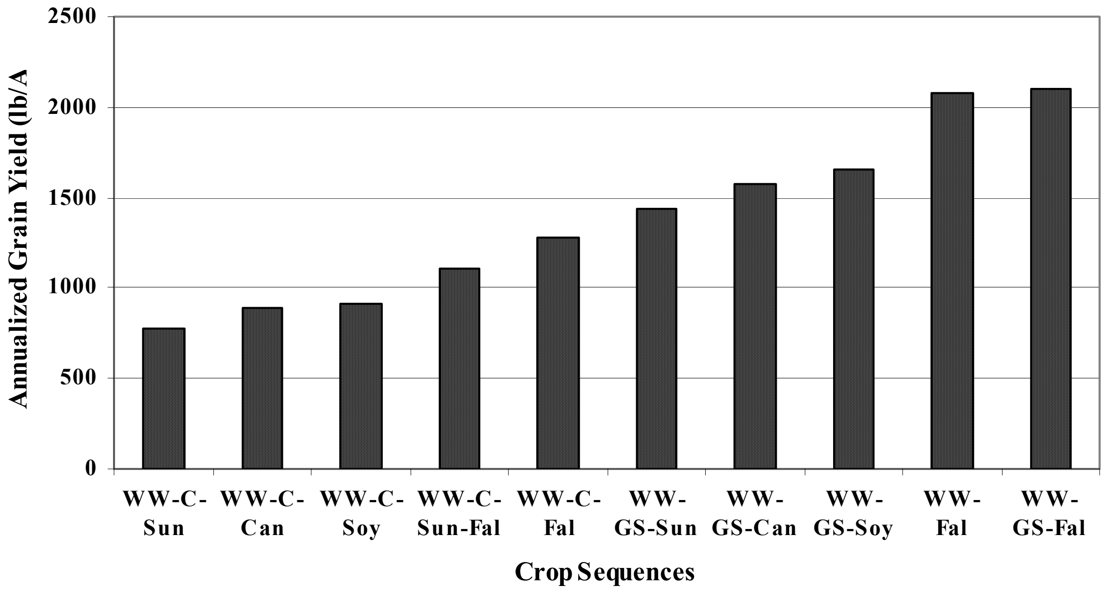

Figure 3. Crop Sequences and Land Productivity Under Agricultural Drought, Colby, KS, 2001 and 2002.

EFFECTS OF INSECTICIDE TIMING AND PLANTING PERIOD ON SUNFLOWER PRODUCTIVITY IN NORTHWEST KANSAS

R. M. Aiken and L. D. Charlet

Summary

The sunflower stem weevil, *Cylindrocopturus adspersus* (LeConte), is a pest of cultivated sunflower. The objective of this study was to test insecticides using different timing strategies and different planting periods to manage weevil densities to reduce losses of sunflower productivity from lodging. Planting periods ranged from early May to mid-June. Delaying planting until late May resulted in higher yields for non-treated sunflower in 2002, but not in 2001. Lack of response to planting date in 2001 is attributed to the effects of uncontrolled sunflower moth infestations. Insecticide treatments improved seed yields by at least 600 lb/a for all planting periods in both years. These results support economic control measures for stem weevil pests.

Introduction

The sunflower stem weevil, *Cylindrocopturus adspersus* (LeConte), is a pest of cultivated sunflower. Since 1993 damage has been reported and populations have been increasing in eastern Colorado, western Kansas, and Nebraska. Adult sunflower stem weevils emerge from over-wintered stalks in mid-to-late June in the Northern Plains. Females lay their eggs at the base of sunflower stalks. Larvae feed apically in the stems until early August and then descend to the lower portion of the stalk or root crown by late August and excavate over-wintering chambers by chewing cavities into the stem cortex. High larval populations can weaken the stem by tunneling, destroying pith, or excavating over-wintering chambers. Subsequent stem breakage and lodging will cause a loss of the entire head prior to harvest. Models for degree-day prediction of weevil emergence have been developed for both the Northern and Central Plains, but have not been used for timing of insecticide treatment. The objective of this study was to test insecticides using different timing strategies and different planting periods to manage weevil densities to reduce losses of sunflower productivity that result from lodging.

Procedures

Sunflower seed (Triumph 652, oilseed at 23,500 seeds/a) was planted in 30-inch rows in three planting periods, beginning mid-May through mid-June, in disked and harrowed soil (Keith silt loam), using a fluted coulter and double-disk opener. Soil fertility was amended with 90 lb N/a and 30 lb P_2O_5/a. Weeds were controlled by herbicide (Glyphosate, or Roundup, 8 oz/a; sulfentrazone, or Spartan, 3 oz/a and pendimethalin, or Prowl, 3.5 pt/a). Sunflower crop development (leaf appearance and reproductive growth stage) was noted at weekly intervals. Canopy leaf area was measured at flowering (R5) using a Li-Cor 2000 canopy analyzer. Soil water was measured at emergence, flowering, and maturity. Crop stand (V8 and R9), yield components and above-ground biomass were measured at physiological maturity from two 17 ft by 5 inch rows from each of four replicated plots. Plots were also machine-harvested when seed moisture was less than 12%. Seed was analyzed for moisture content, test weight, seed weight, and oil content (oilseed) or seed size distribution (confection). In 2001, trials included insecticide application (carbofuran, or Furadan 4F, 16 oz/a) timing based on plant growth stage (V5 to V10, V10 to R1). In 2002, trials included insecticide application timing based on both plant growth stage and the use of degee-day models for weevil emergence to determine which is most effective. All treatments included untreated controls and were replicated four times. The degree of control was measured by comparing the percentage of plant lodging and the number of weevil larvae per stalk. Control of the sunflower longhorned beetle was measured by comparing the populations of this pest found in dissected stalks.

Results

Severe sunflower moth infestations likely reduced yields in 2001 by 45% relative to 2002 yields[1]. Results of this study suggest crop yields with control of stem pests approximates the relative yield potential of the two years. Delaying planting until late May resulted in higher yields for non-treated sunflower in 2002, but not in 2001. Lack of response in 2001 is attributed to the effects of uncontrolled sunflower moth infestations. Insecticide treatments improved seed yields by at least 600 lb/a for all planting dates in both years at the irrigated site (Tables 3 and 4). Greatest seed yield occurred with later insecticide treatment in 2001 (Table 4). These results support economic control measures for stem weevil pests.

Table 3. Seed yields† at NWREC, Colby, KS, 2001.

	May 11, 2001	June 5, 2001	June 22, 2001
		lbs/a	
Untreated	476	445	516
Furadan V5 to V10	1080	1087	1310
Furadan V10 to R1	1646	1658	1358
Water Use (in)	17.47	21.22	20.68

†Seed yields adjusted to 10% moisture content, Triumph 652.

Table 4. Seed yields† at NWREC, Colby, KS, 2002.

	May 10, 2002	May 28, 2002	June 6, 2002
		lbs/a	
Untreated	173	2414	2094
Furadan			
581 GDD (base 6	3399	3045	3044
Furadan V8 to V10	2750	2856	3114

†Seed yields adjusted to 10% moisture content, Triumph 652.

[1]Kansas Performance Tests with Sunflower Hybrids, Report of Progress 905, 2002. The High Plains Committee and the National Sunflower Association provided support for this research.

EFFECTS OF PLANTING PERIOD ON SUNFLOWER PRODUCTIVITY IN NORTHWEST KANSAS

R. M. Aiken and R. D. Stockton

Summary

Available soil water can limit sunflower productivity by direct effects on canopy function, as well as indirect effects on canopy and seed development. The objective of this study was to determine effects of planting period on oilseed and confection sunflower development, seed yield and quality, and water use in rain-fed, semi-arid cropping systems. Planting periods ranged from early May to mid-June. The highest yields for both oilseed and confection crops resulted from the early- or mid-June planting period in both years. Relative yield losses occurred in both years for both oilseed and confection crops planted in the early-May period. These results confirm earlier recommendations to plant sunflower in June when moisture is adequate for rapid emergence and improved crop productivity.

Introduction

Sunflower yield can be reduced by pest infestation, heat stress, and/or water deficits. Optimal planting periods avoid or minimize the impacts of these environmental stress factors on yield. Knowledge of these effects can guide management decisions to sustain or improve water management for sunflower productivity in rain-fed and limited-irrigation crop systems. The objective of this study was to determine effects of planting period on oilseed and confection sunflower development, seed yield and quality, and water use in semi-arid cropping systems.

Procedures

Sunflower seed (SF 187, oilseed at 18,000 seeds/a and Sigco 954, confection at 14,000 seeds/a) was planted (30-inch rows, using a fluted coulter and double-disk opener) in four planting periods beginning early May through mid-June, into a Keith silt loam soil, fallowed after the previous crop. Soil fertility was amended with 90 lb N/a and 30 lb P_2O_5/a. Weeds were controlled by herbicide (Glyphosate, or Roundup, 8 oz/a; sulfentrazone, or Spartan, 3 oz/a and pendimethalin, or Prowl, 3 oz/a). No insecticide was applied for stem or head pests.

Sunflower crop development (leaf appearance and reproductive growth stage) was noted at weekly intervals. Canopy leaf area was measured at flowering (R5) using a Li-Cor 2000 canopy analyzer. Soil water was measured at emergence, flowering, and maturity. Crop stand (V8 and R9), yield components, and above-ground biomass were measured at physiological maturity from two 17 ft by 5 inch rows from each of four replicated plots. Plots were also machine-harvested when seed moisture was less than 12%. Seed was analyzed for moisture content, test weight, seed weight, and oil content (oilseed) or seed size distribution (confection).

Results

Below-normal precipitation and above-normal evaporative demand reduced yield potential of rain-fed sunflower by 24% in 2000, relative to 2001.[1] A heavy infestation of sunflower moth reduced yield potential of the irrigated crop by 24% in 2001, relative to 2000[1], despite insecticide application. Seed quality in this study was poorer in 2001 relative to 2000. Oilseeds tended to lower oil content (Table 5) and confections tended to smaller seed size (Table 6) in 2001 relative to 2000. Weather and insect pests likely affected yield response to planting periods in the two years.

The highest yields for both oilseed and confection crops resulted from the early- or mid-June planting period in both years. Relative yield losses occurred in both years for both oilseed and confection crops planted in the early-May period.

Fewer seeds were harvested per plant for the early planting period relative to later periods. Delayed emergence and low plant populations occurred each year, affecting both crop types. However, yield compensation occurred with more harvested seeds per plant and larger seed size.

These results confirm earlier recommendations[2] to plant sunflower in June when moisture is adequate for rapid emergence and improved crop productivity.

Table 5. Planting period effects on oilseed yield, components, Colby, KS.

Planting Period	Stand	Harvested Seeds/plant	1000 Seed wt	Yield[1]	Oil	Biomass	Planting Date
	plants/a			lb/a	%	lbs/a	
			2000				
1	12,500	445	69.6	838	35.5	na[2]	5/5/00
2	7,875	1,554	62.6	1,665	34.4	4,507	5/19/00
3	10,625	1,729	53.4	1,945	34.9	4,584	6/2/00
4	12,250	1,370	48.7	1,701	35.3	4,312	6/16/00
			2001				
1	12,875	344	33.5	327[3]	31.0	2,179	5/11/01
2	13,500	701	40.8	854	30.9	3,134	5/24/01
3	14,375	814	37.4	970	33.2	3,293	6/8/01
4	6,875	1134	72.6	1,253	32.7	3,874	6/22/01

[1]Yield is adjusted to 10% moisture content.
[2]Not available.
[3]Machine-harvested yield reported for this plot due to nonrepresentative hand-harvest sample.

Table 6. Planting period effects on confection seed yield and size, Colby, KS.

Planting Period	Stand	Harvested Seeds/plant	1000 Seed wt	Yield[1]	<20/64	20-22/62	>22/64	Biomass
	plants/a			lb/a				lbs/a
				2000				
1	9,125	293	96.1	567	28.3	34.2	37.5	na[2]
2	5,750	788	118.9	1,187	9.7	33.4	56.9	na
3	7,000	830	108.6	1,392	20.0	27.6	52.5	na
4	10,125	524	97.3	1,139	20.9	29.1	50.0	na
				2001				
1	8,875	147	91.4	264	88.5	9.9	1.7	2,439
2	11,875	338	84.2	749	65.5	26.5	8.0	3,224
3	11,375	325	83.2	681	68.9	24.3	6.8	3,379
4	5,750	803	107.3	1,097	36.3	28.1	36.3	3,125

[1]Yield is adjusted to 10% moisture content.
[2]Not available.

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[1]Kansas Performance Tests with Sunflower Hybrids, Report of Progress 888, 2001.
[2]H. D. Sunderman, D. W. Sweeney, and J. R. Lawless. 1997. Irrigated Sunflower Response to Planting Date in the Central High Plains. J. Prod. Agric. 10:607-612.

The High Plains Committee of the National Sunflower Association provided support for this research.

EFFECTS OF SUPPLEMENTAL WATER ON SUNFLOWER PRODUCTIVITY IN NORTHWEST KANSAS

R. M. Aiken and R. D. Stockton

Summary

Available soil water can limit sunflower productivity by direct effects on canopy function, as well as indirect effects on canopy and seed development. The objective of this study was to determine effects of water deficits on oilseed sunflower development, seed yield and quality, and water use in semi-arid cropping systems. Supplemental water treatments were applied to sunflower during vegetative, reproductive, or both growth stages. Seed yields ranged from 2100 to 2700 lbs/a in 2000, and were reduced by 38% in 2001. Reduced yields in 2001 are attributed to severe sunflower moth infestation (24% reduction) and inadequate irrigation amounts (14% reduction). Crop water use appears to be limited by available soil water when relative soil water (in the wettest soil layer) is less than 60% of water holding capacity. Available water affects crop canopy development as well. Results from related studies suggest control of insect pests is required to achieve yield potential of supplemental water for improved water use.

Introduction

Available soil water frequently limits grain productivity in rain-fed, semi-arid cropping systems of the central Great Plains. Water use for sunflower can exceed that of other summer crops, due to higher transpiration rates, greater rooting depth, and extraction of soil water. Available soil water can limit sunflower productivity by direct effects on canopy function, as well as indirect effects on canopy and seed development. Knowledge of these effects can guide management decisions to sustain or improve water management for sunflower productivity. Improving the productive use of water by sunflower cultivars would enhance the array of management alternatives for farmers seeking profitable crops for rain-fed and limited irrigation crop systems in this region. The objective of this study was to determine effects of water deficits on oilseed sunflower development, seed yield and quality, and water use in semi-arid cropping systems.

Procedures

Sunflower seed (SF 187, oilseed) was planted (30-inch rows) in early June, into disked and harrowed soil (Keith silt loam), in 20 ft x 90 ft experimental plots, using a fluted coulter and double-disk opener. Soil fertility was amended with 100 lb N/a and 30 lb P_2O_5/a. Weeds were controlled by herbicide (sulfentrazone, or Spartan, 3 oz/a and pendimethalin, or Prowl 3.3EC, 3.5 pt/a). Water deficits (defined as difference between available water and field capacity of rooted soil, exceeding 4 inches) developed according to available soil water, crop growth, weather conditions, and experimental treatment (flood irrigation, using dikes to control runoff).

Supplemental water treatments were:

- SIT1 no supplemental water
- SIT2 water during reproductive development and grain fill (R1 – R9)
- SIT3 water during grain fill (R6 – R9)
- SIT4 water during reproductive development (R1 – R5)
- SIT5 water throughout growing season (V12 – R9).

Sunflower crop development (leaf appearance and reproductive growth stage) was noted at weekly intervals. Canopy leaf area was measured weekly, using a Li-Cor 2000 canopy analyzer. Soil water was measured at weekly intervals by neutron thermalization. Crop stand (V8 and R9), yield components, and above-ground biomass were measured at physiological maturity from two

17 ft by 5 inch rows from each of four replicated plots. Plots were also machine-harvested when seed moisture was less than 12%. Seed was analyzed for moisture content, test weight, seed weight, and oil content.

Results

Irrigated yields in 2001 were 38% lower than yields in 2000 (Table 7). Yield reductions are attributed to a severe sunflower moth infestation, which reduced irrigated sunflower yields by 24% in Crop Performance Trials,[1] as well as insufficient irrigation amounts in 2001, due to faulty readings of soil water. Supplemental irrigation increased seed yields by 480 lbs/a each year, a lower response than expected. It is likely that insect pests limited yield potential of crop with adequate water supply.[2]

Crop water use appears to be limited by available soil water when relative soil water (in the wettest soil layer) is less than 60% of water holding capacity (Figure 4). This result is consistent with other field observations, though the threshold relative water content may vary with soil conditions. Leaf area at flowering (R5) is correlated with relative soil water, observed during the mid-bud (R3) growth stage (Figure 5). Thus, available soil water also appears to alter canopy development, though the effect may be delayed by two weeks.

Table 7. Water supplement effects on sunflower yield components

Watering Regime	Stand	Harvested Seeds/Plant	Seed Weight	Seed Yield	Oil	Biomass
	plants/a		g/1000 seed	lbs/a[1]	%	lbs/a
			2000			
1	14,875	1,897	46	2,119	37.7	6,193
2	15,750	1,799	54	2,602	40.0	7,572
3	15,250	1,814	53	2,703	40.6	7,247
4	14,875	1,784	51	2,541	38.3	6,943
5	14,500	1,945	50	2,348	40.2	6,590
			2001			
1	23,375	873	43	1,237	36.8	4,911
2	23,125	1,001	48	1,705	38.3	5,905
3	23,125	964	45	1,544	39.0	5,451
4	23,250	984	41	1,419	36.6	5,543
5	21,750	1,062	47	1,722	37.2	5,837

[1]Yield is adjusted to 10% moisture content

[1]Kansas Performance Tests with Sunflower Hybrids, Report of Progress 888, 2001.
[2]Effects of Insecticide Timing and Planting Period on Sunflower Productivity in Northwest Kansas, Report of Progress, 2003.

The High Plains Committee of the National Sunflower Association provided support for this research.

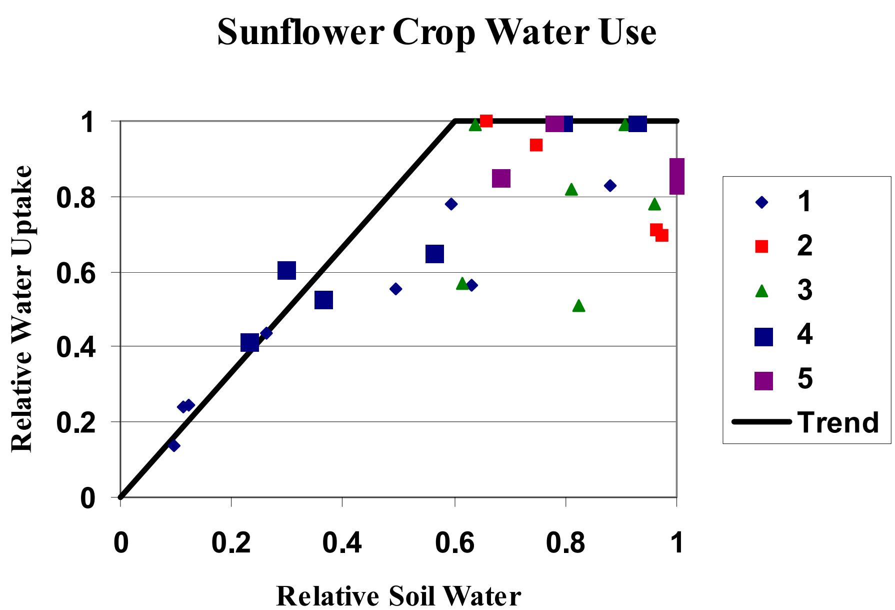

Figure 4. Water uptake by sunflower (relative to maximum observed uptake) in relation to the available soil water in the wettest soil layer (relative to available water capacity).

