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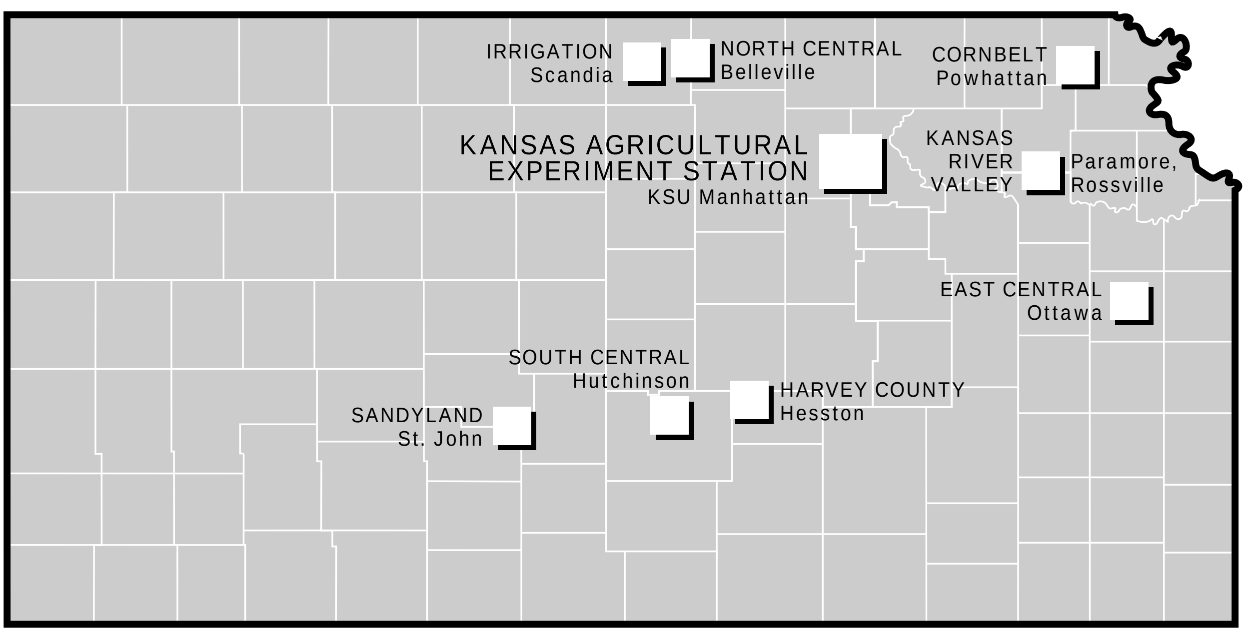
Report of Progress 854

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

FIELD RESEARCH 2000



Agronomy Experiment Fields

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Contribution no. 00-399-S from the Kansas Agricultural Experiment Station.

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CORNBELT EXPERIMENT FIELD

Introduction

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

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

Soil Description

The soils on the Experiment Field are silty, windblown, Pleistocene sediments called loess (pronounced luss). Grundy silty clay loam, the dominant soil, has a black silty clay loam surface, usually more than 15 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.

1999 Weather Information

Precipitation during the growing season in 1999 was above normal in April, May, and June, which delayed corn planting. The below-normal rainfall in July, August, and September resulted in some depression of crop yields.

The last killing frost was on April 16 (normal April 23), and the first killing frost was on October 4 (normal October 15). The frost-free period was 4 days shorter 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, 1998 - September, 1999												
4.72	5.30	0.58	0.49	1.33	1.22	7.79	6.72	8.12	1.48	1.16	2.52	41.43
41-Year Average												
2.79	1.84	1.04	0.78	0.75	2.30	3.01	4.82	5.00	4.53	4.07	4.49	35.42

WHITE FOOD -CORN PERFORMANCE TEST

Larry D. Maddux

Summary

The average yield of the 28 hybrids in the test was 94.2 bu/a, and the range was from 60.2 to 121.1 bu/a. The LSD(.05) was 18.4 bu/a (two hybrids must differ in yield by 18.4 bu/a to be considered significantly different in yielding ability 95% of the time).

Introduction

The Cornbelt Field is one of the 11 locations of a regional fee test coordinated by Dr. L. L. Darrah with USDA-ARS at the University of Missouri. The 1999 test included 25 white hybrids submitted by 12 companies and three yellow hybrid checks. Eight white hybrids were new to the test in 1999.

Procedures

Anhydrous ammonia at 125 lbs N/a was applied. Atrazine 4L at 1.5 qt/a plus Dual at 2.0 pt/a were incorporated with a field cultivator. The hybrids were planted on May 20 at 26,000 seeds/a in 30-inch rows on a silty clay loam soil following a previous crop of soybeans. The test was cultivated once and harvested with a Gleaner E plot combine.

Results

Yields in this ranged from 60.2 to 121.1 bu/a test and averaged 94.2 bu/a (Table 2). Corn yields were low because of the late planting date and subsequent dry weather in July and August. The yellow corn performance test (planted in another field across the road) had an average yield of 105 bu/a and a range from 92 to 127 bu/a. The yellow check B73xMo17 yielded 90.3 bu/a and the other two yellow checks (Pioneer Brand 3245 and 3394) yielded 98.9 and 104.4 bu/a, respectively.

Table 2. Grain yield, stand, root and stalk lodging, ear height, moisture content, and days from planting to half-silk of the white food-corn hybrids, Powhattan, KS, 1999.

Brand	Hybrid	Yield	Stand	Stalk Lodged	Days to Flower	Moisture
		bu/a	%	%	no.	%
Asgrow	RX901W	101.8	100	0.5	72	16.1
Asgrow	RX921W	109.5	104	0.5	72	16.7
DeKalb Genetics	DK665W	97.0	99	0.5	67	14.2
Diener	DB114W	106.3	99	0.0	67	14.6
Garst	8277W	99.6	103	1.4	69	15.7
IFSI	90-1	86.1	85	0.5	67	15.5
IFSI	95-1	73.8	95	0.5	72	19.5
IFSI	97-1	105.4	82	1.8	68	18.0
LG Seeds	NB749W	94.5	103	1.4	70	15.8

Table 2. Grain yield, stand, root and stalk lodging, ear height, moisture content, and days from planting to half-silk of the white food-corn hybrids, Powhattan, KS, 1999.

Brand	Hybrid	Yield	Stand	Stalk Lodged	Days to Flower	Moisture
		(Continued)				
Pioneer Brand	32H39	93.2	102	0.0	69	14.2
Pioneer Brand	32K72	105.5	99	0.5	67	13.6
Pioneer Brand	32Y52	86.6	97	0.5	68	13.8
Pioneer Brand	X1138AW	102.8	94	1.0	68	13.6
Trisler	T-4214w	89.1	105	0.0	70	14.6
Vineyard	V433W	121.1	107	0.4	68	15.2
Vineyard	Vx4548W	84.9	97	0.0	71	15.5
Vineyard	Vx4918W	102.1	109	0.4	71	15.2
Whisnand	50AW	99.6	98	0.0	68	14.2
Whisnand	51AW	88.8	99	2.0	68	14.2
Zimmerman	1780W	105.6	101	1.0	67	14.8
Zimmerman	1851W	92.3	86	0.6	72	15.7
Zimmerman	N71-T7	94.7	85	0.0	68	14.2
Zimmerman	NX7208	89.6	96	1.0	68	14.2
Zimmerman	Z62W	68.9	93	0.0	73	13.2
Zimmerman	Z75W	60.2	82	0.6	73	13.9
Yellow check	B73xMo17	90.3	95	0.0	68	13.9
Yellow check	Pioneer 3245	98.9	104	1.0	69	13.3
Yellow check	Pioneer 3394	104.4	107	0.5	67	13.0
Mean		94.2	97	0.6	69	14.9
LSD 0.05		18.4	10	1.4	2	0.8
CV%		12.0	6	133.7	2	3.4

GRAIN SORGHUM HERBICIDE PERFORMANCE TEST

Larry D. Maddux and Scott A. Staggenborg

Summary

Twenty-seven herbicide treatments were evaluated, and results of 13 are reported. Grass control was good with only two treatments having 70% control or less of large crabgrass and green foxtail. All treatments except for the POST treatment of Paramount + Atrazine gave excellent control of redroot pigweed. This POST treatment also gave only 62% velvetleaf control.

Introduction

Chemical weed control and cultivation have been used to reduce weed competition in row crops for many years. This test included 27 herbicide treatments and an untreated control; 13 treatments are reported here. The major weeds in this test were large crabgrass, green foxtail, redroot pigweed, and velvetleaf.

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 3.2%. Northrup King 73-J6 sorghum hybrid was planted on May 27 at 73,000 seeds/a in 30-inch rows. Anhydrous ammonia at 90 lbs N/a was applied preplant. Herbicides were applied preemergent (PRE) on May 27 and postemergent (POST) on June 19. The plots were not cultivated. The data reported here are for crop injury and weed control ratings made on July 6, 14 days after POST treatments were applied. The first significant rainfall after PRE herbicide application was on May 31 (1.69 inches). Plots were harvested on October 15 using a modified Gleaner E III plot combine.

Results and Discussion

Very little crop injury was observed with any treatment (Table 3). All treatments except Paramount + Atrazine POST gave excellent control of redroot pigweed. Control of large crabgrass and green foxtail was good with most treatments resulting in 80 - 90% control. Two POST treatments, Paramount + Clarity and Paramount + Atrazine, resulted in 70% or less control of these two grass species. Control of velvetleaf was 80% or greater with all but two treatments, Paramount + Atrazine POST and Dual II Magnum PRE. Corn yield tended to follow the weed control ratings. The check plot yielded only 48 bu/a, whereas the herbicide-treated plots yielded 40 to 140 bu/a.

Table 3. Effect of herbicides on sorghum injury, weed control, and grain yield, Powhattan, 1999.

Treatment	Rate	Appl Time[1]	Injury 14 DAT	Weed Control, 14 DAT [2] Lgcg	Grft	Rrpw	Vele	Grain Yield
	prod./a		%	%				bu/a
Untreated check	---	---	0.0	0	0	0	0	48
Dual II Magnum	1.33 pt	PRE	0.0	100	85	100	78	119
Bicep II Magnum	2.1 qt	PRE	0.0	100	92	100	93	134
Guardsman	2.25 qt	PRE	0.0	100	92	100	82	125
Lariat	4.0 qt	PRE	0.0	100	88	100	80	132
Peak + Atrazine 4L[3]	0.5 oz 0.75 qt	POST POST	0.0	0	0	100	87	40
Dual II Magnum + Peak[3]	1.33 pt 0.75 oz	PRE POST	0.0	97	88	100	93	114
Dual II Magnum + Peak + Atrazine 4L[3]	1.33 pt 0.75 oz 1.0 qt	PRE POST POST	0.0	100	88	100	95	122
Dual II Magnum + Peak + Buctril[4]	1.33 pt 0.75 oz 1.0 pt	PRE POST POST	0.0	100	90	100	97	121
Dual II Magnum + Peak + Clarity[4]	1.33 pt 0.75 oz 0.25 pt	PRE POST POST	1.7	98	92	98	92	140
Dual II Magnum + Permit[3]	1.33 pt 1.25 oz	PRE POST	0.0	100	85	100	98	130
Dual II Magnum + Permit + Atrazine 4L[3]	1.33 pt 1.25 oz 0.75 qt	PRE POST POST	0.0	92	92	100	87	137
Paramount + Clarity[4]	0.33 lb 0.25 pt	POST POST	0.0	50	27	95	83	50
Atrazine 4L + Paramount[3]	1.5 qt 0.33 lb	PRE POST	1.7	80	90	98	90	119
Paramount + Atrazine[3]	0.33 lb 0.75 qt	POST POST	0.0	70	70	53	62	105
LSD(0.05%)			NS	15	12	15	19	28

[1] PRE = preemergence; POST = postemergence.

[2] Lgcg = large crabgrass; Grft = green foxtail; Rrpw = redroot pigweed; Vele = Velvetleaf, DAT = days after treatment application; Injury and weed control rated 7/06/99.

[3] Plus crop oil concentrate at 2.0 pt/a.

[4] Plus nonionic surfactant at 0.25%.

SOYBEAN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux and Scott A. Staggenborg

Summary

Fourteen herbicide treatments were evaluated. Significant soybean injury was observed with three postemergence applications. All treatments resulted in 82% or greater control of large crabgrass, green foxtail, and redroot pigweed. All treatments gave excellent control of velevetleaf (92% or greater).

Introduction

Chemical weed control and cultivation are used commonly to control weeds and reduce yield losses in soybean. This test included 14 chemical treatments and an untreated control for evaluation of weed control. The major weed species in this test were large crabgrass, green foxtail, redroot pigweed, and velvetleaf.

Procedures

This test was conducted on a Grundy silty clay loam soil with a pH of 6.7 and organic matter content of 3.2% previously cropped to corn. Pioneer Brand 94B01 soybeans were planted on June 11 at 144,000 seeds/a in 30-inch rows. Preemergence (PRE) herbicides were applied on June 11 and postemergence (POST) on July 9. The first two significant rainfalls received after application of the PRE treatments were June 14 and 16 (0.34 and 0.53 inch). The plots were not cultivated. Ratings reported for crop injury were made on July 16 and 23, 7 and 14 days after application of the POST treatments. Ratings reported for weed control were made on August 5, 28 days after application of the POST treatments. Harvest was on October 21 using a modified Gleaner E III plot combine.

Results

Significant soybean injury was observed with three POST treatments, Flexstar + Fusion, Basagran + Blazer + Poast Plus, and Action + Roundup (Table 4). Large crabgrass and green foxtail control was 82% or greater with all treatments. All treatments gave 82% or greater control of redroot pigweed. Velvetleaf control was excellent, with all treatments resulting in 92% or greater control. Weed pressure was not very heavy, as indicated by the untreated check yield of 28.7 bu/a. Yields on the treated plots ranged from 29.3 to 39.6 bu/a with no significant differences being observed.

Table 4. Effect of herbicides on soybean injury, weed control, and grain yield, Powhattan, 1999.

Treatment	Rate	Appl Time[1]	Soybean Injury 7DAT	14DAT	Weed Control, 28 DAT[2] Lacg	Grft	Rrpw	Vele	Grain Yield
	prod./a		%			%			bu/a
Untreated Check		---	0.0	0.0	0	0	0	0	28.7
Squadron	3.0 pt	PRE	1.7	0.0	97	90	90	97	33.2
Prowl + FirstRate	3.0 pt 0.6 oz	PRE PRE	0.0	0.0	97	93	90	97	29.3
Prowl + FirstRate[3,4]	3.0 pt 0.6 oz	PRE POST	0.0	6.7	95	92	90	97	37.6
Prowl + Raptor[4,5]	3.0 pt 4.0 oz	PRE POST	5.0	0.0	100	98	90	95	33.5
Canopy XL + Assure II[5]	6.8 oz 8.0 oz	PRE POST	0.0	1.7	100	98	98	100	31.5
Valor + Select + FirstRate[5,6]	3.0 oz 8.0 oz 0.3 oz	PRE POST POST	1.7	0.0	98	90	100	98	34.8
Flexstar + Fusion[7]	1.0 pt 10.0 oz	POST POST	30.0	16.7	100	95	100	93	33.3
Canopy XL + Roundup Ultra[6]	3.5 oz 1.5 pt	PRE POST	3.3	1.7	100	98	92	100	33.7
Authority + Roundup Ultra[6]	3.0 oz 1.5 pt	PRE POST	1.7	0.0	100	100	97	95	39.6
Prowl + Raptor + Roundup Ultra[6]	2.5 pt 4.0 oz 1.5 pt	PRE POST POST	3.3	1.7	100	100	92	97	33.4
Command + Roundup Ultra[6]	1.33 pt 1.5 pt	PRE POST	0.0	0.0	100	100	98	98	37.6
Roundup Ultra[6] Roundup Ultra[6]	1.5 pt 1.5 pt	POST POST	0.0	6.7	100	98	95	95	35.7
Action + Roundup Ultra[5,6]	0.5 oz 1.5 pt	POST POST	15.0	6.7	100	98	95	92	39.2
Basagran + Blazer + Poast Plus[4,5]	1.5 pt 0.5 pt 1.5 pt	POST POST POST	30.0	10.0	88	85	82	98	35.1
LSD(0.05)			4.7	10.0	4	6	11	6	NS

[1] PRE = preemergence; POST = postemergence.

[2] Lacg = large crabgrass; Grft = green foxtail; Rrpw = redroot pigweed; Vele = velvetleaf; DAT = days after postemergence treatment application; Ratings: Injury - 7/16/98 & 7/23/99; Weed control - 8/05/99.

[3] Plus nonionic surfactant at 0.25%.

[4] Plus urea ammonium nitrate at 2.0 qt/a.

[5] Plus crop oil concentrate at 2.0 pt/a

[6] Plus ammonium sulfate at 2.55 lb/a.

[7] Plus methlated sunflower oil at1.0%.

EVALUATION OF BT AND NON-BT CORN HYBRIDS IN NORTHEAST KANSAS

Scott A. Staggenborg and Larry D. Maddux

Summary

Sixteen corn hybrids (eight Bt and eight non-Bt) were evaluated for grain yields and test weights during 1999 at the Cornbelt Experiment Field in Northeast Kansas. Average grain yield for the non-Bt hybrids was 111 bu/a whereas that for the Bt hybrids was 108 bu/a. Spring rain that delayed planting until late May and drought during July reduced overall grain yields. In instances where Bt and non-Bt counterparts were included in the study, no significant differences occurred between the two hybrids.

Procedures

Corn plots were established at the Cornbelt Experiment Field near Powhattan, KS on May 26, 1999. Four corn hybrids from four companies (Dekalb, Garst, Novartis, and Pioneer) were utilized. Each company was instructed to enter two Bt hybrids and two conventional hybrids adapted to the area. The hybrids were not required to be genetic relatives either with or without the Bt trait. Hybrids from each company included in the trial are listed in Table 5.

Grain weight, test weight, and moisture were determined using a plot combine on October 27, 1999. Grain yields were adjusted to 15.5% moisture.

Results

Above average rainfall during late April and early May delayed planting approximately 3 to 4 weeks. Previous research indicates that this reduces grain yield potential by approximately 20 bu/a. Below average rainfall and above-average air temperatures during July resulted in plant stress. These two environmentally induced stresses reduced overall plot yields to 110 bu/a.

Growing conditions resulted in few differences in grain yields among all 16 hybrids. Overall, the Bt hybrids averaged 108 bu/a (58.7 lb/bu test weight) and the non-Bt hybrids averaged 112 bu/a (58.4 lb/bu test weight). The six Bt and non-Bt hybrid pairs that were genetically similar showed no grain yield differences. As with grain yields, no consistent relationships between Bt and non-Bt hybrids occurred with test weights.

Table 5. Grain yields and test weight for eight Bt and eight conventional corn hybrids grown at the Cornbelt Experiment Field near Powhattan, KS in 1999.

Hybrid	Company	Relative Maturity (days)	Corn Type	Bt Event	Grain Yield (bu/a)	Test Weight (lbs/bu)
DK626	Dekalb	112	Conventional		105.9	57.8
DK626BtY	Dekalb	112	Bt	MON810	105.3	57.8
DK647	Dekalb	114	Conventional		103.5	56.8
DK647BtY	Dekalb	114	Bt	MON810	113.7	57.9
8285Mp	Garst	118	Conventional		131.9	56.8
8342GLSY	Garst	114	BT	MON810	117.6	58.6
8366LLStarLink	Garst	113	Bt	CBH351	94.9	56.2
8541IT	Garst	108	Conventional		100.8	59.0
N7590	Novartis	115	Conventional		105.9	58.0
N7590Bt	Novartis	115	Bt	Bt11	94.1	57.3
N79L3	Novartis	118	Bt	Bt11	119.5	61.0
N79P4	Novartis	118	Conventional		119.9	59.9
32K61	Pioneer	114	Conventional		119.8	60.6
32K62	Pioneer	114	Bt	MON810	111.3	61.3
33P66	Pioneer	114	Conventional		107.4	58.5
33P67	Pioneer	114	Bt	MON810	108.1	59.5
$LSD_{(0.05)}$					17.5	2.1

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 placement methods for crop efficiency and environmental effects.

Soil Description

Soils on the fields 160 acres are Woodson. The terrain is upland, level to gently rolling. The surface soil is 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 inch per hour when saturated. This makes the soil susceptible to runoff and sheet erosion.

1999 Weather Information

Precipitation during 1999 totaled 43.58 inches, which was 7.19 inches above the 31-yr average (Table 1). Most of the extra moisture occurred during the early and late parts of the growing season. Rainfall during April and May exceeded normal by 6.38 inches. September rainfall was 3.17 inches above normal. July was the driest month with roughly half the normal moisture. Overall, the growing season moisture was adequate for soybean, but deficient for corn.

The coldest temperatures during 1999 occurred during the first 10 days of January with 5 days in the single digits. There were 33 days during the summer on which temperatures exceeded 90 degrees. The hottest period was July 23 through July 30, when daily temperatures exceeded 97 F every day.

The last spring freeze was on April 18 (average, April 18), and the first killing frost in the fall was on October 18 (average, October 21). The number of frost-free days was 182 compared with the 185-day average.

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

Month	1999	31-yr. avg.	Month	1999	31-yr. avg.
January	1.60	1.02	July	1.87	3.60
February	1.21	1.21	August	4.35	3.65
March	1.20	2.62	September	7.18	4.01
April	7.19	3.59	October	0.79	3.47
May	8.11	5.33	November	1.27	2.50
June	6.18	5.27	December	2.63	1.51
Annual Total				43.58	36.39

EFFECTS OF SUBSOILING ON YIELD OF CORN AND SOYBEAN

Keith A. Janssen

Summary

Questions are being raised about the benefits of deep tillage on soils with dense clay subsoils. The effects of deep subsoil ripping, shallower chisel plowing, and no preplant tillage on corn and soybean are being evaluated at the East Central Experiment Field. Corn yields for 1999 were limited by delayed planting and dry summer weather. Yields ranged from 67 to 80 bu/a. Soybean yields ranged from 41 to 43 bu/a. The effects of the tillage treatments on corn and soybean yields were not statistically significant. No-till and the shallower chisel- plow treatments produced yield just as good of as those with the deeper subsoil treatments. In the past study years, rainfall has been in excess of normal. Although 1999 was somewhat of an exception, deep tillage still did not significantly benefit yield. With each passing year, it is becoming more clear that deep tillage is not having a major effect on corn and soybean yields. Additional years of testing will help verify these effects and determine the profitability of deep tillage

Introduction

Extensive acreage of soils in the east-central part of Kansas have dense clay subsoils. These slowly permeable clay subsoils restrict drainage, limit aeration, limit depth of rooting, and limit crop-available moisture. As a result, crop yields are restricted. Various tillage practices have been used to loosen these claypan soils. Some farmers deep chisel or subsoil their fields every year, others every other year, and some on a less frequent basis. The benefits from these deep tillage operations have not been evaluated fully. The clay in these soils is mostly montmorillonite, which expands and contracts with wetting and drying. Also, in many winters, freeze-and-thaw cycles loosen these soils to a depth of 6 to 8 inches or more. These shrink-swell, freeze-thaw processes may be sufficient to alleviate any compaction that results from fertilization, planting, spraying, and harvesting. Consequently, the benefits from deep tillage are being questioned. Another question is whether some crops are affected more than others by deep tillage. This study evaluates various frequencies of subsoil tillage as well as shallower chisel plow and no-till systems for effects on corn and soybean yields.

Procedures

This experiment was started in 1996. Tillage treatments established were no-till (no preplant tillage); chisel plowing every year (5-7 inch depth), and subsoil tillage at 8-14 inch depth yearly, every other year, and every 3 years. Treatments were established in two blocks, one for corn and one for soybean, on a Woodson soil. Subsoil and chisel plow treatments were performed on March 5, 1999 for the 1999 growing season. All plots, except the no-till plots, were field cultivated before planting. Also, all plots were row-crop cultivated once for weed control. Corn (Pioneer 3563) was planted on June 9, 1999 and soybean (Hutcheson) was planted on June 10, 1999. A mixture of 28-0-0 and 7-21-7 liquid fertilizer was coulter knifed to provide 100 lb N, 34 lb P_2O_5 and 11 lb K_2O/a for corn. No fertilizer was applied for soybean.

Results

Corn yields in 1999 were reduced because of the delayed (June 9) planting and then hot, dry weather during tassel and grain fill stages. Corn yields ranged from 67 to 80 bu/a with a test average of 71 bu/a (Table 2). Although numerically variable, tillage effects on corn yields were not statistically significant. Yields, averaged over 4 years, also showed

little yield benefit from subsoiling. Differences were small, and yield patterns were not consistent.

Soybean yields in 1999 ranged from 41.4 to 42.7 bu/a with a test average of 42 bu/a. The tillage treatments in 1999 produced no statistically significant differences in yield. Yields were similar for no-till or with the most frequent subsoiling treatment. The lowest and highest 4-year, average yields differed by only 2.3 bu/a. At best, the response to tillage is enough to pay for the tillage operations.

Three of 4 years of this study were above average for moisture, but 1999 was dry through the middle part of the growing season. Still, there were no clear cut benefits from subsoiling. In fact, no-till continues to produce yields comparable to those with all tilled systems. Plans are to continue this study for a couple of more years, but evidence is mounting that deep subsoil tillage and even chisel-plow tillage are not greatly benefiting soybean and corn yields on Woodson soil.

Acknowledgment

Appreciation is expressed to John Wray, Ottawa, KS for providing the tractor and subsoiler for establishing the subsoil treatments.

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

	Yield			
	Corn		Soybean	
Tillage System and Frequency	1999	4-yr Avg	1999	4-yr Avg
	bu/a			
No-till[1]	73	113	42.7	40.7
Chisel[2] (every year)	67	113	41.6	42.4
Subsoil[3] (every year)	67	118	41.4	42.9
Subsoil (every other year)	70	113	41.7	43.2
Subsoil (every third year)	80	121	42.5	42.4
LSD.05	ns		ns	
CV %	14.4		4.6	

[1] With one in-season cultivation.
[2] 5-7 inch depth.
[3] 8-10 inch depth.