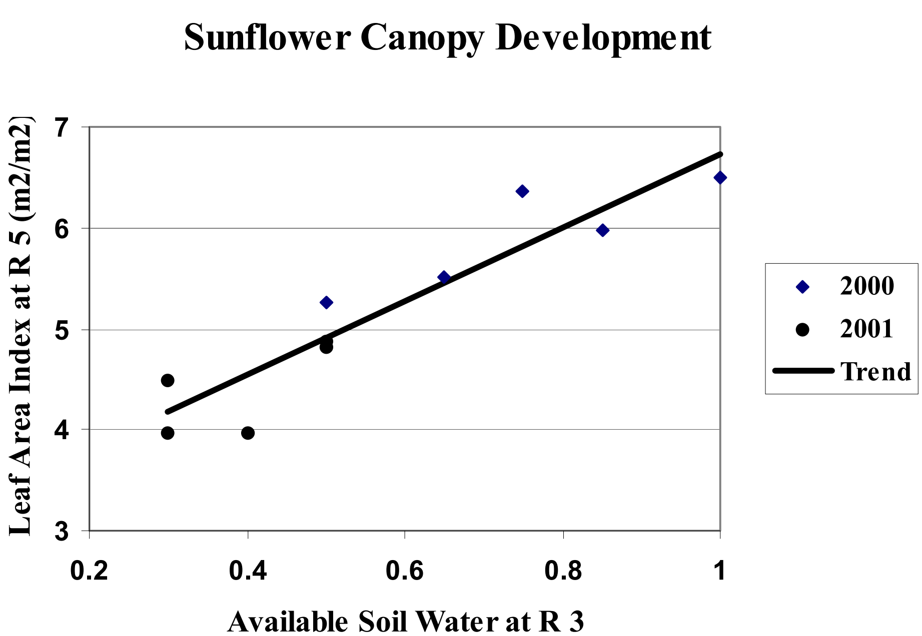

Figure 5. Sunflower leaf area at flowering (R5) in relation to available soil water at mid- bud (R3) growth stage.

SOYBEAN PRODUCTIVITY UNDER DROUGHT: EFFECTS OF PLANTING DATES AND MATURITY GROUPS IN NORTHWEST KANSAS

R. Aiken and W.B. Gordon

Summary

This study was conducted to determine effects of planting date and maturity group in soybean productivity in rain-fed, semi-arid crop systems. Seven cultivars, representing maturity groups (MG) I, II, III, and IV were planted in four periods from late April through late June over three cropping seasons. Soybean yields ranged from 3.4 to 17.1 bu/a under drought conditions. With inconsistent results over years, a superior planting date or maturity group was not identified. Optimal rain-fed soybean yields, under drought conditions, occurred by planting a medium maturity (MG III) cultivar, i.e. ‘Macon’, in late April when soil moisture was adequate. When soil moisture was lacking, planting could be delayed until early June without apparent yield loss. Timing and precipitation amounts, in relation to crop development, likely contributed to yield variation.

Introduction

Soybean productivity in semi-arid regions can exceed 59 bu/a when rainfall is supplemented by irrigation.[1] However, less is known of yield potential in limited rainfall environments. Timing of rainfall, as well as amount, can affect productivity. Soybean maturity groups differ in days to flowering and maturity, as day length affects crop development. To test a range of growing conditions, four planting periods and seven cultivars representing four MG were evaluated. The objective was to determine seed yield and growth characteristics of soybean cultivars representing MG I, II, III, and IV, planted from late April through late June in rain-fed, semi-arid cropping systems.

Procedures

The study was conducted at the Northwest Research–Extension Center, near Colby, Kansas on a Keith silt loam soil. The cultivars/MG included IA 1008 (I), IA 2021 (II), Turner (II), Macon (III), IA 3010 (III), K 1380 (IV), and KS 4694 (IV). Cultivar K 1380, an experimental line discontinued after 2001, was replaced with KS 4202 in 2002. Planting periods included late April, mid-May, early June, and late June. Soybean was planted (30 inch spacing, 7.4 seeds/ft, 130,000 seeds/a) with a JD 7300 planter on 10 x 50 ft plots in land fallowed after the previous crop. Seed was inoculated with *Bradyrhizobium sp.* Soil fertility was amended with 90 lb N/A and 30 lb P_2O_5/a. Herbicides and hand weeding controlled weeds.

Soybean crop development (vegetative and reproductive growth stage) was noted at weekly intervals. Canopy development was measured at flowering, using a LiCor 2000 canopy analyzer. Crop stand (V1 and R8), yield components, plant height, height of lowest pod, and above-ground biomass were measured from two 3.3-ft (1-m) rows from each of four replicate plots. Plots with uniform stand were machine-harvested 7 to 10 days after R8; the best stands of non-uniform plots were hand-harvested. Seed was analyzed for seed weight, oil content, crude protein, and germination fraction.

Results

Drought conditions limited soybean yields throughout the study period (Table 8). Timing of precipitation likely affected stand establishment, canopy development, seed set, and seed fill processes. Early planting resulted in highest yields in 2000, a year when stored soil water was high (Table 8). However, early planting resulted in lowest yields in 2002, when stored soil water was low and hot, dry summer conditions prevailed. Yield variation was high among cultivars, planting periods, and years. Each cultivar yielded both poorly and well among the planting periods and years evaluated. The MG III cultivar ‘Macon’ provided the numerically greatest yield, averaged over planting dates and years. However, the MG IV cultivar ‘KS 4694' provided similar overall yields. The yield potential of cultivars representing MG I and MG II was somewhat limited; however, these cultivars yielded as well as longer-season cultivars, given timely water supply (e.g., late April 2000 and early June 2001 planting periods).

Results at this location indicate that rain-fed soybean yields under drought conditions are maximized by planting a medium maturity (MG III) cultivar, i.e. ‘Macon’, as soon as late April when soil moisture is adequate. When soil moisture was lacking, planting could be delayed until early June without apparent yield loss. Timing and amount of precipitation, in relation to crop development likely contributed to substantial variation in yield.

[1]Three-year average, K-State Soybean Performance Tests, Report of Progress 901, 2002.

The Kansas Soybean Commission Checkoff program provided support for this study.

Table 8. Planting date effects on soybean productivity: Maturity groups I, II, III, and IV, Colby, KS.

Planting Period (Date) x Maturity (Cultivar)			Yield (bu/a)[1] 2000	2001	2002	3-yr Avg
Late April	I	IA 1008	15.0	9.3	3.4	9.2
April 24, 2000	II	IA 2021	16.6	10.6	5.2	10.8
April 27, 2001	II	Turner	15.1	10.7	3.5	9.8
April 24, 2002	III	Macon	15.7	12.6	4.8	11.0
	III	IA 3010	10.8	10.2	7.6	9.5
	IV	K 1380[2]	12.5	12.5	7.5	10.8
	IV	KS 4694	15.6	10.9	9.7	12.1
Mid-May	I	IA 1008	6.1	10.7	6.4	7.7
May 11, 2000	II	IA 2021	9.6	10.4	9.5	9.8
May 17, 2001	II	Turner	8.7	11.4	6.3	8.8
May 16, 2002	III	Macon	17.1	11.2	10.6	13.0
	III	IA 3010	10.1	6.8	11.4	9.4
	IV	K 1380[2]	15.5	12.0	10.5	12.7
	IV	KS 4694	11.2	10.6	9.4	10.4
Early June	I	IA 1008	8.1	16.3	12.5	12.3
June 1, 2000	II	IA 2021	9.9	16.1	9.8	11.9
June 8, 2001	II	Turner	9.2	14.8	9.0	11.0
June 6, 2002	III	Macon	11.6	16.3	12.4	13.4
	III	IA 3010	5.1	16.6	12.7	11.5
	IV	K 1380[2]	10.9	13.4	12.7	12.3
	IV	KS 4694	9.2	14.7	13.9	12.6
Late June	I	IA 1008	10.0	5.7	8.4	8.0
June 19, 2000	II	IA 2021	11.4	9.5	4.6	8.5
June 28, 2001	II	Turner	8.3	6.9	6.8	7.3
June 27, 2002	III	Macon	12.7	10.3	9.0	10.7
	III	IA 3010	10.8	4.6	10.7	8.7
	IV	K 1380[2]	9.7	8.3	9.2	9.1
	IV	KS 4694	14.4	6.6	11.4	10.8
		LSD	5.11	2.93	4.7	---
Planting Period (means)						
Late April			14.6	11.0	6.0	10.5
Mid-May			11.2	10.4	9.2	10.3
Early June			9.1	15.4	11.9	12.1
Late June			11.0	7.4	8.6	9.0
Maturity/Cultivar (means)						
	I	IA 1008	9.8	10.5	7.7	9.3
	II	IA 2021	11.9	11.6	7.3	10.3
	II	Turner	10.3	10.9	6.4	9.2
	III	Macon	14.3	12.6	9.2	12.0
	III	IA 3010	9.2	9.5	10.6	9.8
	IV	K 1380[2]	12.1	11.6	10.0	---
	IV	KS 4694	12.6	10.7	11.1	11.5

[1]Yields are adjusted to 13% moisture content and 60 lbs/bu.
[2]cv. KS 4202 was planted in 2002, replacing the experimental line K 1380 which was discontinued after 2001).

COMPONENTS OF COLD TOLERANCE IN GRAIN SORGHUM: MALE AND FEMALE CONTRIBUTIONS TO GERMINATION AND EARLY GROWTH

R. Aiken, M. Tuinstra, K. Kofoid, and R. Stockton

Summary

Cold tolerance for seedling emergence and growth can improve sorghum grain production. Multiple traits, with independent association, and perhaps multiple loci appear to contribute to cold tolerance. Laboratory, greenhouse, and field studies were conducted to investigate contributions of male and female parents to cold tolerance and to compare growth of breeding lines under cool conditions. Earlier germination resulted from hybrids derived from a cold-tolerant male, relative to germination with a cold-susceptible male parent. The difference appears to result from the germinating seed's ability to accumulate heat units at cooler temperatures. Growth of two cold-tolerant breeding lines from the Highlands of Kenya was two times greater than growth of cold-susceptible lines 30 days after field-planting (April 20, 2001). Hybrids derived from a cold-susceptible male line had intermediate growth rates; analogous hybrids derived from the cold-tolerant male had similar or slightly lower growth rates.

Introduction

Cold tolerance for seedling emergence and growth can improve sorghum grain production by:

- Increasing yield potential from an extended growing season
- Providing stress avoidance by earlier development under more favorable rainfall regimes
- Enabling expanded production zones into the semi-arid cool uplands i.e. central High Plains.

Rapid germination and vigorous growth of grain sorghum seedlings under cool (<15º C) soil conditions is a significant cold-tolerant trait. Temperature sensitive processes in seedling establishment include germination, growth, and emergence. Heritable differences can be independent for each process. This independent inheritance may contribute to the difficulty of developing cold-tolerant sorghum cultivars.

Knowledge of breeding line characteristics provides incomplete knowledge of hybrid effects. The female seed parent contributes 100% genetic traits of the pericarp and embryonic cell cytoplasm, 67% of the endosperm, and 50% of the embryo. Tolerance traits of both male parent and seed parent can confer tolerance traits to progeny when crossed with a susceptible parent. But benefits of male tolerance may provide additional protection when crossed with a tolerant seed parent. Multiple traits, with independent association, and perhaps multiple loci, appear to contribute to cold tolerance. Laboratory, greenhouse, and field studies were conducted to investigate contributions of male and female parents to cold tolerance, and to compare growth of breeding lines under cool conditions.

Procedures

A germination study was conducted in growth chambers using hybrids of susceptible (TX 2737) and tolerant (SQR) male lines, crossed with susceptible (TxArg1), tolerant (Wheatland, Redlan), or intermediate (SA 3042) female lines. Both male breeding lines (self-pollinated) were included for reference.

Seeds were incubated on moist filter paper in petri dishes at 12, 16, 20, or 24° C. Observations included time to germination (radicle protrusion 1 mm beyond seed coat); time to radicle growth exceeding 5 mm and 10 mm, with associated coleoptile lengths; electrolyte leakage, as a measure of membrane stability; and endosperm utilization efficiency.

Seedling growth studies were conducted under greenhouse and field conditions using two sets of genetic material. One set was as described in the germination study above. The second set was selected from 37 cold tolerant lines, derived from the Kenya Highlands, in addition to tolerant and susceptible reference lines. The selected lines exhibited either high-germination or high-emergence rates at 10° C in a previous screening trial. In the greenhouse study, pre-germinated seed was planted in a potting mix of 1:1:2 Keith silt loam:perlite:sand. Seedlings were harvested 10, 20, or 30 days after planting. Observations included seed viability, root length, coleoptile (and shoot) lengths, and dry weights of root and shoot (including coleoptile).

In the field study, seed was planted in a Keith silt loam soil on April 20, 2001 when soil temperature averaged 14° C (5° F) at 10 cm (4 inch) depth. Observations included emergence (three observation periods each week), shoot weight 30 days after planting, heading date, and maturity date. Comparisons of seedling growth among studies are based on cumulative growing degree days, using daily ambient temperature extremes, and limited by a minimum temperature of 8° C (46.4° F).

Results

Heat units and base temperature required for germination can be calculated from time to germination for seeds incubated with a range of constant temperature treatments. Figure 6 shows germination data for two hybrids involving a female line with intermediate cold tolerance (SA 3042) and male lines considered tolerant and susceptible to cold. The inverse of germination time (1/time) is plotted against incubation temperature. The inverse of germination time decreases with cooler temperatures, indicating more time is required for germination when seed is incubated at cooler temperatures.

When SQR is the male parent, the hybrid seed appears to start accumulating heat units when the temperature exceeds 7.3° C; the corresponding base temperature for heat unit accumulation appears to be 10.1° C when TX 2737 is the male parent. Thus, the SQR hybrid appears to accumulate heat units at cooler temperatures than the TX 2737 hybrid, resulting in earlier germination.

Seedling size and weight provide an integrative measure of growth and vigor. Figure 7 shows seedling biomass for selected lines and hybrids, observed in both greenhouse and field studies. The results are plotted in relation to cumulative growing degree days following planting. Change in seedling biomass is consistent with the exponential growth phase of the logistic equation commonly used to represent vegetative growth for annual plants. The two lines susceptible to cold, TX 430R and TX 2737, exhibit low growth rates under field conditions (data points at 280° C-days, at 30 days after planting). In contrast, two tolerant lines from the Highlands of Kenya (IS11352 and IS 25527) exhibited growth two times greater under these field conditions. Hybrids derived from the TX 2737 male line had intermediate growth rates; analogous hybrids derived from the SQR male had similar or slightly lower growth rates.

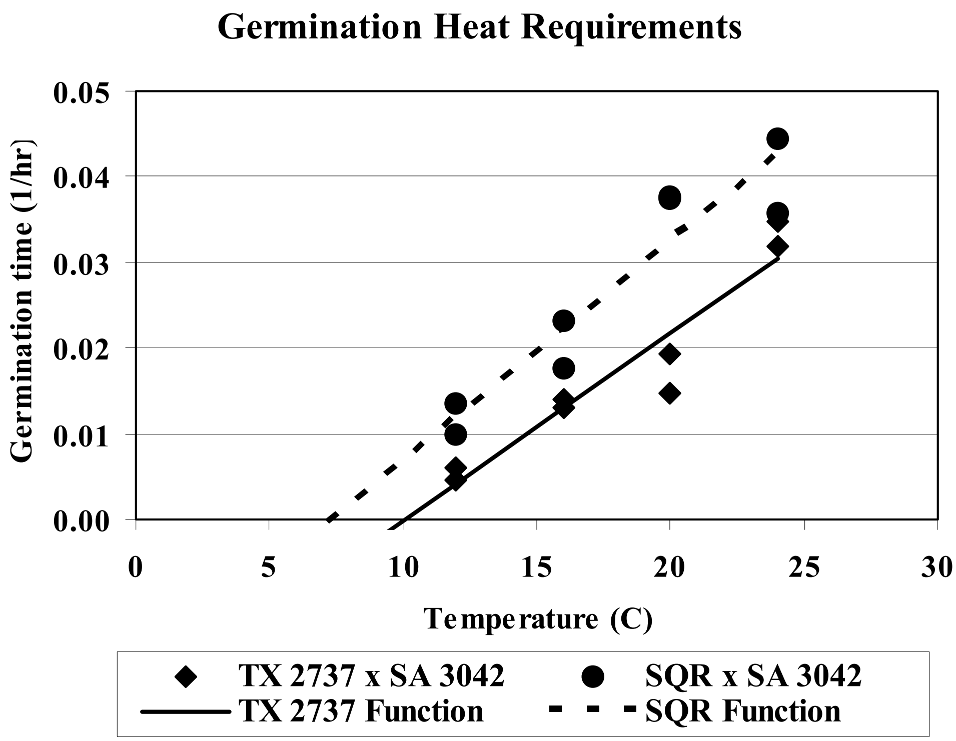

Figure 6. Heat requirements for seed germination can be calculated from time required for germination when incubated at a range of temperatures. Seeds with SQR as male parent accumulated heat units more rapidly than seeds with TX 2737 as male parent.

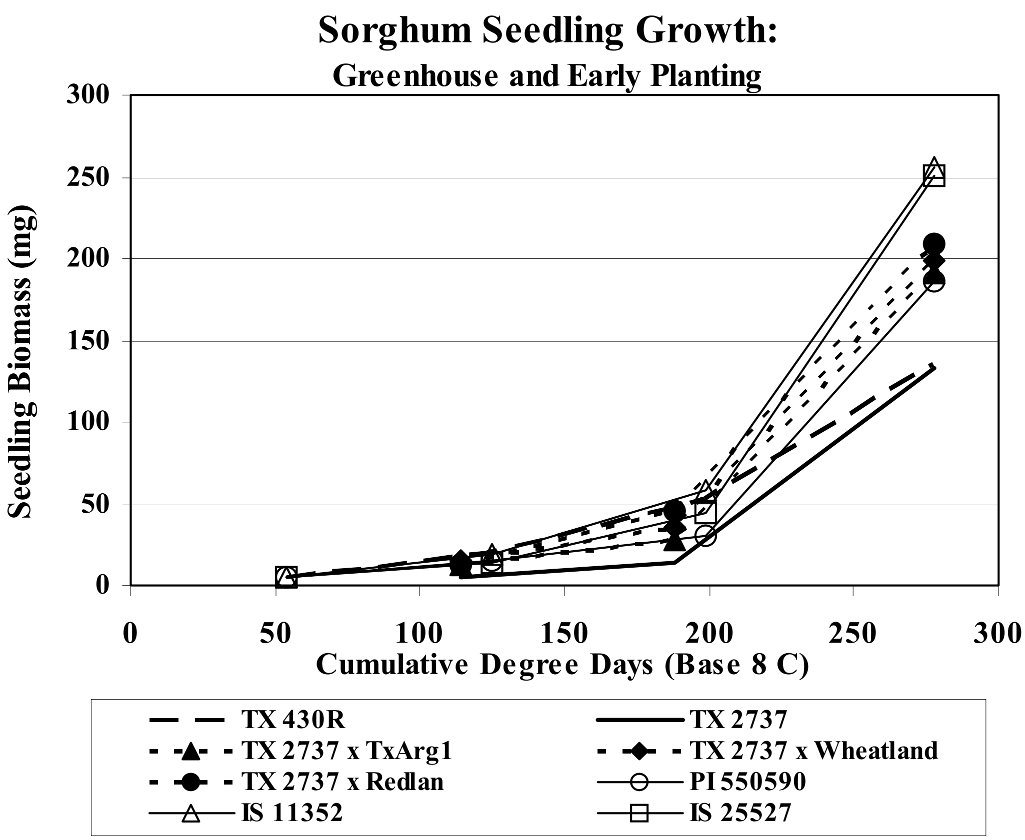

Figure 7. Seedling biomass for five breeding lines and three selected hybrids are presented in relation to accumulated growing degree days since planting. Data points up to 200° C-days are from a greenhouse study, harvested 10, 20, or 30 days after planting; data points at 280° C-days are from a field study, harvested 30 days after planting.

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 SC 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 helped define adapted varieties/hybrids of wheat, soybeans, alfalfa, grain sorghum, cotton, and corn. As irrigated corn, soybean, wheat, and alfalfa 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, the evaluation of new pesticides for the area, the practicality of dryland crop rotations involving summer annual forages, corn nitrogen fertilizer requirements, and re-examining accepted cultural practices. Winter forage studies for cattle were initiated in 1999 and involved planting wheat, rye, and triticale. These studies were expanded in 2000.

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.

2002 Weather Information

The growing season was characterized by hot conditions from mid-June through September. Conditions for the 2003 wheat crop were hampered by excessive rainfall in October (Table 1) and overall cooler than normal temperatures. Growing season length was slightly longer than the long-term average of 185 days by 3 days. Precipitation was under the long-term average of 26.1 inches (Table 1) by 2.2 inches. This number is somewhat deceiving as 52% of the year's precipitation was received in two months (June and October). Rainfall from January though March was 47% of normal; rainfall from April through September was 80% of normal, although the distribution was skewed with 36% occurring in June. From October through December subsoil moisture levels were helped with 7.6 inches of precipitation, 181% of normal. Wheat yields in 2002 were variable with many fields severely impacted by dry conditions from September 2001 through May 2002, which had only 52% of normal precipitation. The August 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.

Table 1. Precipitation at the Sandyland Experiment Field, St. John, 20-year average, 2001, 2002.

Month	20-Year Average	2001	2002
	inches		
January	0.8	2.7	0.6
February	1.0	2.3	0.9
March	2.3	1.7	0.5
April	2.4	1.5	1.9
May	3.8	6.7	1.4
June	4.0	2.7	5.2
July	3.1	4.6	1.5
August	2.4	1.1	3.1
September	2.2	3.4	1.3
October	2.3	0.0	7.1
November	1.0	0.0	0.1
December	0.9	0.1	0.4
Annual Total	26.1	26.7	23.9

GRAZING CATTLE ON WINTER CEREAL UNDER DRYLAND CONDITIONS ON SANDY SOILS

V.L. Martin, R. Hale, and D. Blasi

Summary

Rye, wheat, and triticale pasture were evaluated in 2000, 2001, and 2002 for their ability to increase cattle weight from late fall through mid-spring. Large scale studies were conducted on two 80-acre sites divided into either 25- or 40-acre pastures. Cattle at these sites were stocked at 1 head/acre with an average initial weights between 500 and 550 lb/head. At the Sandyland Experiment Field, small scale studies were conducted using the same winter cereals for forage but at higher stocking rates, ranging from 2 to 3 head/acre. Supplemental feeding, as necessary, included summer annual forage hay, prairie hay, and grain consisting of wheat mids and processed grain sorghum. Winter cereals were planted at 100 lb/acre in September of each year. Rye provided the best pasture in terms of cattle weight gain and needed the least supplemental feeding. Wheat was next in producing pounds of beef and triticale produced substantially less gain than either rye or wheat. Rye and wheat were more able to support increased stocking rates than triticale.

Introduction

Annually, forage in Kansas supports 1.5 million beef cows and calves, 0.8 million dairy cows, and 4-5 million yearling cattle. Cattle and the production of forage and grain for feed represent a significant portion of agricultural revenues in Kansas. Dryland grain production in the Sandyland service area is variable due to both soil type and climate. Typically, adequate moisture is available for good pre-flowering vegetative growth; however, available soil moisture, erratic rainfall, and high temperatures often severely impact grain yield. Wheat vegetative and early reproductive growth are normally good due to adequate rainfall and moderate temperatures. Wheat yield reduction is due to high temperatures during late grainfill that essentially halt grain development and kill the plant.

More efficient and consistent use can be made of available moisture if dryland producers focused on harvesting vegetative growth and relied less on grain production for income. Using summer annual forages and winter cereals as forage for hay and grazing connects to the market for which most of their production is already geared – cattle. These forages and systems integrating their use are well-adapted for cattle production, less expensive than traditional grain production, and decease risk.

Forage systems are not without negatives. If forages are grown for hay, producers must either invest in haying equipment or contract with custom hay operations. Forages used for pasture require investments in fencing, need available sources for watering livestock, and are labor and time intensive. Additionally, pasturing cattle properly requires intensive management. Finally, although risks are lessened as reliance on grain production is reduced, producers raising their own cattle are susceptible to fluctuations in the cattle market.

The primary objective of this study is to determine actual cattle weight gain on dryland winter cereal pasture and develop production systems/best management practices to optimize cattle production. Objective two, determine the practicality of a dryland winter cereal pasture-summer annual forage production system.

Procedures

All costs were the same each year for each pasture with the exception of seed costs. Cost per acre were $7 for rye seed, $10 for wheat, and $20 for triticale. Rye, wheat and triticale pastures were all treated identically with the exception of stocking rates during the 2001-2002 year.

Winter 1999-2000

The site was summer fallowed in 1999 after wheat harvest, prior to fall planting of winter cereals. Fertilization consisted of 100 lb/a 18-46-0 and 50 lb/a N broadcast as urea (46-0-0). Fertilizer was incorporated with the final tandem disking. Tillage consisted of one offset disking followed by two offset diskings. Tillage was accomplished by September 1. Four pastures (0.8 acre each) were established with wheat (Jagger), Rye (Amilo), triticale (Presto), and a 50/50 rye/triticale blend. Target seeding rate was 100 lb/acre with an actual rate of 105 lb/acre planted on September 23 using a hole drill and 10 inch rows. Heifers, two head per pasture, were turned out on December 4 on all pastures except the triticale, which was delayed until February 3. Cattle were supplemented with 2 lb/day grain and during snow cover with 230 lb/head/day of alfalfa hay. Heifers were weighed initially on December 4, February 1 and March 21.

Winter 2000-2001

The study was expanded in the winter of 2000-2001. At Sandyland three, 3-acre pastures were established following the 2000 wheat harvest on fine sandy loam soils. Tillage and fertilization were identical to 1999-2000 as was the stocking rate. Rye, wheat, and triticale, same varieties as in 1999-2000, were planted at 100 lb/acre on September 26. Cattle were weighed on November 29, January 4, February 5, March 16, April 19, and May 16.

Two 80-acre offsite locations were established. Each was split into three 25-acre pastures and treated and planted the same as the small scale Sandyland sites. One site is a loamy fine sand and the other a fine sandy loam. The only difference between off-site and Sandyland studies was stocking rate. Sandyland heifers were stocked at 0.6 acres/head while large scale studies were at 1.0 acres/head.

After heifers were removed in May, pastures at Sandyland were chisel plowed and disked twice. Fertilizer was applied prior to the final disking using 100 lb/acre 18-46-0 and 108 lb/acre urea (46-0-0). A BMR sorghum X Sudan hybrid was planted on June 12 at 18 lb/acre and harvested in mid-August to allow for a return to pasture in September.

The off-site loamy fine sand pastures were disked, fertilized and planted to NC+ Sweetleaf at 20 lb/acre in mid-June and harvested in Mid-August. The sandy loam was too wet to plant to a summer annual forage. Wheat, rye, and triticale regrowth were swathed and baled in late June. Crabgrass already present was allowed to grow until Mid-August and then swathed and baled.

Winter 2001-2002

After baling of supplemental summer annual forages, tillage and fertilization was the same as in 2000-2001. Wheat planted was again Jagger while triticale was stitched to Tricale 2+2, and the rye variety was not stated.

Dry conditions in late fall and early winter made it necessary to pasture cattle on corn stubble and supplement with hay. Pastures were not suitable for grazing for mid-April. Stocking rates were determined by qualitative examination of growth (height and degree of tillering). Stocking rates are described in Table 6. After cattle were removed, the ground was prepared as described in 2000-2002. Honey Sioux V sorghum x Sudan hybrid was seeded at 16 lb/acre in 10 inch rows in early June following rye, Jagger wheat and triticale. One Jagger wheat pasture was summer fallowed. The Betty wheat pasture was seeded to hybrid pearl millet at 12 lb/acre in 10 inch rows at the same time. Both summer annual forages were seeded on adjacent lots that were winter fallowed to allow comparison with sites that were pastured over the winter.

Results

The target date for seeding winter pastures was September 1 all three years. Heat combined with low soil moisture contents delayed planting each year until the end of September (Table 2). To maximize the period of cattle on pasture, November 1 is the desired date to turn cattle out. In 1999-2000 and 2000-2001, growth was not adequate until late November and cattle were turned out on pasture 4r weeks later than planned. During the 1999-2000 grazing season, cattle were removed from pasture in mid-March after almost 8 inches of rain flooded the pastures.

During 2001-2002, extremely dry conditions from August through March (6.6 inches or 50% of the long-term average) prevented turning cattle out until April. From December 2001 through March 15, 2002, cattle were placed on a circle of irrigated Bt corn stalks and supplemented with summer annual forage hay. From March 15 until mid-April, cattle were penned and fed summer annual forage hay and 5 lb/head/day grain.

For all three years, cattle on rye pasture outperformed wheat and triticale (Tables 3, 5, 6). Except during 2000-2001, cattle on wheat performed slightly less than on rye and better than on triticale. During 2000-2001, cattle performance was about equal on wheat and triticale (Table 5).

Conventional wisdom states that rye should outperform triticale late fall/early spring but weight gain for cattle on triticale will exceed rye and wheat late spring and provide for a longer pasture season. This was the case in 1999-2000 (Table 3). However, in 2000-2001 triticale outperformed rye late fall and lagged significantly behind rye during the entire spring period (Table 5). This data contradicts results from producers in NC and NW Kansas and clipping studies conducted at the KSU Agricultural Research Center at Hays. Possible reasons include the coarser texture of the soil used in this study, which has a lower water holding capacity. Secondly, clipping studies do not necessarily translate into actual cattle grazing results. Finally, from observing cattle grazing, cattle on the triticale pastures did not appear to graze the triticale as aggressively, even though good vegetative growth was present.

Stocking rates affected average daily gain in 2000-2001 (Table 4). Late fall/early winter gain was significantly less at Sandyland with 0.5 acres/head as opposed to the other two sites stocked at 1.11 acres/head. However, during spring grazing gain per head was slightly less at the higher stocking rate, but pound per acre gain was twice that of the conventional rate of approximately one head per acre. This was likely due to the relatively dry fall conditions which limited regrowth while spring conditions were excellent for pasture growth.

In 2001-2002, cattle were turned out on Betty wheat and, though results were not quite as good as Jagger wheat, cattle gain was much better than cattle on triticale (Table 6). It should be noted that this was spring grazing only and does not mean that Betty wheat is suitable for late fall/early winter pasture. Since the grazing period was quite brief, cattle stocking rates were successfully increased for the wheat and rye (Table 6). Rye, stocked at 0.3 acres/head, resulted in gains of 1.9 lb/head and 6.1 lb/acre/day. Jagger wheat pasture resulted in 4.5 lb/acre/day with Betty wheat producing 3.9 lb/acre/day. Triticale gains were much lower at 2.0 lb/acre/day and required much greater supplemental feeding to produce significantly less beef. Cattle placed on cornstalks during 2001-2002 maintained and in fact gained 0.60 lb/head/day (Table 6). This provides a viable option for producers needing pasture before winter cereal pasture is ready, providing supplemental hay and grain are practical.

Overall, rye produced the best gains not only per head but also allowed for higher stocking rates and seeding costs were low. Wheat was intermediate in performance per head and stocking rate, but still allowed for higher than normal rates. Triticale seeding costs were much higher, $20 per acre, weight gain was at best comparable to wheat but typically lower, and higher stocking rates were not practical.

Summer annual forage production, sorghum x Sudan hybrid and hybrid pearl millet, were severely affected by extreme heat and drought conditions during the 2001 growing season (Table 2). Pearl millet production was slightly higher than the sorghum x Sudan hybrid, 1.7 tons/acre vs. 1.5 tons/acre. Native crabgrass production was also affected by extreme heat and drought stress and averaged 0.25 tons/acre. Crabgrass and pearl millet hay contained few broadleaf weeds. The sorghum x Sudan hybrid hay was approximately 20% Palmer amaranth.

Growing conditions for summer annual forage production were less stressful during the 2002 season. Pearl millet production following winter fallow was 2.2 tons/acre and slightly less following winter grazing at 2.2 tons/acre. Sorghum x Sudan hybrid hay production was also lower after winter grazing at 2.6 tons/acre vs. 2.8 tons/acre after winter fallow. Broadleaf weeds were nonexistent in the pearl millet hay and, while the sorghum x Sudan hybrid hay contained some Palmer amaranth, it was much less than during the 2001 season. This is likely the result of the forages competing more effectively during 2002.

A demonstration plot examining the effect of planting date on Pearl millet and sorghum X Sudan hybrid hay production indicated two trends. Production was unaffected by planting date from June 1 through July 15. Although this is atypical, it is likely the result of precipitation patterns that allowed later planting to compete with earlier planting. Of greater interest is weed competition. Very few herbicides are available for weed control in common summer annual forages. Some weeds, such as crabgrass, do not negatively impact feed quality, while mature pigweed and sandbur decrease palatability and feed value. Weed density decreased dramatically as planting was delayed and the only real weed pressure after mid-June was crabgrass. Crabgrass should only present a problem under extreme heat and moisture stress.

Table 2. Monthly precipitation totals, 1999 - 2002, and long-term average. Sandyland Experiment Field.

Month	1999-2000	2000-2001	2001-2002	Long-term Average
	---------------------------------- in.	------------------------------		
July	3.3	5.2	4.6	3.1
August	0.7	0.05	1.1	2.4
September	3.2	0.8	3.4	2.2
October	0.2	4.6	0.0	2.3
November	0.03	0.5	0.0	1.0
December	0.2	0.6	0.06	0.9
January	1.25	2.7	0.6	0.8
February	2.5	2.3	0.9	1.0
March	7.7	1.7	0.5	2.3
April	0.6	1.5	1.9	2.4
May	4.1	6.7	1.4	3.8
Total	19.7	19.95	13.7	18.3

Table 3. Winter grazing demonstration, winter 1999 - 2000. Sandyland Experiment Field. Heifer weight gain by pasture.

Item	Wheat	Rye	Rye/Triticale	Triticale
Heifers/pasture (.8 ac)	2	2	2	2
Grazing days	105	105	105	47
Daily gain (lb/day)				
Dec. 4-Feb 1 (58 days)	1.55	1.97	1.94	xxx
Feb. 1-Mar. 21 (49 days)	0.35	0.29	-0.29	0.73
Overall ADG*	1.00	1.20	0.92	0.73
Gain/acre (lb/a)	214	257	197	72
Total feed costs (grain + hay)	$57.00	$50.20	$50.20	$9.80

* ADG - Average Daily Gain

Table 4. Winter grazing study, winter 2000 - 2001. Sandyland Experiment Field and off-site studies. Heifer weight gain by location averaged across rye, triticale, and wheat.

Item	Sandyland*	Loamy sand#	Sandy loam@
No. of heifers	12	72	72
Initial wt. (11/29), lb	574[b]	491[a]	497[a]
Jan. 4 wt., lb	616[b]	567[b]	539[a]
Weight change, lb	42[a]	76[b]	42[a]
Dec. Gain, lb/day	0.84[a]	2.06[b]	1.15[a]
Feb. 5 wt, lb	596[b]	571[b]	547[a]
Weight change lb	-20[a]	4[b]	8[b]
Jan. gain, lb/day	-0.32[a]	0.26[b]	0.27[b]
Winter Weight change, lb	22[a]	80[b]	50[c]
Winter gain, lb/day	0.31[a]	1.21[b]	0.73[c]
Winter gain, lb/acre	0.62[a]	1.21[b]	0.73[c]
March 16 wt., lb	586[b]	536[a]	523[a]
Weight change, lb	-10[a]	-35[b]	-24[a]
Drylot gain, lb/day	-0.51[a]	-0.72[b]	-0.40[a]
April 19 wt., lb	615[a,b]	635[b]	614[a]
Weight Change, lb	44[a]	99[b]	90[b]
Mar./Apr. wt. gain, lb/day	1.26[a]	2.84[b]	2.57[b]
May 16 wt., lb	670[a,b]	675[b]	656[a]
Weight change, lb	79[b]	39[a]	41[b]
Apr./May Weight gain lb/day	2.93[b]	1.44[a]	1.52[a]
Spring wt. gain, lb	125[a]	139[b]	131[a,b]
Spring ADG, lb/day	2.27[a]	2.52[b]	2.38[a,b]
Spring weight gain, lb/acre	5.04[a]	2.52[b]	2.38[a,b]

Within a row, means with a different letter superscript are significantly different at $P<.05$.
* 6.0 acres (0.5 acres/heifer)
# 80 acres (1.11 acres/heifer)
@ 80 acres (1.11 acres/heifer)

Table 5. Winter grazing study, winter 2000 - 2001. Sandyland Experiment Field and off-site studies. Heifer weight gain by winter cereal pasture across location (Sandyland, sandy loam, and loamy sand).