CROP RESIDUE REMOVAL AND FERTILIZER EFFECTS ON CROP YIELD AND SOIL SUSTAINABILITY

Keith A. Janssen and David A. Whitney

Summary

Research was continued during 1999 to measure the long-term (19th year) effects of removal and return of various levels of crop residues on crop yield and soil properties in a soybean-wheat-grain sorghum/corn rotation fertilized with different levels of N, P, and K. In 1999, the residue treatments caused no statistically significant differences in grain or residue yields. Wheat grain yields, averaged across all fertilizer treatments, were 25.4 bu/a with residue removed, 24.0 bu/a with normal residue incorporated, and 21.7 bu/a with 2X normal residue incorporated. The fertilizer treatments (zero, low, normal, and high levels of N, P, and K) produced significant yield differences. Yields of wheat, averaged across all residue treatments, ranged from 16.3 bu/a at the zero fertilizer rate to 29.1 bu/a at the highest level of fertilizer. Soil analyses showed that soil pH, exchangeable K, and soil organic matter are declining with crop residue removal.

Introduction

Crop residues are being considered as a source of raw materials for various non-agricultural uses. But crop residues also are needed for soil erosion protection and to replenish organic matter in the soil. Grain producers currently harvest crop residues for livestock feed or other farm uses. Generally, this is not done on an annual basis from the same field. Also, some of these plant materials may be returned as animal wastes. With nonagricultural uses, this likely would not be the situation, and the probability for more frequent harvests would increase. Harvesting crop residues continually would remove larger amounts of plant nutrients and accelerate the loss of soil organic matter. The effects of fertilizer management in offsetting these losses are not well understood.

This study was established to measure the long-term effects of removal and additions of various 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 started in the fall of 1980 on a nearly level, nonerosive (0-1% slope) Woodson silt loam soil at the East Central Kansas Experiment Field. The residue treatments were: (1) crop residue removed annually, (2) normal residue incorporated, and (3) twice (2X) normal residue incorporated (accomplished by evenly spreading the residue from the residue-removal treatments). Superimposed over the residue treatments were fertilizer treatments; zero, low, normal, and high levels of N-P-K fertilizer as listed in Table 3. The cropping sequence was a soybean, wheat, grain sorghum rotation with corn substituted for grain sorghum beginning in 1994. Only one crop was grown each year. Grain yields and residue yields were measured each year. Soil samples (0 to 2-inch depth) were collected for chemical analysis after the 16th year

Results

Grain yields and residue yields for the last 10 years of this study are summarized in Tables 4 and 5. The residue treatments, with the exception of 1987, caused no differences in grain or residue yield for any crop in any year. Neither the annual removal of crop residue nor the doubling of crop

residue has had a significant effect on grain or residue yields. In 1987, less residue was produced with the 2X normal residue treatment than with normal residue. This may have been the result of uneven hail damage rather than an effect of treatment. Summed over all years, the totals of all grain and residue yields for all residue treatments differ by less than 2%. In contrast, the fertilizer treatments significantly affected grain and residue yields almost every year. Highest grain and residue yields were produced with the normal and high fertilizer treatments, and the lowest grain and residue yields with the zero and low fertilizer treatments. The normal and high fertilizer levels increased grain and residue yields on average 32% over no fertilizer. These data confirm that well fertilized crops will benefit not only in grain yield, but also in increased residue production.

Soil properties after the 16th year of residue and fertilizer treatments are shown in Table 6. Unlike grain and residue yields, soil properties were affected significantly by the residue treatments. Soil pH, exchangeable K, and soil organic matter decreased with crop residue removal. Soil exchangeable K was affected the most. The removal of crop residue depleted exchangeable K in the soil by nearly 20%. Doubling crop residue increased exchangeable K by nearly the same amount. This is because of the high K content in crop residue.

Soil organic matter decreased with crop residue removal. Doubling crop residue increased soil organic matter. The fertilizer treatments caused the expected changes in soil properties. Soil pH decreased with fertilizer application. Available P, exchangeable K, and organic matter increased with fertilizer application.

These data suggest that the occasional harvest of crop residues likely will have minimal impact on grain production. However, very long-term, continuous removal of crop residues remains questionable as a sustainable practice. This is because very long-term removal could cause further decreases in soil organic matter and eventually impact yield. These effects of removing crop residue occur slowly and could take many years before stabilizing at a new level of equilibrium. With different environments and soil conditions, the effects of removing crop residues could be much different. This soil was initially quite high in soil organic matter and had high levels of soil fertility. Soils with lower organic matter and lower fertility may be affected more quickly by crop residue removal.

Table 3. N-P-K fertilizer treatments for crops in rotation, Ottawa, KS, 1999.

	Crop and Fertilizer Rate		
	$N-P_2O_2-K_2O$		
Fertilizer Treatment	Soybean	Wheat	Grain Sorghum/Corn
		lbs/a	
Zero	0-0-0	0-0-0	0-0-0
Low	0-0-0	40-15-25	40-15-25
Normal	0-0-0	80-30-50	80-30-50
High	0-0-0	120-45-75	120-45-75

Table 4. Mean effects of crop residue and fertilizer treatments on grain yields, Ottawa, KS (1990-1999).

Treatment	Soy '90	Wht '91	G.S. '92	Soy '93	Corn '94	Wht '95	Soy '96	Corn '97	Soy '98	Wht '99	19-yr total
						bu/a					
Residue											
Removed	29	34	128	21	104	21	42	89	47	25	1096
Normal	29	37	127	22	108	19	46	88	47	24	1109
2X normal	27	39	130	21	107	17	48	82	46	22	1095
L.S.D. 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Fertilizer											
Zero	27	26	120	19	89	12	43	46	44	17	936
Low	28	35	123	20	103	17	43	76	46	22	1070
Normal	28	41	135	22	114	22	47	99	47	26	1156
High	30	44	136	25	120	24	48	123	50	29	1237
LSD 0.05	1	2	7	2	5	2	2	9	2	2	

Table 5. Mean effects of crop residue and fertilizer treatments on residue yields, Ottawa, KS (1990-1999).

Treatment	Soy '90	Wht '91	G.S. '92	Soy '93	Corn '94	Wht '95	Soy '96	Corn '97	Soy '98	Wht 99	19-yr total
						tons/a					
Residue											
Removed	0.54	0.92	1.80	0.38	1.63	1.22	0.48	1.46	1.00	0.63	24.55
Normal	0.54	1.00	1.85	0.39	1.73	1.22	0.52	1.49	1.03	0.59	25.04
2X normal	0.47	1.04	1.92	0.39	1.56	1.24	0.54	1.39	1.03	0.51	25.02
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Fertilizer											
Zero	0.50	0.65	1.83	0.34	1.38	0.50	0.46	1.09	0.95	0.34	20.24
Low	0.50	0.93	1.74	0.35	1.46	1.02	0.52	1.35	0.97	0.49	23.75
Normal	0.52	1.10	1.95	0.40	1.91	1.71	0.53	1.57	1.07	0.68	26.72
High	0.55	1.27	1.90	0.45	1.81	1.67	0.54	1.78	1.08	0.80	28.39
LSD. 0.05	0.04	0.11	0.17	0.03	0.26	0.16	0.04	0.19	0.06	0.08	

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

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

TIMING OF ROUNDUP HERBICIDE FOR SOYBEAN WEED CONTROL

Keith A. Janssen

Summary

This study compared timing of single applications of Roundup with sequential and combination applications for soybean planted in 30-inch rows in a tilled field that was cultivated just before planting. A single application of Roundup at 5 weeks gave excellent weed control and soybean yield. With more weed pressure or some weeds present at planting, timing may need to be earlier.

Introduction

Use of Roundup for broad-spectrum, postemergence weed control in soybean became possible with the development of Roundup Ready soybeans. Questions regarding the best timing for a single application have arisen, because soybean producers would prefer to apply Roundup just one time, if they can get adequate weed control.

Past research showed that controlling weeds early is important for preventing yield loss. If a single application of Roundup is made too early, weeds can regrow afterwards. If application is delayed too long, weed competition can reduce soybean yield.

This study evaluates the effects of timing of single applications of Roundup in comparison with sequential and combination applications for weed control and yield of soybean planted in 30-inch rows.

Procedures

The experiment was located at the East Central Experiment Field in a naturally weed-infested area. Waterhemp pigweed and foxtail were the main weed problems. The seedbed tillage system was disk with field cultivation just prior to planting. Soybean variety Dyna Grow 3388RR was planted on June 10, 1999 in 30-inch rows. The preemergence (PRE) treatments were applied immediately following planting. All Roundup applications were made at the 1.5 pt/a rate in 20 gal water/a and at times shown in Table 7. All treatments were replicated four times. Weed control ratings were taken, and soybean yields were measured.

Results

Planting conditions and stand were excellent. The preemergence herbicides were activated by 0.85-inch rainfall the day following application. Total rainfalls for June through September are shown in Table 1. Weed pressure was moderate. Best weed control occurred with Command plus Roundup, sequential Roundup, and a single application of Roundup at 5 weeks. Yield was numerically highest with sequential Roundup (3 + 6 weeks), Command + Roundup, and a single Roundup application at 5 weeks, but was not statistically better than yields with all other single Roundup applications. Lowest yields occurred in the checks.

Based on these results, the best timing for single Roundup applications appears to be 3 to 5 weeks after planting for tilled systems with all weeds controlled at the time of planting. For situations with heavier weed pressure or in no-till systems with some weeds present at planting, timing may need to be earlier.

Table 7. Timing of Roundup herbicide for soybean weed control, Ottawa, 1999.

Treatment	Rate	Time after Planting	Yield, bu/a	Percent Control Waterhemp	Percent Control Foxtail
Roundup Ultra	1.5 pt/A	2 wks	45.5	75	96
Roundup Ultra	1.5 pt/A	3 wks	46.0	81	96
Roundup Ultra	1.5 pt/A	4 wks	46.4	94	98
Roundup Ultra	1.5 pt/A	5 wks	46.7	99	100
Roundup Ultra	1.5 pt/A	6 wks	43.7	86	89
Roundup Ultra	1.5 pt/A	7 wks	43.8	68	80
Roundup Ultra	1.5 + 1.5 pt/A	3 wks & 6 wks	49.1	100	98
Command 3ME	1.0 qt/A	PRE	47.4	100	100
+ Roundup Ultra	1.5 pt/A	5 wks			
Squadron	3.0 pt/A	PRE	42.7	90	92
Frontier 6EC	1.5 pt/A	PRE	42.3	74	92
Check 1			34.5	0	0
Check 2			36.0	0	0
L.S.D. 0.05			5.0	7	7

Planting date: June 10, 1999

Variety: Dyna Gro 3388RR

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

Keith A. Janssen and W. Barney Gordon

Summary

Five soybean varieties from four maturity groups were planted on four dates. Averaged over varieties and groups, yields were highest for the June plantings. Rainfall favored group IV and V varieties, which had the highest yields.

Introduction

Soybean producers in east-central Kansas have a wide window for planting soybean (late April through the middle of July) and a wide choice of possible soybean maturity groups (II, III, IV, and V). Very early soybean plantings run the risk of reduced stand and injury by a killing late-spring freeze, but tend to maximize the vegetative growth period before flowering, maximize maturity group differences, and increase yield potential if other conditions are favorable. Delayed or very late plantings reduce the time for vegetative growth, reduce maturity group differences, reduce potential yield, and run the risk of a fall freeze killing the crop before it is mature. Other factors, such as soil and air temperatures, disease and weed pressures, and most importantly water stress during pod fill can interact and affect yield. Selection of maturity group can help manage these or other situations such as planting delays or attempts to match the grain fill period with the most favorable seasonal moisture pattern, spread the harvest load, or shorten the time to maturity in order to plant another crop more quickly.

This study evaluates the yield responses of five soybean varieties from four different maturity groups (II, III, IV, and V) planted on five dates.

Procedures

The experiment was conducted at the East Central Experiment Field on a Woodson soil. The variety/maturity groups planted were IA2021 (II), Sherman (III), Macon (III), KS4694 (IV), and Hutcheson (V). The seeding rate was 175,000 seeds/a. Planting was in 7-inch rows, on May 14, June 8, June 15, July 8, and July 23, 1999. Weeds were controlled with Tri-Scept herbicide and hand weeding. Stand counts were taken. At maturity, the center nine rows of each 11-row plot (6.4 ft x 50 ft) were harvested for yield. All treatments were replicated four times

Results

Yields and final stand for all planting date and maturity group combinations are shown in Table 8. Averaged across all variety/maturity groups, soybean yields were highest with the June 8 and June 15 plantings; intermediate with the May 14 and July 8 plantings; and lowest with the July 23 planting. The group IV and V varieties had the highest yields. Overall highest yields were produced by Hutcheson (MGV), with 53 bu/a for each of the first three planting dates. KS4694 (MGIV) produced the highest yield with the July 8, planting and Macon (MGIII) produced the highest yield for the July 23 planting. The availability of moisture during pod fill favored the later maturity groups. Rainfall during August and September totaled 11.53 inches.

Table 8. Effects of planting date and maturity group on soybean production, Ottawa, KS, 1999

Planting Date	Maturity/Variety		Yield, bu/a	Final Stand per Acre
May 14	II	IA2021	13.8	84,000
	III	Sherman	31.4	61,000
	III	Macon	36.7	77,000
	IV	KS4694	46.3	76,000
	V	Hutcheson	53.9	85,000
June 8	II	IA2021	33.1	86,000
	III	Sherman	41.6	63,000
	III	Macon	44.0	70,000
	IV	KS4694	52.8	73,000
	V	Hutcheson	53.5	118,000
June 15	II	IA2021	34.1	89,000
	III	Sherman	40.2	72,000
	III	Macon	44.2	78,000
	IV	KS4694	45.9	78,000
	V	Hutcheson	53.2	91,000
July 8	II	IA2021	25.3	87,000
	III	Sherman	23.9	69,000
	III	Macon	28.6	99,000
	IV	KS4694	31.0	81,000
	V	Hutcheson	29.2	80,000
July 23	II	IA2021	12.3	79,000
	III	Sherman	9.8	53.000
	III	Macon	14.4	73,000
	IV	KS4694	11.0	65,000
	V	Hutcheson	2.0	69,000
<u>Planting Date (means)</u>				
May 14			36.4	77,000
June 8			45.0	82,000
June 15			43.5	82,000
July 8			27.6	83,000
July 23			9.9	68,000
L.S.D. 0.05			4.0	ns
<u>Maturity/Variety (means)</u>				
II		IA2021	23.7	85,000
III		Sherman	29.4	64,000
III		Macon	33.6	79,000
IV		KS4694	37.4	75,000
V		Hutcheson	38.3	89,000
LSD 0.05			2.1	6,000

Seeding rate: 175,000 seeds/a in 7-inch rows.

The 1999 rainfall pattern favored the later maturities.

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 benefit directly the agricultural industry of the area. Focus is primarily on wheat, grain sorghum, and soybean, but also includes alternative crops such as corn and oats. Investigations include variety and hybrid performance tests, chemical weed control, tillage methods, 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, comprises 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.

1998-1999 Weather Information

The wheat growing season began with excessive fall rains in late October and early November that virtually destroyed stands in some experiments. The period from December to March was slightly drier than usual. Rainfall was below average in May, but well above normal in April and June. Average temperatures were near to or slightly above normal in the fall and above normal from November through February, which was particularly warm. Temperatures were cooler than normal during March through June. Wheat diseases generally were not significant. Wet weather caused harvest delays.

June rains also delayed the planting of row crop experiments. Summer temperatures averaged near to or below normal. However, below-average rainfall in July coupled with high temperatures late in the month resulted in drouth stress. August also presented stressful conditions with rainfall somewhat below normal. September became unusually wet. October turned very dry and allowed for excellent harvesting conditions.

Frost occurred last in the spring on April 18. A light frost occurred next on the 4th of October and a killing frost on the 18th of that month. The frost-free season of 169 days was about 1 day 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
	1998				1999		
October	7.08	7.65	2.55	March	1.06	1.13	2.42
November	3.95	4.87	1.73	April	5.45	6.24	2.71
December	0.86	0.78	1.16	May	3.77	5.76	4.41
				June	7.45	7.29	4.67
	1999			July	1.81	2.38	2.90
January	1.83	1.74	0.67	August	4.31	2.75	3.11
February	0.26	0.29	0.87	September	7.07	6.20	3.63
Twelve-month total					44.90	47.08	30.83
Departure from normal					14.07	16.25	

[1] Three experiments reported here were conducted at the North Unit: Reduced Tillage and Rotation Systems with Wheat, Grain Sorghum, Corn, and Soybean; Effect of Early Harvest Plant Growth Regulator on Grain Sorghum; and Grass Herbicide Effects on Early-Planted 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

Mark M. Claassen

Summary

Tillage system effects on continuous wheat, continuous grain sorghum, and annual rotations of wheat with row crops were investigated for a 3rd consecutive year. Winter replanting of wheat was necessary, because excessive rainfall destroyed stands. Cheat control was poor in no-till continuous wheat, but yields were comparable to those of clean-tilled (burn) continuous wheat. Prior tillage for row crop did not meaningfully affect wheat in rotations. Soybean and corn rotations improved wheat production significantly by an average of 17.8 and 13.9 bu/a in comparison with the highest continuous wheat yields. Wheat after grain sorghum produced yields not significantly greater than those of the best yielding continuous wheat systems. Tillage systems did not meaningfully affect yields of row crops in rotation with wheat. However, wheat rotation increased sorghum yields by 20.4 bu/a in comparison with continuous sorghum. Tillage systems did not affect continuous sorghum. Yields from June sorghum plantings exceeded those of the May plantings by 10.8 bu/a.

Introduction

Crop rotations facilitate reduced-tillage practices, while enhancing control of diseases and weeds. Long-term research at Hesston has shown that winter wheat and grain sorghum can be grown successfully in an annual rotation. Although subject to greater impact from 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 established 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

Wheat after soybean

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

WS-NTNT = No-till after No-till soybean

Continuous wheat

WW-B = Burn (burn, disk, field cultivate)

WW-C = Chisel (chisel, disk, field cultivate)

WW-NT = No-till

Corn after wheat

CW-V = V-blade (V-blade, sweep-treader, mulch treader)

CW-NT = No-till

Sorghum after wheat

GW-V = V-blade (V-blade, sweep-treader, mulch treader)

GW-NT = No-till

Soybean after wheat

SW-V = V-blade (V-blade, sweep- treader, mulch treader)

SW-NT = No-till

Continuous sorghum

GG-C = Chisel (chisel, sweep-treader, mulch treader)

GG-NT = No-till

Continuous wheat no-till plots were sprayed with Landmaster BW + Roundup Ultra (54 + 16 oz/a) on July 22 and with Roundup Ultra at 1 qt/a + ammonium sulfate (AMS) on September 17 and October 15. All no-till wheat plots following row crops received the same treatment as WW-NT in mid-October. Variety 2137 was planted on October 22 in 8-inch rows at 90 lb/a with a CrustBuster no-till drill equipped with double disk openers. The same procedure was used to overseed variety Jagger at 120 lb/a in all plots without tillage on February 17. Wheat was fertilized with 120 lb N/a and 32 lb P_2O_5/a applied as preplant, broadcast ammonium nitrate and in-furrow diammonium phosphate at initial planting. No herbicides were applied for broadleaf weed control in wheat during the growing season. Wheat was harvested on July 8, 1999.

No-till corn after wheat plots received the same herbicide treatments as WW-NT during the summer and fall. The CW-NT plots also were sprayed with Roundup Ultra + 2,4-D_{LVE} + AMS at 1 qt + 2 oz + 3.4 lb/a in mid-April. Weeds were controlled during the fallow period in CW-V plots with four tillage operations and one fall application of Roundup Ultra. 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 Golden Harvest H-2404 at approximately 23,000 seeds/a on May 7, 1999. Partner 65 DF + AAtrex 90 DF (3.85 + 0.56 lb/a) were applied for weed control prior to corn emergence. In CW-NT plots, Banvel + crop oil concentrate (4 oz + 1 qt/a) were included in the tank mix. Row cultivation was not used. Corn was harvested on September 7.

No-till sorghum after wheat plots were treated with Roundup Ultra as noted for WW-NT. Both GW-NT and GG-NT were sprayed with Roundup Ultra + 2,4-D_{LVE} + Banvel + AMS (1 qt/a + 1.5 pt/a + 2 oz/a + 3.4 lb/a) in mid-April. The GW-V plots were managed like CW-V areas during the fallow period between wheat harvest and planting. A sweep-treader was used for the final preplant tillage operation in GW-V. The GG-C plots were tilled once each with a chisel, mulch treader, and a sweep-treader between crops. Sorghum was fertilized like corn, but with 116 lb/a total N. Pioneer 8500 treated with Concep III safener and Gaucho insecticide was planted at 38,100 seeds/a in 30-inch rows on May 10. A second set of continuous sorghum plots was planted on June 9. Dual II at 1 pt/a + AAtrex 4L at 1 pt/a (rotation) or 1 qt/a (continuous sorghum) were applied shortly after planting for preemergence weed

control. In GW-NT and GG-NT$_{May}$, 1 pt of Roundup Ultra + 2 oz of Banvel were added to the tank mix to control emerged weeds. The NT plots planted in June required a separate, preplant application of Roundup Ultra + 2,4-D$_{LVE}$ + Banvel (1qt/a + 4 oz/a + 2 oz/a). No row cultivation was necessary during the season. May- and June-planted sorghum were harvested on September 9 and October 13, respectively.

Fallow weed control procedures for no-till soybean after wheat were as described for GW-NT. The SW-V field procedures were those indicated for GW-V. However, soybean received only starter fertilizer, and weeds were controlled after planting with preemergence Dual II + Scepter 70 DG (1 pt/a + 2.8 oz/a). Roundup Ultra at 1 pt/a was included with these herbicides on SW-NT. Soybean was planted at 8 seeds/ft in 30-inch rows on May 10 and harvested on October 7.

Results

Wheat

Crop residue covers after planting averaged 67, 66, and 48% in no-till wheat after corn, sorghum, and soybean, respectively (Table 2). In continuous wheat, residue covers ranged from 4% in burned plots to 89% with no-till. Copious rainfall after planting resulted in water ponding and poor wheat stands, especially in WW-B and WW-C. Best wheat stand establishment occurred in rotation plots, most notably WC-NTNT, WG-NTNT, WS-NTNT, and WS-NTV. In mid-February, just before reseeding, wheat stands following row crops averaged about 57%. Complete stands were achieved in all plots by reseeding.

Aside from excessive rainfall at the beginning of the wheat growing season, the precipitation pattern during the late fall and winter months was favorable for wheat, particularly in rotations. Above-normal rainfall in April aided the development of reseeded wheat. Broadleaf weed control was generally good to excellent, except in WW-C, where late-emerging wild buckwheat competed with reseeded wheat. Also, cheat control was poor in WW-NT.

Heading dates for fall planted wheat were relatively uniform among tillage and rotation treatments. However, WW-NT plots headed about 2 days later than WW-B or the average for wheat following row crops. Wheat planted in February headed about 12 days later, without evidence of tillage or rotation effects.

Whole-plant N was significantly greater in wheat after soybean and continuous wheat than in wheat after corn or sorghum. Tillage systems did not affect plant N level. Wheat after soybean and corn produced the highest yields, averaging 17.8 and 13.9 bu/a more than the highest yields for continuous wheat. Wheat after sorghum yielded about the same or slightly more than WW-B and WW-NT. The WW-C yields were lowest because of poor initial stands and late weed competition. Prior tillage for row crop did not meaningfully affect the yield of wheat in rotations.

Test weights were higher for wheat following a row crop than for continuous wheat. Tillage systems generally had little effect of test weight within each cropping system, but averages across rotations favored continuous no-till.

Row Crops

Crop residue covers for row crops following wheat averaged 31% for V-blade and 86% for no-till systems (Table 3). Tillage effects on corn stands, maturity, ears per plant, yield, and test weight were not significant. However, corn leaf N concentration was lower in no-till than in the V-blade system.

Continuous sorghum as well as sorghum after wheat generally were not significantly

affected by tillage system. The only exceptions were a slight increase in stands, a small delay in maturity (number of days from planting to half bloom), and a slight decrease in heads/ plant in GW-NT versus GW-V.

Crop sequence significantly affected sorghum in several ways. In comparison with monoculture sorghum (May planting), rotation with wheat increased leaf N content, slightly increased the number of heads/plant, improved test weight slightly, and increased yields by 20.4 bu/a. Continuous sorghum planted in June had a higher stand percentage, lower leaf N level, shorter period from planting to half bloom, fewer heads/plant, higher test weight, and greater yield (10.8 bu/a) than that planted in May.

Soybean was not affected meaningfully by tillage system.

Table 2. Effects of row crop rotation and tillage on wheat, Harvey County Experiment Field, Hesston, KS, 1999.

Crop Sequence[1]	Tillage System	Crop Residue Cover [2]	Yield[3] '99	Yield[3] 3-Yr	Test Wt	Stand[4] 2/16	Stand[4] 4/20	Heading[5]	Plant N[6]	Cheat Control[7]
		%	bu/a		lb/bu	%		date	%	%
Wheat-corn	V-blade	64	43.3	59.4	57.8	33	100	12	1.13	100
(No-till)	No-till	71	49.4	61.1	58.5	84	100	10	1.00	100
Wheat-sorghum	V-blade	67	30.6	42.0	56.2	39	100	12	0.96	95
(No-till)	No-till	66	42.1	40.1	57.5	69	100	12	1.09	83
Wheat-soybean	V-blade	43	45.4	57.7	57.1	56	100	12	1.30	100
(No-till)	No-till	54	55.0	63.2	58.1	60	99	12	1.27	100
	Burn	4	32.4	49.6	55.5	11	97	12	1.23	100
Continuous	Chisel	63	14.4	44.5	52.1	6	100	--	—	100
wheat	No-till	89	29.3	44.2	55.9	37	99	14	1.27	72
LSD .05		9	13.5	----	1.4	32	NS	1	0.22	6
Main effect means:										
Crop Sequence										
Wheat-corn		67	46.3	60.3	58.1	58	100	11	1.06	100
Wheat-sorghum		66	36.3	41.0	56.9	54	100	12	1.03	89
Wheat-soybean		48	50.2	60.5	57.6	58	99	12	1.28	100
Continuous wheat		76	21.8	44.3	54.0	21	100	–	—	86
LSD .05		7	9.5	----	1.0	24	1	1	0.16	5
Rotation Tillage System										
No-till/V-blade		58	39.8	53.0	57.0	43	100	12	1.13	98
No-till/no-till		63	48.8	54.8	58.0	71	100	11	1.12	94
LSD .05		5	8.5	----	0.8	21	NS	1	NS	3

[1] All wheat planted no-till after row crops. Crop sequence main effect means exclude continuous wheat-burn treatment. Tillage main effect means exclude all continuous wheat treatments.