Item	Rye	Triticale	Wheat
No. of heifers	52(3 pens)	52(3 pens)	52(3 pens)
Initial wt. (11/29), lb	509[a]	514[a,b]	539[b]
Jan. 4 wt., lb	553[a]	569[a,b]	589[b]
Weight change, lb	44[a]	55[b]	50[a,b]
Dec. Gain, lb/day	1.26[a]	1.54[b]	1.39[a,b]
Feb. 5 wt, lb	558[a]	569[a,b]	587[b]
Weight change lb	5[a]	0[a,b]	-2[b]
Jan. gain, lb/day	0.17[a]	0.08[a,b]	-0.01[a,b]
Winter Weight change, lb	49[a]	55[b]	48[a]
Winter gain, lb/day	0.73[a,b]	0.84[b]	0.69[c]
March 16 wt., lb	544[a]	541[a]	567[b]
Weight change, lb	-14[a]	-28[b]	-20[a,b]
Drylot gain, lb/day	-0.49[a]	-0.59[b]	-0.52[a,b]
April 19 wt., lb	619[a]	620[a]	626[b]
Weight Change, lb	78[a]	80[a]	75[a]
Mar./Apr. wt. gain, lb/day	2.24[b]	2.28[b]	2.15[a]
May 16 wt., lb	680[b]	661[a,b]	660[a]
Weight change, lb	64[b]	46[a]	49[a]
Apr./May Weight gain lb/day	2.37[b]	1.71[a]	1.83[a]
Spring wt. gain, lb	143[b]	127[a]	125[a]
Mar./May ADG, lb/day	2.59[b]	2.30[a]	2.28[a]

Within a row, means with a different letter superscript are significantly different at P<.05.
* 6.0 acres (0.5 acres/heifer)
# 80 acres (1.11 acres/heifer)
@ 80 acres (1.11 acres/heifer)

Table 6. Winter grazing study, winter 2001 - 2002. Sandyland Experiment Field. Cattle weight gain.

Item	Jagger Wheat	Betty Wheat	VNS Rye*	Triticale#
Weight gain on corn stalks				
Nov 20-Feb 11ADG[1]	0.68	0.68	0.68	0.68
Feb 11-Mar 15 ADG	0.40	0.40	0.40	0.40
Nov 20-Mar 15 ADG	0.60	0.60	0.60	0.60
Total gain/head, lb.	70	70	70	70.0
Drylot wt. change lb/day				
March 15 - April 11	-0.47	-0.47	-0.47	-0.47
Total gain/head, lb.	-12.7	-12.7	-12.7	-12.7
Stocking rate (acre/head)	0.5	0.5	0.3	0.7
Grazing days	43	43	43	43
April 11 wt., lb.	616	562	602	584
May 23 wt., lb.	676	622	672	652
Weight gain, lb.	60	60	70	68
Daily gain, lb/day	1.7	1.65	1.9	1.65
Gain lb/acre	161	141	239	83
Gain lb/acre/day	4.5	3.9	6.1	2.0
Grain fed, lb/head	108	108	108	323

* VNS Rye - variety not stated
# Triticale - Trical 2+2
[1] ADG - Average Daily Gain

SOUTH CENTRAL KANSAS EXPERIMENT FIELD

Hutchinson and Sumner County

Hutchinson Location

Introduction

The South Central Kansas Experiment Field, Hutchinson 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 the South Central area of 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 Peirce farm.

Research at the South Central Kansas Experiment Field is designed to help the area's agriculture develop to its full agronomic 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, oats, alfalfa, corn, soybean, rapeseed/canola, sunflower and 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

A new soil survey was completed for Reno County and has renamed some of the soils on the Field. The new survey overlooks some of the soil types present in the older survey and it is felt that the descriptions of the soils as follows is more precise. The South Central Kansas Experiment 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 inches. 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.

2001-2002 Weather Information

In 2000 the U.S. Department of Commerce National Oceanic and Atmospheric Administration National Weather Service rain gage (Hutchinson 10 SW 14-3930-8) measured 33.4 inches of precipitation, 3.4 inches above the 30-year (most recent) average of 30.0 inches. The year 2001 proved to be quite different from the previous 5 years in that the total precipitation for the year was below normal. However, it should be noted that the normal has been increasing in the past few years. The first 2 months of the year and September were above normal. Precipitation for the year totaled only 22.96 inches, 7.01 inches below the 30-year average. Even with the below normal precipitation, rainfall was recorded in every month of the year. The lack of moisture for 2001 started in March continued into mid-September. Precipitation for 2002 ended above normal (0.95) even though most months reported below normal precipitation. There were only four months where above normal precipitation was recorded (January, June, August, and October; Table 1). The 2002 crop year started out with good rains in mid-September and early October. The fall planting of wheat and canola went in with good soil moisture. Rainfall after early October was limited and the wheat and canola were stressed during the winter months. Winter temperatures were above normal which allowed the wheat to continue to grow and use the limited soil moisture. Timely rains in April and May had the wheat crop looking good. Three major rainfall events in June put the precipitation for that month well above normal. The following months alternated from below normal to above normal (Table 1). Two precipitation events (June 15 and August 12) are important in that they caused considerable damage to crops on the South Central Field and the surrounding area. The June 15 storm produced high winds and hail that shattered a large portion of the wheat and stripped the leaves off the summer crops that had emerged. The 2003 year started out dry as well.

The summer annuals (grain sorghum, sunflower, and soybean) that emerged or were planted after the June hail benefitted from the late rains. But these crops were then damaged by high winds in the August 12 storm. A frost-free growing season of 200 days (April 5 - October 21, 2002) was recorded. This is 17 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 (inches)	30-yr Avg* (inches)	Month	Rainfall (inches)	30-yr Avg (inches)
2001			April	2.58	2.86
September	3.06	3.01	May	2.88	4.18
October	1.15	2.43	June	6.59	4.02
November	0.11	1.54	July	1.40	3.48
December	0.16	1.00	August	6.04	2.98
2002			September	0.83	3.04
January	1.91	0.69	October	6.22	2.34
February	0.58	1.08	November	0.38	1.47
March	0.78	2.76	December	0.68	1.00
			2002 Total	30.87	29.92

* Most recent 30 years.

CROP PERFORMANCE TESTS AT THE SOUTH CENTRAL FIELD

W.F. Heer and K.L. Roozeboom

Introduction

Performance tests for winter wheat, grain sorghum, alfalfa, canola, sunflower, oat, and spring wheat were conducted at the South Central Kansas Experiment Field. Results of these tests, except for the oat and spring wheat, can be found in the following publications, which are available at the local county extension office or online at http://www.ksu.edu/kscpt. The oat and spring wheat tests were severely damaged by the June 15 hail storm. Oat data is presented in Table 2 of this report; the spring wheat test was abandoned due to extreme variability. The spring cereals tests were seeded on February 23, 2002 at a rate of 2 bu/a. Soil conditions were good but late February and early March were extremely cold. The remainder of the spring was cooler than normal and thus the spring cereals did not grow much until early May. The lack of spring growth and the above mentioned hail resulted in poor yields.

2002 Kansas Performance Tests with Winter Wheat Varieties. KAES Report of Progress 896.
2002 National Winter Canola Variety Trial. Agronomy Department Report (available from KSU Department of Agronomy).
2002 Kansas Performance Tests with Grain Sorghum Hybrids. KAES Report of Progress 900.
2002 Kansas Performance Tests with Sunflower Hybrids. KAES Report of Progress 905.
2002 Kansas Performance Tests with Alfalfa Varieties. KAES Report of Progress 904.

Table 2. 2002 Spring Oat Variety Performance Test Reno Co. South Central Field.

Variety	Origin	Yield	Moisture	Test Wt.	Plant Ht.	Spring Stand
		bu/a	%	lb/bu	inches	%
Armor	OH	11.5	10.6	25.4	26.5	85.0
Bates	MO	22.8	9.9	28.3	28.3	98.7
Blaze	IL	12.4	10.6	26.1	27.3	90.0
Chaps	IL	21.7	9.5	24.6	27.0	97.0
Classic	IN	9.6	11.0	21.4	27.3	67.5
Dane	WI	14.6	10.7	22.5	27.5	82.7
Don	IL	11.8	10.4	28.2	27.0	94.2
Gem	WI	11.3	10.9	24.7	26.8	66.3
INO9201	IN	13.2	11.2	26.5	26.3	92.0
Jay	IN	12.4	10.9	25.8	27.5	87.5
Jerry	ND	11.5	12.0	24.7	26.3	76.3
Jim	MN	20.1	10.1	27.2	28.5	94.5
Monida	ID, MT, OR, WA	8.0	11.2	22.8	27.0	89.0
Moraine	WI	13.2	11.9	28.8	29.8	65.0
Ogle	IL	15.3	11.1	23.5	25.0	80.0
Powell	IN	8.9	10.5	21.7	25.8	98.2
Rio Grande	ID, CO	11.7	9.7	20.7	28.3	95.2
Riser	SD	16.4	11.5	29.2	27.0	91.0
Rodeo	IL	12.7	10.4	25.2	25.8	83.2
Russell	Canada	5.2	14.9	26.0	25.3	73.8
	CV (%)	20.9	9.8	8.3	8.4	10.8
LSD (0.05)		5.2	0.02	2.9	3.2	13.0

EFFECTS OF NITROGEN RATE AND PREVIOUS CROP ON GRAIN YIELD IN CONTINUOUS WHEAT AND ALTERNATIVE CROPPING SYSTEMS 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. To determine how winter wheat and alternative crop yields are affected by these alternative cropping systems, winter wheat was planted in rotations following the alternative crops. Yields were compared to continuous winter wheat under conventional (CT) and no-till (NT) practices. Initially, the CT continuous wheat yields were greater then 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, CT continuous winter wheat out yields 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 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 have not always been observed in association with increased soil water in NT. Cropping systems with winter wheat following several alternative crops would provide improved weed control through additional herbicide options and reduced disease incidence by interrupting disease cycles, as well as allow producers several options under the 1995 Farm Bill. However, fertilizer nitrogen (N) requirements 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 was 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 the start of the experimental cropping systems. The study 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 to determine grain yield, moisture, and test weight.

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. 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 the continuous wheat. Since 1999 a group III soybean has been used. In 1999, this delayed harvest to October 5 effectively eliminating the potential recharge time as the wheat was planted October 12. After a wet October, the winter was extremely dry. This, coupled with the late soybean harvest, caused reduced yield in this rotation. In 2002, the wheat crop looked excellent until the June hail that severely shattered the grain. The effect of N rate on maturity can be seen in the yields as affected by hail.

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

Winter wheat is planted into grain sorghum stubble harvested the previous fall. 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 the continuous wheat.

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

Results

Continuous Wheat

Continuous winter wheat grain yield data from the plots are summarized by tillage and N rate in Table 3. 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 3). In 2000 the differences were wider up to the 100 lb/a N rate. At that point the 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. Yields for 2002 were severely affected by the June hail.

Wheat after Soybean

Wheat yields after soybean also reflect the differences in N-rate. However, when comparing the wheat yields from this cropping system with those where wheat followed corn, the effects of residual N from soybean production in the previous year can be seen. This is especially true for the 0 to 75 lb/a N rates in 1993 and the 0 to 125 lb/a rate in 1994 (Table 4). 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 for this crop. Yields for 1997 and 1998 both show a leveling off after the first four increments of N. As with the wheat in the other rotations in 1999, the ideal moisture and temperature conditions allowed the wheat yields after soybean to express the differences in N rate up to the 100 lb/a rate. In the past, those differences stopped at the 75 lb/a N treatment. When compared to the 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 timely 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. The effects of the June hail storm are reflected in the 2002 yield data. 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 5. Over these 4 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. With the fallow period after the sorghum in this rotation, the wheat crop has a moisture advantage over wheat after soybean. The hail in June of 2002 caused considerable shattering and equalized the grain yields to some extent.

Other Observations

Nitrogen application significantly increased grain N contents in all crops. Grain phosphate levels did not seem to be 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 will have the potential to produce grain in favorable years (cool and moist) and silage in non-favorable 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 time of application to control grasses.

Soybean and Grain Sorghum in Rotations

Soybean was added to intensify the cropping system in the South Central area of 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 the soybean following grain sorghum in the rotation are given in Table 6. Soybean yields are more affected by weather for a given year than by the previous crop. In 3 out of 5 years there was no effect of N rate that was applied to the wheat and grain sorghum crops in the rotation. In the 2 years that N application rate did affect yield it was only at the lower N rates. This effect was seen in other crops. Yield data for the grain sorghum after wheat in the soybean-wheat-grain sorghum rotation is in Table 7. As with soybean, weather is the main factor affecting yield. It can also be seen that the addition of a cash crop (soybean),thus intensifying the rotation (cropping system) will reduce the yield of grain sorghum 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 8) than in the wheat-cover crop-grain sorghum rotation (Table 7).

It is hoped that these rotations will be continued after personnel are removed from the Field and it becomes a satellite Field. Other systems studies at the Field are: wheat-cover crop (winter pea)-grain sorghum rotation with N rates (data presented in Report of Progress 854, 2000), a date of planting, date of termination cover crop rotation with small grains (oat)- grain sorghum.

Table 3. Wheat Yields by Tillage and Nitrogen Rate in a Continuous Wheat Cropping System. Hutchinson.

	1996		1997		1998		1999		2000		2001		2002	
N Rate [1]	CT [2]	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT
	Yield bu/a													
0	46	23	47	27	52	19	49	36	34	15	50	11	26	8
25	49	27	56	45	61	37	67	51	46	28	53	26	34	9
50	49	29	53	49	61	46	76	61	52	28	54	35	32	8
75	49	29	50	46	64	53	69	64	50	34	58	36	34	7
100	46	28	51	44	55	52	66	61	35	33	54	34	35	5
125	45	25	48	42	56	50	64	58	31	32	56	36	32	5
LSD* (0.01)	NS	NS	8	8	5	5	13	13	14	14	10	10	6	NS

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

[1] Nitrogen rate in lb/a.

[2] CT conventional NT no-tillage.

Table 4. Wheat Yields after Soybean in a Soybean-Wheat-Grain Sorghum Rotation with Different Nitrogen Rates. Hutchinson.

	Yield											
N-Rate	1991	1992	1993	1994	1995	1996[1]	1997	1998	1999	2000	2001	2002[2]
lb/a	bu/a											
0	51	31	24	23	19	35	13	21	31	26	12	9
25	55	36	34	37	26	36	29	34	46	37	16	10
50	55	37	41	47	34	36	40	46	59	46	17	9
75	52	37	46	49	37	36	44	54	66	54	17	7
100	51	35	45	50	39	36	45	55	69	55	20	8
125	54	36	46	52	37	36	47	57	68	50	21	8
$LSD_{(0.01)}$	NS	4	6	2	1	1	4	3	7	5	7	4
$CV_{(\%)}$	7	6	9	5	7	2	9	4	5	7	23	24

* Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be in one being greater than the other.
1. Spring wheat yields.
2. Yields severely reduced by hail

Table 5. Wheat Yields after Grain Sorghum in a Wheat-Cover Crop-Grain Sorghum Rotation with Different Nitrogen Rates. Hutchinson.

	Yield					
N-Rate	1997	1998	1999	2000	2001	2002[2]
lb/a	bu/a					
0	17	25	26	4	45	10
HV[1]	43	50	39	16	45	10
50	59	52	50	21	41	8
WP[1]	43	51	66	21	41	9
100	52	56	69	26	39	5
SC[1]	53	54	70	22	42	6
$LSD_{(0.01)}$	21*	12	5	5	5	3
$CV_{(\%)}$	26	14	6	16	6	20

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

Table 6. Soybean Yields after Grain Sorghum in Soybean-Wheat-Grain Sorghum Rotation with Different Nitrogen Rates, Hutchinson.

	Yield						
N-Rate[1]	1996	1997	1998	1999	2000	2001	2002
lb/a				bu/a			
0	16	26	22	33	25	7	22
25	17	29	23	35	21	8	22
50	18	30	23	36	23	9	22
75	20	29	24	36	24	8	21
100	22	31	25	37	21	9	21
125	20	25	24	34	22	8	22
$LSD_{(0.01)}$	3	7	NS	NS	NS	NS	ns
$CV_{(\%)}$	10	12	6	12	15	13	7

* Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be in one being greater than the other.
1. N rates are not applied to the soybean plots in the rotation.

Table 7. Grain Sorghum Yields after Cover Crop in Cover Crop-Grain Sorghum-Wheat Rotation with Different Nitrogen Rates. Hutchinson.

	Yield						
N-Rate	1996	1997	1998	1999	2000	2001	2002[2]
lb/a				bu/a			
0	73	26	69	81	68	17	22
HV[1]	99	36	70	106	54	17	21
50	111	52	73	109	66	13	25
WP[1]	93	35	72	95	51	19	23
100	109	54	67	103	45	12	25
SC[1]	94	21	72	92	51	19	19
$LSD_{(0.01)}$	13	14	NS	21	16	6	NS
$CV_{(\%)}$	8	22	13	12	16	21	20

* Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be in one being greater than the other.
1. HV hairy vetch, WP winter pea, SC sweet clover.
2. Yields affected by hot dry conditions in July and bird damage.

Table 8. Grain Sorghum Yields after Wheat in a Soybean-Wheat-Grain Sorghum Rotation with Different Nitrogen Rates. Hutchinson.

	Yield						
N-Rate	1996	1997	1998	1999	2000	2001	2002
lb/a				bu/a			
0	32	13	57	52	55	15	34
25	76	29	63	67	56	15	41
50	93	40	61	82	54	13	43
75	107	41	60	84	49	9	43
100	106	65	55	77	50	7	46
125	101	54	55	82	49	7	47
$LSD_{(0.01)}$	8	13	NS	13	NS	NS	8
$CV_{(\%)}$	5	18	10	9	10	58	11

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

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

The effects of the cover crop were most likely not expressed in the first year (1996) grain sorghum harvest (Table 9). Limited growth of the cover crop (winter peas) 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 2000 and harvested in June 2001. Winter peas were planted in September 2001 and terminated in April and May of 2002. Grain sorghum was planted in June and harvested in October. Yield data for the grain sorghum is presented in Table 9.

Introduction

There has been a renewed interest in the use of winter cover crops as a means of soil and water conservation, a substitute for commercial fertilizer, and for maintenance of soil quality. One of the winter cover crops that may be a good candidate is winter peas. Winter peas are established in the fall, over-winter, produce sufficient spring foliage, and are returned to the soil prior to planting of a summer annual. Winter peas are a legume, meaning there is a potential for adding 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 peas and their 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 soil in the experimental area is an Ost loam. The site had been in wheat prior to starting the cover crop cropping system. The study used a randomized block design and was replicated four times. Cover crop treatments consisted of fall planted winter peas with projected termination dates in April and May, and no cover crop (fallow). The winter peas are planted into wheat stubble in early September at a rate of 35 lb/a in 10-inch 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 are four fertilizer N levels (0, 30, 60, and 90 lb/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, 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

Winter Pea/Grain Sorghum

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 treatment regardless of the presence or lack of winter peas.

Grain sorghum yields for 2002 are presented in Table 9. These yields reflect the later planting date (June 22). The growing season in 2002 favored the later planted summer crops. These emerged after the June 15 hail storm and were not as mature for the August wind storm, thus they had less lodging and stock damage resulting in less secondary tillering and sucker heads. This allowed the main head to fill and produce a quality grain.

Winter Wheat

The fall of 2000 was wet, this after a very hot and dry August and September. Thus, the planting of wheat was delayed until November 24, 2000. Along with the wet fall, 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 precipitation and temperature. Wheat plots were harvested June 29, 2001.

Wheat yields were reported in Field Research 2002 (KSU Report of Progress 893, pg. 117) and data are not presented in this report. Wheat yields reflect 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 most by rainfall at harvest time. This was also true for the percent nitrogen in the seed at harvest. Weed pressure is a particular concern with this rotation. The April termination pea plus 90 lb/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.

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 succeeding crop.

Table 9. Winter Pea Cover Crop and Termination Date Effects on Grain Sorghum after Winter Wheat-Cover Crop -- Sorghum Yield, KSU South Central Field, Hutchinson KS, 1996.

		Flag leaf		Grain Sorghum								
Termination	N	1996		1996			1999			2002		
Date	Rate[1]	N	P	N	P	Yield	N	P	Yield	N	P	Yield
	lb/a		%			bu/a		%	bu/a		%	bu/a
April[2] N/pea	0	2.5	0.38	1.6	0.26	86.5	1.1	0.32	72.6	1.5	0.38	78.4
	30	2.7	0.44	1.6	0.27	93.9	1.2	0.29	90.9	1.6	0.40	87.5
	60	2.8	0.43	1.7	0.27	82.6	1.5	0.32	106.4	1.8	0.40	82.8
	90	2.8	0.44	1.7	0.25	90.4	1.7	0.34	101.8	1.8	0.35	92.5
April[2] /pea	0	2.4	0.40	1.5	0.29	80.2	1.3	0.31	93.5	1.6	0.37	79.9
	30	2.7	0.39	1.6	0.26	85.7	1.3	0.32	97.4	1.7	0.38	91.1
	60	2.7	0.38	1.7	0.27	90.0	1.5	0.33	105.1	1.8	0.40	87.5
	90	2.9	0.41	1.8	0.23	83.8	1.8	0.32	97.9	2.0	0.37	77.2
May[3] N/pea	0	2.1	0.39	1.4	0.30	81.4	1.1	0.34	40.5	1.6	0.41	56.4
	30	2.4	0.39	1.5	0.28	88.1	1.1	0.32	66.6	1.7	0.40	71.6
	60	2.6	0.40	1.6	0.27	90.7	1.2	0.30	93.3	1.8	0.40	71.4
	90	2.6	0.40	1.6	0.26	89.6	1.4	0.31	105.9	1.9	0.40	82.6
May[3] /pea	0	2.3	0.40	1.4	0.29	85.0	1.2	0.31	92.4	1.7	0.39	74.8
	30	2.5	0.40	1.5	0.31	92.4	1.3	0.31	97.7	1.8	0.38	81.5
	60	2.6	0.38	1.6	0.26	92.9	1.5	0.30	112.3	1.9	0.36	86.8
	90	2.7	0.41	1.6	0.25	90.5	1.5	0.32	108.7	1.8	0.39	90.3
LSD (P=0.05)		0.2	0.02	0.1	NS	8.9	0.2	0.04	16.0	0.14	0.05	14.0

[1] Nitrogen applied as 34-0-0 after pea termination prior to planting grain sorghum on 17 June 1996, 11 June 1999, and 22 June 2002.

[2] Early April termination. Actual termination 16 May 1996, 21 April 1999, and 13 April 2002.

[3] Early May termination. Actual termination 4 June 1996, 19 May 1999, and 25 May 2002 .

SOUTH CENTRAL KANSAS EXPERIMENT FIELD

Hutchinson and Sumner County

Sumner County Locations

Introduction

Kansas State University Department of Agronomy has been involved in research in the south central region of Kansas for several decades. In 1999 the department began conducting research at the Wellington Area Test Farm. 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. Soils at the Wellington location consist of Bethany silt loam (Bb). These soils have a 1 to 3 percent slope, are well drained, but slowly permeable soils formed on old alluvium and loess. Other Bethany silt loam (Ba) soils on this location are similar to the Bb soil but have slopes of 0 to 1 percent. The other soil on 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, making them less than ideal for research. Soils at the Argonia locations are primally Bethany silt loams.

Research at Wellington and Argonia locations consists of variety tests with corn, grain sorghum, soybean, and cotton. Other studies include a soybean date of planting by maturity group study; a study of grain sorghum planting rate; and an evaluation of cotton herbicide and date of planting.

SOYBEAN DATE OF PLANTING BY MATURITY GROUP SOUTH CENTRAL KANSAS LOCATIONS

W.F. Heer

Summary

Four soybean varieties each from a different maturity group were planted at four dates in both Sumner County and at the South Central Field, Hutchinson. Averaged over groups, yields were highest for group II and III varieties for late April and early May planting dates in 1999 and 2000. Due to the extreme temperatures recorded in July 2001, the late June and July planting dates had higher yields than the early plantings. The 2002 date of planting study at Argonia was lost due to adverse weather conditions and poor weed control. At Hutchinson, the first two planting dates were severely affected by hail on June 15. This resulted in soybean from these planting dates maturing after the third planting date.

Introduction

The planting window for soybeans 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 an early maturing (group 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 scheduling spring planting of various crops. Several factors influence the selection of maturity group and variety, including soil type and moisture, potential rainfall and the possibility of a killing freeze in the fall before the crop is mature. The objective of this study was to evaluate soybean from different maturity groups planted across a range of dates.

This study was funded in part by the Kansas Soybean Commission.

Procedures

Plots were established at locations throughout Kansas. Experiments reported here were conducted at the South Central Field, Hutchinson in all four years. In Sumner County they were conducted on the Wellington Area Test Farm in 1999 and on land belonging to Jeff Tracy in 2000, and Mark Tracy in 2001and 2002, both sites are located south of Argonia. Varieties planted were Midland 8280 (II), Macon (III), Midland 8410 (IV), and Pioneer (V). Seeding rate was 160,000 plants/a in 30-inch rows. Planting dates for year by location are given in Table 10. 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 2 rows (30 ft x 5 ft) were harvested for yield. All treatments were replicated 4 times at all locations. The 2002 plantings at Argonia were lost to wet conditions that resulted in poor weed control.

Results

Yield data by year, location, maturity group, and planting date are given in Table 10. In 1999 and 2000 the early planted group 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 inches 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, late planted beans had higher yields, as did the late maturity groups (Table 10). Results from the 2002 Hutchinson location reflect hail damage and delayed maturity for first two planting dates.

Table 10. 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 1999 Argonia 2000-02				
	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
2002									
April 29	12	14	10	12	April 25	---	---	---	---
May 20	15	10	12	14	June 3	---	---	---	---
June 11	23	18	18	16	July 2	---	---	---	---
June 29	14	16	13	15	July 2	---	---	---	---
LSD (0.05)	5.3	5.3	5.3	NS					

* Unless two yields in the same column differ by at least the least significant difference, (LSD) little confidence can be 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

VARIETY PERFORMANCE TESTS

All the variety performance test planted in Sumner county were lost except for the corn and those results were so varied that they are published here (Table 11) rather than in the 2002 Kansas Crop Performance Tests With Corn Hybrids (available at local Extension office or online at http//:www.ksu.edu/kscpt).

Table 11. 2002 Sumner County Corn Performance Test – Wellington Area Test Farm, Wellington, KS

Brand	Name	Yield	Average	TW	Moist	Lodging
		bu/ac	%	lb/bu	%	%
NK	N43-C4	30.98	231.19	49.5	12.1	1.17
ASGROW	RX601RR/YG	23.39	174.55	52.2	12.6	2.22
DEKALB	DKC53-34	22.45	167.54	45.7	11.6	12.01
MYCOGEN	2784	21.27	158.73	50.0	12.1	2.27
PIONEER	35R58	20.02	149.40	50.5	12.2	5.14
PIONEER	34H31	18.89	140.97	54.8	12.4	8.09
PIONEER	33B51	17.14	127.91	51.7	12.8	3.48
MYCOGEN	2722IMI	16.18	120.75	53.8	12.8	1.75
ASGROW	RX740RR	15.01	112.01	52.2	13.0	3.75
MAT CHK	FULL- M798	14.03	104.70	50.8	13.6	0.00
MAT CHK	MID-H2649	12.96	96.72	50.5	11.8	5.28
MAT CHK	SHORT-G8590	12.36	92.24	54.4	12.7	4.09
MYCOGEN	2888IMI	8.73	65.15	52.2	12.3	3.38
NK	N67-T4	8.40	62.69	52.9	11.8	0.70
MIDLAND	7B15	5.91	44.10	51.8	11.9	1.27
MIDLAND	7E24Bt	5.72	42.69	51.5	11.8	2.04
NK	N68-K7	5.12	38.21	50.9	11.7	0.47
MAT CHK	FULL-P3162	3.97	29.63	47.5	11.5	2.80
CROPLAN GEN	541Bt	3.30	24.63	48.1	11.6	0.65
MIDLAND	7A04Bt	2.19	16.34	48.4	11.4	0.78
	AVERAGES	13.40		51.0	12.2	3.07
	CV (%)	51.16		4.8	6.7	94.56
LSD (0.05)		9.71		3.5	1.2	4.10

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

RESEARCH AT OTHER LOCATIONS

EVALUATING TWIN ROW CORN PLANTING SYSTEMS

S. Staggenborg, W.B. Gordon, and L. Maddux

Summary

A study was conducted under dryland and irrigated conditions to evaluate three row spacing configurations (30 inch, 20 inch, and twin row) at two plant density levels. Low corn yields as a result of high temperature and drought stress resulted in few differences between the row spacings or the plant density treatments at three of the four locations. At the lowest yielding location, the 30 inch rows produced higher yields than the other two row spacing treatments.

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 inch) and centered on a standard 30 inch 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 inch will not consistently increase corn yields.

Procedures

Three row spacing configurations were tested under dryland at Manhattan, KS on a Reading silt loam; at Belleville, KS on a Crete silt loam; at Powhattan, KS on a Grundy silt loam; and under irrigation at Silver Lake, KS on a Eudora silt loam. The row spacing configurations consisted of 30 inch, 20 inch 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 '35P12' was used at all locations in 2002. Plots were planted in Manhattan on April 16, 2002; at Belleville on April 26, 2002; on May 2, 2002 and on April 17, 2002 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. Grain yield was determined by hand harvesting 30 row-feet from the center 5-ft of each plot.

Results

Corn yields were lower than expected in 2002 due to extreme heat and dry conditions throughout late June and the entire month of July. Corn yields averaged below 100 bu/a at all locations and as a result, no differences between row spacings were found at Manhattan and Powhattan (Table 1). Damage to the overhead irrigation systems at Silver Lake on June 9 delayed initial irrigation and significantly reduced yields. Despite extremely low yields (30 bu/a) at Belleville, 30 inch rows produced higher yields than the 20 inch and paired rows. This is consistent with results found in row spacing experiments conducted in 1997 at the same locations.

Table 1. Effects of row spacing and plant population on corn yields.

		Locations			
Row Spacing	Target Population	Manhattan	Belleville	Powhattan	Silver Lake
		bu/a			
30 in.	High	49.4	21.7	66.9	92.8
20 in.	High	42.1	11.4	73.0	84.7
Paired-row	High	49.7	11.7	59.4	90.2
30 in.	Low	40.0	27.4	67.0	86.7
20 in.	Low	48.3	11.7	68.6	87.7
Paired-row	Low	41.8	8.1	69.8	103.8
		NS	NS	NS	NS
Population Means					
Low		47.1	15.8	68.5	92.7
High		43.4	14.9	66.4	89.2
LSD(0.05)		NS	NS	NS	NS
Row Spacing Means					
30 in.		44.7	24.5	66.9	89.7
20 in.		45.2	11.6	70.8	86.2
Paired-row		45.7	9.9	64.6	97.0
LSD(0.05)		NS	6.6	NS	NS

COTTON RESPONSE TO HAIL DAMAGE

S.R. Duncan and W.F. Heer

Introduction

The Kansas growing season is relatively short for cotton, with average growing degree-day (GDD_{60}) accumulations ranging from 2075 to 2475 in the cotton growing regions of the state. Acreage has bloomed from approximately 2,000 harvested in 1996 to over 60,000 acres harvested in 2002, with plans to plant nearly 100,000 acres in 2003. Three gins are now operating in Kansas with a fourth planned.

Results from a current study have indicated that the cotton planted between May 1 and June 15 in central Kansas will usually produce yields adequate to cover all inputs and costs. Yield levels of different planting dates are greatly influenced by the amounts and timeliness of heat and rainfall received, especially from fruiting to fiber maturity. Thunderstorms with accompanying hail can cause damage to cotton fields ranging from yield losses to field abandonment. The objective of this research was to evaluate the response of cotton at different stages of development to defoliation by hail.

Procedures

The response of cotton to date(s) of planting (DOP) was evaluated at the Kansas State University South Central Experiment Field near Hutchinson, KS, in the 2000 and 2001 growing seasons. The final year of the study was to be 2002. Six-row plots were planted in 30-in. rows on May 2 (DOP 1), May 28 (DOP 2), June 10 (DOP3), June 21 (DOP 4) and July 10 (DOP 5), 2002. Approximately 70,000 seeds/acre were dropped. The cotton variety planted was Delta and Pine Land 'PM 2280 BG/RR'. A starter band containing 35 lb/acre of actual nitrogen (N) and phosphorus (P) was applied as liquid over the row. A preemerge herbicide combination of 1.0 pt/acre Dual II Magnum® plus 0.6 oz/acre Staple® was applied to plots immediately after planting. Roundup Ultra Max® at 26 oz/acre was applied postemergence when cotton seedlings reached the four leaf stage, and hand weeding was used for late season weed control. The center two rows of each plot were machine harvested November 19 and yields were calculated according to Kelley et al. (2002).

Results

Prior to the hailstorm that altered the original objectives of this study, precipitation received (Fig. 1) was at or above the long-term average (LTA) and GDD_{60} (Fig. 2) below the LTA. Prior to the hailstorm of June 15, DOP 1 and DOP 2 cotton had seven and three fully developed leaves, respectively. Following the hailstorm, all DOP 1 and DOP 2 cotton was 95-100% defoliated with stems broken and bruised. DOP 3 cotton plants had hypocotyls just breaking the soil surface or the cotyledons had just unfurled. DOP 1 cotton populations were reduced by 50% as compared to populations in the replant (DOP 4), yet still had more surviving plants than those of DOP 2 and DOP 3. The storm had similar effects, as noted by remaining plant populations, on the less developed seedlings of DOP 2 and DOP 3.

Beginning bloom dates were approximately one week later than what was expected from previous years' results. When cotton was in full bloom and fiber development stages, timely, useable precipitation amounts were received. The number of bolls per acre is strong evidence of the timely climatic events. No differences in boll counts existed between the first three DOP regardless of the fact that differences in plant populations were reported. These boll numbers resulted in exceptional cotton yields (Table 2), similar to trends reported by Morrow and Krieg (1990). Though bolls per acre were similar, yields from DOP 2 cotton were greater than those of DOP 1. The DOP 1 plants were already beginning to develop fruiting nodes when injured and had to regenerate photosynthetic area to be able to regenerate new fruiting branches, potentially slowing development of the plants. In addition, the stems that survived were injured, as evidenced by excessive scarring and branching, perhaps restricting nutrient and water flow to the bolls which resulted in reduced boll weights when compared to DOP 2 plants. DOP 1 yields were similar to those from DOP 3, which, according to Peng et al. (1989), would be the result of lighter bolls from later plantings.

Conclusions

These results indicate that when timely and adequate precipitation events, coupled with LTA levels of GDD_{60}, accumulate after a severe weather event, surviving cotton populations can still produce adequate yields. Results should be interpreted with caution since they represent data from only one year at one site.

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Table 2. The effects of hail on cotton populations, boll counts and lint yield.

Date of Planting	Developed Leaves†	Final Populations	Boll Number	Yield
	per plant	plants/a	bolls/plant	lb/a
May 2	7	32,307	214,896	838
May 28	3	19,239	215,259	1213
June 10	emerging	21,417	190,938	918
June 21	----	64,251	87,483	134
Mean		34,304	177,144	776
$LSD_{(0.05)}$		9,218	71,106	351
C.V.		16.8	25.1	28.3

† Number of fully developed leaves at the time of the hailstorm

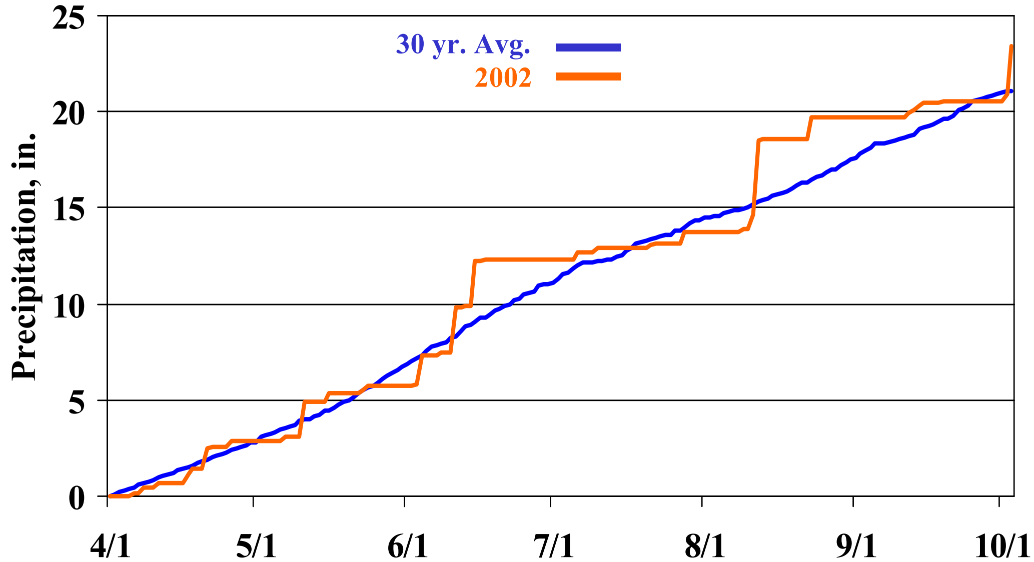

Figure 1. Precipitation received during the 2002 growing season near Hutchinson, KS

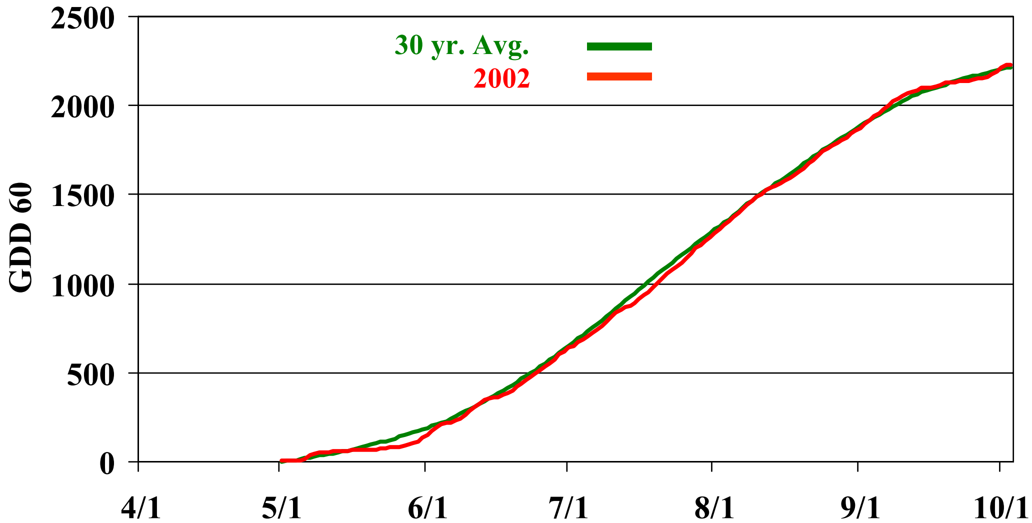

Figure 2. GDD_{60} received during the 2002 growing season near Hutchinson, KS.