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

[3] Means of four replications adjusted to 12.5% moisture.

[4] Stands existing before (2/16) and after replanting (4/20).

[5] Date in May on which 50% heading occurred in fall-planted wheat. Second planting reached 50% bloom on 5/24 without treatment differences.

[6] Whole-plant N levels at late boot to early heading.

[7] Visual rating of cheat control in June.

Table 3. Effects of wheat rotation and reduced tillage on corn, grain sorghum, and soybean, Harvey County Experiment Field, Hesston, KS, 1999.

Crop Sequence	Tillage System	Crop Residue Cover [1]	Yield[2] ‘99	Yield[2] 3-Yr	Test Wt	Stand	Matur-ity[3]	Ears or Heads/ Plant	Leaf N[4]
		%	bu/a		lb/bu	1000's/a	days		%
Corn-wheat	V-blade	36	75.0	81.5	58.0	19.5	59	0.96	1.86
	No-till	86	69.4	74.6	58.0	20.8	60	0.97	1.62
LSD .05		16	NS	----	NS	NS	NS	NS	0.19
Sorghum-wheat	V-blade	30	86.0	102.5	60.4	34.3	70	1.56	2.43
	No-till	86	97.6	109.0	60.4	36.8	72	1.37	2.31
Contin. sorghum (May)	Chisel	22	72.1	86.7	59.7	35.4	71	1.32	2.19
	No-till	68	70.6	83.6	59.7	35.0	71	1.22	2.13
Contin. sorghum (June)	Chisel	19	83.7	73.2	60.9	37.9	66	1.04	1.96
	No-till	71	80.6	76.7	60.6	37.9	67	1.05	2.10
LSD .05[5]		12	12.6	----	0.6	1.4	1.5	0.19	0.19
Soybean-wheat	V-blade	28	35.5	35.8	----	----	132	----	----
	No-till	86	33.7	35.6	----	----	132	----	----
LSD .05		16	NS	----			NS		
Main effect means for sorghum:									
Crop Sequence									
Sorghum-wheat		58	91.8	105.8	60.4	35.5	71	1.46	2.37
Contin. sorghum (May)		45	71.4	85.2	59.7	35.2	71	1.27	2.16
Contin. sorghum (June)		45	82.2	75.0	60.8	37.9	67	1.05	2.03
LSD .05		8	8.9	----	0.4	1.0	1	0.14	0.13
Tillage System									
V-blade/chisel		24	80.6	87.5	60.3	35.8	69	1.31	2.19
No-till/no-till		75	82.9	89.8	60.2	36.6	70	1.22	2.18
LSD .05		7	NS	----	NS	NS	1	NS	NS

[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).

[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 upper ear leaf at late silking, sorghum flag leaf at late boot to early heading.

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

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

Mark M. Claassen

Summary

Wheat following sorghum that had been fertilized with 120 lb/a of nitrogen (N) yielded an average of 7 bu/a more than wheat following sorghum that had received only 60 lb/a of N. This effect was not eliminated as wheat N rates increased. A large positive yield response resulted from each 40 lb/a increment of fertilizer N. Highest yields averaging 75 bu/a were obtained with 120 lb/a of N following 120 lb/a of N on sorghum. Test weight, plant height, and plant N concentration also increased with N rate. Contrary to expectations, wheat yields tended to be highest with seeding at 60 lb/a rather than 90 or 120 lb/a. Although no significant interaction occurred between seeding rate and N rate effects on yield, a trend toward lower average yields was observed at the highest seeding rates when N was limiting. The absence of a yield benefit from increased seeding rate appeared to be the result of unusually high rainfall and excellent stand establishment.

Introduction

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

Procedures

The experiment site was located on a Geary silt loam soil with pH 6.4, 2.4% organic matter, 20 lb/a of available phosphorus (P), and 493 lb/a of exchangeable potassium. Grain sorghum had been grown continuously on the site for a period of years. A split-plot design was utilized with main plots of 60 and 120 lb/a N rates on the preceding sorghum crop and subplots of 0, 40, 80, and 120 lb/a of N on wheat in factorial combination with seeding rates of 60, 90, and 120 lb/a. Pioneer 8500 grain sorghum was planted at 38,100 seeds/a in 30-inch rows on May 20 and harvested on September 10, 1998. Soil was sampled to a depth of 2 ft to determine residual N shortly after sorghum harvest. The N rates were applied as ammonium nitrate on September 19. Variety 2137 was planted into undisturbed sorghum stubble with a no-till drill equipped with double-disk openers on 8-inch spacing and P_2O_5 at 37 lb/a was banded in the seed furrow. Whole-plant wheat samples were collected at heading to early bloom stage for determination of N and P concentrations. Wheat was harvested on June 28, 1999. Grain subsamples were analyzed for N and P levels.

Results

Sorghum yields averaged 81 and 110 bu/a with 60 and 120 lb/a of N, respectively. Soil nitrate N (0 to 2 ft) after sorghum differed little between treatments, averaging 24 and 23 lb/a following these N rates. Abundant rains totaling 7.61 inches fell between N fertilizer application and wheat planting, and an additional 9.57 inches fell during the first 4 weeks after planting. Precipitation was somewhat below normal in December,

February, and March, but well above average during the remaining months of the growing season. Average temperatures were near to or slightly above normal in the fall, above normal from November through February, and cooler than normal during March through June.

Despite little measured difference in residual soil nitrate N following N rates on sorghum, the residual effect of those treatments was seen clearly in the succeeding wheat crop (Table 4). When averaged over wheat N rates and seeding rates, the high versus low sorghum N rate significantly increased wheat plant height by 0.8 inch, whole-plant N content by 0.04%, yield by 7 bu/a, and grain test weight by 0.3 lb/bu. No significant interactions occurred between sorghum N rate and wheat seeding rate. A significant interaction between sorghum N rate and wheat N rate occurred only for wheat plant N. This was noted as increased N concentration in response to 120 lb/a of N fertilizer following the high N rate on sorghum, but not after the low N rate.

The N rate effect on wheat yield was highly significant, with large increases resulting from each 40 lb/a increment. Top yields of 75 bu/a were obtained with 120 lb/a of N following 120 lb/a of N on sorghum. Test weight, plant height, and plant N concentration (low because of late sampling) also increased with N rate. Plant P concentration and grain protein were highest at the zero N rate, reflecting the dilution effect of greater plant growth and higher yields that resulted from fertilizer application.

The anticipated pattern of positive seeding rate effect on wheat yield did not occur because of unusually high fall precipitation, which resulted in complete stand establishment and likely a diminished allelopathic effect of sorghum residue. Contrary to expectations, wheat yields tended to be highest with seeding at 60 lb/a, rather than 90 or 120 lb/a. Although no significant interaction occurred between seeding rate and N rate effects on yield, a trend toward lower average yields at the highest seeding rates was observed at the lowest levels of N fertilizer. Seeding rate did not affect plant height, plant N, or grain test weight. Plant P decreased slightly at the highest seeding rate. Grain protein increased slightly with seeding rate.

Table 4. Effects of nitrogen and seeding rates on no-till winter wheat after grain sorghum, Hesston, KS, 1999.

Sorghum N Rate[1]	Wheat N Rate	Seeding Rate	Yield	Bushel Wt	Plant Ht	Plant N^2	Plant P^2	Grain Protein[3]
	lb/a		bu/a	lb	inch		%	
60	0	60	19.6	58.5	24	.83	.23	10.4
		90	15.2	58.6	24	.86	.22	11.4
		120	14.3	58.7	23	.80	.21	11.3
	40	60	31.9	58.8	29	.74	.19	10.2
		90	28.5	58.9	27	.79	.20	10.4
		120	30.8	58.8	28	.74	.18	10.2
	80	60	55.8	59.5	33	.75	.17	10.2
		90	51.9	59.2	32	.73	.17	9.5
		120	48.2	59.3	33	.78	.15	10.2
	120	60	69.4	60.0	35	.87	.17	10.1
		90	69.4	59.9	35	.83	.17	10.2
		120	68.0	59.9	35	.82	.16	10.7
120	0	60	22.2	58.8	25	.79	.22	10.8
		90	20.6	58.9	25	.80	.23	11.3
		120	19.0	58.9	24	.81	.21	11.2
	40	60	40.0	59.5	30	.77	.20	10.0
		90	36.4	59.3	30	.78	.20	10.1
		120	39.2	59.3	30	.76	.18	10.5
	80	60	61.8	59.7	33	.87	.18	9.8
		90	59.9	59.8	33	.81	.17	10.0
		120	59.5	59.6	33	.79	.18	10.1
	120	60	75.5	60.0	35	.98	.17	10.4
		90	75.8	60.1	35	.99	.17	10.5
		120	73.5	60.3	35	.91	.17	10.8
LSD .05			5.8	0.46	1.8	.12	.025	0.78
Means:								
Sorghum N Rate								
60			41.9	59.2	30	.80	.18	10.4
120			48.6	59.5	31	.84	.19	10.5
LSD.05			3.9	0.09	0.4	.04	NS	NS
	N Rate							
	0		18.5	58.7	24	.82	.22	11.1
	40		34.5	59.1	29	.77	.19	10.3
	80		56.2	59.5	33	.79	.17	10.0
	120		71.9	60.0	35	.90	.17	10.5
	LSD .05		2.4	0.19	0.7	.04	.009	.32
		Seed Rate						
		60	47.0	59.3	30	.83	.19	10.2
		90	44.7	59.3	30	.83	.19	10.5
		120	44.1	59.3	30	.80	.18	10.7
		LSD .05	2.1	NS	NS	NS	.008	0.27

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

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

Mark M. Claassen

Summary

Nitrogen (N) response of sorghum grown in the second cycle of a vetch-sorghum-wheat rotation was compared with that of sorghum in a sorghum-wheat rotation at N rates of 0 to 90 lb/a. Vetch was terminated by tillage (disking) or herbicides (no-till). Heavy rainfall after hairy vetch planting resulted in little or no fall growth. After winter reseeding, hairy vetch established stands late and produced an average of 1.18 ton/a of dry matter by mid-June. The average potential amount of N to be mineralized for use by the sorghum crop was 70 lb/a. However, in the absence of fertilizer N, the cover crop failed to increase sorghum leaf N. Also, when averaged over all N rates, sorghum leaf N concentration did not increase where hairy vetch was included in the rotation. On average, N rates tended to increase leaf N up to 60 lb/a. This occurred notably in no-till sorghum after vetch and in sorghum without a cover crop. In sorghum after disked vetch, leaf N reached a maximum at 30 lb/a of fertilizer N. Averaged across N rates, sorghum yields declined by 8.3 bu/a following hairy vetch. The main effect of N rate on grain yield was significant. Maximum yields occurred with 60 lb/a in sorghum without a cover crop and in NT sorghum after vetch, whereas no significant yield increase occurred with increasing N rates in sorghum after disked vetch.

Introduction

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

Procedures

The experiment was established on a Geary silt loam soil with the initial planting of hairy vetch following winter wheat in the fall of 1995. Another cycle of these procedures was begun on a second site in the fall of 1996. Here sorghum was grown in 1997 after vetch had been terminated, and the comparison again was made with sorghum in annual rotation with wheat alone. Wheat was planted without tillage into sorghum shortly after harvest and later top-dressed with the same N rates that had been applied to the preceding sorghum crop. After wheat harvest, volunteer wheat and weeds were controlled with Roundup Ultra. In this second cycle of the rotation, hairy vetch plots were no-till planted at 31 lb/a in 8-inch rows with a grain drill equipped with double-disk openers on October 27, 1998 and replanted at 40 lb/a on February 19, 1999. One set of vetch plots was terminated by disking on June 15. Hairy vetch in a second set of plots was terminated at that time with Roundup Ultra + 2,4-D_{LVE} + Banvel (1 qt + 1.5 pt +0.25 pt/a). Weeds were controlled with tillage in plots without hairy vetch.

Vetch forage yield was determined by harvesting a 1-sq-m area from each plot on June 14, 1999. Nitrogen fertilizer treatments were broadcast as ammonium nitrate on June 30. All plots received 35 lb/a of P_2O_5, which was banded as 0-46-0 at sorghum planting. Pioneer 8505, treated with Concep III safener and Gaucho insecticide, was planted after a rain delay at approximately 42,000 seeds/a on July 6, 1999. Weeds were controlled with a

preemergence application of Dual II + AAtrex 4L (1 qt + 0.5 pt/a). Grain sorghum was combine harvested on October 29.

Results

Wet conditions prevented timely planting of hairy vetch. Excessive rainfall shortly after planting resulted in little or no vetch emergence in the fall. Replanting during the winter enhanced the uniformity of stands, which eventually established and produced a late-developing cover crop. Hairy vetch was beginning to bloom at the time of termination in June. Vetch dry matter yield averaged 1.18 ton/a, and N content was 2.99% (Table 5). The average potential amount of N to be mineralized for use by the sorghum crop was 70 lb/a. Disking to terminate hairy vetch growth did not adversely affect soil moisture at the surface because of subsequent rains, which ultimately delayed planting. However, sorghum stands after vetch averaged 1,600 plants/a fewer than stands where no cover crop had been grown. Drouth stress occurred at varying degrees between late July and early September. When averaged over N rates, hairy vetch did not result in higher N concentrations of sorghum flag leaves at boot to early heading stages. When averaged over cover crop/tillage systems, N rates tended to increase leaf N up to 60 lb/a, but more notably in no-till sorghum after vetch and in sorghum without a cover crop. In sorghum after disked vetch, leaf N reached a maximum at 30 lb/a of fertilizer N.

Grain sorghum maturity (days to half bloom) was not affected by any of the treatments. The number of heads per plant increased slightly with 60 and 90 lb/a of N versus lower fertilizer rates. Sorghum without a cover crop and sorghum after disked vetch had a slightly higher head/plant ratio than NT sorghum after vetch. When averaged over N rates, hairy vetch lowered sorghum yields by 8.3 bu/a. The main effect of N rate on grain yield was significant. Maximum yields occurred with 60 lb/a in sorghum without a cover crop and in NT sorghum after vetch, whereas no significant yield increase occurred with increasing N rates in sorghum after disked vetch.

Table 5. Effects of hairy vetch cover crop, termination method, and N rate on grain sorghum after wheat, Harvey County Experiment Field, Hesston, 1999.

				Grain Sorghum					
Cover Crop/ Termination	N Rate[1]	Vetch Yield[2] Forage	N	Grain Yield	Bushel Wt	Stand	Half[3] Bloom	Heads/ Plant	Leaf N[4]
	lb/a	ton/a	lb	bu/a	lb	1000's /a	days	no.	%
None	0	--	--	86.3	59.2	38.2	59	1.1	2.52
	30	--	--	90.2	59.4	37.2	58	1.1	2.45
	60	--	--	99.1	59.4	36.7	59	1.2	2.71
	90	--	--	98.8	59.2	35.3	59	1.3	2.67
Vetch/Disk	0	0.90	55	86.8	59.4	36.0	59	1.1	2.52
	30	1.32	80	87.3	58.9	36.3	59	1.1	2.65
	60	1.26	70	88.1	59.1	33.6	59	1.3	2.64
	90	1.12	63	87.9	59.0	34.6	59	1.2	2.53
Vetch/No-till	0	1.50	92	72.8	58.2	35.5	59	1.0	2.39
	30	1.13	67	81.4	58.9	34.3	59	1.1	2.57
	60	1.26	71	91.6	58.7	35.3	59	1.2	2.67
	90	0.97	58	87.1	58.4	35.9	58	1.2	2.61
LSD .05		NS	NS	13.0	0.71	3.0	NS	0.1	NS
LSD .10		NS	NS	----	----	----	NS	---	0.21
Means: Cover Crop/ Termination									
None		--	--	93.6	59.3	36.8	58	1.2	2.59
Vetch/Disk		1.15	67	87.5	59.1	35.1	59	1.2	2.58
Vetch/No-till		1.21	72	83.2	58.6	35.3	59	1.1	2.56
LSD .05		NS	NS	6.5	0.35	1.5	NS	NS	NS
LSD .10		NS	NS	----	----	----	NS	NS	NS
N Rate									
0		1.20	73	82.0	58.9	36.5	59	1.1	2.48
30		1.22	74	86.3	59.1	35.9	58	1.1	2.56
60		1.26	71	92.9	59.1	35.2	59	1.2	2.67
90		1.04	60	91.3	58.9	35.3	59	1.2	2.60
LSD .05		NS	NS	7.5	NS	NS	NS	0.07	NS
LSD .10		NS	NS	----	NS	NS	NS	----	0.12

[1] N applied as 34-0-0 on June 30, 1999.

[2] Oven dry weight and N content on June 14, 1999.

[3] Days from planting (July 6, 1999) to half bloom.

[4] Flag leaf at late boot to early heading.

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

Mark M. Claassen

Summary

Wheat production was evaluated in the second cycle of annual wheat-sorghum and wheat-vetch-sorghum rotations. Treatment variables included disk and herbicide termination methods for hairy vetch as well as N fertilizer rates of 0 to 90 lb/a. Residual soil nitrate N was greatest after sorghum following hairy vetch terminated by disking, primarily at the 90 lb/a N rate. Both hairy vetch and N rate significantly increased wheat yield. At 0 lb/a of fertilizer N, the residual effect of hairy vetch increased wheat yields by 29 and 15 bu/a in disk and no-till systems, respectively. These residual vetch benefits were equivalent to those from 35 and 16 lb/a of fertilizer N. In wheat after sorghum without vetch, each 30 lb/a increment of fertilizer N significantly increased yield. The trend suggested that yields had not exceeded the maximum at 90 lb/a of fertilizer N. In wheat after vetch-sorghum, yields also increased with increasing fertilizer N, but appeared to be closer to a maximum at 60 lb/a of N.

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 concludes the second cycle of the crop rotation in which the residual effects of vetch and N fertilizer rates were measured in terms of soil N as well as N uptake and yield of wheat.

Procedures

The experiment was established on a Geary silt loam soil with the initial planting of hairy vetch following winter wheat in the fall of 1995. Sorghum was grown in 1996 with or without the preceding cover crop and fertilized with N rates of 30, 60, or 90 lb/a or not fertilized. Winter wheat was no-till planted in 8-inch rows into sorghum stubble in the fall of 1996. In the second cycle of the rotation, hairy vetch plots were seeded at 20 lb/a in 8-inch rows on September 16, 1997. Volunteer wheat was controlled by an April application of Fusilade DX + crop oil concentrate (10 oz/a + 1% v/v). One set of vetch plots was terminated by disking on May 14. Hairy vetch in a second set of plots was terminated at that time with Roundup Ultra + 2,4-D_{LVE} (1 qt + 1.5 pt/a).

Vetch forage yield was determined by harvesting a 1-sq-m area from each plot on May 13, 1998. Nitrogen fertilizer treatments were broadcast as ammonium nitrate on June 11, 1998. All plots received 35 lb/a of P_2O_5, which was banded as 0-46-0 at sorghum planting. After a rain delay, Pioneer 8505 was planted in 30-inch rows at approximately 42,000 seeds/a on June 29, 1998. Weeds were controlled with a preemergence application of Microtech + AAtrex 90 DF (2.5 qt/a + 0.28 lb/a). Grain sorghum was combine harvested on October 24. After a rain delay, soil was sampled to a depth of 2 ft on November 23. Variety 2137 winter wheat was no-till planted in 8-inch rows into sorghum stubble on November 24, 1998, at 120 lb/a with 32 lb/a

of P_2O_5 fertilizer banded in the furrow. Fertilizer N was broadcast as 34-0-0 on March 17, 1999, at rates equal to those applied to the prior sorghum crop. Wheat was harvested on June 29.

Results

Hairy vetch terminated in mid-May, 1998 produced an average of 1.64 ton/a of dry matter, yielding 94 lb/a of N potentially available to the sorghum that followed (Table 6). However, the contribution of vetch to the yield of sorghum was equivalent to approximately 30 lb/a of fertilizer N. Prior hairy vetch cover crop/termination method as well as N rates significantly affected soil nitrate N (0 to 2 ft) at the time of wheat planting. Averaged over N rates, soil nitrate N averaged about 9 lb/a greater after disked vetch-sorghum than after no-till vetch-sorghum or sorghum without a cover crop. Following sorghum without a cover crop and sorghum after disked vetch, N fertilizer at the 90 lb/a rate increased residual soil nitrate N but had no significant effect on soil N in no-till sorghum after vetch.

At 0 lb/a of fertilizer N, the residual effect of hairy vetch increased wheat yields by 29 and 15 bu/a in disk and no-till systems, respectively. These residual vetch benefits were equivalent to those with 35 and 16 lb/a of fertilizer N. Averaged over N rates, hairy vetch in these systems accounted for yield increases of 14 and 8 bu/a, respectively. In wheat after sorghum without vetch, each 30 lb/a increment of fertilizer N significantly increased yield. The trend suggested that yields had not exceeded the maximum at 90 lb/a of fertilizer N. In wheat after vetch-sorghum, yields also increased with increasing fertilizer N, but appeared to be closer to a maximum at 60 lb/a of N.

Vetch treatments averaged over N rates had no significant residual effect on wheat test weight, but tended to increase plant N and grain N slightly. Nitrogen rates increased plant N mainly at 60 and 90 lb/a, but decreased grain N somewhat at 30 and 60 lb/a.

Table 6. Residual effects of hairy vetch cover crop, termination method, and N rate on no-till wheat after grain sorghum, Harvey County Experiment Field, Hesston, KS, 1999.

Cover Crop/ Termination[1]	N Rate[2]	Vetch Yield[3] Forage	Vetch Yield[3] N	Sorghum Yield 1998	Initial Soil NO_3-N[4]	Wheat Yield	Wheat Bushel Wt	Wheat Plant N[5]	Wheat Grain N
	lb/a	ton/a	lb	bu/a	lb/a	bu/a	lb	%	%
None	0	--	--	66.6	8	18.3	60.2	0.95	1.92
	30	--	--	77.9	12	45.8	60.0	1.02	1.72
	60	--	--	80.3	16	60.3	59.8	1.12	1.76
	90	--	--	79.1	20	73.8	59.6	1.47	1.89
Vetch/Disk	0	1.89	119	79.6	18	47.1	60.7	1.00	1.90
	30	1.36	78	66.6	19	62.1	60.1	1.19	1.76
	60	1.95	106	77.9	19	71.3	60.0	1.33	1.88
	90	1.57	77	79.8	36	71.6	59.5	1.53	2.03
Vetch/No-till	0	1.88	110	77.1	13	32.8	60.7	1.01	1.95
	30	1.75	107	72.5	15	58.5	60.3	1.10	1.79
	60	1.56	85	81.4	14	68.6	60.2	1.26	1.81
	90	1.35	77	70.4	17	71.3	59.5	1.57	1.95
LSD .05		NS	NS	NS	9.6	6.7	0.51	0.19	.095
Means: Cover Crop/ Termination									
None		--	--	76.0	14	49.5	59.9	1.14	1.82
Vetch/Disk		1.69	95	76.0	23	63.0	60.1	1.26	1.89
Vetch/No-till		1.63	95	75.4	15	57.8	60.2	1.23	1.87
LSD .05		NS	NS	NS	4.8	3.3	NS	0.10	.047
N Rate									
0		1.88	115	74.5	13	32.7	60.5	0.99	1.92
30		1.56	93	72.3	15	55.5	60.1	1.10	1.76
60		1.75	96	80.0	16	66.7	60.0	1.24	1.81
90		1.46	77	76.4	24	72.3	59.5	1.52	1.96
LSD .05		NS	NS	NS	5.5	3.9	0.30	0.11	.055

[1] Hairy vetch planted in mid-September, 1997 and terminated the following spring.
[2] N applied as 34-0-0 June 11, 1998 for sorghum and March 17, 1999 for wheat.
[3] Oven dry weight and N content just prior to termination.
[4] Mean nitrate nitrogen at 0 - 2 ft depth on November 23, 1998.
[5] Whole-plant N concentration at early heading.

EFFECTS OF EARLY HARVEST PLANT GROWTH REGULATORS ON GRAIN SORGHUM

Mark M. Claassen

Summary

Early Harvest TST seed treatment at 2.8 oz of dry product (talc)/cwt resulted in an averages of approximately 3,350 plants/a more than Early Harvest PGR applied at 2 fluid oz/cwt and 3,950 plant/a more than the untreated check. Each of the three grain sorghum hybrids evaluated responded similarly. Early Harvest seed treatments had no effects on plant dry weight at 39 DAP, days to half bloom, plant height, or heads/plant. Neither Early Harvest seed treatments nor foliar treatment affected yield or test weight of grain sorghum.

Introduction

Early Harvest PGR and Early Harvest TST, registered by NutraChem, Inc. and distributed by Griffin Corporation, are plant growth regulators that contain three essential hormones (cytokinins, gibberellic acid, and indole butyric acid). These hormones affect various aspects of plant growth, such as seed germination, cell division, cell differentiation, root formation and development, shoot elongation, and flowering. This experiment was conducted 1) to determine if these plant growth regulators applied to early-planted grain sorghum as seed treatments would enhance stand establishment, plant vigor, and ultimately grain yield and 2) to compare the effects of seed treatments alone and in combination with foliar treatment with Early Harvest PGR.

Procedures

The experiment site was on a Ladysmith silty clay loam soil that had been cropped to continuous sorghum. Reduced tillage practices were used for seedbed preparation. The area was fertilized with 115 lb N/a and 35 lb P_2O_5/a broadcast as 46-0-0 and 18-40-0 and incorporated in early May.