HARVEST DELAY EFFECTS ON MACHINE STRIPPED COTTON YIELD AND QUALITY

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

Introduction

Kansas farmers have increased cotton plantings from about 2,000 acres in 1996 to over 60,000 acres in 2002. Three gins are now operating in counties bordering Oklahoma. Custom operators do the bulk of the harvesting, and occasionally harvest is delayed by weather events and the availability of equipment.

Ray and Minton (1973) reported lint yield losses of up to 18, 12 and 6.5 pounds per week if cotton was left in the field up to 1, 4 or 11 weeks, respectively, after the crop reached harvestable condition. Micronaire was not significantly affected, but fiber length, strength and reflectance were all reduced by extended field exposure. Yellowness decreased as exposure to the elements lengthened. Kelley et al., (2002) reported similar negative effects on fiber quality as field exposure time increased. Based on the USDA loan value, these reductions in quality translated into approximate losses of \$0.06/lb (Kelley et al.) in 2002 or up to \$9.50/acre (Ray and Minton) in the first week of harvest in 1973. The objective of this study was to quantify potential cotton yield, quality and income losses due to delayed harvest.

Procedures

Date(s) of harvest (DOH) effects on machine-harvested cotton was evaluated at the South Central Experiment Field near Hutchinson, KS, in the 2001 and 2002 growing seasons. Four-row plots were planted in 30-in. rows on June 13, 2001, and May 28, 2002. Approximately 66,200 seeds/ acre were dropped both years. The cotton variety planted was Delta and Pine Land 'PM2156RR' which is commonly grown in Kansas. This variety also has one of the lowest storm-proof ratings of cotton varieties commonly grown in Kansas, therefore representing a worst-case scenario for weather related losses. A total of 50 lb/acre nitrogen (N) was applied each year to the plot area. A preemerge herbicide combination was applied after planting, Roundup Ultra Max® at 26 oz/acre was applied post emergence and plots were hand weeded for late season weed control. Harvest aids were applied each year to the plots. The center two rows of each plot were machine harvested and yields were calculated similar to the methodology of Kelley et al. (2002). Harvest dates (Table 1) were set at 14-day intervals, weather dependant, or as soon as possible after significant precipitation events. Precipitation between harvests is summarized in Table 1. A sub-sample was taken from each plot, ginned and the fiber submitted to the International Textile Center at Texas Tech Univ., Lubbock, TX, for fiber quality analysis. Lint values were calculated using the Cotton Loan Value calculator developed by Kelley at Texas A&M (2000).

Results

2001

Consistent, untimely rainfall in 2001 delayed planting until June 13. Once planted, the crop emerged rapidly and uniformly. In spite of timely rains the crop was heat and moisture stressed throughout the fruiting and filling periods. Yields (Table 3 and Figure 3) were unaffected for the first three harvest dates, but did decline between DOH 3 and 4. No significant yield losses were recorded between DOH 4 and 5 even though a sleet storm and a heavy, wet snow storm occurred. In the 26 days between DOH 3 and DOH 4 only a trace of precipitation fell, but high winds (wind speeds of at least 15 mph) were recorded 20 of those days and may be the cause for the lint loss. The fiber qualities affected were Rd and +b (Table 4), which increased and decreased, respectively. The effect of delayed harvest on lint yields was similar to results reported by Ray and Minton (1973). Kelley et al., (2002) however, reported that field weathering significantly reduced staple length, uniformity and strength on the High Plains of Texas. In our study, fiber strength was not significantly reduced, but was numerically reduced by 15-25 points after DOH 1 (Table 4), according to the Plains Cotton Cooperative Association loan rate chart. The USDA loan value fluctuated only about $0.01 per lb through the harvest season (Table 5). The value of lint lost from weathering was from $28.42-$39.95 per acre from the first three DOH, to DOH 4. Delaying harvest another 43 days cost reduced revenue another $9.26 per acre. The lint and monetary loss trends are similar to those reported by Ray and Minton (1973). When value was lost, the biggest loss was the first loss. The magnitude of yield and revenue reductions declined with delayed harvest(s) after the first big loss.

2002

Excessive precipitation and cool temperatures resulted in slow emergence and growth of seedlings. In addition, a hailstorm hit the plots at the two to three leaf stages. Final plant stands averaged about 31,700 plants/acre, barely half the targeted populations. However, above normal HU accumulation and timely precipitation resulted in exceptional lint yields (Figure 3). Gross returns from the 2002 crop (Table 5) were higher than those of 2001. Lint yields trended up in the 8 days between DOH 1 and 2, probably as the result of late maturing bolls opening. The $36.60 per acre increase in value between harvest dates is certainly appealing. The supposition that DOH 2 yields were supplemented by later maturing bolls is supported by the corresponding drop in micronaire (Table 4) as harvest was delayed. A wet snow fell between DOH 2 and DOH 3 and contributed to 33% harvested lint reductions. No differences existed between DOH 3 and DOH 4 in spite of an intense rainstorm. Two wet snows fell between DOH 4 and DOH 5, but lint yields were not adversely affected. The trend of the first significant harvest losses resulting from the first weather event and then lower to no losses from subsequent weathering events was consistent. Ray and Minton (1973) reported similar results. Only the first two DOH fiber quality characteristics will be discussed. The favorable weather during fiber development, vs that in 2001, is obvious (Table 4) with the 2002 fiber having premium micronaire, length and strength values. Micronaire values decreased significantly with delayed harvest, in contrast to the results of previous investigators (Ray and Minton,1973; Kelley et al., 2002), who found no change in micronaire after field weathering. Both Ray and Minton (1973) and Kelley et al. (2002) reported reduced fiber length and strength as a result of field weathering, but neither of those trends was measured in the two harvests of 2002.

Conclusions

When harvest date is delayed past optimum, lint yields and gross income will be significantly reduced. The higher the yield levels, the greater the magnitude of yield loss from weathering. The first major weather event had the greatest impact on yield losses with subsequent weather contributing little to the overall yield reductions. Kansas harvest season precipitation amounts were less than those in studies of other investigators, which may have resulted in "less" field weathering of fiber grown in Kansas. Consequently, fiber quality of Kansas cotton has not been reduced when harvest was delayed, contrary to the findings from Texas.

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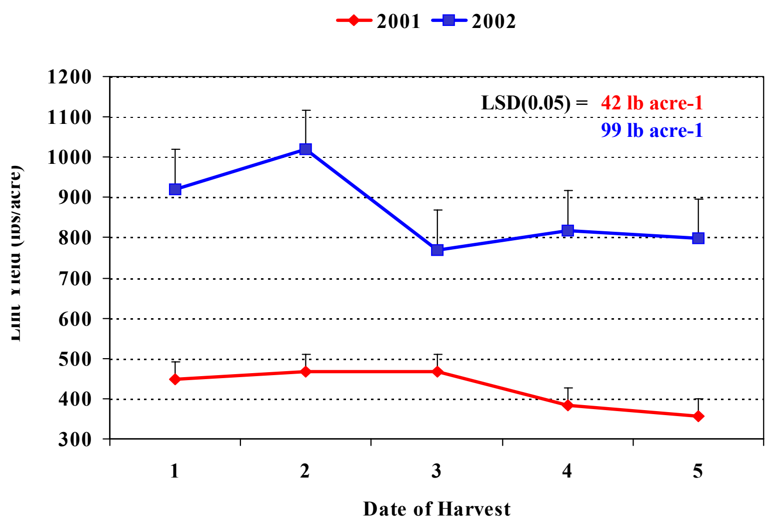

Figure 3. Delayed harvest effects on lint yields at Hutchinson, KS.

Table 3. Dates of harvest and precipitation received prior to lint yield of each harvest.

2001			2002		
Harvest Date	Precipitation	Yield	Harvest Date	Precipitation	Yield
	inches	lb acre^{-1}		inches	lb acre^{-1}
November 19	0.11†	449	November 13	0.04†	920
December 3	trace	468	November 21	0.22	1019
December 21	0.16	467	December 6	0.25‡	769
January 16	trace	384	December 16	0.36	818
February 28	2.48‡	357	December 30	0.08	798
Mean		425			865
$LSD_{(0.05)}$		42			99
C.V.		6.4			7.0

† precipitation received the week prior to this harvest
‡ snow included in the precipitation total

Table 4. Date of harvest effects on cotton fiber quality characteristics.

Harvest Date	Micronaire	Length	Uniformity	Strength	Rd	+b
2001		inches	%	g tex^{-1}		
November 19	4.7	0.96	81.9	30.0	67.5	6.9
December 3	4.7	0.95	81.1	28.7	69.9	7.3
December 21	4.5	0.95	80.4	28.3	70.7	6.7
January 16	4.8	0.95	81.4	29.1	68.0	6.1
February 28	4.5	0.95	81.1	28.0	71.5	6.1
Mean	4.6	0.95	81.2	29.0	69.5	6.6
$LSD_{(0.05)}$	NS	NS	NS	NS	4.0	1.1
C.V.	5.3	1.3	1.3	6.0	3.1	8.7
2002						
November 13	4.1	1.04	83.6	29.5	68.4	7.7
November 21	3.7	1.05	83.5	31.1	69.9	6.9
Mean	3.9	1.05	83.6	30.3	69.2	7.3
$LSD_{(0.05)}$	0.39	NS	NS	NS	NS	NS
C.V.	4.6	2.2	0.5	4.4	5.2	8.9

Table 5. Delayed harvest effects on cotton gross returns acre^{-1}.

2001			2002		
Harvest Date	Lint Value†	Gross Returns‡	Harvest Date	Lint Value†	Gross Returns‡
	lb/a	$/a		lb/a	$/a
November 19	0.4240	190.43	November 13	0.4435	408.24
December 3	0.4302	201.21	November 21	0.4346	442.84
December 21	0.4325	201.96			
January 16	0.4218	162.01			
February 28	0.4278	152.75			

† Lint value determined using Cotton Loan Value calculator
‡ Gross returns=Yield x Lint value

LIMITED IRRIGATION OF SUNFLOWER IN NORTHWEST KANSAS

R. Stockton, R.M. Aiken, D. O'Brien and D. Belshe

Summary

Sunflower yields under irrigation have been erratic and difficult to predict. This research was implemented to examine sunflower yield under limited or partial season irrigation to determine yield potential and economic yield. In 2001, oil type sunflowers were grown on a cooperator's center pivot irrigated field. The dryland control replicates produced 1510 lb/a, while the irrigated treatment produced 2800 lb/a with 8.3 inches of irrigation. In 2002, yields ranged from 708 lb/a dryland to over 2500 lb/a with 7.7 inches of irrigation. The 2002 yields were decreased by uncontrolled insect pressure and bird and deer predation. When yields were adjusted to remove insect damage and predation effects, the range was from 1259 dryland to over 2900 lb/a with 7.7 inches of irrigation. When stalks of the two hybrids were split and examined for insect larvae, a standard height hybrid had spotted stem weevil larvae in 50 out of 50 stalks, while a short statured hybrid had no spotted stem weevil larvae in 50 stalks. Lodging in the taller hybrid was greater than 25%, while the shorter hybrid had less than 5% lodging. With only one year's observation, it is not known whether the shorter hybrid may have some stem weevil resistance, or if this was just a random occurrence.

Introduction

Interest in irrigated sunflowers is increasing in western Kansas as effects of decreasing irrigation well productivity, depletion of the Ogallala aquifer and rising fuel prices become more evident. Due to the relative newness of sunflowers as an irrigated crop, there is a scarcity of current research data on sunflower response to irrigation. There is even less information on the effectiveness of limited irrigation of sunflowers. Anecdotal reports from producers on sunflower response to irrigation range from "no better than dryland" to "fantastic". In an effort to better define sunflower response to irrigation and maximize profitability of the practice, and as part of the technology transfer effort of sunflower irrigation research conducted by Rob Aiken at the Kansas State University Northwest Research and Extension Center, a cooperative field study was conducted in eastern Sherman County, KS in 2001. A replicated plot at the Colby research station was utilized to test water response of semi-dwarf versus standard height hybrids in 2002.

Procedures

Plots were established in a center pivot irrigated cooperator field northwest of Brewster, KS, in 2001. Plots were seeded on 29 May 2001, at a population of 21000/a irrigated and also on dry corners, which were used as control treatments. Plots in 2002 were established with surface line source irrigation (soaker hose) at the Northwest Research and Extension Center at Colby, KS. Weed control both years was accomplished by a PPE application of pendimethalin (32 oz/a) and sulfentrazone (3 oz/a) and hand hoeing. The soil both years was a Keith silt loam with an available water holding capacity of approximately 2.2 inches per foot. The 2001 plots had been fallow since a late summer harvest of forage sorghum in 2000. The 2002 plots were established in a growing, dryland wheat crop which was terminated on 1 May 2002 by glyphosate herbicide application. Irrigation of 2001 plots was by cooperator schedule (Table 6). All 2002 plots received a 1.5 in. irrigation on 18 June and 5 July to ensure adequate moisture for germination and establishment. Thereafter, control treatments were rain-fed dryland while the limited irrigation treatments were scheduled to maintain soil water content above 40 % using the KanSched irrigation scheduling software (Kansas State University) and data from the weather station on the Colby research station. Two identical irrigated treatments were maintained until 3 Sept. when the late irrigation treatment was given 1 in. more water (Table 8). Triumph 545A (standard height) was used both years, while Triumph 567DW (semi-dwarf) sunflowers were added to the 2002 trial, which was seeded on 18 June 2002 at a final population of 17,500 plants/a. This was less than desired (24,000plants/a) due to extreme drought and grasshopper pressure. Both years, plots were fertilized for a 3000 lb/a yield goal according to soil test results. Both years, stand counts were made in early July and 17.5 feet of two rows were hand harvested in each replicate in late Sept. and threshed in a stationary threshing unit approximately 2 weeks later.

Results

2001

Sunflower populations were uniform across all irrigation treatments. Precipitation from May 1 through harvest was 10.85 in., which produced 1510 lb/a average dryland yield, while the average irrigated sunflower yield was 2780 lb/a with 8.35 in. of additional water (Table 7). The limited irrigation yielded 152 lb/a for each inch of irrigation. Irrigated replication 2 yielded only 390 lb/a less than the other irrigated replications due to non-uniform plant spacing (bunching and skips) even though the population was 21,000 plants/a. Gross returns, based on a $9.80/cwt cash price plus premium for oil content, were $162.02/a for dryland and $298.29/a for irrigation. The dryland yield in this plot was about 200 to 300 lb/a more than average in the area this year, which would indicate that the amount and timing of rainfall was quite beneficial to yield and oil content.

2002

Sunflower populations were uniform across all irrigation treatments, but had uneven spacing between plants characterized by four to five 2 ft skips per 100 ft of row. Precipitation, irrigation, grass-based evapo-transpiration (ET) and sunflower ET amounts are reported in Table 8. Yields and gross returns are reported in Table 9. The cumulative ET for this crop location was calculated by KanSched software (KSU) as 28.84 in., which is 8.6 to 9.7 in. more than the combined rainfall and irrigation amounts. The soil at planting time was too dry to allow penetration of a steel rod probe. The soil moisture content prior to irrigation is assumed to near permanent wilting point within the top 3 ft of soil. After 3 in. of irrigation just after planting, which all plots received, the steel rod probe penetrated to a depth of 42 to 46 in. It is estimated that the soil profile from 3 to 6 ft contained as much as 3 in. available water for crop growth. The 2002 growing season was about 5°F hotter than average and precipitation was 5 to 7 in. less than average.

The plots were not sprayed for insect control. While head moth damage was slight, stem weevil, *Cylindrocopturus adspersus*(LeConte), and stem borer, *Dectes texanus* (LeConte), pressure was heavy. Hybrid 545A had more than 25 % lodging and the majority of pith eaten away in the lower 2 ft of stem. Hybrid 567DW had less than 5 % lodging and relatively little of the lower stem pith eaten. Notably, examination of 50 stems of each hybrid revealed no spotted stem weevil larvae in 567DW compared to about 25 per stem in 545A (data not shown). Soybean stem borer larvae were found in both hybrids equally. Hybrid 545A matured about 10 days earlier than 567DW, which may have been a result of the differences in stem weevil pressure. Also, deer and bird predation of 25% in 545A and 10% in 567DW was recorded. Again, the difference in maturity date could account for the predation difference. The lodging difference could be partially due to maturity, partially due to less insect damage to the interior of the stalk and partially due to less mechanical wind force on the shorter hybrid. Also, the stalk diameter of 567DW was slightly larger than that of 545A. Yields were adjusted to account for lodging and predation to show the true irrigation effect (Table 9). Hybrid 545A's oil content was about 46.0 %, while hybrid 567DW's oil content was about 37 %. Hybrid 567DW has not been noted for above average oil content. Gross returns, based on a $12.75/cwt cash price (27 Nov. 2002) plus premium for oil content, or on $13.50/cwt for bird seed quoted the same day are reported in Table 9. These prices were higher than long-term averages; however, 2003 NuSun contracts are available locally for $11.50/cwt or more. Seed yield response to irrigation is reported in Figure 4 and ranged from 125 lb/a in. to 199 lb/a in., based on adjusted seed yield.

The adjusted dryland yield of 545A was similar to the average yield in the KSU dryland sunflower variety plots, located less than a half mile away, while 567DW yielded similar to the best yielding hybrid in the KSU variety plots. The differences in lodging and as-harvested versus adjusted seed yields underscore the importance of controlling stem pests. It is not known whether hybrid 567DW has a physiological or morphological resistance to stem weevil and the observations of one site-year are not sufficient to draw conclusions, but it is a possibility that needs further investigation. Recent research (Charlet, et al., 2001) shows 600 to 1100 lb/a seed yield increase for one insecticide application to control stem pests. Part of that increase is due to decreased lodging, but part is due premature death of plants caused by insect damage and associated diseases vectored by the insects. Thus, it is possible that the best adjusted yields reported in this study could have been 300 to 500 lb/a better with timely insect control. Seed yield was reduced by as much as 450 lb/a due to less than desired population and skips and doubles in row in 2001, and could have been reduced for the same reason in this plot, but there was no control to aid documentation. The adjusted seed yields could have possibly been 600 to 1000 lb/a higher and such yields have been seen in 2001 and 2002 in the NWREC irrigated NuSun sunflower performance trials and other trials in the area.

Table 6. 2001 Seasonal precipitation and irrigation for eastern Sherman County, KS

Month	May	June	July	Aug	Sept	Oct	Total
Rain	3.35 *	0.5	3.0	1.5	2.0	0.5	10.85
Irrigation	0.6	1.75	4.0	2.0	0	0	8.35

*2.35 received prior to May 10.

Table 7. Effect of irrigation on sunflower yield components, Sherman County, KS, 2001.

Treatment	Head dia.[1]	Test wt.	Yield	Oil	Gross Return[2]
	Range (in.)	lb/bu	lb/a	%	$/a
Dryland(avg)	3.5-5.5	28.85	1510	51.2	162.02
Irrigated(avg)	6.5-8.5	31.9	2780	44.75	298.29
Rep 1		32.4	2920	45.1	
Rep 2		31.5	2490	45.4	
Rep 3		31.0	2900	43.7	
Rep 4		32.6	2840	44.8	

[1] Range in diameter in inches of 10 consecutive heads at a random location in plot.
[2] Base price of $9.80/cwt + oil premium of 2% price increase/each 1% oil above 40%.

Table 8. Seasonal precipitation, irrigation and ET at NWREC, Colby, KS*

Month	May	June	July	Aug.	Sept.	Total
Rain	1.31	1.26	1.49	4.17	1.16	9.39
Irrigation	0.00	1.50	1.50	6.60	1.10**	9.6/10.7**
Reference ET	5.48	10.8	10.91	9.00	5.73	41.92
Corn ET	1.24	6.05	10.26	8.13	2.15	27.83

*12 May, 2002 to 24 Sept., 2002 **Late irrigation treatment only

Table 9. Effects of irrigation on sunflower yield components at NWREC, Colby,. KS, 2002.

Treatment	Head dia.[1]	Yield	Oil	Income[2]	Adjusted yield[3]	Income
	Range (in.)	lb/a	%	$/a	lb/a	$/a
Dryland (avg)						
545A	3.5-5.5	708	46.5	102.00	1259	186.42
567DW	3.5-5.5	1719	37.5	232.07B	2010	271.35B
9.6" Irrigation(avg)						
545A	6.5-8.5	1205	45.8	171.46	2143	304.95
567DW	8 - 9	2356	37.3	318.06B	2756	372.06B
10.7" irrigation(avg)						
545A	6.5-8.5	1530	46.2	219.26	2720	392.50
567DW	8 - 9	2515	35.9	339.53B	2941	397.04B

[1] Range in diameter in inches of 10 consecutive heads at a random location in plot.
[2] Gross income based on cash price of $12.75/cwt (27 Nov., 2002) + oil premium of 2% price increase/each 1% oil above 40%, or bird seed price quote for the same time of $13.50/cwt denoted 'B', whichever produces the greatest gross income.
[3] Yield adjusted to compensate for lodging and predation to better evaluate effect of irrigation. Lodging was 25%(545A) or 5%(567DW) and predation was 25%(545A) and 10%(567DW).

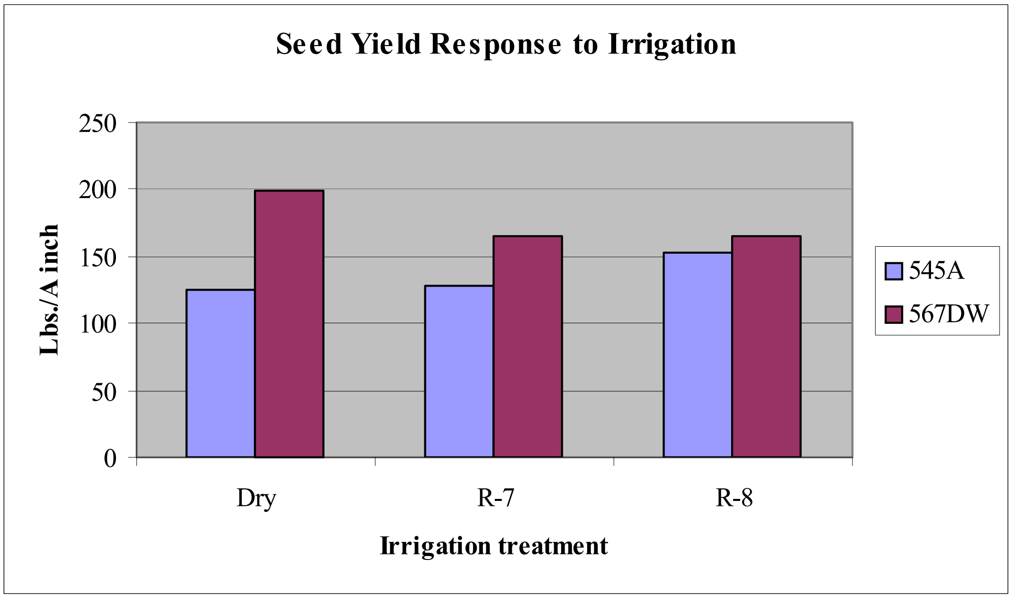

Figure 1. Seed yield response to irrigation of two sunflower hybrids. Yield response values are based on adjusted seed yield and assume no water available in the top three feet of soil and 3 in. water available in the three to six foot deep profile and 5.3 in. water use to develop plant prior to seed development. All treatments received 9.39 in. rain from 12 May '02 until 24 Sept. '02 and 3.0 in. irrigation for stand establishment. Treatment R-7 received an additional 6.6 in. irrigation. Treatment R-8 received an additional 7.7 in. irrigation.

BROADLEAF WEED CONTROL IN WINTER WHEAT

D.E. Peterson and D.L. Regehr

Introduction and Procedures

An experiment was conducted near Manhattan, KS on a Reading silt loam soil with 2.5% organic matter and a pH of 5.7 to evaluate broadleaf weed control in winter wheat. Hybrid '2137' hard red winter wheat was seeded at 70 lb per acre on October 8, 2001. Precipitation of 0.9 inch was received within 1 week after planting, resulting in uniform germination and emergence of the crop and weeds. Fall postemergence (FP) treatments were applied to 3- to 4-leaf and 2- to 5-tiller wheat, and 1- to 4-inch bushy wallflower and field pennycress rosettes on November 15 with 68 F, 68% relative humidity, and clear skies. Dormant (DOR) treatments were applied to tillering wheat, and 1- to 3-inch rosettes of bushy wallflower and field pennycress on February 20 with 45 F, 41% relative humidity, and partly cloudy skies. Spring postemergence (SP) treatments were applied to fully tillered wheat, 3- to 4-inch tall bushy wallflower and field pennycress, and cotyledon to 1-leaf wild buckwheat on April 9 with 66 F, 43% relative humidity, and mostly clear skies. Treatments were applied with a CO_2 backpack sprayer delivering 20 gpa at 25 psi through XR8002 flat fan spray tips to the center 6.3 ft of 10- by 20-ft plots. The experiment was a randomized complete block design with three replications. Wheat injury was evaluated December 6 and April 16. Weed control was visually estimated on May 13. Wheat was harvested on June 27.

Results

Several fall postemergence treatments caused stunting that was apparent through early spring, but disappeared over the remainder of the season. Field pennycress infestations were light, and control was excellent with all treatments. Most treatments provided good control of bushy wallflower. Spring postemergence treatments that included Finesse, Amber, or Rave tended to give the highest wild buckwheat control. Wild buckwheat control with Rave and Finesse was lower with fall postemergence than dormant or spring postemergence applications, probably because of dry conditions in the fall. Wheat yields were erratic and not related to weed control. Although there were no visible injury symptoms, wheat yields with Starane plus Finesse treatments were less than the untreated check.

Table 10. Broadleaf weed control in winter wheat (Peterson and Regehr).

Treatment[a]	Application Rate	Application Time[b]	Wheat Injury 12-6-01	Wheat Injury 4-16-02	Buwf[c]	Fipc[c]	Wibw[c]	Wheat yield
	(oz/a)		-----------(%)---------		------------(% control)-----------			(Bu/a)
MCPA-ester	12	FP	0	0	100	100	0	35
Rave + NIS	3.5	FP	5	0	100	100	50	41
Finesse + NIS	0.3	FP	7	2	100	100	77	42
Maverick + NIS	0.67	FP	9	3	100	100	57	45
Olympus + NIS	0.9	FP	10	3	93	100	10	45
Finesse + NIS	0.3	DOR		1	100	100	93	42
Rave + NIS	3.5	DOR		1	100	100	90	43
Amber + 2,4-D LV4 + NIS	0.35 + 8	SP		0	100	100	94	40
Rave + NIS	3.5	SP		5	100	100	97	43
Finesse + 2,4-D LV4 + NIS	0.3 + 8	SP		0	100	100	96	41
Finesse + Clarity + NIS	0.3 + 2	SP		3	100	100	99	46
Ally + 2,4-D LV4 + NIS	0.1 + 8	SP		1	100	100	87	44
Maverick + NIS	0.67	SP		1	93	100	92	43
Olympus + NIS	0.9	SP		3	90	100	77	43
Express + NIS	0.17	SP		1	80	100	83	46
Express + NIS	0.33	SP		0	97	100	77	46
Harmony Extra + NIS	0.3	SP		0	90	100	77	45
Harmony Extra + NIS	0.5	SP		0	88	100	77	42
Peak + 2,4-D LV4 + NIS	0.25 + 8	SP		2	100	100	88	45
Peak + NIS	0.375	SP		1	100	100	89	44
Aim + NIS	0.33	SP		4	98	100	73	43
Aim + 2,4-D LV4 + NIS	0.33 + 8	SP		3	100	100	83	47
Starane + Salvo	10.7 + 10	SP		0	100	100	87	43
Starane + Finesse + NIS	5.3 + 0.3	SP		0	100	100	97	35
Starane + Finesse + NIS	10.7 + 0.3	SP		0	100	100	94	36
2,4-De	12	SP		2	100	100	63	43
Clarity + 2,4-D LV4	2 + 8	SP		5	97	100	83	46
No Treatment								47
LSD (5%)			3	2	8	NS	14	7

[a] NIS = Activate Plus nonionic surfactant from Agriliance applied at 0.5% v/v; 2,4-D LV4 = ethylhexyl ester of 2,4-D.
[b] FP = fall postemergence; DOR = dormant season; SP = spring postemergence.
[C] Buwf = bushy wallflower; Fipc = field pennycress; Wibw = Wild buckwheat.

CHEATGRASS CONTROL IN WINTER WHEAT

D.E. Peterson and D.L. Regehr

Introduction and Procedures

An experiment was conducted near Manhattan, KS on a Reading silt loam soil with 2.5% organic matter and a pH of 5.7 to evaluate several herbicide treatments for cheatgrass control in "2137" hard red winter wheat seeded with a double disk drill on October 8, 2001. Preemergence treatments were applied to the soil surface on October 8, with 72 F and 59% relative humidity. Precipitation of 0.9 inch was received within 1 week after planting, resulting in uniform germination and emergence of crop and weeds. Early fall postemergence (EFP) treatments were applied to 2- to 3-leaf wheat and 1- to 3-leaf cheat and downy brome on November 1 with 68 F, 48% relative humidity, and clear skies. Fall postemergence (FP) treatments were applied to 4-leaf and 2- to 4-tiller wheat, and 1- to 3-tiller cheat and downy brome on November 15 with 67 F, 57% relative humidity, and clear skies. Early spring postemergence (ESP) treatments were applied to tillering wheat and weeds on March 16, 2002 with 42 F, 49% relative humidity, and clear skies. Spring postemergence (SP) treatments were applied to fully tillered wheat and cheatgrass on April 4 with 53 F, 21% relative humidity, and mostly clear skies. Treatments were applied with a CO_2 back-pack sprayer delivering 20 gpa at 25 psi through XR8002 flat fan spray tips to the center 6.3 ft of 10- by 20-ft plots. The experiment was a randomized complete block design with three replications. Wheat injury was evaluated November 21 and May 14. Cheat and downy brome control was visually estimated on May 14 and June 7. Wheat was harvested on June 26.

Results

Several treatments caused minor stunting after application, but injury disappeared with time. AEF 130060 caused severe wheat injury and stand reduction with the fall application, but was applied without a safener that is normally included to reduce the risk of wheat injury. Spring applied AEF 130060 was less injurious. Maverick preemergence did not give good cheat or downy brome control, despite good soil moisture following planting and application. Cheat control was generally better than downy brome control with most postemergence treatments. Treatments with Olympus or Everest gave near complete cheat control from both spring and fall applications. Fall applied Maverick gave excellent cheat control, but control with spring applied Maverick tended to be slightly lower. Downy brome control was similar for Maverick and Olympus, which was better than with Everest. Early fall postemergence treatments provided the best downy brome control. Wheat yield generally related to cheatgrass control and crop injury.

Table 11. Cheatgrass control in winter wheat.

Treatment[a]	Application Rate[b]	Application Time[c]	Wheat 11-21-01	Wheat 5-14-02	Cheat 5-14-02	Cheat 6-7-02	Downy Brome 5-14-02	Downy Brome 6-7-02	Wheat yield
	(oz/a)		-----(% injury)-----		----------------(% control)			----------------	(Bu/a)
Maverick	0.67	PRE	0	0	57	43	53	37	39
Maverick + NIS	0.67 + 0.5%	EFP	10	3	100	99	87	87	43
Olympus + NIS	0.62 + 0.5%	EFP	9	3	100	100	92	93	37
Olympus + NIS	0.9 + 0.5%	EFP	15	5	100	100	95	98	43
Everest + NIS	0.6 + 0.5%	EFP	6	1	99	100	50	33	42
Maverick + NIS	0.67 + 0.5%	FP	4	0	99	100	67	65	36
Olympus + NIS	0.62 + 0.5%	FP	4	0	100	100	57	50	41
Olympus + NIS	0.9 + 0.5%	FP	4	1	100	100	73	63	39
Everest + NIS	0.6 + 0.5%	FP	3	1	100	100	33	23	36
AEF 130060 + MSO + 28%N	0.29 + 1% + 2%	FP	5	53	97	100	91	85	32
Maverick + NIS	0.67 + 0.5%	ESP		4	96	96	53	50	39
Olympus + NIS	0.9 + 0.5%	ESP		2	99	100	57	60	40
Olympus + Sencor + NIS	0.9 + 3 + 0.5%	ESP		4	100	100	68	67	40
Everest + NIS	0.6 + 0.5%	ESP		2	98	100	43	23	36
Maverick + NIS	0.67 + 0.5%	SP		3	87	91	75	68	39
Olympus + NIS	0.9 + 0.5%	SP		0	95	100	68	67	45
Olympus + Sencor + NIS	0.9 + 3 + 0.5%	SP		5	95	100	65	67	34
Everest + NIS	0.6 + 0.5%	SP		0	97	98	27	10	42
AEF 130060 + MSO + 28%N	0.29 + 1% + 2%	SP		9	73	78	37	23	34
No treatment									
LSD (5%)			2	3	15	15	17	13	7

[a] NIS = Activate Plus nonionic surfactant from Agriliance; MSO = Destiny methylated seed oil from Agriliance; 28%N = 28% UAN liquid nitrogen fertilizer.

[b] % = % v/v.

[c] PRE = preemergence; EFP = early fall postemergence; FP = fall postemergence; ESP = early spring postemergence; SP = spring postemergence.

COMPARISON OF GLYPHOSATE PRODUCTS

D.E. Peterson and D.L. Regehr

Introduction and Procedures

An experiment was conducted near Manhattan, KS on a Wymore silty clay loam soil with a cation exchange capacity of 18.4, 2.8% organic matter, and a pH of 5.8 to compare glyphosate products and additives for efficacy. Two rows each of velvetleaf, common sunflower, sorghum, and corn were planted as assay strips across each replication into conventionally tilled seedbed on June 8, 2002. Postemergence treatments were applied to 4 to 6 leaf (4-6 inch) velvetleaf, 8 leaf (6-8 inch) sunflower, V5 (8-10 inch) sorghum, and V5 (14 inch) corn on June 24 with 81 F, 50% relative humidity and clear skies. Treatments were applied with a compressed air, tractor mounted sprayer delivering 15 gpa at 18 psi through TT11003 flat fan spray tips to the center 10 ft of the plots, and perpendicular to the direction of the assay strips. The experiment had a randomized complete block design with three replications and 15- by 25-ft plots. Plant response was visually evaluated on July 23.

Results

Weed escapes were most common and occurred primarily in the tractor wheel tracks. Weed control was similar among all glyphosate formulations applied at equal acid equivalent rates and with a source of ammonium sulfate. Weed control with glyphosate was less if no ammonium sulfate source was included in the treatment. Class Act NG is an adjuvant from Agriliance that includes nonionic surfactant, fructose, and ammonium sulfate. Array is a guar based adjuvant from Rosens that reduces drift potential and provides a source of ammonium sulfate.

Table 12. Comparison of glyphosate products.

Treatment[a]	Rate	Velvet-leaf	Sun-flower	Sorghum	Corn
	(product/a)	----------------(% control)----------------			
Cornerstone + NIS + AMS	12 oz + 0.25% + 2%	88	91	95	94
Cornerstone + Class Act NG	12 oz + 2.5%	87	92	93	96
Glyphomax + NIS + AMS	12 oz + 0.25% + 2%	86	90	93	96
Glyphomax Plus + AMS	12 oz + 2%	91	92	96	98
Roundup Ultra + AMS	12 oz + 2%	91	92	93	95
Touchdown IQ + AMS	12 oz + 2%	88	92	97	97
Roundup Ultra Max + AMS	9.7 oz + 2%	89	93	93	96
Roundup Ultra Max + Array	9.7 oz + 9 lb/100G	90	94	96	97
Roundup Ultra Max + AMS	9.7 oz + 1%	88	92	95	97
Roundup Ultra Max	9.7 oz	72	85	90	94
Roundup WeatherMax + AMS	8 oz + 2%	86	91	94	96
Cornerstone + NIS + AMS	32 oz + 2%	96	99	99	100
Glyphomax Plus + AMS	32 oz + 2%	98	99	99	100
Roundup Ultra + AMS	32 oz + 2%	97	96	99	99
Touchdown IQ + AMS	32 oz + 2%	98	100	100	99
Roundup Ultra Max + AMS	26 oz + 2%	98	99	99	100
LSD (5%)		4	4	4	3

[a] NIS = Activate Plus nonionic surfactant from Agriliance applied on a % v/v basis;
AMS = ammonium sulfate applied on a % w/w basis.