Three sorghum hybrids were chosen for this experiment in order to provide a range of cold tolerance, vegetative growth characteristics, and maturity. Early Harvest PGR and Early Harvest TST were applied at 2 fluid oz/cwt and at 2.8 oz of dry product (talc)/cwt, respectively, to Concep III-treated seed. Sorghum was planted at 48,790 seeds/a in 30-inch rows on May 11, 1999. The site was sprayed shortly after planting with 1 qt/a Dual II + 1 qt/a AAtrex 4L. Plant vigor was evaluated at 22 days after planting (DAP), and plant populations were determined at 28 DAP. Ten Pioneer 8505 plants/plot were harvested at 39 days after planting to determine dry matter accumulation. Early Harvest PGR also was applied as a foliar treatment at 4 fluid oz/a at the early bloom stage. Sorghum was harvested on October 6.

Results

Antecedent moisture led to the preparation of a seedbed that was somewhat cloddy at the surface, with firm moist soil beneath. Temperatures were below normal during the spring. Excessive rainfall in June was detrimental to sorghum development. Also, an unusual infestation of sooty stripe disease occurred and resulted in necrosis of lower leaves. These factors, coupled with some drouth stress after mid-season, contributed to reduced yields.

Plant ratings at 22 DAP showed slightly less vigor for DeKalb 40y than for Mycogen 1506 and Pioneer 8505 (Table 7). However, no meaningful differences in vigor ratings occurred among PGR treatments. Early Harvest TST seed treatment resulted in an average of approximately 3,350 plants/a more than Early Harvest PGR and 3,950 plant/a

more than the untreated check. Treatment effects did not differ significantly among hybrids.

Seed treatments had no effect on plant dry weight at 39 DAP, days to half bloom, plant height, heads/plant, grain yield, or test weight.

Similarly, foliar treatment with Early Harvest PGR did not improve sorghum yield or test weight.

Table 7. Effects of Early Harvest plant growth regulators on grain sorghum, Harvey County Experiment Field, Hesston, Kansas, 1999.

Hybrid	Treatment[1]	Appli-cation	Yield	Bu Wt	Vigor	Plant Wt	Stand	Half Bloom	Plant Ht	Heads/ Plant
			bu/a[2]	lb	score[3]	gram[4]	1000s	days[5]	inch	
DeKalb 40y	Early Harvest PGR	Seed	43	58.7	1.6	--	36.5	74	40	1.1
	Early Harvest TST	Seed	48	58.6	1.4	--	39.9	73	41	1.0
	Early Harvest PGR + PGR	Seed + foliar	47	58.7	1.5	--	37.0	73	42	1.0
	Early Harvest TST + PGR	Seed + foliar	49	58.6	1.5	--	39.1	73	41	1.0
	No Treatment		51	58.6	1.6	--	36.7	73	42	1.0
Mycogen 1506	Early Harvest PGR	Seed	62	58.6	1.2	--	34.8	73	48	1.1
	Early Harvest TST	Seed	60	58.6	1.2	--	36.6	75	47	1.1
	Early Harvest PGR + PGR	Seed + foliar	49	58.6	1.0	--	33.3	76	47	1.1
	Early Harvest TST + PGR	Seed + foliar	57	58.7	1.1	--	40.0	74	48	1.0
	No Treatment		53	58.4	1.4	--	32.2	76	47	1.1
Pioneer 8505	Early Harvest PGR	Seed	56	58.2	1.5	39	38.7	72	43	1.1
	Early Harvest TST	Seed	54	58.2	1.3	42	41.4	72	41	1.0
	Early Harvest PGR + PGR	Seed + foliar	61	58.1	1.2	46	37.9	72	43	1.1
	Early Harvest TST + PGR	Seed + foliar	60	58.1	1.2	40	41.5	71	42	1.0
No Treatment			63	58.1	1.3	46	38.6	71	43	1.0
LSD .05			15	NS	0.3	NS	4.0	2	3	NS

(Continued)

Table 7. Effects of Early Harvest plant growth regulators on grain sorghum, Harvey County Experiment Field, Hesston, Kansas, 1999.

Hybrid	Treatment[1]	Appli-cation	Yield	Bu Wt	Vigor	Plant Wt	Stand	Half Bloom	Plant Ht	Heads/ Plant
			bu/a[2]	lb	score[3]	gram[4]	1000s	days[5]	inch	
Means:										
DeKalb 40y			48	58.6	1.5	--	37.8	73	41	1.0
Mycogen 1506			56	58.6	1.2	--	35.4	75	47	1.1
Pioneer 8505			59	58.1	1.3	--	39.6	72	42	1.1
LSD .05			7	NS	0.1	--	1.8	0.9	1.4	NS
	Early Harvest PGR	Seed	54	58.5	1.4	--	36.7	73	43	1.1
	Early Harvest TST	Seed	54	58.5	1.3	--	39.3	73	43	1.0
	Early Harvest PGR + PGR	Seed + foliar	53	58.5	1.2	--	36.1	73	44	1.1
	Early Harvest TST + PGR	Seed + foliar	55	58.4	1.3	--	40.2	73	44	1.0
	No Treatment		56	58.4	1.4	--	35.8	73	44	1.1
	LSD .05		NS	NS	NS	--	2.3	NS	NS	NS

[1] Early Harvest PGR applied as a seed treatment at 2 fluid oz/cwt or as a foliar treatment at 4 fluid oz/a at early bloom stage. Early Harvest TST applied as a seed treatment at 2.8 oz of dry product (talc)/cwt.
[2] Yield adjusted to 12.5% moisture and 56 lb/bu.
[3] Visual score of plant vigor at 22 days after planting: 1 = normal, vigorous growth; 5 = slow, nonuniform growth.
[4] Dry matter/plant at 39 days after planting.
[5] Days from planting to half bloom.

GRASS HERBICIDE EFFECTS ON EARLY-PLANTED GRAIN SORGHUM

Shannon W. Claborn, Mark M. Claassen, Richard L. Vanderlip, and David L. Regehr

Summary

Chloroacetamide herbicides were applied preemergence at normal and double use rates to eight grain sorghum hybrids treated with the seed safener, Concep III, and planted in early May. Data recorded from this study included injury ratings and stand counts at 10 and 23 days after planting (DAP), as well as plant height, days to half-bloom, heads per plant, bushel weight, and yield. No interactions occurred between herbicide treatments and hybrids for any observations recorded. At 23 DAP, sorghum injury approached a maximum of only 2% with double rates of Dual II Magnum, Partner, Frontier, and Harness CR. Variation in injury levels among hybrids were minor. Sorghum stands differed significantly among hybrids but were reduced only by Harness CR treatments. Yields reflected a significant hybrid effect but were not reduced by any of the grass herbicide treatments.

Introduction

In prior research at Hesston, grain sorghum planted early in May outperformed that planted at the conventional time in June during years with favorable seasonal weather patterns. In those experiments, unsafened sorghum seed was planted, and Ramrod (propachlor) was applied for preemergence grass control. Stronger grass herbicides such as Dual, Partner, and Frontier were avoided here to reduce the possibility of injury to stand establishment under stressful conditions of cool soil temperatures. Over time, grass control became a greater concern in early-planted grain sorghum because of a slower development of plant canopy and late emergence of weeds. This experiment was conducted to assess the effects of five grass herbicides applied at normal and double use rates on eight early-planted grain sorghum hybrids.

Procedures

Grain sorghum hybrids were selected for this study on the basis of genetic diversity, grower preference, previous investigations of cold tolerance, and endosperm color. Grain sorghum was grown on the site during the previous 2 years. The area was fertilized with 114 lb N/A and 32 lb P_2O_5/A broadcast in late March and subsequently incorporated. The seedbed was prepared with a field cultivator and mulch treader. Sorghum seed treated with Concep III and Gaucho was planted about 1.25 inches deep at 2.8 seeds/ft of 30- inch row on May 8, 1999. All herbicide treatments were applied shortly after planting in 20 gal/a of water with XR8003 flat-fan nozzles. Injury ratings and stand counts were taken at 10 and 23 daus after planting (DAP). Plots were maintained free of weed competition and harvested on October 14 and 15.

Results

Soil physical condition at planting was good, with adequate soil moisture in the seed zone. Soil temperatures were monitored at seed depth throughout the early stages of emergence. Temperatures during the first 10 DAP averaged 80°F for the maximum high and 58°F for the minimum low. Thereafter until 23 DAP, average maximum and minimum temperatures were 95° and 65°F, respectively. Light rains measuring less than 0.10 inch fell on 3 ,7 ,8 , 9 , and 16 DAP. More substantial rains of 1.71, 0.35, and 1.26 inches fell on 12, 14, and 23 DAP, respectively. Sorghum emergence began in mid-May.

Injury ratings were made on the basis of the specific herbicide injury symptoms such

as leaf malformation and discoloration. They were calculated by dividing the number of injured sorghum seedlings by the number of emerged plants (Table 8). On May 18, sorghum injury averaged less than 1%, and no significant differences occurred among herbicide treatments. On May 31, the average injury ratings increased slightly to 1%. The greatest injury resulted from the double use rates of Frontier, Harness CR, Partner, and Dual Magnum, as well as the normal use rate of Harness CR. Rate effects were significant with each of these herbicides except Partner.

Hybrid effect at the initial injury rating on 10 DAP was not significant, but the second rating 13 days later did indicate differences among hybrids. Pioneer 8500 exhibited the highest level of injury at 1.9%, which was statistically different from all other hybrids except DeKalb DK-40y and Mycogen 1506. Mycogen 1482 showed the least amount of injury.

Sorghum populations on May 18 averaged 30,800 plants/a or 59% of the planting rate. Final populations on May 31 increased to 41,300 plants/a or 79% of the number of seeds planted. Herbicide treatments did not significantly affect sorghum stands at 10 DAP. However, final stands were significantly different. Harness CR was the only herbicide resulting in significant stand loss on May 31. In comparison with the atrazine check treatment, observed reductions of 6 to 8% occurred with the normal and double rates of Harness CR, respectively.

Hybrid effect on plant population was considerably greater than that of herbicide treatment. Initially, Pioneer 8699 and NC+ 6B50 had the highest stand percentages, and DeKalb DK-35 had the lowest population. However, in the final evaluation, DeKalb DK-35, Pioneer 8500, and NC+ 6B50 had the best stand percentages, averaging 84%. Mycogen 1482 and N. King KS 710 had the lowest final stand percentages of 72 and 74%, respectively.

Both rates of Harness CR and the double rate of Frontier caused very slight, but statistically significant, increases in the number of days to half-bloom (Table 9)

Plant heights were affected by herbicides, but differences among treatments were minimal. Number of heads per plant was not significantly different among either herbicide treatments or hybrids.

Herbicide treatments had no significant effect on bushel weight of grain produced. Only small differences in bushel weight were noted among hybrids.

Yield differences resulted from both herbicide treatment and hybrid effects. None of the grass herbicides reduced sorghum yield in comparison with the atrazine check. On the other hand, significant yield increases occurred with several treatments, including normal rates of Frontier and Harness CR as well as the double rate of Partner. Pioneer 8500, NC+ 6B50, and Northrup King KS 710 produced the highest yields ranging from 69 to 72 bu/a.

Table 8. Effects of grass herbicides and hybrids on injury, stand, and plant height of early-planted grain sorghum, Harvey County Experiment Field, Hesston, KS, 1999.

Herbicide Treatment[1]	Rate	Sorghum Brand Hybrid	Injury 5/18	Injury 5/31	Stand 5/18	Stand 5/31	Plant Height
Main effects means:	lb ai/a		%		%		inch
1 Dual Magnum + Atraz	1.25 + 1.0		0.2	0.5	59	79	47
2 Dual Magnum + Atraz	2.5 + 1.0		0.3	1.7	59	81	46
3 Partner + Atraz	2.5 + 1.0		0.3	1.2	61	81	46
4 Partner + Atraz	5.0 + 1.0		0.3	1.8	59	78	47
5 Ramrod + Atraz	4.0 + 1.0		0.2	0.2	60	82	46
6 Ramrod + Atraz	8.0 + 1.0		0.4	0.1	59	80	47
7 Frontier + Atraz	1.25 + 1.0		0.2	0.4	60	81	47
8 Frontier + Atraz	2.5 + 1.0		0.2	2.1	61	78	47
9 Harness CR + Atraz	1.8 + 1.0		0.2	1.4	58	75	46
10 Harness CR + Ataz	3.6 + 1.0		0.5	1.9	59	74	46
11 Atrazine	1.0		0.3	0.3	57	80	46
LSD .05			NS	0.8	NS	3.5	0.6
		DeKalb DK-35	0.1	1.0	51	84	45
		DeKalb DK-40y	0.2	1.4	61	75	46
		Mycogen 1482	0.4	0.5	57	72	45
		Mycogen 1506	0.1	1.3	61	77	51
		NC+ 6B50	0.4	0.8	63	84	47
		N. King KS 710	0.5	0.7	57	74	42
		Pioneer 8699	0.3	0.8	64	82	48
		Pioneer 8500	0.4	1.9	60	85	47
		LSD .05	NS	0.6	4.2	3.0	0.5

[1]**Note: Harness and Harness CR are not currently labeled for grain sorghum.**

Formulations: Aatrex 90 DF, Dual II Magnum 7.64 EC, Frontier 6.0 EC, Harness CR 3.8 L, Partner 65 DF, and Ramrod 4L.

Table 9. Effects of grass herbicides and hybrids on maturity and yield of early-planted grain sorghum, Harvey County Experiment Field, Hesston, KS, 1999.

Herbicide Treatment[1]	Rate	Sorghum Brand Hybrid	Yield	Bushel Weight	Half Bloom	Heads/ Plant
Main effects means:	lb ai/a		bu/a	lb	DAP	
1 Dual Magnum + Atraz	1.25 + 1.0		61	59.7	74	1.1
2 Dual Magnum + Atraz	2.5 + 1.0		64	59.6	74	1.1
3 Partner + Atraz	2.5 + 1.0		62	59.6	74	1.1
4 Partner + Atraz	5.0 + 1.0		68	59.6	74	1.2
5 Ramrod + Atraz	4.0 + 1.0		66	59.6	73	1.1
6 Ramrod + Atraz	8.0 + 1.0		66	59.6	73	1.2
7 Frontier + Atraz	1.25 + 1.0		69	59.7	74	1.1
8 Frontier + Atraz	2.5 + 1.0		63	59.8	75	1.1
9 Harness CR + Atraz	1.8 + 1.0		66	59.7	75	1.1
10 Harness CR + Ataz	3.6 + 1.0		61	59.7	76	1.1
11 Atrazine	1.0		61	59.6	74	1.1
LSD .05			4.3	NS	0.7	NS
		DeKalb DK-35	61	59.7	73	1.2
		DeKalb DK-40y	58	59.7	75	1.1
		Mycogen 1482	59	59.3	75	1.1
		Mycogen 1506	65	59.4	76	1.0
		NC+ 6B50	70	59.4	73	1.1
		N. King KS 710	69	59.9	75	1.2
		Pioneer 8699	62	60.0	71	1.2
		Pioneer 8500	72	59.8	74	1.2
		LSD .05	3.7	0.1	0.6	NS

[1]**Note: Harness and Harness CR are not currently labeled for grain sorghum.**

Formulations: Aatrex 90 DF, Dual II Magnum 7.64 EC, Frontier 6.0 EC, Harness CR 3.8 L, Partner 65 DF, and Ramrod 4L.

HERBICIDES FOR WEED CONTROL IN GRAIN SORGHUM

Mark M. Claassen

Summary

Twenty-three herbicide treatments were evaluated for crop tolerance and weed control efficacy in grain sorghum. Weed competition consisted of dense populations of Palmer amaranth and large crabgrass. All treatments except Paramount alone postemergence provided good to excellent control of Palmer amaranth. Soil-applied treatments gave the best control of large crabgrass. However, because of heavy rainfall after planting, preemergence herbicides for grass control were slightly better than preplant incorporated treatments. Paramount postemergence had little apparent effect on large crabgrass. Herbicide treatments, except for Paramount alone, significantly increased sorghum yields by 74 bu/a in comparison with the untreated check. Yield differences generally were not significant among treatments providing good weed control.

Introduction

Atrazine has been a versatile, cost-effective herbicide for both preemergence and postemergence weed control in grain sorghum for a long period of time. However, off-target movement of atrazine under certain conditions has raised environmental concerns. A few newer alternatives to atrazine have been marketed in recent years. This experiment was conducted to evaluate various standard treatments in comparison with some newer products or product formulations as well as herbicide combinations that might provide greater flexibility for growers.

Procedures

Spring oats were grown on the experiment site in 1998. The soil was a Geary silt loam with pH 7.1 and 2.7% organic matter. Fertilizer nitrogen was applied at 105 lb/a as 46-0-0 on May 19. Weed seed was broadcast over the area to enhance the uniformity of weed populations. Pioneer 8505 with Concep II safener and Gaucho insecticide seed treatment was planted at approximately 42,000 seeds/a in 30-inch rows on June 15, 1999. Seedbed condition was excellent. All herbicides were broadcast in 20 gal/a of water, with three replications per treatment (Table 10). Preemergence (PRE) applications were made shortly after planting with XR8003 flat fan nozzles at 18 psi. Postemergence treatments were applied with the same equipment and setting on July 8 (EPOST) or on July 21 (POST). The EPOST treatments were applied to 0.5- to 5-inch Palmer amaranth and 0.5- to 3-inch large crabgrass in 8-inch sorghum. The POST herbicides were applied to 1- to 7-inch Palmer amaranth in 24-inch sorghum. Plots were not cultivated. Crop injury and weed control were rated twice during the growing season. Sorghum was harvested on October 27.

Results

Rainfall totaled about 1 inch during the 2 weeks before planting. Light rain interfered with application of treatments 7 through 10 and 12 by causing some soil to stick on tractor wheels. More than 0.5 inch of rain fell within hours after planting and PRE herbicide application. A 16-day wet period followed in which total rainfall exceeded 6.5 inches. Dense populations of Palmer amaranth and large crabgrass emerged. Slight injury associated with preplant-incorporated (PPI) or PRE applications of Guardsman as well as POST Peak did not appear to be meaningful (Table 10).

Paramount alone EPOST failed to control Palmer amaranth. However, all other treatments, including Paramount + atrazine EPOST, provided good to excellent control of this species. Crabgrass control was good to excellent with all soil-applied treatments, but

tended to be slightly lower with PPI Guardsman and Bicep II Magnum. Presumably this resulted from the heavy rainfall after application. Paramount EPOST had little or no activity on[pl crabgrass. Herbicide treatments, except for Paramount alone, significantly increased sorghum yield by an average of 74 bu/a in comparison with the untreated check. Drouth stress accentuated yield variation across the site. Yield differences among treatments providing good weed control generally were not significant.

Table 10. Weed control in grain sorghum, Harvey County Experiment Field, Hesston, KS, 1999.

	Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury[3] 7/21	Lacg[4] Control 8/19	Paam[5] Control 8/19	Yield
						%	%	%	bu/a
1	Bicep II Magnum	5.5 F	2.33	Qt	PPI	0	91	97	99
2	Guardsman	5 F	2	Qt	PPI	4	87	94	107
3	Bicep II Magnum	5.5 F	1.6	Qt	PRE	0	99	100	110
4	Bicep Lite II Magnum	6 F	1.5	Qt	PRE	0	100	100	101
5	Guardsman	5 F	1.75	Qt	PRE	3	95	99	104
6	Lariat	4 F	3	Qt	PRE	0	94	100	98
7	Dual II Magnum	7.62 EC	1.33	Pt	PRE	0	96	98	102
	Peak +	57 WG	0.75	Oz	POST				
	COC		1	Qt	POST				
8	Frontier	6 EC	1.67	Pt	PRE	0	92	98	107
	Peak +	57 WG	0.75	Oz	POST				
	COC		1	Qt	POST				
9	BAS 656	6 EC	1	Pt	PRE	1	97	99	101
	Peak +	57 WG	0.75	Oz	POST				
	COC		1	Qt	POST				
10	Dual II Magnum	7.62 EC	1.33	Pt	PRE	0	97	100	110
	Peak +	57 WG	0.5	Oz	POST				
	AAtrex +	4 F	1.5	Pt	POST				
	COC		1	Qt	POST				
11	Bicep Lite II Magnum	6 F	1.5	Qt	PRE	0	100	100	115
	Peak +	57 WG	0.5	Oz	POST				
	AAtrex +	4 F	1.5	Pt	POST				
	COC		1	Qt	POST				
12	Dual II Magnum	7.62 EC	1.33	Pt	PRE	0	98	100	112
	Peak +	57 WG	0.25	Oz	POST				
	AAtrex +	4 F	1.5	Pt	POST				
	COC		1	Qt	POST				
13	Bicep Lite II	6 F	1.5	Qt	PRE	0	99	100	108
	MagnumPeak +	57 WG	0.25	Oz	POST				
	AAtrex +	4 F	1.5	Pt	POST				
	COC		1	Qt	POST				
14	Dual II Magnum	7.62 EC	1.17	Pt	PRE	0	95	96	111
	Peak +	57 WG	0.75	Oz	POST				
	COC		1	Qt	POST				

(Continued)

Table 10. Weed control in grain sorghum, Harvey County Experiment Field, Hesston, KS, 1999.

	Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury[3] 7/21	Lacg[4] Control 8/19	Paam[5] Control 8/19	Yield
						%	%	%	bu/a
15	Dual II Magnum	7.62 EC	1.17	Pt	PRE	0	94	100	113
	Peak +	57 WG	0.5	Oz	POST				
	AAtrex +	4 F	2	Pt	POST				
	COC		1	Qt	POST				
16	Dual II Magnum	7.62 EC	1.17	Pt	PRE	0	95	96	111
	Peak +	57 WG	0.5	Oz	POST				
	Buctril +	2 EC	1	Pt	POST				
	NIS		0.25	% V/V	POST				
17	Dual II Magnum	7.62 EC	1.17	Pt	PRE	4	97	100	108
	Peak +	57 WG	0.5	Oz	EPOST				
	2,4-D Ester +	3.8 EC	0.53	Pt	EPOST				
	NIS		0.25	% V/V	EPOST				
18	Dual II Magnum	7.62 EC	1.17	Pt	PRE	0	94	99	79
	Peak +	57 WG	0.5	Oz	POST				
	Banvel +	4 EC	0.25	Pt	POST				
	NIS		0.25	% V/V	POST				
19	Dual II Magnum	7.62 EC	1.17	Pt	PRE	0	96	100	105
	Peak +	57 WG	0.5	Oz	POST				
	AAtrex +	4 F	1.5	Pt	POST				
	COC		1	Qt	POST				
20	Paramount +	75 DF	5.33	Oz	EPOST	0	0	7	19
	28% N +		1.25	% V/V	EPOST				
	COC		1.25	% V/V	EPOST				
21	Paramount +	75 DF	5.33	Oz	EPOST	0	0	95	92
	AAtrex +	4 F	2	Pt	EPOST				
	28% N +		1.25	% V/V	EPOST				
	COC		1.25	% V/V	EPOST				
22	Dual II Magnum	7.62 EC	1.17	Pt	PRE	0	97	98	96
	Permit +	75 WG	0.67	Oz	POST				
	COC		1	Qt	POST				
23	Dual II Magnum	7.62 EC	1.17	Pt	PRE	0	97	100	116
	Permit +	75 WG	0.67	Oz	POST				
	AAtrex +	4 F	1.5	Pt	POST				
	COC		1	Qt	POST				
24	24 No Treatment					0	0	0	30
	LSD .05					1	4	4	21

[1] **Note: BAS 656 is currently not labeled for grain sorghum**. COC = Farmland Crop Oil Plus. NIS = Pen-A-Trate II nonionic surfactant. UAN = 28% urea ammonium nitrate fertilizer.

[2] PPI = preplant incorporated with field cultivator on June 15. PRE= preemergence on June 15; EPOST = early postemergence 22 DAP.; POST = postemergence 35 DAP.

[3] No injury occurred from subsequent POST treatments.

[4] Lacg =large crabgrass.

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

GRAIN SORGHUM RESPONSE TO SIMULATED DRIFT OF PURSUIT, LIBERTY, ROUNDUP, AND POAST HERBICIDES

Mark M. Claassen and Kassim Al-Khatib

Summary

Soybean herbicides at levels ranging from 1/100 to 1/3 of their labeled rates (LR) were applied to 8- to 12-inch grain sorghum in early July. Symptoms and their severity differed significantly among treatments. None of these herbicides at 1/33 LR or less significantly affected sorghum. At 1/10 LR, only Pursuit and Roundup impacted yields, with reductions of 30% and 17%, respectively. The 1/3 LR of these herbicides caused the greatest injury and largest yield losses of 77% and 99%, respectively. Liberty and Poast at 1/3 LR reduced yields by 37% and 8%, respectively.

Introduction

Herbicide drift is a problem in many areas when winds prevail at the time of spray application or other environmental conditions exist that favor volatilization and redeposition. Because grain sorghum often is grown in close proximity to soybean, the potential for injury to sorghum from soybean herbicides is an important concern. Many soybean herbicides affect grain sorghum at extremely low rates. Currently, little information is available concerning the effect of low levels of soybean herbicides on sorghum, in terms of symptoms produced as well as yield response. This experiment was conducted at Hesston and several other Kansas locations in 1999 to evaluate sorghum injury symptoms and yield following application of low rates of four soybean herbicides.

Procedures

The site was located on a Geary silt loam soil. Pioneer 8505 grain sorghum was planted in 30-inch rows at 45,000 seeds/a on June 10, 1999. Weeds were controlled with a preemergence application of Dual II + AAtrex 4L (1 qt/a + 1 qt/a). On July 7, sorghum at 8- to 12-inch height was treated with 1/100, 1/33, 1/10, and 1/3 of the labeled rate (LR) of Pursuit, Liberty, Roundup, and Poast applied in 20 gal/a of water with XR8003 flat fan nozzles at 18 psi. Control plots received no herbicide. These applications were based on an LRs of 0.063, 0.36, 1.0, and 0.15 lb ai/a for the respective herbicides. The experimental design was a split-plot with four replications. Poast was applied with 1% v/v crop oil concentrate, and all other treatments included 0.25% v/v nonionic surfactant. Injury symptoms and recovery were evaluated on a scale of 0 (no injury) to 100 (complete kill) by visual score at 2, 4, and 8 weeks after treatment (WAT). Plant population, height, and yield were determined at maturity. Sorghum was harvested on October 26.

Results

Winds delayed herbicide application, resulting in treatments targeting somewhat larger sorghum than intended. Moisture conditions before and after application favored herbicide uptake by sorghum. Large herbicide and rate effects as well as herbicide x rate interactions were observed. (Table 11). Injury scores were highest at 2 WAT and declined over time with all treatments except the highest rates of Pursuit and Roundup.