DORMANT TREATMENTS FOR WEED CONTROL IN ALFALFA

D.E. Peterson and S.R. Duncan

Introduction and Procedures

An experiment was conducted near Great Bend, KS in established alfalfa growing on a Naron sandy loam soil with 1.5% organic matter and a pH of 6.3 to evaluate several dormant season herbicide treatments for winter and summer annual weed control. Herbicide treatments were applied to dormant alfalfa and 1- to 3-inch diameter flixweed and shepherdspurse rosettes on March 6, 2002 with 60 F, 25% relative humidity, and mostly cloudy skies. Treatments were applied with a CO_2 backpack sprayer delivering 20 gpa at 25 psi through XR8002 flat fan spray tips to the center 6.3 ft of 10- by 30-ft plots. The experiment was a randomized complete block design with three replications. Crop response and weed control were visually evaluated on May 3, July 26, and August 15.

Results

None of the herbicide treatments caused any visible injury to alfalfa throughout the season (data not shown). Treatments with Velpar, flumioxazin plus surfactant, Pursuit, or Raptor gave excellent flixweed control. Many treatments gave good shepherdspurse control. Treflan or Gramoxone Extra did not provide good control of either flixweed or shepherdspurse. The addition of nonionic surfactant greatly enhanced flixweed and shepherdspurse control with flumioxazin, and probably also would have enhanced control with sulfentrazone. Palmer amaranth populations were light and variable. Flumioxazin and sulfentrazone tended to give the best residual Palmer amaranth control among the treatments evaluated. Pursuit also gave good Palmer amaranth control, indicating the Palmer amaranth in the field was still an ALS susceptible population. Flumioxazin and sulfentrazone appear to have good potential for winter annual broadleaf and residual pigweed control in alfalfa.

Table 13. Dormant treatments for weed control in established alfalfa.

Treatment[a]	Application Rate[b]	Flixweed	Shepherdspurse	Palmer Amaranth July 26	Palmer Amaranth August 15
	(Product/acre)	(% control)			
Karmex	1 lb	67	93	83	73
Karmex	2 lb	80	100	87	73
Velpar	1 pt	98	98	73	53
Velpar	2 pt	97	100	90	73
Karmex + Velpar	1 lb + 1 pt	100	100	92	70
Sencor	8 oz	70	100	0	0
Karmex + Sencor	1 lb + 8 oz	97	100	100	80
Treflan TR10	20 lb	0	0	80	70
Sulfentrazone		60	70	100	100
Sulfentrazone	0.34	77	87	100	99
Flumioxazin	0.094	37	60	100	90
Flumioxazin	0.13	67	90	95	93
Flumioxazin + NIS	0.13 + 0.25%	97	98	100	95
Flumioxazin + NIS	0.25 + 0.25%	100	100	100	98
Flumioxazin + 2,4-DB	0.13 + 0.5	67	97	100	97
Butyrac 200	2 pt	53	100	0	0
Gramoxone Extra + NIS	1.25 pt + 0.25%	67	47	0	0
Pursuit + NIS + 28% N	1.44 oz + 0.25% + 2Q	100	93	87	87
Pursuit + NIS + 28% N	2.1 oz + 0.25% + 2Q	100	100	90	87
Raptor + NIS + 28% N	4 oz + 0.25% + 2Q	100	93	43	23
Raptor + NIS + 28% N	5 oz + 0.25% + 2Q	100	97	77	63
LSD (5%)		17	11	16	17

[a] NIS = Activate Plus nonionic surfactant from Agriliance; 28% N = 28% UAN liquid nitrogen fertilizer.
[b] % = % v/v; Q = quarts per acre.

GLYPHOSATE WEED CONTROL PROGRAMS AND APPLICATION TIMING EFFECT

D.E. Peterson and D.L. Regehr

Introduction and Procedures

An experiment was conducted near Manhattan, KS on a Reading silt loam soil with a cation exchange capacity of 10.6, 3.2% organic matter, and a pH of 5.8 to compare glyphosate weed control programs and application timing with conventional weed control programs. 'Asgrow 3302' Roundup Ready soybeans were seeded 1.5 inches deep at 150,000 seeds per acre into conventionally tilled seedbed with adequate soil moisture on May 30, 2002. Preemergence treatments were applied to the soil surface following planting. Postemergence treatments at 3 weeks after planting (3 WAR) were applied to 2-trifoliate soybeans, 1 to 12 inch Palmer amaranth, 1 to 6 inch velvetleaf, 1 to 6 inch sunflower, and 4 to 8 inch ivyleaf morningglory on June 20 with 87 F, 42% relative humidity and mostly clear skies. Postemergence treatments at 4 weeks after planting (4 WAR) were applied to 3-trifoliate (8 inch) soybeans, 2 to 20 inch Palmer amaranth, 4 to 12 inch velvetleaf, 12 to 16 inch sunflower, and 4 to 12 inch ivyleaf morningglory on June 26 with 83 F, 65% relative humidity and mostly clear skies. Postemergence treatments at 5 weeks after planting (5 WAR) were applied to 4-trifoliate (12 inch) soybeans, 6 to 32 inch Palmer amaranth, 12 to 18 inch velvetleaf, 24 to 28 inch sunflower, and 6 to 18 inch ivyleaf morningglory on July 3 with 75 F, 89% relative humidity and cloudy skies. Treatments were applied with a compressed air, tractor mounted sprayer delivering 15 gpa at 20 psi through TT11003 flat fan spray tips to the center two rows of the four 30-inch row plots. The experiment had a randomized complete block design with three replications and 10- by 25-ft plots. Palmer amaranth, velvetleaf, and common sunflower were evaluated on August 20. Ivyleaf morningglory was evaluated July 23. Soybeans were harvested on October 21.

Results

None of the herbicides caused important injury to soybeans. Adequate moisture was present at planting to stimulate an early flush of weeds. However, minimal early season precipitation resulted in poor activation and weed control from preemergence treatments. Early weed emergence combined with warm weather stimulated rapid early season weed growth. By 4 weeks after planting, weeds were already up to 20 inches tall. Consequently, Flexstar plus Fusion treatments at 4 WAR were not very effective. Postemergence treatments, especially Flexstar plus Fusion realistically would have been applied earlier than 4 WAR due to the large weed size. Even though preemergence treatments were not very effective for early season Palmer amaranth control, sequential programs with Touchdown gave better control than Touchdown alone. Velvetleaf control with glyhosate was good, but declined as application date was delayed. Touchdown and Roundup treatments gave complete control of common sunflower (cultivate) at all application times. Sequential Touchdown or Roundup applications gave the best ivyleaf morningglory control. Soybean plots that were deemed too weedy to harvest were assigned a zero yield. Soybean yields were low and variable due to the dry conditions during the first 2 months of the growing season.

Highest soybean yields occurred with sequential treatments of Touchdown or Roundup at 3 and 6 WAR, and sequential treatments of a preemergence herbicide followed by Touchdown at 4 WAR. Soybean yields with a single Touchdown treatment at 4 WAR were lower than sequential Touchdown or Roundup, or PRE fb Touchdown at 4 WAR treatments. Soybean yields tended to decrease as Touchdown applications were delayed from 4 WAR to 6 WAR with or without a Boundary PRE foundation treatment. However, sequential treatments with Boundary fb Touchdown always tended to be better than comparable Touchdown alone treatments. Boundary and/or Flexstar plus Fusion treatments had poor soybean yields due to the poor weed control.

Table 14. Glyphosate weed control programs and application timing effect.

Treatment[a]	Application Rate	Application Time[b]	Paam[c]	Vele[c]	Cosf[c]	Ilmg[c]	Soybean yield
	(product/a)		---------(% control)--------				(bu/a)
Boundary	1.5 pt	PRE	17	17	0	0	6
Boundary	2.25 pt	PRE	43	33	0	13	9
Boundary/Flexstar+Fusion+COC+28%N	1.5 pt/16oz+10oz	PRE/4 WAR	36	50	10	36	0
Boundary/Flexstar+Fusion+COC+28%N	1.5pt/20oz+10oz	PRE/4 WAR	33	50	7	33	8
Flexstar+Fusion+COC+28%N	20oz+10oz	4 WAR	7	43	0	37	3
Boundary/Touchdown IQ+AMSU	1.5pt/2pt	PRE/4 WAR	94	90	100	67	28
Domain/Touchdown IQ+AMSU	10oz/2pt	PRE/4 WAR	88	93	100	70	25
Authority/Touchdown IQ+AMSU	3oz/2pt	PRE/4 WAR	88	92	100	77	28
Canopy XL/Touchdown IQ+AMSU	3.5oz/2pt	PRE/4 WAR	89	90	100	78	26
Touchdown IQ+AMSU	2 pt	4 WAR	75	95	100	70	19
Boundary/Touchdown IQ+AMSU	1.5pt/2pt	PRE/5 WAR	88	92	100	50	24
Touchdown IQ+AMSU	2 pt	5 WAR	72	90	100	40	15
Boundary/Touchdown IQ+AMSU	1.5pt/2pt	PRE/6 WAR	82	77	100	33	18
Touchdown IQ+AMSU	2 pt	6 WAR	66	70	100	26	14
Touchdown IQ+AMSU/Touchdown IQ+AMSU	2pt/2pt	3 WAR/6 WAR	88	100	100	87	29
Touchdown IQ+AMSU/Touchdown IQ+AMSU	1.5pt/1pt	3 WAR/6 WAR	87	100	100	88	30
Roundup Ultra Max+AMSU/Roundup Ultra Max+AMSU	26oz/26oz	3 WAR/6 WAR	87	100	100	92	27
No Treatment							0
LSD (5%)			11	9	6	14	7

[a] / = sequential application; COC = Crop Oil Plus petroleum oil with 17% emulsifier from Farmland Industries applied at 1% v/v;
28%N = 28% UAN liquid nitrogen fertilizer applied at 2.5% v/v; AMSU = ammonium sulfate applied at 2% w/w or 17 lb/100 gal spray.
[b] PRE = preemergence; WAR = weeks after planting.
[c] Paam = Palmer amaranth, Vele = velvetleaf; Cosf = common sunflower; Ilmg = ivyleaf morningglory.

JAPANESE BROME CONTROL IN WINTER WHEAT

D.E. Peterson and T.M. Maxwell

Introduction and Procedures

An experiment was conducted near Assaria, KS on a Crete silt loam soil with 2.4% organic matter and a pH of 5.4 to evaluate several herbicide treatments in different spray carrier solutions for Japanese brome control in 'Jagger' hard red winter wheat seeded October 1, 2001. Fall postemergence (FP) treatments were applied to 3- to 4-leaf and 3-tiller wheat, and 1- to 3-leaf Japanese brome on November 2 with 63 F, 38% relative humidity, and clear skies. Spring postemergence (SP) treatments were applied to multiple tillered wheat and Japanese brome on March 30 with 50 F, 37% relative humidity, and mostly clear skies. Treatments were applied with a CO_2 backpack sprayer delivering 20 gpa at 25 psi through XR8002 flat fan spray tips to the center 6.3 ft of 10- by 30-ft plots. The experiment was a randomized complete block design with three replications. Wheat injury was evaluated November 14, April 12, and May 8. Japanese brome control was evaluated on May 8 and May 23.

Results

Application of Maverick, Olympus, or Everest with liquid nitrogen fertilizer as carrier resulted in wheat foliar burn, which was greater with fall than spring treatments, and increased with fertilizer carrier concentration. However, crop response was temporary and new growth was unaffected. All fall treatments provided excellent Japanese brome control, which generally was better than comparable spring treatments. Olympus and Everest gave better Japanese brome control than Maverick with spring applications. Japanese brome control with spring applications of Maverick was higher when applied with liquid nitrogen carrier than water only carrier. Scattered downy brome in the plot area generally was not controlled as well as Japanese brome, especially with Olympus treatments.

Table 15. Japanese brome control in winter wheat.

	Application		Fertilizer	Wheat			Japanese brome	
Treatment[a]	Rate[b]	Time[c]	Carrier	11-14-01	4-12-02	5-8-02	5-8-02	5-23-02
	(oz/a)		(% v/v)	-------------(% injury)-------------			----(% control)----	
Maverick + NIS	0.67+0.25%	FP	0	2	0	0	100	99
Maverick + NIS	0.67+0.25%	FP	50	5	0	0	100	100
Maverick + NIS	0.67+0.25%	FP	100	13	0	0	99	99
Olympus + NIS	0.9+0.25%	FP	0	4	0	0	99	98
Olympus + NIS	0.9+0.25%	FP	50	7	0	0	100	99
Olympus + NIS	0.9+0.25%	FP	100	17	0	0	99	99
Everest + NIS	0.61+0.25%	FP	0	4	0	0	99	99
Everest + NIS	0.61+0.25%	FP	50	7	0	0	99	99
Everest + NIS	0.61+0.25%	FP	100	15	0	0	99	99
Maverick + NIS	0.67+0.25%	SP	0		0	0	73	67
Maverick + NIS	0.67+0.25%	SP	50		3	0	80	87
Maverick + NIS	0.67+0.25%	SP	100		4	0	86	83
Olympus + NIS	0.9+0.25%	SP	0		0	0	90	96
Olympus + NIS	0.9+0.25%	SP	50		3	0	92	96
Olympus + NIS	0.9+0.25%	SP	100		5	0	92	97
Everest + NIS	0.61+0.25%	SP	0		0	0	92	92
Everest + NIS	0.61+0.25%	SP	50		4	0	89	93
Everest + NIS	0.61+0.25%	SP	100		5	0	92	96
LSD (5%)				3	1	NS	8	6

[a] NIS = Activate Plus nonionic surfactant from Agriliance.
[b] % = % v/v.
[c] FP = fall postemergence; SP = spring postemergence.

WEED CONTROL AND CROP TOLERANCE IN CLEARFIELD WHEAT

D.E. Peterson and D.L. Regehr

Introduction and Procedures

An experiment was conducted near Manhattan, KS on a Reading silt loam soil with 2.5% organic matter and a pH of 5.7 to evaluate winter annual grass control and imidazolinone resistant wheat tolerance to Beyond and competitive treatments. Cereal rye, downy brome, and cheat seed were broadcast in strips across each replication and incorporated prior to establishing the experiment. An experimental Clearfield-resistant hard red winter wheat variety from ApriPro was seeded at 70 lb per acre on October 8, 2001. Precipitation of 0.9 inch was received within 1 week after planting, resulting in uniform germination and emergence of the crop and weeds. Fall postemergence (FP) treatments were applied to 3- to 4-leaf and 2- to 5-tiller wheat, 2- to 4-leaf and 1- to 3-tiller cheat and downy brome, and 3- to 5-leaf and 2- to 5-tiller rye on November 15 with 66 F, 70% relative humidity, and clear skies. Spring postemergence (SP) treatments were applied to multi-tillered wheat, cheat, downy brome, and rye on March 28 with 68 F, 35% relative humidity, and clear skies. Treatments were applied with a CO_2 backpack sprayer delivering 20 gpa at 25 psi through XR8002 flat fan spray tips to the center 6.3 ft of 10- by 20-ft plots. The experiment was a randomized complete block design with three replications.

Wheat injury was evaluated March 3 and May 15. Winter annual grass control was visually estimated on June 7. Wheat was harvested on June 26.

Results

Fall and spring applied Beyond caused general stunting to Clearfield wheat. Wheat injury was much higher with Beyond plus Finesse than with Beyond alone. Maverick, Olympus, and Everest also caused minor injury symptoms on wheat. Fall applied Beyond provide excellent control of downy brome, cheat, and rye. The addition of Clarity to Beyond tended to reduce downy brome and rye control compared to Beyond alone. Weed control with Beyond was lower for spring than fall treatments, especially for rye and downy brome. Cheat control with Olympus and Everest was excellent with both fall and spring treatments. Fall applied Maverick also provided excellent cheat control, but control was slightly lower with spring treatments. Downy brome control with Maverick, Olympus, and Everest was less than cheat control. Downy brome control tended to be slightly higher with Maverick than Olympus. Downy brome control was poor with Everest. All treatments provided good control of bushy wallflower (data not presented). Wheat yields generally corresponded to weed control and crop tolerance.

Table 7. Weed control and crop tolerance in Clearfield wheat (Peterson and Regehr).

	Application		Wheat		Downy			Wheat
Treatment[a]	Rate	Time[b]	3-3-02	5-15-02	Brome	Cheat	Rye	yield
	(oz/a)		------(% injury)-----		-----------(% control)----------			(Bu/a)
Beyond + NIS + N	4	FP	7	3	98	100	96	25
Beyond + NIS + N	5	FP	12	3	99	100	99	24
Beyond + Finesse + NIS + N	4 + 0.4	FP	43	23	94	100	91	23
Beyond + Clarity + NIS + N	4 + 4	FP	8	3	91	99	89	25
Mavercik + NIS	4	FP	3	0	70	100	27	29
Maverick + Finesse + NIS	0.67 + 0.4	FP	5	5	63	100	17	26
Olympus + NIS	0.9	FP	3	0	63	100	0	28
Everest + NIS	0.6	FP	1	0	13	100	0	26
Beyond + NIS + N	4	SP		0	50	92	23	28
Beyond + NIS + N	5	SP		1	43	93	33	26
Beyond + Finesse + NIS + N	4 + 0.4	SP		22	37	87	17	23
Beyond + Clarity + NIS + N	4 + 4	SP		5	40	90	7	27
Maverick + NIS	0.67	SP		0	63	93	17	30
Maverick + Finesse + NIS	0.67 + 0.04	SP		1	47	90	3	29
Olympus + NIS	0.9	SP		0	50	100	3	28
Everest + NIS	0.6	SP		0	17	100	0	27
No Treatment								22
LSD (5%)			4	5	19	6	11	4

[a] NIS = Activate Plus nonionic surfactant from Agriliance applied at 0.5% v/v; N = 28% UAN liquid nitrogen fertilizer applied at 2 pt/a.
[b] FP = fall postemergence; SP = spring postemergence.

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The entire Agronomy Field Research Report can also be obtained on CD-ROM in January 2004. The CD will contain the current and past four issues of Agronomy Field Research; Kansas Fertilizer Research; all current Kansas Crop Performance Tests; the most recent Chemical Weed Control for Field Crops, Pastures, Rangeland andNoncropland; recent Insect Management guides, and related publications. Contact the Distribution Center at K-State Research and Extension or any K-State Research and Extension County Office.

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