Pursuit

At 1/100 and 1/33 LR, Pursuit caused no sorghum injury. However, significant injury was observed at higher rates. Symptoms were stunting and leaf chlorosis at 1/10 LR. Severe stunting along with leaf purpling and necrosis plus significant stand reduction of 11% occurred with 1/3 LR. Pursuit at 1/10 and 1/3 LR caused major yield losses of 30%

and 77%, respectively. Grain test weight decreased by 7% only at 1/3 LR.

Liberty

The 1/100 LR and 1/33 LR Liberty treatments resulted in no injury symptoms in sorghum. At 1/10 LR, slight injury in the form of leaf chlorosis was noted, but, as with lower rates, yield was not affected. The highest rate of Liberty produced stunting, leaf chlorosis, and necrosis. Stands declined 6% and plant heights were reduced by 15% with 1/3 LR. Also, yield loss was highly significant at 37%, and grain test weight declined by 4%.

Roundup

Roundup at 1/100 LR and 1/33 LR had no apparent effects on sorghum. The 1/10 LR treatment caused leaf chlorosis and necrosis but had few or no effects on plant height and stands. However, yield declined by 17 % at this rate. At 1/3 LR, essentially all sorghum was killed.

Poast

Poast had no significant effects on sorghum at the two lowest rates, and only minor injury in the form of leaf chlorosis occurred at 1/10 LR. This symptom was more pronounced at 1/3 LR, but, even at this rate, it disappeared with time and resulted in no stunting or stand loss. A yield loss of 8 bu/a approached statistical significance at the 5% probability level. Grain test weight was not affected.

Table 11. Grain sorghum responses to soybean herbicides, Harvey County Experiment Field, Hesston, KS, 1999.

Herbicide[1]	Relative Rate[2]	Injury Rating[3] 2 WAT	4 WAT	8 WAT	Plants/ Acre[4]	Plant Ht	Grain Yield	Yield Loss	Test Wt
			%		1000's	inch	bu/a	%	lb/bu
Control	0	0	0	0	38.0	47	105	--	60.9
Pursuit	1/100	0	0	0	37.2	48	112	0	60.9
	1/33	0	0	0	37.5	47	105	0	60.9
	1/10	31	26	16	39.1	44	74	30	60.3
	1/3	75	71	70	34.0	33	24	77	56.8
Liberty	1/100	0	0	0	38.2	47	107	0	60.8
	1/33	0	0	0	39.7	48	105	0	60.5
	1/10	14	7	0	39.6	47	107	0	60.6
	1/3	54	28	21	35.7	40	66	37	58.6
Roundup	1/100	0	0	0	38.2	47	102	3	60.9
	1/33	0	0	0	38.1	46	108	0	60.9
	1/10	28	25	14	39.7	44	88	17	60.6
	1/3	100	100	99	0.1	9	1	99	59.3
Poast	1/100	0	0	0	38.3	47	112	0	60.9
	1/33	0	0	0	37.6	47	110	0	61.1
	1/10	6	3	0	36.5	46	109	0	61.0
	1/3	27	15	1	36.7	46	96	8	60.7
LSD .05		2	4	2	1.85	5.6	10.5	8.7	0.48

[1] Herbicide formulations: Pursuit 70 DG, Liberty 1.67 L, Roundup Ultra 4L, Poast 1.5 E

[2] Applications based on labeled rates of 1.4 oz, 1.7 pt, 2 pt, and 0.8 pt/a for Pursuit, Liberty, Roundup, and Poast, respectively.

[3] WAT = weeks after treatment.

[4] Stand count at end of season.

HERBICIDES FOR WEED CONTROL IN SOYBEAN

Mark M. Claassen

Summary

Twenty-three herbicide treatments were evaluated for crop tolerance and weed control efficacy in soybean. Dense populations of Palmer amaranth and large crabgrass were present. Most treatments completely controlled Palmer amaranth; only single applications of Roundup failed to do so. The best control of large crabgrass was achieved with preplant-incorporated Pursuit Plus followed by Roundup Ultra postemergence; Authority + Pursuit Plus and Dual II Magnum + Scepter preemergence; and sequential applications of Roundup Ultra. Treatments involving Blazer caused some foliar burn, but without significant effect on soybean yield. Herbicide treatments resulted in an average yield of 38 bu/a versus 5 bu/a for the untreated check. Yield differences among herbicides were not meaningful.

Introduction

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

Procedures

Spring oats were grown on the experiment site in 1998. The soil was a Smolan silt loam with pH 7.1 and 2.7% organic matter. To promote uniformity of weed populations, pigweed and crabgrass seed were broadcast and incorporated with a field cultivator at the last preplant tillage. Asgrow 3601 Roundup Ready + STS soybean was planted at 139,000 seeds/a in 30-inch rows on June 14, 1999. Seedbed condition was excellent. All herbicide treatments were broadcast in 20 gal/a of water, with three replications per treatment. These were applied with XR8003 flat fan nozzles at 18 psi as PPI on June 14, PRE on June 15, POST on July 7, and SEQ treatments on August 9 (Table 12). The POST treatments were applied when soybean was 5 to 7 inches tall with one to two trifoliolate leaves. Palmer amaranth mostly ranged from 0.5 to 5 inches, and large crabgrass height was 0.5 to 3 inches. The SEQ Roundup in treatments 20 through 22 was applied to relatively few Palmer amaranth plants ranging from 2 to 25 inches in height and to large crabgrass from 0.75 to 12 inches in height. Crop injury and/or weed control were evaluated several times during the growing season. Soybean was harvested on October 28.

Results

Approximately 1 inch of rain fell during the 2-week period before planting. Nearly 4 inches of rain were received within 5 days after planting. By the end of June, the total exceeded 6.5 inches. Dense populations of pigweed, primarily Palmer amaranth, and large crabgrass developed. Weather factors delayed SEQ Roundup application and resulted in treatment of some large Palmer amaranth.

A majority of the treatments completely controlled Palmer amaranth; only single applications of Roundup Ultra failed to do so. Herbicide treatment effects on large crabgrass ranged from poor to excellent. Pre-plant-incorporated Pursuit Plus followed by Roundup Ultra POST; Authority + Pursuit Plus and Dual II Magnum + Scepter PRE; and SEQ applications of Roundup Ultra provided superior control of large crabgrass. Authority

+ Classic PRE and treatments involving PPI of Prowl alone followed by POST herbicides for broadleaf weeds were least effective in controlling large crabgrass.

Minor crop injury without significant effect on yield occurred with treatments involving Blazer. Soybean yield was improved significantly by all herbicide treatments. However, mid-season drouth contributed to yield variation within the site. Consequently, yield differences among these treatments were not meaningful.

Table 12. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 1999.

Herbicide Treatment[1]		Product Form	Rate/a	Unit	Timing[2]	Injury 7/22	Lacg[3] Control 10/28	Paam[4] Control 10/28	Yield
						%	%	%	bu/a
1	Authority	75 DF	4.25	Oz	PRE	0	70	100	31
	Classic	25 DF	2.56	Oz	PRE				
2	Authority +	75 DF	4.25	Oz	PRE	0	86	100	43
	Classic	25 DF	2.56	Oz	PRE				
	Assure II +	0.88 EC	10	Fl oz	POST				
	COC +		1	% V/V	POST				
	AMS		2	Lb	POST				
3	Authority +	75 DF	2.24	Oz	PRE	0	87	100	37
	Classic	25 DF	1.36	Oz	PRE				
	Classic +	25 DF	0.33	Oz	POST				
	Roundup Ultra +	4 L	1.5	Pt	POST				
	NIS +		0.25	% V/V	POST				
	AMS		2	Lb	POST				
4	Authority +	75 DF	2.24	Oz	PRE	0	89	100	37
	Classic	25 DF	1.36	Oz	PRE				
	Synchrony STS +	42 DF	0.5	Oz	POST				
	Roundup Ultra +	4 L	1.5	Pt	POST				
	NIS +		0.25	% V/V	POST				
	AMS		2	Lb	POST				
5	Authority	75 DF	3.0	Oz	PRE	0	87	100	41
	Classic +	25 DF	0.33	Oz	POST				
	Roundup Ultra +	4 L	1.5	Pt	POST				
	NIS +		0.25	% V/V	POST				
	AMS		2	Lb	POST				
6	Authority	75 DF	3.0	Oz	PRE	0	88	100	46
	Synchrony STS +	42 DF	0.5	Oz	POST				
	Roundup Ultra +	4 L	1.5	Pt	POST				
	NIS +		0.25	% V/V	POST				
	AMS		2	Lb	POST				

(Continued)

Table 12. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 1999.

	Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/22	Lacg[3] Control 10/28	Paam[4] Control 10/28	Yield
						%	%	%	bu/a
7	Authority	75 DF	4.5	Oz	PRE	0	88	100	45
	Classic +	25 DF	0.33	Oz	POST				
	Roundup Ultra +	4 L	1.5	Pt	POST				
	NIS +		0.25	% V/V	POST				
	AMS		2	Lb	POST				
8	Authority	75 DF	4.5	Oz	PRE	0	89	100	37
	Synchrony STS +	42 DF	0.5	Oz	POST				
	Roundup Ultra +	4 L	1.5	Pt	POST				
	NIS +		0.25	% V/V	POST				
	AMS		2	Lb	POST				
9	Authority +	75 DF	4.5	Oz	PRE	0	98	100	40
	Pursuit Plus	2.9 L	2.5	Pt	PRE				
10	Authority +	75 DF	2.19	Oz	PRE	0	86	100	29
	Classic +	25 DF	1.32	Oz	PRE				
	Sencor +	75 DF	3.0	Oz	PRE				
	Flufenacet	60 DF	4.0	Oz	PRE				
	Roundup Ultra	4 L	1.5	Pt	POST				
11	Prowl	3.3 EC	3.0	Pt	PPI	3	76	100	38
	Pursuit +	70 DG	1.44	Oz	POST				
	Blazer +	2 L	10	Fl oz	POST				
	NIS +		0.25	% V/V	POST				
	28% N		2	Qt	POST				
12	Prowl	3.3 EC	3.0	Pt	PPI	5	80	100	34
	Raptor +	1 SL	4.0	Fl oz	POST				
	Blazer +	2 L	10	Fl oz	POST				
	NIS +		0.25	% V/V	POST				
	28% N		2	Qt	POST				
13	Prowl +	3.3 EC	1.0	Pt	PPI	5	88	100	31
	Squadron	2.33 EC	3.0	Pt	PPI				
	Blazer +	2 L	10	Fl oz	POST				
	NIS +		0.25	% V/V	POST				
	28% N		2	Qt	POST				
14	Pursuit Plus	2.9 L	2.5	Pt	PPI	0	98	100	39
		4 L	1.0	Pt	POST				
	Roundup Ultra +		2.5	Lb	POST				
	AMS								
15	Pursuit +	70 DG	1.44	Oz	POST	0	93	99	35
	Roundup Ultra +	4 L	1.0	Pt	POST				
	NIS +		0.25	% V/V	POST				
	AMS		2.5	Lb	POST				

(Continued)

Table 12. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 1999.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/22	Lacg[3] Control 10/28	Paam[4] Control 10/28	Yield
					%	%	%	bu/a
16 Roundup Ultra	4 L	1.0	Pt	POST	0	82	88	44
17 Roundup Ultra	4 L	1.5	Pt	POST	0	85	88	37
18 Roundup Ultra +	4 L	1.5	Pt	POST	0	84	87	40
AMS		3.4	Lb	POST				
19 Roundup Ultra	4 L	2.0	Pt	POST	0	85	88	36
20 Roundup Ultra	4 L	1.0	Pt	POST	0	99	100	45
Roundup Ultra	4 L	1.0	Pt	SEQ				
21 Roundup Ultra	4 L	1.5	Pt	POST	0	100	100	40
Roundup Ultra	4 L	1.5	Pt	SEQ				
22 Roundup Ultra	4 L	2.0	Pt	POST	0	100	100	34
Roundup Ultra	4 L	2.0	Pt	SEQ				
23 Dual II Magnum +	7.62 EC	1.16	Pt	PRE	0	99	100	38
Scepter	70 DG	2.8	Oz	PRE				
No Treatment					0	0	0	5
LSD .05					1	5	3	16

[1]Note: The Authority + Classic combination is equivalent to Canopy XL at 6.8 oz/a in treatments 1 - 2, and Canopy XL at 3.6 oz/a in treatments 3 - 4. COC = Farmland Crop Oil Plus. NIS = Pen-A-Trate II nonionic surfactant. UAN = 28% urea ammonium nitrate fertilizer. AMS = sprayable ammonium sulfate.

[2] PPI = preplant incorporated with field cultivator on June 14. PRE= preemergence to soybeans and weeds on June 15; POST = postemergence 23 DAP; SEQ = sequential 56 DAP.

[3] Lacg =large crabgrass.

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

IRRIGATION AND NORTH CENTRAL KANSAS EXPERIMENT FIELDS

Introduction

The 1952 Kansas legislature provided a special appropriation to establish the Irrigation Experiment Field in order to serve expanding irrigation development in North-central Kansas. The original 35-acre field was located 9 miles northwest of Concordia. In 1958, the field was relocated to its present site on a 160-acre tract near Scandia in the Kansas-Bostwick Irrigation District. Water is supplied by the Miller Canal and stored in Lovewell Reservoir in Jewell County, Kansas and Harlen County Reservoir at Republican City, Nebraska. A 5-acre site in the Republican River Valley on the Mike Brazon Farm also is utilized for irrigated crop research. In 1997, 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 production of corn, sorghum, and soybean.

Soil Description

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

1999 Weather Information

The 1999 growing season was characterized by above-normal rainfall in April and May but below-normal rainfall in July (Table 1). Rainfall in August was slightly above normal and very timely for soybean and grain sorghum production. Temperatures were below normal for most of the growing season.

Table 1. Weather data for the north central Kansas experiment fields

	Rainfall, inches			Temperature ^{0}F		Growth Units	
Month	Scandia 1999	Average	Belleville 1999	Daily Mean 1999	Average Mean	1998	Average
April	3.8	2.4	4.9	50	53	191	242
May	5.8	3.7	6.9	62	64	412	427
June	4.5	4.8	5.0	71	74	618	718
July	0.5	3.3	2.0	81	79	841	835
August	3.8	3.3	4.5	76	77	745	748
Sept.	2.0	3.5	2.1	65	67	475	518
Total	20.4	20.9	25.3	67	69	3281	3487

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

W. Barney Gordon, David A. Whitney, and Dale L. Fjell

Summary

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 17-year average soybean yield was 36 bu/a. Soybean yields were not affected by N applied to the previous grain sorghum crop. In 1996, four additional N rates (120, 150, 180, and 210 lb/a) were added to the experiment. When averaged over the period 1996-1999, yields were greater in the rotated system than in the continuous sorghum at all levels of N. Yields in the continuous system continued to increase with increasing N rate up to 90 lb/a. Yields in the rotated system were maximized with application of 60 lb/a N.

Introduction

Crop rotations were necessary to maintain soil productivity before the advent of chemical fertilizers. Biological fixation of atmospheric N is a major source of N for plants in natural systems. Biological fixation through legume-*Rhizobium* associations is utilized extensively in agricultural systems. Using a legume in a crop rotation system can reduce the N requirement for the following nonlegume 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 starting in 1982. Treatments included cropping system (continuous grain sorghum and grain sorghum rotated with soybeans) and N rates (0, 30, 60, and 90 lb/a). During 1982-1989, the two N sources anhydrous ammonia and urea- ammonium nitrate solution (28% UAN) were evaluated. Both N sources were knife applied in the middle of rows from the previous year's crop. After 1989, anhydrous ammonia was used as the sole N source. In each year, N was knife applied 7-14 days prior to planting. Grain sorghum was planted at the rate of 60,000 seed/a, and soybeans were planted at the rate of 10 seed/foot in 30-inch rows. Soybean yields were not affected by N applied to the previous sorghum crop and, therefore, are averaged over all N rates. In 1996, four additional N rates (120, 150, 180, and 210 lb/a were added to the experiment in order to further define N response.

Results

In the continuous grain sorghum system, grain yields (1982-1995) continued to increase with increasing N rate up to 90 lb/a (Table 2). Sorghum yields in the rotated system were maximized with an application of 60 lb/a N. When no N was applied, rotated sorghum 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 in 3 of 4 years (Table 3). Addition of N alone did not make up yield losses in a continuous sorghum production system. When averaged over cropping system and N rate from 1982-1989, sorghum 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). Over the 18-year period (1982-1999), soybean yields averaged 36 bu/a and were not affected by N applied to the previous sorghum crop (Table 4).

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 nitrogen rate on grain sorghum yields, Belleville, KS 1996-1999.

N Rate	Cropping System	1996	1997	1998	1999	Avg.
lb/a				bu/a		
0	Continuous	92	51	55	73	68
	Rotated	120	88	87	112	102
30	Continuous	110	71	75	95	88
	Rotated	137	108	115	119	120
60	Continuous	131	110	118	115	119
	Rotated	164	128	142	127	140
90	Continuous	143	121	126	125	129
	Rotated	163	141	144	126	144
120	Continuous	148	122	128	123	130
	Rotated	162	144	145	128	145
150	Continuous	148	120	127	123	130
	Rotated	162	143	145	129	145
180	Continuous	148	121	128	126	131
	Rotated	162	144	145	129	145
210	Continuous	148	122	128	126	131
	Rotated	162	145	145	129	145
System Means						
	Continuous	134	105	111	113	116
	Rotated	154	130	134	125	136
N Rate Means						
0		106	70	71	92	85
30		124	90	95	107	104
60		148	119	130	121	130
90		153	131	135	126	136
120		155	133	137	126	138
150		155	132	136	126	137
180		155	133	137	127	138
210		155	134	137	127	138
LSD(0.05)		8	6	6	6	

Table 4. Yield of soybeans grown in rotation with grain sorghum, North Central Kansas Experiment Field, Belleville, KS , 1982-1999*

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

*Average 1982-1999= 36 bu/a

EFFECTS OF PLACEMENT, RATE, AND SOURCE OF STARTER FERTILIZER CONTAINING POTASSIUM ON CORN AND SOYBEAN PRODUCTION

W. Barney Gordon

Summary

Field studies were conducted at the North Central Kansas Experiment Field, located near Scandia, on a Crete silt loam soil. Starter fertilizer (7-21-7) included three sources of potassium (K): sulfate of potassium (SOP), potassium chloride (KCL), and potassium thiosulfate (KTS). The test also included two placement methods (in-furrow with the seed and 2 inches to the side and 2 inches below the seed at planting) and four application rates (50, 100, 150, 200 lb/a of 7-21-7). A no-starter check plot also was included in the experiment. Sulfur rates were balanced so that all plots received the same amount, regardless of K source. Experiments were conducted with both corn and soybeans. For the corn experiment, nitrogen (N) as urea-ammonium nitrate solution (28% UAN) was applied immediately after planting so that all plots received 200 lb/a N. Soybeans received no additional N. When liquid 7-21-7 starter fertilizer containing KCL was placed in-furrow, grain yield, plant stand, and early season dry matter were reduced in both the corn and soybean experiments. In the corn experiment, starter fertilizer containing KCL applied at the 50 lb/a rate reduced yield by 12 bu/a compared to the same rate applied 2x2. Corn yield was reduced 36 bu/a when starter fertilizer containing KCL was applied in-furrow at the 200 lb/a rate compared with 2x2 placement. When starter fertilizer containing SOP was placed in-furrow, no yield reduction occurred until the rate exceeded 100 lb/a. Grain yield with KTS applied in-furrow was equal to that with SOP at 50 lb/a. When averaged over sources and rates, corn yields were 20 bu/a less for in-furrow fertilizer placement than for 2x2 placement. Whole plant N, P, and K concentrations at the V-6 stage were all significantly greater when starter fertilizer was placed 2x2 rather than in-furrow. Starter fertilizer containing SOP applied in-furrow at the 50 lb/a rate increased soybean yields by 7 bu/a over the no-starter check. Soybean yields declined when higher rates of SOP were applied with the seed. Starter fertilizer containing KCL and KTS applied in-furrow at the 50 lb/a rate did not improve yields. Yields declined with all in-furrow applications when rates exceeded 50 lb/a, regardless of K source.

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 on 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 testing high in available nutrients. Many producers favor in-furrow 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 nitrogen and potassium is placed in contact with seed. The objective of this research was to determine corn and soybean responses to starters using three different sources of potassium, two placement methods and various application rates.

Procedures

Irrigated ridge-tilled experiments were conducted at the North Central Experiment Field, near Scandia, on a Crete silt loam soil. Analysis by the KSU Soil Testing Laboratory showed that in the corn experimental area, initial soil pH was 6.4; organic matter content was 2.4%; and Bray-1 P and exchangeable K in the top 6 inches of soil were 43 and 380 ppm, respectively. In the soybean area, soil pH was 6.5, organic matter content was 2.2%, Bray-1 P was 45 ppm, and exchangeable K was 350 ppm in the top 6 inches of soil. The experimental design was a randomized complete block with three factors. Both the corn and soybean tests included starter fertilizer (7-21-7) made with three potassium (K) sources applied either in-furrow or 2 inches to the side and 2 inches below the seed (2 x 2) at five different rates. A no-starter check also was included. The three sources of K were sulfate of potassium (SOP), potassium chloride (KCL), and potassium thiosulfate (KTS). A liquid 7-21-7 fertilizer was made using ammonium polyphosphate (10-34-0) and either SOP, KCL, or KTS and was applied at 50, 100, 150, and 200 lb/a. Sulfur was balanced so that all plots received the same amount. Nitrogen as 28% UAN also was balanced on all corn plots to give a total of 200 lb/a. The soybean experiment received no additional N. The corn hybrid NC+ 5445 was planted on 20 April at the rate of 32,000 seed/a. The soybean variety Dekalb CX370RR was planted on 15 May at the rate of 200,000 seed/a in 30-inch rows. Stand counts were taken 3 weeks after emergence. Whole plant samples (20 plants/plot) were taken at the V-6 stage in the corn experiment and 28 days after emergence in the soybean experiment. The center two rows of each four-row plot were harvested for yield determination..

Results

Corn grain yields were affected by a starter fertilizer x placement x rate interaction (Table 5). When SOP was used as the K source in the 7-21-7 starter fertilizer and placed in-furrow with the seed, grain yields were not different than those with fertilizer placed 2x2, until rate exceeded 100 lb/a. When KCL was used as the K source for 7-21-7 starter fertilizer placed in-furrow, yields were reduced at all application rates compared to the 2x2 placement. A 50 lb/a in-furrow application of 7-21-7 containing KCL reduced grain yield by 12 bu/a and plant population by 4510 plants/a compared to the same rate applied 2x2. When in-furrow rates of starter fertilizer containing KTS exceeded 50 lb/a, yield, plant population, and V6 dry weight all were reduced compared to 2x2 fertilizer placement. Whole-plant K concentration at the V-6 stage (Table 6) was significantly greater when starter fertilizer was applied 2x2 than when placed in-furrow with the seed. Tissue concentration increased with increasing rate of starter fertilizer. When starter fertilizer containing KCL or KTS was placed in-furrow with the soybean seed, yield and plant population were significantly reduced at rates exceeding 50 lb/a compared to the no-starter check (Table 7). Starter fertilizer containing SOP applied in-furrow at the 50 lb/a rate increased soybean yield by 7 bu/a compared to the no starter check. When averaged over source and rate, in-furrow application reduced yield by 13 bu/a compared to 2x2 placement. Starter fertilizer placed 2x2 increased soybean yield by 7 bu/a compared to the no-starter check, when averaged over all other variables. Whole-plant K concentration in small soybeans was greater when starter fertilizer was applied 2x2 than when placed in-furrow with the seed (Table 8).

In both corn and soybean experiments, in-furrow applications of starter fertilizer containing SOP resulted in less salt injury than those containing KCL. Even at low application rates, in-furrow applications of fertilizer containing KCL reduced plant population and yield.

Table 5. Effects of placement, rate, and K source of 7-21-7 starter fertilizer on grain yield, population, and V-6 stage whole-plant dry matter uptake of corn, Scandia, KS, 1999.

Source	Placement	Rate of 7-21-7	Yield	Population	V-6 Dry Wt.
		lb/a	bu/a	plants/a	lb/a
		0*	175	32580	266
SOP**	In-furrow	50	182	26917	405
		100	180	26917	428
		150	174	24735	425
		200	170	24153	420
	2 x 2	50	184	31282	480
		100	186	31719	490
		150	204	32010	510
		200	201	32446	501
KCL***	In-furrow	50	174	25026	385
		100	166	23862	370
		150	168	22843	285
		200	159	22407	219
	2 x 2	50	186	29536	410
		100	184	31573	463
		150	197	31573	505
		200	195	30264	528
KTS****	In-furrow	50	182	25171	399
		100	175	24880	388
		150	163	22407	256
		200	166	21825	241
	2 x 2	50	184	30991	420
		100	186	31719	489
		150	197	31137	520
		200	201	31864	522
LSD(0.05)			8	405	45

*No-starter check plot was not included in statistical analysis.

**7-21-7 Starter fertilizer made using sulfate of potassium (SOP) as the K source.

***7-21-7 Starter fertilizer made using potassium chloride (KCL) as the K source.

****7-21-7 Starter fertilizer made using potassium thiosulfate (KTS) as the K source

Table 6. Effects of placement, rate, and K source of 7-21-7 starter fertilizer on V-6 stage whole-plant N, P, and K concentrations of corn, Scandia, KS, 1999.

Source	Placement	Rate of 7-21-7	N	P	K
		lb/a		%	
		0*	2.91	0.308	4.01
SOP**	In-furrow	50	3.14	0.358	4.95
		100	3.19	0.363	4.97
		150	3.25	0.397	5.19
		200	3.47	0.396	5.25
	2 x 2	50	3.34	0.392	5.06
		100	3.50	0.407	5.09
		150	3.47	0.400	5.27
		200	3.58	0.417	5.35
KCL***	In-furrow	50	3.05	0.350	4.69
		100	3.17	0.354	5.06
		150	3.34	0.365	5.05
		200	3.38	0.383	5.07
	2 x 2	50	3.37	0.361	5.04
		100	3.42	0.399	5.09
		150	3.56	0.408	5.14
		200	3.59	0.404	5.19
KTS****	In-furrow	50	3.14	0.357	4.90
		100	3.20	0.360	5.01
		150	3.20	0.360	5.14
		200	3.46	0.374	5.13
	2 x 2	50	3.30	0.370	4.95
		100	3.44	0.372	5.06
		150	3.46	0.375	5.30
		200	3.59	0.403	5.52

*No-starter check plot was not included in statistical analysis.
**7-21-7 Starter fertilizer made using sulfate of potassium (SOP) as the K source.
***7-21-7 Starter fertilizer made using potassium chloride (KCL) as the K source.
****7-21-7 Starter fertilizer made using potassium thiosulfate (KTS) as the K source

Table 7. Effects of placement, rate, and K source of 7-21-7 starter fertilizer on yield, population, and V-6 stage whole plant dry matter of soybeans, Scandia, KS, 1999.

Source	Placement	Rate of 7-21-7	Yield	Population	V-6 Dry Wt.
		lb/a	bu/a	plant/a	lb/a
		0*	64	112367	290
SOP**	In-furrow	50	71	88666	322
		100	61	81200	335
		150	58	63600	280
		200	51	70933	258
	2 x 2	50	72	102533	344
		100	72	105840	365
		150	72	101466	360
		200	76	100533	367
KCL***	In-furrow	50	62	82000	288
		100	57	66933	250
		150	56	64266	220
		200	50	66400	211
	2 x 2	50	67	109570	314
		100	69	114400	322
		150	74	105359	330
		200	73	101266	328
KTS****	In-furrow	50	59	79733	300
		100	59	69066	269
		150	56	63833	260
		200	56	64133	255
	2 x 2	50	69	111240	330
		100	69	104381	355
		150	74	102600	351
		200	75	106708	361
LSD(0.05)			5	8236	21

*No-starter check plot was not included in statistical analysis.
**7-21-7 Starter fertilizer made using sulfate of potassium (SOP) as the K source.
***7-21-7 Starter fertilizer made using potassium chloride (KCL) as the K source.
****7-21-7 Starter fertilizer made using potassium thiosulfate.

Table 8. Effects of placement, rate, and K source of 7-21-7 starter fertilizer on N, P, and K concentrations in aboveground soybean tissue 28 days after emergence, Scandia, KS, 1999.

Source	Placement	Rate of 7-21-7	N	P	K
		lb/a		%	
		0*	2.39	0.249	2.22
SOP**	In-furrow	50	2.41	0.254	2.49
		100	2.48	O.254	2.50
		150	2.49	0.259	2.55
		200	2.43	0.256	2.51
	2 x 2	50	2.49	0.259	2.50
		100	2.52	0.261	2.55
		150	2.53	0.275	2.58
		200	2.54	0.276	2.58
KCL***	In-furrow	50	2.42	0.232	2.40
		100	2.45	0.238	2.40
		150	2.49	0.236	2.39
		200	2.48	0.230	2.39
	2 x 2	50	2.43	0.256	2.50
		100	2.49	0.259	2.54
		150	2.53	0.260	2.55
		200	2.48	0.261	2.56
KTS****	In-furrow	50	2.46	0.250	2.48
		100	2.49	0.249	2.47
		150	2.52	0.245	2.42
		200	2.49	0.241	2.43
	2 x 2	50	2.48	0.255	2.51
		100	2.54	0.259	2.55
		150	2.55	0.260	2.58
		200	2.50	0.260	2.60

*No-starter check plot was not included in statistical analysis.
**7-21-7 Starter fertilizer made using sulfate of potassium (SOP) as the K source.
***7-21-7 Starter fertilizer made using potassium chloride (KCL) as the K source.
****7-21-7 Starter fertilizer made using potassium thiosulfate.

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

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Summary

This experiment was conducted at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Soil test P was in the "high" range. Treatments consisted of tillage systems and starter fertilizer placement and composition. Tillage systems consisted of no-tillage and minimum tillage (spring disk and harrow treatment). Methods of starter fertilizer application included placement 2 inches to the side and 2 inches below the seed at planting (2x2) and dribbled in a band on the soil surface 2 inches beside the seed row. Liquid starter fertilizer treatments consisted of N and P_2O_5 combinations giving 15, 30, and 45 lb N/a and 30 lb P_2O_5/a. Starter treatments containing either 30 lb N or 30 lb P_2O_5/a applied alone and a no-starter check also were included. In both tillage systems, yields were maximized by 2x2 placement of starter fertilizer containing either 30 or 45 lb N/a with 30 lb P_2O_5/a. Starter fertilizer containing 30 lb N and 30 lb P_2O_5/a decreased the number of days from emergence to mid-bloom by 6 days compared to starter treatments that contained N or P applied alone. Although dribble applications improved yields over the no-starter check, they were not as effective as 2x2 starter fertilizer placement.

Introduction

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

Procedures

The experiment was conducted at the North Central Kansas Experiment Field on a Crete silt loam soil. Analysis by the KSU Soil Testing Laboratory showed that initial soil pH was 6.2, organic mater was 2.2%, Bray P-1 was 42 ppm, and exchangeable K was 320 ppm in the top 6 inches of soil. Treatments consisted of two tillage systems (no-tillage and minimum tillage). The minimum-tillage treatment received one disking and harrowing operation in the spring 3 weeks prior to planting. Starter fertilizer was placed either 2 inches to the side and 2 inches below the seed at planting (2x2) or dribbled in a band on the

soil surface 2 inches beside the seed at planting. Starter fertilizer treatments consisted of N and P_2O_5 combinations giving 15, 30, or 45 lb N/a with 30 lb P_2O_5/a. Treatments consisting of either 30 lb N/a or 30 lb P_2O_5/a applied alone and a no-starter check were also included. Starter combinations were made using 10-34-0 and 28% UAN. After planting, knife applications of 28% UAN were made to bring N applied to each plot to a total of 140 lb/a. Grain sorghum (NC+ 7R83) was planted at the rate of 60,000 seed/a on May 28, 1999. At the V6 stage of growth, 20 plants were selected randomly from the first or fourth row of each plot for analysis of dry matter and N and P concentrations. At first bloom, 20 flag leaves/plot were harvested and analyzed for N and P concentrations. Beginning on 8 September, 10 heads from the first or fourth row of each plot were selected randomly for grain moisture determination The center two rows of each plot were harvested on October 12, 1999 for grain yield determination.

Results

Although surface dribble application of starter fertilizer increased grain yield over the no-starter check, yields were higher when fertilizer was placed 2x2 (Table 9). When averaged over tillage and starter combinations, yields were 12 bu/a greater when starter fertilizer was placed subsurface as compared to surface dribbled. Regardless of tillage system, the greatest yields occurred with 2x2 applications of starter fertilizer containing either 30 or 45 lb N/a with 30 lb P_2O_5/a. The higher N starters also were most efficient in reducing the number of days from emergence to mid-bloom. The N alone or the P alone treatments did not yield as well as those with starters that contained both N and P. The treatment containing only 15 lb N/a with 30 lb P_2O_5/a also was not as effective as starters containing more N. Use of starter fertilizer resulted in greater yields in both tillage systems. At the V6 stage, whole-plant concentrations of N and P were greater when fertilizer was placed 2x2 rather than dribbled on the soil surface (Table 10). Early season differences in nutrient uptake between starter fertilizer application methods were still present at later growth stages. Leaf tissue concentrations of N and P at early bloom were greater when starter fertilizer was applied 2x2 compared to surface dribble applications. Early season dry matter was greater in the reduced tillage system than in with no-tillage. The use of 2x2 placed starters that contained at least 30 lb N in combination with 30 lb P_2O_5/a accelerated grain moisture dry-down (Figure 1). Grain yield, days from emergence to mid-bloom, and plant tissue nutrient concentrations were not affected by tillage system.

Table 9. Effects of tillage system and starter fertilizer placement and composition on grain sorghum yield, number of days from emergence to mid-bloom, and V6-stage whole-plant dry matter accumulation, Belleville, KS, 1999.

Tillage	Placement	Starter N	Starter P_2O_5	Yield	Days to Mid-bloom	V-6 Dry Matter
		lb/a		bu/a		lb/a
Reduced		0	0	124	68	543
	2x2	0	30	132	60	680
		30	0	130	60	764
		15	30	141	60	798
		30	30	150	56	948
		45	30	151	55	933
	Dribble	0	30	133	61	646
		30	0	134	61	648
		15	30	134	61	755
		30	30	136	56	822
		45	30	135	56	883
No-Tillage		0	0	118	67	313
	2x2	0	30	144	61	593
		30	0	141	62	572
		15	30	145	60	766
		30	30	155	55	872
		45	30	155	55	916
	Dribble	0	30	135	64	466
		30	0	133	63	613
		15	30	130	63	613
		30	30	134	58	635
		45	30	133	58	675
Tillage Means	Reduced Till			138	59	789
	No-Till			141	60	671
	LSD(0.05)			NS	NS	49
Placement Means	2x2			144	58	783
	Dribble			134	60	677
	LSD(0.05)			6	1	52
Starter Means	0-30			136	62	596
	30-0			135	62	649
	15-30			138	60	733
	30-30			144	56	819
	45-30			143	56	852
	LSD(0.05)			6	1	50

Table 10. Effects of tillage system and starter fertilizer placement and composition on V6 stage whole-plant N and P concentrations and flag leaf N and P concentrations of grain sorghum, Belleville, KS, 1999.

Tillage	Placement	Starter N	Starter P_2O_5	V6 N	V6 P	Leaf N	Leaf P
		lb/a			%		
Reduced		0	0	2.81	0.277	2.49	0.301
	2x2	0	30	3.06	0.295	2.77	0.309
		30	0	3.29	0.325	2.73	0.311
		15	30	3.35	0.350	2.79	0.324
		30	30	3.55	0.344	2.88	0.328
		45	30	3.78	0.355	2.84	0.327
	Dribble	0	30	3.03	0.295	2.48	0.307
		30	0	3.18	0.301	2.64	0.306
		15	30	3.20	0.297	2.72	0.319
		30	30	3.27	0.308	2.60	0.314
		45	30	3.31	0.314	2.71	0.315
No-Tillage		0	0	2.79	0.269	2.44	0.300
	2x2	0	30	3.19	0.292	2.65	0.328
		30	0	3.33	0.326	2.64	0.324
		15	30	3.36	0.338	2.69	0.323
		30	30	3.75	0.367	2.80	0.338
		45	30	3.62	0.368	2.86	0.341
	Dribble	0	30	3.14	0.277	2.45	0.313
		30	0	3.21	0.283	2.48	0.315
		15	30	3.17	0.305	2.63	0.325
		30	30	3.41	0.314	2.68	0.328
		45	30	3.47	0.304	2.65	0.335
Tillage Means	Reduced Till			3.30	0.318	2.72	0.316
	No-Till			3.36	0.317	NS	0.327
	LSD(0.05)			NS	NS	NS	NS
Placement Means	2x2			3.43	0.336	2.77	0.325
	Dribble			3.23	0.300	2.60	0.318
	LSD(0.05)			0.10	0.011	0.08	0.006
Starter Means	0-30			3.11	0.290	2.59	0.314
	30-0			3.25	0.309	2.62	0.314
	15-30			3.27	0.322	2.71	0.323
	30-30			3.50	0.333	2.74	0.327
	45-30			3.55	0.335	2.77	0.330
	LSD(0.05)			0.11	0.012	0.09	0.008

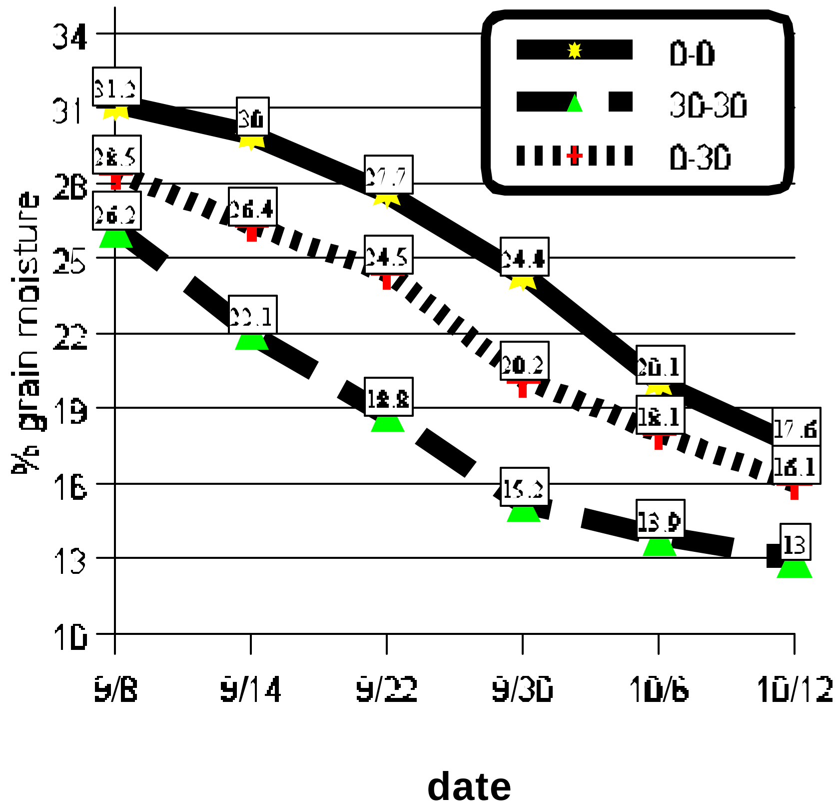


Figure 1. Effect of starter fertilizer N-P_2O_5 composition on grain moisture dry-down for 2x2 placement (values averaged over tillage system), Belleville, KS, 1999.

USE OF EARLY-SEASON SOYBEAN PRODUCTION SYSTEMS IN CROP ROTATIONS[1]

W. Barney Gordon, Scott A. Staggenborg, and Dale L. Fjell

Summary

Eighteen soybean varieties in Maturity Groups (MG) I-IV were grown in rotation with grain sorghum. Yields of late MG II soybeans were equal to yields of MG III and superior to yields of MG IV. Yields of MG I soybeans were not as good as MG III soybeans. Early MG II and late MG II soybeans matured 26 and 18 days earlier, respectively, than MG IV soybeans, thus allowing for earlier harvest and a longer fall period of soil water recharge. Total water use was 2.7 inches greater in MG IV soybeans than in MG I soybeans. Seed quality was poorer in MG I and II soybeans than in later maturing soybeans. When averaged over the 3 years of the experiment, yields were equal from late MG II to mid-MG III.

Introduction

The resent passage of new farm legislation gives farmers the flexibility to plant the most profitable crop rather than plant to maintain base acres of a farm program crop. This encourages crop rotations. Opportunities exist for expanding soybean acres in central Kansas. Grain sorghum is grown on a large number of dryland acres in central Kansas. In the past, much of this sorghum was grown either in a continuous system or in occasional rotation with wheat.

A dryland grain sorghum-soybean rotational study was established at the North-Central Kansas Experiment Field at Belleville in 1981. Results show that yield of grain sorghum when grown in annual rotation with soybeans was 25% greater than yield of continuous sorghum. Nitrogen fertilizer required to achieve maximum sorghum yield was reduced by 30 lb/a by rotation with soybeans. Soybean yield averaged over the period 1982-1997 was 36 bu/a. Soybean yields ranged from a low of 12 bu/a to a high of 61 bu/a. Producer acceptance of soybean production in the 24- to 28-inch annual rainfall area of Kansas has been somewhat slow. This may be due to large year-to-year variation in soybean yields and the perception that sorghum following soybean may yield less because of water use by soybean during the preceding year. The traditional Maturity Groups (MGs) of soybeans grown in the area (late MG III and early MG IV) can use significant amounts of water in August and early September. Earlier maturing soybeans (late MG I through early MG III) use the maximum amount of water earlier in the growing season when it is more likely to be available, thus potentially providing greater year-to-year yield stability and leaving a longer period for soil water recharge for the following crop. This research is designed to investigate the yield potential, seed quality, and water use of soybeans and to assess the effects of MG on seed yield of soybeans grown in rotation with sorghum.

Soybeans have an optimum planting date that can differ by both region and cultivar. Several studies in the Midwest have included combinations of planting dates, row widths, and cultivars. In many of these studies, planting date was the variable having the greatest impact on yield. Conflicting reports have been published concerning optimum planting dates for early maturing soybeans. Little current information is available concerning soybean planting dates in Kansas. In 1999, a study was initiated to investigate

[1]Research supported in part by the Kansas Soybean Commission

planting dates and MG effects on soybean production.

Procedures

This research was conducted at the North Central Kansas Experiment Field located near Belleville on a Crete silt loam soil. The study included 18 soybean varieties ranging in maturity from late MG I to early MG IV (Table 11) that were grown in rotation with grain sorghum. Soybeans were planted on 26 May at the rate of 10 seed/ft into grain sorghum stubble without additional tillage. MG I soybeans were harvested on 28 September, and MG II, III, and IV soybeans were harvested on 16 October. Seed samples were tested for germination by the Kansas Crop Improvement Association Seed Testing Laboratory. Gravimetric soil water measurements were made at planting and again at maturity to a depth of 36 inches.

In the second study, soybeans in four MGs were planted on four dates. Varieties used in 1999 were: Pioneer 9172 (MG I), IA 2021 (MG II), Macon (MG III), and Midland 8410 (MG IV). Each variety was planted at the rate of 10 seed/ft on 10 May, 28 May, 8 June, and 25 June. A late April planting date had been planned, but wet weather conditions prevented this early planting.

Results

Rainfall was above average in May and June but below average in July. September was very dry. Seed yields of later maturing soybeans probably were reduced by late-season drought (Table 12). In 1999, yields were greatest in late MG II and early MG III varieties. Varieties in MGs I and IV yielded least. Early and late MG II soybeans matured 26 and 18 days earlier than MG IV soybeans, respectively (Table 13). Earlier harvest allows producers to spread out the work load and plant wheat following fall soybean harvest in a timely manner. Soybeans in late MG II used 1.4 inches less water during the growing season than soybeans in MG IV. Soybeans in MG I were shorter in height than soybeans in later groups. Short stature limits potential pod sites and reduces seed yield. Seed quality is generally poorer in early maturing groups than in later groups. Seed of early-season varieties mature during a time when temperatures are still very warm, whereas seed of later maturing groups mature in September when temperatures are normally cooler. When averaged over the 3 years of the experiment, seed yields were stable from late MG II to mid MG III (Table 14).Yields were poorer in earlier or later MGs.

In the planting date study, yields were greatest for May planting dates (Table 15). Yields declined when planting was delayed until June. When averaged over MGs, yields were 12 bu/a less for the early June planting date compared to a late May date. Yields of MG II and MG III soybeans were equal.

Table 11. Soybean varieties grown in rotation with grain sorghum, North Central Kansas Experiment Field, Belleville, KS, 1999.

	Variety		
Maturity Group	Midland	Dekalb	Pioneer
Late I	X188	173	9172
Early II	X229	228	9233
Late II	8286	289	9281
Early III	8312	313	9306
Mid III	8355	351	9352
Early IV	8410	415	9421

Table 12. Yield of soybean varieties grown in rotation with grain sorghum, North Central Kansas Experiment Field, Belleville, KS, 1999.

Variety	Group	Yield, bu/a
Midland X188	Late I	33
Dekalb 173	Late I	34
Pioneer 9172	Late I	33
Midland X229	Early II	35
Dekalb 228	Early II	37
Pioneer 9233	Early II	37
Midland 8286	Late II	46
Dekalb 289	Late II	42
Pioneer 9281	Late II	42
Midland 8312	Early III	48
Dekalb 313	Early III	46
Pioneer 9306	Early III	41
Midland 8355	Mid III	44
Dekalb 351	Mid III	43
Pioneer 9352	Mid III	42
Midland 8410	Early IV	37
Dekalb 415	Early IV	38
Pioneer 9421	Early IV	35
LSD (0.05)		

Table 13. Maturity, plant height, water use, and seed germination of soybean groups, North Central Kansas Experiment Field, Belleville, KS, 1999.

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

Table 14. Seed yield (bu/a) of soybean groups, North Central Kansas Experiment Field, Belleville, KS, 1997-1999.

Maturity Group	1997	1998	1999	Average
Late I	29	40	33	34
Early II	35	44	36	38
Late II	42	43	43	43
Early III	42	44	45	44
Mid III	45	44	43	44
Early IV	31	35	37	34

Table 15. Planting date and maturity group effects on soybean yield (bu/a), Belleville, KS, 1999.

	Planting Date				
Maturity Group*	May 10	May 28	June 8	June 25	Group Avg
I	51	51	41	15	40
II	60	56	48	21	46
III	61	60	46	22	47
IV	55	53	36	11	39
Date Avg	57	55	43	17	----

*MG I=Pioneer 9172, MG II=IA 2021, MG III=Macon, MG IV=Midland 8410.

WHITE FOOD-CORN PERFORMANCE TEST

W. Barney Gordon

Summary

In 1999, 25 white corn hybrids and 3 yellow hybrid checks were evaluated. Yield of the white hybrids averaged 178 bu/a, with 13 yielding more than 180 bu/a. Lodging averaged 2.1%, and grain moisture at harvest averaged 15.3%.

Introduction

Increased marketing opportunities and profit potential have created interest among area farmers to convert acres to white food-corn production. White corn hybrids have distinctive genetic traits for specific end-use purposes. Dry millers grind food corn into a range of degermed corn products including flaking grits, corn flour, brewer grits, germ, and meal. These products are used for breakfast cereals and snack foods. The best quality dry-milling corn has large-sized kernels, low kernel-size variability, harder kernel texture, and higher protein content. Harder type dent is desired because dry millers prefer larger flaking grits vs. a kernel that is easily crumbled. Breakfast cereal manufactures pay a premium for large pieces of unbroken corn endosperm that can produce larger corn flakes. Wet millers separate corn into basic components (starch, protein, fiber, and germ),with the principal component being starch. The general qualities for wet milling corn include low moisture, no mold or mycotoxins, minimum broken kernels, and low incidence of stress cracks. *Masa* millers cook the food corn with lime in order to soften the kernel and remove the pericarp. This process is known as *nixtaamalization* and the resulting corn is known as *nixtamal*. The *nixtamal* is ground with stones into *masa* which then is made into tortillas, tortilla chips, or other Mexican snack foods.

This test is one of 13 locations included in a regional white corn performance test conducted by Dr. L.L. Darrah with the USDA-ARS at the University of Missouri-Columbia. The 1999 test included 25 white corn hybrids and 3 yellow hybrid checks.

Procedures

Anhydrous ammonia was applied on 20 March at the rate of 200 lb/a. The test was planted on 8 May at the rate of 30,000 seed/a. Starter fertilizer (30 lb N + 30 lb $P2O5$/a) was applied 2 inches to the side and two inches below the seed at planting. Furrow-irrigations were applied on 7 July, 19 July, and 1 August. Three inches of water were applied at each irrigation. The test was harvested on 12 October using a modified E gleaner combine.

Results

Yields ranged from 146 to 228 bu/a and overall grain yield in this test was 180 bu/a (Table 16). Yield of white corn hybrids (25 hybrids) averaged 178 bu/a. The average of the 3 yellow corn hybrids included in the test (Pioneer 3245, pioneer 3394, and B73xMo17) was 182 bu/a. Thirteen of the white corn hybrids (Asgrow RX901W, Garst 8277W, IFSI 90-1, IFSI 97-1, Pioneer 32H39, Pioneer 32K72, Pioneer 32Y52, Pioneer X1138W, Vineyard V433W, Vineyard VX4548W, Whisnard 50AW, Zimmerman 1851W, and Zimmerman N71-T7) yielded more than 180 bu/a. Five of these hybrids (Pioneer 32H39, Pioneer 32K72, Pioneer x1138AW, Zimmerman N71-T7, and Zimmerman 1851W) yielded more than 200 bu/a. Stalk lodging was minimal and ranged from 0 to 5%, with the average being 2%. Grain quality information for all entries (averages of five test locations) is given in Table 17.

Table 16. Grain yield and agronomic data from 1999 Late White Food-Corn Performance Test at Scandia, KS.

Entry	Yield 1999	Yield 1998	Yield 1999 Average*	Stalk Lodging	Ear Height	Days to Mid-Silk	Moist.
	bu/a			%	inches		%
Asgrow RX901W	183.4	195.4	137.4	0.9	43.3	75.0	14.8
Asgrow RX921W	164.1		136.9	1.7	43.7	75.0	15.3
Dekalb DK665W	166.9		131.3	2.6	40.3	71.0	14.7
Diener DB 114W	173.9		136.9	3.4	43.3	71.0	15.3
Garst 8277W	181.5		136.6	3.0	45.3	72.0	15.4
IFSI 90-1	187.0	138.0	138.2	0.9	42.7	74.3	14.5
IFSI 95-1	162.4	170.0	124.6	3.0	45.0	74.0	18.5
IFSI-97-1	181.4		142.5	2.6	44.3	71.7	17.3
LG Seeds NB749W	145.5		130.4	2.2	44.7	75.0	15.2
Pioneer 32H39	206.9	187.3	140.5	3.4	43.0	71.0	14.7
Pioneer 32K72	203.5		148.2	3.9	41.0	72.0	14.9
Pioneer 32Y52	191.7		141.3	3.0	43.3	73.0	15.6
Pioneer X1138AW	228.0		159.4	0.9	44.7	72.3	14.4
Trisler T-4214W	161.5		136.8	1.7	42.0	73.7	15.0
Vineyard V433W	189.9	160.8	146.4	2.5	43.3	73.3	15.6
Vineyard VX4548W	183.7		131.6	0.9	43.0	72.0	15.2
Vineyard VX4618W	162.1		130.4	0.0	40.0	72.3	15.9
Whisnard 50AW	182.5	171.7	138.5	1.8	44.3	72.0	15.0
Whisnard 51AW	165.1	177.0	139.5	2,1	45.0	73.0	15.1
Zimmerman 1780W	162.8		137.3	5.1	42.0	71.0	15.6
Zimmerman 1851W	202.6		150.3	0.0	45.0	75.7	16.7
Zimmerman N71-T7	213.8	184.3	143.4	0.9	41.7	72.3	14.9
Zimmerman NX 7208	171.7		136.1	0.9	44.0	71.7	14.6
Zimmerman Z62W	166.1	153.9	133.6	2.3	41.7	75.3	14.2
Zimmerman Z75W	166.7	155.4	123.2	1.3	40.7	72.0	14.9
B73 x Mo17 (yellow)	183.9	165.1	129.8	1.7	42.7	72.3	15.3
Pioneer 3245 (yellow)	190.6	191.2	153.1	2.7	41.0	73.0	14.4
Pioneer 3394 (yellow)	172.1	172.5	140.1	0.4	43.7	70.0	13.5
Mean	180.0	170.6	136.9	2.1	43.1	72.7	15.3
LSD(0.05)	11.6	8.8	11.8	NS	2.4	0.6	1.0
CV%	4.0	3.2	10.8		3.5	0.5	3.9

* Average of Champaign, IL; Winchester, IL; Powhattan, KS; Scandia, KS; Franklin, KY; Lexington, KY; Columbia, MO; Knoxville, TN; Union City, TN; and College Station, TX

Table 17. Combined grain quality data from the 1999 Late White Food-Corn Performance Test, Scandia, KS.

Entry	Test Weight	100-Kernel Weight	Kernel Size	Thins*	Kernel Density	Horny Endosperm
	lb/bu	grams	cc	%	g/cc	%
Asgrow RX901W	63.1	28.7	0.21	61.5	1.34	90
Asgrow RX921W	63.6	29.7	0.22	53.3	1.34	94
Dekalb DK665W	63.7	35.7	0.27	28.5	1.34	90
Diener DB 114W	61.2	27.8	0.21	38.1	1.32	85
Garst 8277W	64.1	30.5	0.23	41.5	1.36	91
IFSI 90-1	63.4	31.4	0.23	36.8	1.35	89
IFSI 95-1	64.8	30.4	0.23	39.4	1.36	93
IFSI 97-1	64.2	30.3	0.22	49.6	1.35	88
LG Seeds NB749W	62.8	31.4	0.24	42.2	1.34	84
Pioneer 32H39	62.0	28.3	0.21	60.8	1.34	88
Pioneer 32K72	62.5	31.3	0.24	50.4	1.34	91
Pioneer 32Y52	62.4	31.6	0.25	27.3	1.34	88
Pioneer X1138AW	61.6	31.9	0.24	34.5	1.33	90
Trisler T-4214W	63.2	31.6	0.24	37.9	1.34	88
Vineyard V433W	62.0	30.6	0.24	74.7	1.31	88
Vineyard VX4548W	62.8	29.7	0.23	69.7	1.33	89
Vineyard VX4618W	61.6	31.7	0.24	40.1	1.31	86
Whisnard 50AW	62.5	30.7	0.23	43.7	1.33	84
Whisnard 51AW	63.3	31.7	0.24	38.5	1.34	85
Zimmerman 1780W	60.2	28.7	0.22	33.0	1.31	81
Zimmerman 1851W	61.6	35.5	0.27	12.6	1.34	85
Zimmerman N71-T7	61.4	27.5	0.21	60.2	1.32	80
Zimmerman NX 7208	61.4	26.6	0.20	61.5	1.32	84
Zimmerman Z62W	60.3	29.9	0.23	28.8	1.33	88
Zimmerman Z75W	61.4	34.0	0.26	22.9	1.34	91
B73 x Mo17 (yellow)	59.1	28.1	0.22	47.0	1.29	78
Pioneer 3245 (yellow)	62.9	34.7	0.26	28.5	1.35	91
Pioneer 3394 (yellow)	61.7	33.1	0.25	30.8	1.33	88
Mean	62.2	30.9	0.23	41.3	1.33	87
LSD (0.05)	1.2	3.0	0.02	12.3	0.01	5
CV%	1.4	6.8	6.8	21.2	0.7	3.7

*Percent of a 250-kernel sample passing through a 20/64 inch round-hole sieve.

SWEET CORN PRODUCTION IN NORTH CENTRAL KANSAS

W. Barney Gordon

Summary

Sweet corn is being evaluated for use as an alternative crop in north-central Kansas. A group of local producers is in the process of forming a cooperative and building a sweet corn canning facility. The sweet corn canning industry is concentrated in the upper Midwest, so most hybrids are adapted to Wisconsin and Minnesota. This research was initiated to provide information on hybrid performance and to examine the effects of planting date on sweet corn yield. In 1999, 16 sweet corn hybrids were planted at two dates (14 May and 15 June). Yields at the first planting date averaged 7.46 tons/a. Yields averaged only 5.82 tons/a for the June planting date. Harvest moisture content averaged 72.1 and 70.5% for the first and second planting dates, respectively. Cut corn % (cut corn kernels/total husked ear weight) averaged 52% and did not vary for hybrid or planting date.

Introduction

Modern sweet corn hybrids tend to be of either two types: fresh market or processing. General differences between the two are summarized in Table 18. Standard sweet corn is a mutant type that differs from field corn by a mutation at the sugary (*su*) locus. The sweet corn mutation causes the endosperm of the seed to accumulate about two times more sugar than field corn. Recently, a number of new mutants have been used to improve sweet corn quality, particularly the sugary enhanced (*se*) and shrunken-2 (sh_2) genes. The *se* varieties contain more sugars than that of normal and will remain sweet 2-4 days after harvest if refrigerated. The sugars in *se* endosperm hybrids convert to starch at the same rate as those in *su* hybrids. Two levels of *se* sweet corn hybrids are available, heterozygous and homozygous. Heterozygous *se* varieties are recommended for processing, because they offer sugar levels up to 30% higher than those of normal *se* types. The shrunken (sh_2) sweet corn, also called supersweet, has two major advantages over the other types: 1) it is at least 2-3 times sweeter, and 2) the conversion of sugar to starch is negligible; thus, this corn type will remain sweet up to 10 days after harvest, if properly cooled. The sh_2 sweet corns should be isolated from all other corn types, because they will have starchy endosperm if cross pollinated. In general, seeds of sh_2 varieties are less vigorous than those of other sweet corn types because lower starch reserves are available for germination. Improvement in sh_2 stand establishment has been a key objective for sweet corn breeders. Steady progress has been made in introducing sh_2 hybrids with improved genetic potential for stand establishment and seedling performance.

Procedures

Anhydrous ammonia was applied on 20 March at the rate of 160 lb/a. The first planting was made on 14 May, and the second was made on 15 June. Seeding rate at both planting dates was 24,000 seed/a. Starter fertilizer (30 lb N and 30 lb P_2O_5) was applied 2 inches to the side and 2 inches below the seed at planting. Furrow irrigations were applied on 7 July and 19 July to both plantings. An additional irrigation was applied to the second planting on 1 August. Three inches of irrigation water were applied at each irrigation. The first planting was harvested on 4 August, and the second on 26 August. Plots were harvested by hand. Subsamples from each plot were husked and weighed, and then kernels were removed from the cob to determine cut corn percentage. The sample then was weighed and dried in a microwave

oven and weighed again to determine moisture.

Results

Harvest populations averaged 22,766 and 22,080 plants/a for the first and second planting dates, respectively (Table 19). Rodgers GSS-9377, a sh_2 endosperm hybrid, had the poorest stands at both planting dates. Populations were greatest for Asgrow Endevor, Asgrow El Toro, Asgrow Sequal, Asgrow Ex8414667, Rodgers GH-2547, and Rodgers 2783. When averaged over hybrids, yields were 7.46 tons for the first planting date and 5.82 for the second date (Table 20). Asgrow El Toro had the greatest yield at both planting dates. Rodgers Jubilee did well at the early planting date but was below average at the later date. Average moisture contents were 72 and 70 % for the first and second planting dates, respectively. Cut corn percentage (cut kernels/total ear weight) averaged 53% and was not affected by planting date or hybrid.

Table 18. Relative importance of traits of sweet corn hybrids in the fresh market and processing trades.

		Processing	
Trait	Fresh Market	Whole-Kernel	Cream-Style
Yield			
Green Weight	1	3	3
Weight of cut corn	1	3	3
Usable ears/a	3	2	2
Ear Characteristics			
Husk cover	3	2	2
Ear length	2	2	2
Tip fill	3	2	2
Ease of husk removal	1	3	3
Color of Cob	3	3	3
Kernel Characteristics			
Size	2	3	1
Depth	1	3	2
Tenderness	2	3	2
Flavor	3	3	2
Black layer	1	3	2

*Rated **1**, relatively unimportant to **3**, very important.
Adapted from Kaukis, K and D.W. Davis. Sweet Corn Breeding.

Table 19. Harvest populations of sweet corn hybrids at two planting dates, north central Kansas, 1999.

Hybrid	Population 1st Date	Population 2nd Date
	no. plants	
Asgrow Sheba	22740	21654
Asgrow Endevor	23523	22796
Asgrow Esquire	22739	21892
Asgrow El Toro	23523	22890
Asgrow Shaker	22130	21869
Asgrow Sequal	24527	23980
Asgrow Ex 3098	22042	21869
Asgrow Ex 8414667	23698	22988
Asgrow Chase	22042	21764
Rodgers GH-0937	22565	21862
Rodgers Jubilee	22304	21906
Rodgers GH-2547	23959	23012
Rodgers GSS-9299	21084	20861
Rodgers Bonus	22652	21571
Rodgers GSS-9377	19167	18612
Rodgers 2783	24569	23760
Average	22766	22080
LSD (0.05)	2234	
CV%	6.2	

Table 20. Sweet corn yield as affected by planting date, north central Kansas, 1999.

Hybrid	Maturity*	Endosperm Type	1st Date**	2nd Date**
	GDU		tons/a	
Asgrow Sheba	1550	sh_2	6.00	4.92
Asgrow Endeaver	1670	sh_2	6.52	3.56
Asgrow Esquire	1785	*se*	7.56	7.00
Asgrow El Toro	1710	*se*	9.55	8.56
Asgrow Shaker	1720	sh_2	7.14	5.41
Asgrow Sequal	1710	*su/se*	7.80	6.71
Asgrow Ex3089	1750	*se*	6.63	3.56
Asgrow Ex8414667	1780	*se*	6.89	5.12
Asgrow Chase	1590	*su/se*	7.99	5.62
Rodgers GH-0937	1750	*su*	6.91	7.55
Rodgers Jubilee	1697	*su*	9.30	4.56
Rodgers GH-2547	1793	*su*	6.17	5.11
Rodgers GSS- 9299	1640	sh_2	8.13	6.72
Rodgers Bonus	1750	*su*	8.67	6.62
Rodgers GSS-9377	1750	sh_2	6.29	5.58
Rodgers 2783	1760	*su*	7.83	6.53
Date Average			7.46	5.82
LSD(0.05)	0.65			
CV%	10			

*GDU=growing degree unit
** 1st date average moisture content=72%
**2nd date average moisture content=70.5%

KANSAS RIVER VALLEY EXPERIMENT FIELD

Introduction

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

Soil Description

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

1999 Weather Information

The frost-free season was 26 days longer than the 173-day average at the Paramore Unit and 4 days shorter at the Rossville Unit. The last 32° F frosts in the spring were on April 18 at the Rossville Unit and on March 29 at the Paramore Unit (average, April 21), and the first frosts in the fall were on October 4 at the Rossville Unit and on October 17 at the Paramore Unit (average, October 11). Precipitation was above normal in the fall of 1998 and in April, May, June, and September of 1999 and below normal from January through March and in July and August (Table 1). Precipitation totals for October, 1998 through September, 1999 were 0.91 and 10.90 inches above normal for the Paramore and Rossville Units, respectively. Corn and soybean yields were about normal.

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

Month	Rossville Unit		Paramore Unit	
	1998-1999	30-Yr. Avg.	1998-1999	30-Yr. Avg.
	Inches		Inches	
Oct.	5.48	0.95	4.01	0.95
Nov.	6.06	0.89	3.86	1.04
Dec.	1.02	2.42	1.22	2.46
Jan.	1.06	3.18	1.17	3.08
Feb.	1.03	4.88	0.94	4.45
Mar.	1.48	5.46	1.26	5.54
Apr.	9.37	3.67	8.70	3.59
May	7.07	3.44	5.38	3.89
June	5.96	4.64	3.23	3.81
July	1.48	2.97	1.58	3.06
Aug.	1.88	1.90	1.23	1.93
Sep.	4.65	1.24	3.56	1.43
Total	46.54	35.64	36.14	35.23

EFFECTS OF REDUCED TILLAGE ON CORN-SOYBEAN CROPPING SEQUENCES

Larry D. Maddux

Summary

Three tillage systems (conventional, reduced, and no-till) have been evaluated in a corn/soybean rotation and continuous monocultures of each crop from 1984 through 1999. Over the 15-year period, yields averaged 6 bu/a/yr greater for corn following soybeans than for continuous corn, and soybeans following corn averaged 6.2 bu/a/yr greater yields than continuous soybeans. Corn had no significant response to cropping sequence in the first 5-year period, whereas soybeans did show a response. When differences in tillage were observed, no-till yielded less than conventional or reduced tillage in the monocultures, but not in the rotation.

Introduction

Research has shown that both corn and soybeans benefit from a corn-soybean cropping sequence. The objective of this study was to evaluate the long-term effects of conventional tillage, reduced tillage, and no-till on a corn-soybean cropping sequence and continuous corn and soybeans.

Procedures

The study was initiated in 1983 when the cropping sequences were started on a conventionally tilled field. The tillage treatments were started that fall. Tillage treatments consisted of: (1) conventional till (fall tillage with an offset disk and chisel plus spring tillage with a disk or field cultivator); (2) reduced till (1983 - 1991: fall tillage with an offset disk and spring tillage with a disk or field cultivator after corn in the cropping sequence or every other year with continuous corn or soybeans; 1992-1999 - disk once in the spring every year); (3) no-till (plant on the ridge). All plots were cultivated and furrowed for irrigation.

Anhydrous ammonia at 175 lbs N/a was applied preplant on 30-inch centers (between plant rows) on corn plots. Starter fertilizer was banded at planting: 1983-1991 - 130 lb/a of 8-32-16 and 1992-1999 - 110 lb/a (10 gpa) of 10-34-0. Chemical weed control was used, with the herbicides being varied from year to year in an attempt to get the best weed control possible.

Corn was planted in 30-inch rows in mid-April at 26,200 seeds/a from 1983-1997 and at 30,000 seeds/a in 1998 and 1999. Various adapted hybrids have been used. Various soybean varieties were planted in 30-inch rows in mid-May at 174,000 seeds/a from 1983-1992 and at 140,000 seeds/a from 1993-1999. A hail storm on October 2, 1991 resulted in the loss of soybean yields for that year, and a severe wind storm on July 1, 1994 resulted in stalk breakage and loss of corn yield for that year. Each year, a plot combine was used to harvest corn in early to mid-September and soybeans in early to mid-October.

Results

Corn Yield

No significant differences in corn yield was observed during the first 5 years (Table 2). During the second 5 years, the corn/soybean rotation yielded an average of 9 bu/a per year more than the continuous corn. This difference was still present during the last 5 years (8 bu/a/yr). During the second 5 years, the no-till continuous corn yielded 14 bu/a/yr less than the conventional-till corn and

12 bu/a/yr less than the reduced-till corn. During the last 5 years of the test, no-till plots yielded an average of 9 bu/a/yr less than the conventional tilled plots. Both the conventional and corn/soybean rotations showed this effect, although the corn/soybean rotation tended to have less loss than continuous corn.

Table 2. Long term effects of cropping sequence and tillage on corn yields, Kansas River Valley Experiment Field, 1984-1999.

Crop		Yield, 5-Year Averages			Yield
Sequence	Tillage[1]	1984-88	1989-93	1995-99	15-yr Avg.
Continuous	Conventional	172	168	179	173
	Reduced	175	166	164	168
	No-Till	167	154	167	163
Corn-Soybean	Conventional	170	173	184	176
	Reduced	169	171	173	172
	No-Till	170	174	176	173
LSD(0.05) (Interaction)		NS	9	NS	NS
Cropping Sequence Means:					
Continuous		171	163	170	168
Corn-Soybean		170	172	178	174
LSD(0.05)		NS	5	7	5
Tillage Means:					
	Conventional	171	171	181	174
	Reduced	172	168	169	170
	No-Till	168	164	172	168
LSD(0.05)		NS	NS[2]	9	NS[2]

[1]Conventional: Fall disk and chisel, spring disk or field cultivate

Reduced: 1984 - 1991 - Disk fall & spring every other year or after corn in sequence
1992 - 1992 - Disk in spring every year

No-Till: Plant on top of old row

[2]Significant at the 10% level

Soybean Yield

A significant yield increase for soybeans following corn over that of continuous soybeans was observed for all three 5-year periods (Table 3). The yield advantages for the rotation were: 9.1 bu/a/yr in the first 5 years; 3.3 bu/a/yr in the second 5 years, and 6.6 bu/a/yr in the last 5 years for a 15-year average increase of 6.2 bu/a/yr. As with the corn, yields of the continuous soybeans with no-till were lower than yields with conventional or reduced till. No differences in tillage were observed with soybeans following corn.

Table 3. Long-term effects of cropping sequence and tillage on soybean yields, Kansas River Valley Experiment Field, 1984-1999.

Crop		Yield, 5-Year Averages			Yield
Sequence	Tillage[1]	1984-88	1989-93	1995-99	15-yr Avg.
Continuous	Conventional	51.5	65.1	54.3	57.3
	Reduced	51.4	65.7	58.3	58.4
	No-Till	38.6	66.4	56.6	63.4
Corn-Soybean	Conventional	56.8	68.9	61.9	62.6
	Reduced	56.1	69.9	64.1	54.0
	No-Till	56.1	68.1	63.0	62.4
LSD(0.05) (Interaction)		6.0	NS	NS	NS
Cropping Sequence Means:					
Continuous		47.2	65.7	56.4	56.6
Corn-Soybean		56.3	69.0	63.0	62.8
LSD(0.05)		3.5	1.9	2.2	1.6
Tillage Means:					
	Conventional	54.1	67.0	58.1	59.9
	Reduced	53.7	67.8	61.2	60.9
	No-Till	47.3	67.3	59.8	58.2
LSD(0.05)		4.2	NS	NS[2]	2.0

[1]Conventional: Fall disk and chisel, spring disk or field cultivate

Reduced: 1984 - 1991 - Disk fall & spring every other year or after corn in sequence
1992 - 1992 - Disk in spring every year

No-Till: Plant on top of old row

[2]Significant at the 10% level

CORN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux

Summary

Thirty-two herbicides and herbicide combinations were evaluated in this test in 1999, and the results of 18 treatments are reported. Significant corn injury was observed with only two treatments. Palmer amaranth control was 95% or greater with all treatments. All but two treatments gave 80% or greater control of large crabgrass, 85% or greater control of ivyleaf morningglory, and 95% or greater control of common sunflower.

Introduction

Weed competition can limit crop yields. Chemical weed control and cultivation have been used to control weeds in row crops. This test included 32 preemergence and postemergence herbicides, and the results of 18 of these treatments are discussed. The major 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 Sarpy fine sandy loam soil previously cropped to soybeans with a pH of 6.8 and an organic matter content of 1.1%. Pioneer Brand 3335 corn hybrid was planted at 26,200 seeds/a in 30-inch rows on May 8. Anhydrous ammonia at 150 lbs N/a was applied preplant, and 10-34-0 fertilizer was banded at planting at 120 lbs/a. Herbicides were applied preemergent (PRE) on May 9 and postemergent (POST) on June 8. Plots were not cultivated. The crop injury and weed control ratings reported here were made on June 25, 17 days after POST treatment (DAT). The first significant rainfall after PRE herbicide application was on May 11 (0.37 inches). Rainfall was above normal in May and June. Plots were harvested on September 30 using a modified John Deere 3300 plot combine.

Results

Significant corn injury was observed with only the Aim + Clarity and Aim + atrazine treatments (Table 4). Large crabgrass control was less than 80% with only two treatments, Epic + atrazine PRE and Basis Gold + Distinct POST. All treatments gave 95% or greater control of Palmer amaranth. Common sunflower control was less than 98% with only two treatments, Dual II Magnum PRE + Aim + Atrazine POST (72%) and Bicep II Magnum PRE (85%). Ivyleaf morningglory control was 85% or greater with most treatments except Bicep II Magnum PRE (53%) and Epic + Atrazine PRE (60%). Corn yields were good but variable, mainly because the loss of N on some plots in the sandier areas of the study resulted in lower yields on those plots.

Table 4. Effects of herbicides on corn injury, weed control, and grain yield, Kansas River Valley Experiment Field, Rossville, KS, 1999.

Treatment	Rate	Appl Time	Corn Inj. 17 DAT[1]	Weed Control, 17 DAT[2] Lgcg	Paam	Cosf	Ilmg	Grain Yield
	prod./a		%		%			bu/a
Untreated check	---		0	0	0	0	0	39
Fultime	3.75 qt	PRE	0	88	100	100	92	177
Bicep II Magnum	2.1 qt	PRE	0	80	100	85	53	185
Axiom	12.0 oz	PRE	0	80	100	100	100	140
+ Distinct	6.0 oz	POST						
Axiom	12.0 oz	PRE	0	83	97	98	92	122
+ Atrazine	1.67 lb	PRE						
Epic	9.0 oz	PRE	0	73	95	100	60	152
+ Atrazine	1.11 lb	PRE						
Epic	9.0 oz	PRE	2	97	100	100	97	179
+ Distinct	6.0 oz	POST						
Balance	1.0 oz	PRE	0	90	100	100	92	203
+ Basis Gold[3]	14.0 oz	POST						
Basis Gold	14.0 oz	POST	0	77	100	100	88	200
+ Distinct[3]	4.0 oz	POST						
Bicep II Magnum	2.1 qt/a	PRE	0	65	100	100	100	204
+ NorthStar[4]	5.0 oz	POST						
Bicep II Magnum	2.1 qt/a	PRE	0	97	100	100	97	209
+ Beacon[5]	0.76 oz	POST						
Bicep II Magnum	2.1 qt/a	PRE	0	95	100	100	97	183
+ Spirit[5]	1.0 oz	POST						
Bicep II Magnum	2.1 qt/a	PRE	0	98	100	100	85	227
+ Exceed[5]	1.0 oz	POST						
Dual II Magnum	1.33 pt/a	PRE	3	92	100	72	93	196
+ Aim	0.33 oz	POST						
+ Atrazine[6]	0.83 lb	POST						
Dual II Magnum	1.33 pt/a	PRE	7	95	100	98	95	212
+ Aim	0.33 oz	POST						
+ Clarity[6]	0.50 pt	POST						
Dual II Magnum	1.33 pt/a	PRE	0	97	100	100	95	195
+ Hornet	1.6 oz	POST						
+ Atrazine[5]	1.0 lb	POST						
Hornet	2.4 oz	POST	0	85	100	100	98	182
+ Basis Gold[5]	14.0 oz	POST						
Harness	1.8 pt	PRE	0	95	100	100	95	211
+ Shotgun	2.5 pt	POST						
LSD(.05)			3	24	4	7	24	74

[1] Crop injury rated - 6/25/99; DAT = days after postemergence treatment application.
[2] Lgcg = large crabgrass; Paam = Palmer amaranth; Cosf = common sunflower; Ilmg= ivyleaf morningglory (Rated 6/25/99).
[3] Plus crop oil concentrate (COC) 1.0% + urea ammonium nitrate (UAN) 2.0 qt/a POST.
[4] Plus COC 1.0 qt/a POST.
[5] Plus nonionic surfactant (NIS), 0.25% + UAN 2.5% POST.
[6] Plus NIS 0.25% POST.

SOYBEAN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux

Summary

Results of 11 and 12 treatments in a conventional test and a glyphosate test, respectively, are reported. Significant soybean injury was observed with several treatments. The preemergence treatments, and especially the preplant incorporated treatments, resulted in poorer than normal weed control because of greater than usual rainfall after application. Weed control with most postemergence applications was good. Roundup gave poor control of ivyleaf morningglory.

Introduction

Chemical weed control and cultivation have been used commonly to control weeds in row crops. Weeds can seriously depress soybean yields. Two weed control tests are reported: (1) conventional soybeans and (2) glyphosate soybeans. The conventional test included preplant incorporated (PPI), preemergence (PRE), and postemergence (POST) herbicides, and the glyphosate test included various PRE and POST herbicides with or without glyphosate. The major weeds evaluated in these tests were large crabgrass (Lacg), Palmer amaranth (Paam), and common sunflower (Cosf).

Procedures

Both tests were conducted on a Sarpy fine sandy loam soil with pHs of 6.9 and 6.8 and organic matter contents of 1.1% and 1.5% for the conventional and glyphosate tests, respectively, on land previously cropped to corn. Pioneer Brand 93B54 and 94B01 soybeans were used in the conventional and glyphosate tests, respectively. Both tests were planted on May 25 at 144,000 seeds/a in 30-inch rows. Fertilizer (10-34-0) was banded at 120 lbs/a at planting. The herbicides were applied as follows: PPI on May 25, PRE on May 26; POST on June 29. The first significant rainfall after the PPI and PRE treatments was on May 30 (0.92 inch). The plots were not cultivated. Ratings for crop injury were made on July 6 and 13, 7 and 14 days after POST treatment (DAT), respectively. Ratings reported for weed control were made on July 27, 28 DAT. Harvest was on October 14 using a modified John Deere 3300 plot combine, although some plots were not harvested because of high infestations of Paam and Cosf.

Results

Conventional Test

Significant soybean injury was observed with seven POST treatments (Table 5). Lacg, Paam, and Cosf were controlled less with the PPI treatment than with the PRE treatments because of excess rainfall after application. Lacg and Paam were controlled only 27 and 23%, respectively with the Treflan + FirstRate PPI treatment. Control of Lacg was generally low with only three treatments giving 80% or greater control. Six treatments gave 80% or greater control of Paam. Control of Cosf was also poor with the PPI treatment, but was excellent with all other treatments (82 - 100%). Yields were related to weed control with a range for the treated plots of 22.4 - 50.2 bu/a. The untreated check yielded only 8.6 bu/a.

Glyphosate Test

Only two treatments in this test showed significant injury (Table 6). With the exception of one treatment, Prowl PRE + Pursuit + Flexstar POST, Lacg and Paam were controlled fairly well. Control of Lacg by the other treatments ranged from 85 - 97%. Control of Paam was not quite as good, 78 -

98%. Cosf control was excellent, 98 - 100%. Control of Ilmg was excellent by all but three treatments. Two applications of Roundup Ultra only gave 67% control of Ilmg. Grain yield for the Prowl + Pursuit + Flexstar treatment was only 26.2 bu/a, whereas the other treatments produced yields of 45.9 - 52.3 bu/a. The untreated check was unharvestable because of the weeds.

Table 5. Effects of herbicides on conventional soybean injury, weed control, and grain yield, Kansas River Valley Experiment Field, Rossville, KS, 1999.

Treatment	Rate	Appl Time	Soybean Injury[1] 7 DAT	Soybean Injury[1] 14 DAT	Weed Control, 28 DAT[2] Lgcg	Weed Control, 28 DAT[2] Paam	Weed Control, 28 DAT[2] Cosf	Grain Yield
	prod./a		%		%			bu/a
Untreated check	---	---	0.0	0.0	0	0	0	8.6
Treflan	2.0 pt	PPI	0.0	0.0	27	23	65	22.4
+ FirstRate	0.6 oz	PPI						
Prowl	3.0 pt	PRE	0.0	0.0	83	50	100	26.3
+ FirstRate	0.6 oz	PRE						
Prowl	3.0 pt	PRE	0.0	0.0	57	75	100	25.3
+ Python	1.3 oz	PRE						
Prowl	3.0 pt	PRE	0.0	0.0	57	68	100	33.2
+ Python	1.3 oz	PRE						
+ FirstRate[3]	0.3 oz	POST						
FirstRate	0.3 oz	POST	11.7	6.7	63	73	100	39.7
+ Flexstar	1.0 pt	POST						
+ Select[3]	6.0 oz	POST						
Flexstar	1.0 pt	POST	16.7	10.0	80	80	100	35.8
+ Fusion[4]	10.0 oz	POST						
Reflex	1.0 pt	POST	15.0	10.0	78	83	82	22.7
+ Fusion[4]	10.0 oz	POST						
Valor	3.0 oz	PRE	5.0	1.7	98	97	100	50.2
+ Select	8.0 oz	POST						
+ FirstRate[5]	0.3 oz	POST						
Python	1.0 oz	PRE	18.3	10.0	82	88	100	49.5
+ Select	8.0 oz	POST						
+ Cobra	8.0 oz	POST						
+ FirstRate[5]	0.3 oz	POST						
Turbo	1.5 pt	PRE	21.7	13.3	92	95	100	41.9
+ Select	8.0 oz	POST						
+ Cobra	8.0 oz	POST						
+ FirstRate[5]	0.3 oz	POST						
Authority	4.5 oz	PRE	11.7	6.7	78	98	100	42.1
+ Synchrony STS	0.5 oz	POST						
+ Assure II[6]	8.0 oz	POST						
LSD(0.05%)			2.8	2.4	27	27	45	16.6

[1] DAT = days after treatment application - Preemergence/Postemergence. Injury rated on 7/6/99 & 7/13/99.
[2] Lgcg = large crabgrass; Paam = Palmer amaranth; Cosf = common sunflower - Rated on 7/27/99.
[3] Plus urea ammonium nitrate (UAN) 2.5% + non-ionic surfactant 0.125%.
[4] Plus methylated sunflower oil (MSO) 1.0%.
[5] Plus crop oil concentrate (COC) 2.0 pt/a + ammonium sulfate (AMS) 4.0 lb/a.
[6] COC 1.0%, AMS 2.55 lb/a

Table 6. Effects of postemergent herbicides on glyphosphate soybean injury, weed control, and grain yield, Rossville, KS. 1999.

Treatment	Rate	Appl Time	Soybean Injury[1]		Weed Control, 28 DAT[1]				Grain Yield
			7DAT	14DAT	Lgcg	Paam	Cosf	Ilmg	
	prod./a		%		%				bu/a
Untreated Check	—	—	0.0	0.0	0	0	0	0	0.0
Authority + Roundup Ultra[3]	3.0 oz 1.5 pt	PRE POST	5.0	5.0	90	90	100	100	49.1
Authority + Roundup Ultra + Classic[4]	3.0 oz 1.5 pt 0.33 oz	PRE POST POST	5.0	5.0	87	90	98	100	50.5
Canopy XL + Roundup Ultra[3]	3.5 oz 1.5 pt	PRE POST	0.0	0.0	85	87	100	100	46.9
Steel + Roundup Ultra[3]	3.0 pt 1.5 pt	PRE POST	0.0	0.0	87	78	100	100	46.0
Squadron + Roundup Ultra[3]	3.0 pt 1.5 pt	PRE POST	0.0	0.0	80	78	100	100	51.5
Pursuit Plus + Roundup Ultra[3]	2.5 pt 1.5 pt	PRE POST	0.0	0.0	87	78	100	100	45.9
Prowl + Pursuit + Flexstar[5]	2.5 pt 1.44 oz 10.0 oz	PRE POST POST	3.3	1.7	47	57	58	50	26.2
Prowl + Raptor + Roundup Ultra[3]	2.5 pt 4.0 oz 1.5 pt	PRE POST POST	3.3	1.7	92	98	100	67	52.3
Command + Roundup Ultra[3]	2.0 pt 1.5 pt	PRE POST	0.0	0.0	97	97	100	91	51.7
Command + Roundup Ultra[3]	1.33 pt 1.5 pt	PRE POST	0.0	0.0	92	93	100	89	49.3
Roundup Ultra[3] + Roundup Ultra[3]	1.5 pt 1.5 pt	POST POST	0.0	0.0	92	92	100	67	50.9
Touchdown[4] + Touchdown[4]	1.5 pt 1.5 pt	POST POST	0.0	0.0	92	90	100	90	51.8
LSD(.05)			3.8	1.7	22	19		10	11.5

[1] Injury ratings - 7/6/99 & 7/13/99; DAT = days after postemergence treatment application.
[2] Lgcg = large crabgrass; Paam = Palmer amaranth; Cosf = common sunflower; Rated - 7/27/99.
Ilmg = ivyleaf morningglory; Rated at harvest - 10/14/99.
[3] Plus ammonium sulfate (AMS), 2.55 lb/a.
[4] Plus nonionic surfactant (NIS) 0.25% + AMS 2.55 lb/a.
[5] Plus NIS 0.25% + urea ammonium nitrate (UAN) 1.0 qt/a.

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 help define adapted varieties/hybrids of wheat, soybeans, alfalfa, grain sorghum, and corn. As irrigated production of corn, soybean, wheat, and alfalfa grew in importance, research determined proper management strategies for irrigation, fertilizer, pest control, and related cultural practices. Current research focuses on variety/hybrid evaluation, the evaluation; of new pesticides for the area; the practicality of dryland crop rotations vs. continuous wheat; corn nitrogen fertilizer requirements; reexamining accepted cultural practices for corn and grain sorghum; and the long-term effects of cropping systems on yield, soil conditions, and residue cover. A long-term study was initiated in 1996 to determine cultural practices to maximize the efficiency of irrigation inputs from both engineering and agronomic standpoints. In 1999, a project was initiated to examine cotton production variables and potential in the area. Also in 1999, work was begun to examine the long-range feasibility of dryland soybean production. Winter forage studies for cattle were planted using wheat, rye, triticale, and blends of these small grains. No only is total dry matter production being determined, but an area is devoted to evaluating weight gain for cattle under wheat, rye, triticale, and a rye/triticale blend.

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.

1999 Weather Information

The weather pattern of 1999 differed from those of 1997 and 1998, resulting in above average precipitation in April and June, more normal rainfall in May and July, and almost none in August (Table 1 and Figure 1). After good precipitation in September, the last quarter of the year was extremely dry with less than 0.5 inch of moisture. In contrast to the abundant precipitation in much of SC Kansas, precipitation for 1999 was slightly below the long-term average for the field.

Wheat yields overall were well above average. Harvest was delayed by almost 6 inches of rain during June; consequently, test weights were lower than normal. Dryland sorghum and corn grain yields were good where crops were planted in a timely fashion, especially no-till corn. Where planting was delayed by rainfall, yields were impacted negatively by the severe heat and moisture stress during the latter half of July and August. Irrigated corn grain yields were much improved over those for 1998 and ranged from average to well above the long-

term average of 160-180 bu/a. Irrigated soybean production was impacted severely by severe heat in late August to early September during peak pod fill, especially the later planted soybeans. Those planted in late April through early May were much less affected.

Soil moisture conditions were quite variable in the area for establishment of the 2000 wheat crop. Portions of the area such as Sandyland received 2.5 to 4 inches of rain in September, whereas others received less than 1 inch. Even those areas receiving significant September moisture were not excessively wet because of the extreme conditions during July and August. Most of the area received little moisture from October through the end of the year. Overall, although most fields germinated, early season growth was well below average. January 2000 produced two significant snowfalls in the area that greatly improved surface soil moisture.

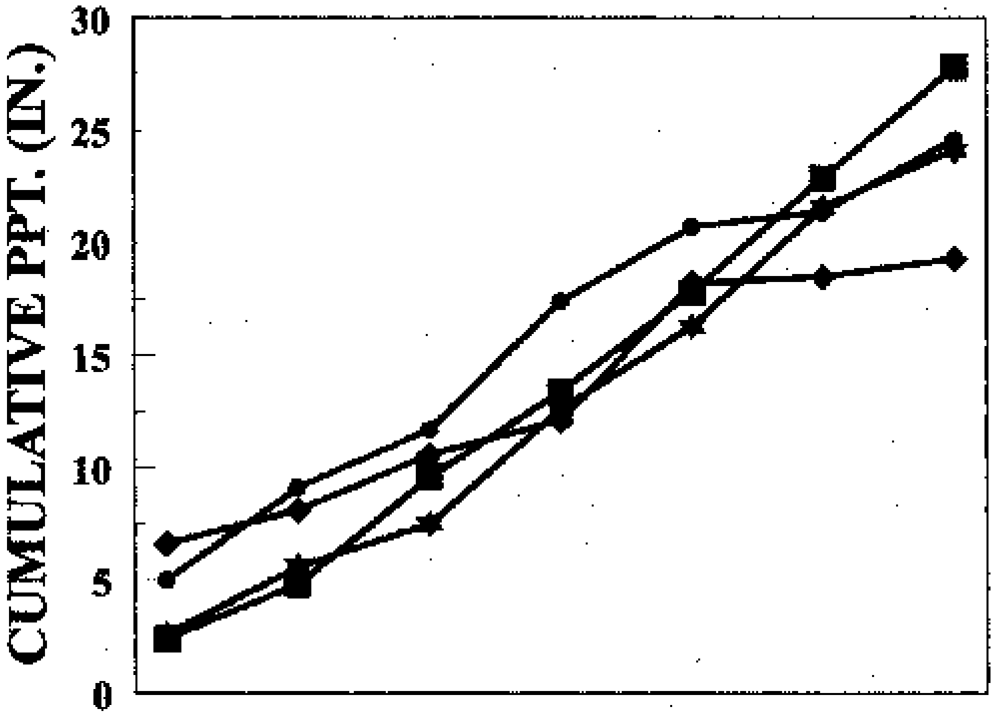
Total precipitation for 1998 was slightly below normal even with a wet April and June (Table 1). Total 1999 precipitation measured 25.0 inches compared to the long-term average of 25.9 inches. Precipitation was 108% of normal from April through September. However, rainfall was only 80% of normal during the period May through August, 70% of normal for July and August, and 25% of normal for August.

The low temperature for 1999 of 1°F occurred on 2 days in January. Overall, the winter of 1999 was relatively mild, but significant snowfalls occurred in January and March. The period January through March included 25 days with temperatures over 60°F and 3 days with temperatures over 70°F. The yearly high of 105°F occurred on 4 days in August. From May 1 to September 30, temperatures were 90°F or higher on 59 days and 100° or higher on 13 days. Temperatures were 100° or higher on 7 days in July and 6 days in August. Temperatures were 90° or higher on 25 days in July, 22 days in August, and 6 days in September. The storm season was much quieter than normal with the exception of two very severe storms in the Hudson area.

The frost-free season lasted from April 17 until October 4, resulting in a growing season of 169 days, approximately 16 days shorter than the long-term average.

Table 1. Precipitation at the Sandyland Experiment Field, St. John, KS, 18-year average, 1998, 1999.

Month	18-year average	1998	1999
		inches	
January	0.7	1.7	2.7
February	0.8	0.5	0.0
March	2.1	4.4	2.4
April	2.6	1.5	4.0
May	3.8	2.5	2.7
June	4.0	1.5	5.7
July	3.0	6.1	3.3
August	2.6	0.3	0.7
September	2.2	0.8	3.2
October	2.0	5.6	0.2
November	1.1	1.7	0.0
December	1.0	0.2	0.2
Annual Total	25.9	26.7	25.9



MONTH	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1996	2.4	4.8	9.6	13.4	17.8	22.9	27.8
1997	2.6	5.6	7.5	12.6	16.3	21.6	24.1
1998	6.6	8.1	10.6	12.1	18.2	18.5	19.3
1999	5.0	9.1	11.7	17.4	20.7	21.4	24.6

Figure 1. Cumulative precipitation from March through September, Sandyland Experiment Field, St. John, KS, 1996-1999

CROP PERFORMANCE TESTING AND NEW PROJECTS

Victor L. Martin

During the 1999 cropping season, performance tests were conducted on dryland wheat corn, cotton, and grain sorghum, as well as irrigated wheat, soybeans, grain sorghum, alfalfa, cotton, and both full- and short-season corn hybrids. The dryland corn test was abandoned because of intense weed pressure. The dryland cotton test was impacted negatively by heavy rains in June. Waterlogged conditions resulted in severe stunting and test abandonment. Essentially no significant differences occurred in the irrigated alfalfa variety trial. Information from the other crop performance tests is summarized in the respective crop performance test publications available at local county extension offices.

In 1999, a cotton research program was established to evaluate the long-term feasibility of cotton production in the Great Bend Prairie. Research includes variety evaluation, weed control, tillage, and planting date studies.

A study evaluating nitrogen requirements for corn under no-tillage following soybeans and corn also was initiated in 1999 under irrigation. The sorghum breeding program implemented a breeding site at Sandyland to assist in developing grain sorghum hybrids better adapted to the extreme heat and drought stress typical of the region. A 3-year study begun in 1999 is evaluating the effects of planting date and hybrid maturity on grain yield under different row spacings.

During the fall of 1999, in conjunction with animal scientists, a long-term on- and off-site study was initiated to evaluate the forage production potential of different varieties of wheat, rye, triticale, and blends of those crops. In addition, study was begun to determine weight gain of cattle grazing different fall-seeded small grains.

A study will be initiated in the spring of 2000 to examine the feasibility of no-till wheat production and determine cultural practices to maximize chances of success.

Data collection will start in 2000 on a dryland rotation/tillage study involving wheat, corn, and grain sorghum. Bt corn studies are continuing, as are several fertilizer studies, both dryland and irrigated. This information can be found in the Kansas Fertilizer Research and the Southwest Research-Extension Center Field Day Reports of Progress. You also may contact the Sandyland Experiment Field, if your local extension office does not possess this information.

SOYBEAN HERBICIDE EVALUATION

Victor L. Martin and Dallas E. Peterson

Summary

Weed control in irrigated soybean fields on the sandy soils of SC Kansas presents several challenges including weed resistance to herbicides, especially Pursuit-resistant amaranth species and the risk of severe crop damage by SU herbicides such as Classic and Pinnacle. New soybean varieties are bred for SU tolerance (STS soybeans), Roundup tolerance, or both. This study examined various weed control strategies including Roundup, SU herbicides, and several combinations. Overall, treatments combining both pre- and postemergence strategies and Roundup with SU herbicides provided the most consistent weed control.

Introduction

Irrigated soybean is an extremely important production component for producers on the sands of the Great Bend Prairie in SC Kansas. Soybeans are grown in rotation typically after corn, continuously, and double-cropped after wheat. Herbicide strategies exist that are normally effective in controlling grasses in this area. Consistent broadleaf control is more difficult, especially when soybeans are produced for more than one year at the same location. The problem is increasing as ALS-resistant weeds, especially Palmer amaranth, are increasing in numbers This study was designed to evaluate pre- and postemergence strategies primarily for broadleaf weeds on sandy soils. The study involved herbicides currently labeled for use on sandy soils and the use of a soybean variety tolerant to both Roundup (glyphosate) and SU herbicides (STS tolerant).

Procedures

A Pratt loamy fine sand was used for this study. Corn was present on this site in 1998, and soybeans in 1997. Tillage consisted of offset disking during the fall of 1998 with tandem disking and packing twice prior to planting. Fertilizer consisting of 100 lb/a 18-46-0 was applied in mid-April. Preemergence (PRE) treatments were applied on June 18. Postemergence (POST) applications were made on July 2 and July 16. Soybean variety Asgrow 3302, containing both Roundup and STS tolerance, was planted in 30-inch rows at 150,000 seeds/a on June 14. Plots were 25 ft long by 10 ft wide (four 30-inch rows). Irrigation totaled 11.25 inches in 14 applications from June 8 through August 23. There was a total of 17 treatments including an untreated check (Table 2). This resulted in 68 plots in four replications arranged in a randomized complete block design.

Treatments were applied using a tractor-mounted compressed air sprayer at 30 psi with 20 gal water/a. A wind screen was used to minimize herbicide drift. Herbicides for the surrounding field consisted of 1 qt/a Dual followed by 1 qt/a Roundup POST. Herbicide injury and weed pressure were monitored throughout the growing season with ratings taken on July 1, 13, 26 and August 12. Plots were harvested with a combine equipped with a two-row row header.

Results

Results are listed in descending order of yield (Table 3). Two numbers within the same column must differ by more than the LSD to be significantly different. Yields were affected by shattering following the wet conditions in September.

No significant crop injury was noted, even with treatments containing Pinnacle (Synchrony). In past years, non-STS soybeans were consistently and severely stunted by any treatment containing Pinnacle. The only grass species present was crabgrass, and control was excellent except for treatments 3, 4, 5, and 12 (Table 3). Even in those treatments, grass pressure was not severe (averaging almost 70% grass-free soil surface).

The primary broadleaf weed present was pigweed Palmer amaranth. With the exception of the check treatment, puncture vine was absent. Almost all treatments, with the exception of treatments 12 and 2, provided excellent broadleaf weed control. As with all studies of this type, a timely cultivation would have enhanced weed control. With the use of newer compounds over the last 4 to 6 years in both the corn and soybean herbicide studies that are alternated on this site, previously common weeds including lambsquarters, Russian thistle, cocklebur, and devil's claw have been either greatly reduced or almost entirely eliminated. Previously, redroot pigweed and water hemp were the predominant amaranth species; however, they are also greatly reduced in numbers.

These treatments demonstrate the excellent season-long grass control provided with a PRE/POST program when compared to a total PRE or total POST protocol. Also programs incorporating Roundup Ultra into a program with PRE and other POST emergence herbicides appears overall more effective than a simple POST application of Roundup.

Some of these treatments are either not labeled for use in the Sandyland service area or may have use restrictions based upon soil type or groundwater levels. Always read and follow label recommendations. Also please be aware that many of these treatments require the use of SU-tolerant soybeans; otherwise, crop injury and/or crop loss is likely on the sands. The same precaution holds true for the use of Roundup-Ready soybeans with treatments involving Roundup Ultra.

Table 2. Soybean herbicide treatments 1999, Sandyland Experiment Field, St. John, KS.

Trt No. & Product		Timing*	Product Rate/A#	Adjuvant+
1.	Command 3ME	PRE	2 pints	
	Authority	PRE	2.67 oz.	
	Roundup Ultra	POST	1 pint	
2.	Command 3ME	PRE	2 pints	0.25% v/v NIS
	Authority	PRE	2.67 oz.	2 lb/a Amsulf
	Synchrony	POST	0.5 oz.	
3.	Authority	PRE	3 oz.	
	Touchdown	POST	1 pint	
4.	Canopy XL	PRE	6.8 oz/a	
5.	Canopy XL	PRE	6.8 oz.	1% v/v COC
	Assure II	POST	10 fl. oz.	2 lb/a Amsulf
6.	Canopy XL	PRE	3.6 oz.	0.25% v/v NIS
	Classic	POST	0.33 oz.	2 lb/a Amsulf
	Roundup Ultra	POST	1.5 pints	
7.	Canopy XL	PRE	3.6 oz.	0.25% v/v NIS
	Synchrony	POST	0.5 oz	2 lb/a Amsulf
	Roundup Ultra	POST	1.5 pints	
8.	Authority	PRE	3 oz.	0.25% v/v NIS
	Classic	POST	0.33 oz.	2 lb/a Amsulf
	Roundup Ultra	POST	1.5 pints	
9.	Authority	PRE	3 oz.	0.25% v/v NIS
	Synchrony	POST	0.5 oz	2 lb/a Amsulf
	Roundup Ultra	POST	1.5 pints	
10.	Authority	PRE	4.5 oz.	0.25% v/v NIS
	Classic	POST	0.33 oz.	2 lb/a Amsulf
	Roundup Ultra	POST	1.5 pints	
11.	Authority	PRE	4.5 oz.	0.25% v/v NIS
	Synchrony	POST	0.5 oz.	2 lb/a Amsulf
	Roundup Ultra	POST	1.5 pints	
12.	Authority	PRE	4.5 oz.	
	Pursuit Plus	PRE	1.5 pints	
13.	Classic (25 WG)	PRE	1.3 oz	
	Authority	PRE	2.2 oz.	
	Sencor DF (75 WG)	PRE	3 oz.	
	Flufenacet WG (60 PC)	PRE	4 oz.	
	Roundup Ultra	POST	1.5 pints	
14.	Roundup Ultra	POST	1.5 pints	3.4 lb/a Amsulf
15.	Roundup Ultra	EP	1.5 pints	3.4 lb/a Amsulf
	Roundup Ultra	POST	1.5 pints	3.4 lb/a Amsulf
16.	Roundup Ultra	POST	2.5 pints	3.4 lb/a Amsulf
17.	Check			

* - PRE=preemergence; POST=postemergence; EP=early postemergence.
# - Rate of product applied per acre.
+ - NIS=nonionic surfactant; Amsulf=ammonium sulfate; COC=crop oil concentrate; v/v=volume per volume

Table 3. Soybean herbicide evaluation 1999: weed control 17 and 60 days after planting and bean yield, Sandyland Experiment Field, St. John, KS.

Trt No.	Grass 1#	Grass 2#	Broadleaf 1#	Broadleaf 2#	Yield
	% soil surface free of grasses		% soil surface free of broadleaves		bu/a
14	97%	99%	95%	92%	37
13	100	100	99	86	37
1	100	100	99	93	36
15	100	98	95	91	33
6	100	98	97	96	32
8	100	99	98	95	31
4	100	68	100	88	30
16	100	99	96	89	30
10	99	99	98	94	28
3	100	84	100	87	28
9	100	100	99	96	28
7	99	99	96	94	26
11	100	98	99	93	26
5	100	84	100	82	24
12	100	76	100	70	24
2	99	95	97	73	21
Check	100	90	96	11	13
LSD(.10)	NS	6.3	NS	4.7	2.9

- 1=17 days after planting; 2=60 days after planting.

CORN HERBICIDE EVALUATION

Victor L. Martin and Dallas E. Peterson

Summary

The sandy soils of SC Kansas raise concerns regarding groundwater contamination for the use of atrazine at high rates, especially preemergence. High levels of weed pressure from crabgrass and amaranth species are the main pest challenges to irrigated corn production. This study evaluates a variety of new products using no or lower rates of atrazine and some total postemergence (POST) strategies. The total POST strategies worked well in 1999, producing consistent weed control and grain yields. Some of the new preemergence (PRE) products such as Axiom worked well controlling crabgrass and early season broadleaves. Long-term, PRE/POST combination strategies provided the most consistent weed control and yields.

Introduction

Weed control is a major problem in irrigated corn production, especially when postemergence cultivation is eliminated. This problem is accentuated on sandy soils low in organic matter. Additionally, there is concern involving the use of atrazine, a common herbicide in SC Kansas, and the potential for its movement into groundwater. Atrazine is one of the best, most cost-effective herbicides for season-long broadleaf control on the sandy soils of the Great Bend Prairie. Problems with atrazine do exist especially when corn is grown continuously, because populations of atrazine-resistant weeds develop. This study was initiated to determine the effectiveness of alternatives to herbicide programs containing preemergence (PRE) atrazine applications on sandy soils in SC Kansas and to compare newly labeled, not yet labeled, and nonresidual compounds for use in Kansas to more conventional programs.

Procedures

A loamy fine sand (Pratt and Naron) which was cropped to soybeans in 1998 and corn in 1997, was used for this study. The entire site was tandem disked once and packed prior to planting in the spring of 1998. Fertilization included 100 lb/a 18-46-0 and 125 lb/a N applied as urea (46-0-0) prior to spring tillage and 100 lb/a N at V-6. The 110-day corn hybrid NC+ 4616 was planted on May 10 at 28,500 seeds/a at a depth of 1.5 inches. No soil insecticides were used. Plots were 25 ft long and 10 ft wide (four 30-inch rows) with four replications in a randomized complete block.

There was a total of 24 treatments (Table 4). Preemergence (PRE) treatments were applied on May 14 and postemergence (POST) treatments on May 28. Treatments were applied using a tractor-mounted compressed-air sprayer at 30 psi with 20 gal/a water. Crop injury and weed pressure were monitored throughout the growing season and examined extensively immediately prior to POST treatments and 2 weeks after. Plots were irrigated as necessary from June 8 until August 23 with a total of 11.25 inches of water in 14 applications. Corn was hand-harvested in mid-October and mechanically shelled. Yields were adjusted to 15.5% moisture.

Results

Yield and weed control results are listed in order of descending yield (Table 5). Some crop injury was noted with treatments containing Aim and Axiom, although stunting was slight in most instances. As in most years, the only grass present was crabgrass. With the exception of treatment 22, all

herbicide combinations provided good to excellent crabgrass control.

The two major broadleaf weeds were puncture vine and pigweed species, predominantly Palmer amaranth. This site is rotated with the soybean herbicide study. Over the last 4 to 6 years, with the introduction of new herbicides, broadleaf weeds previously considered to be major problems such as lambsquarters, Russian thistle, cocklebur, and devil's claw have been reduced or eliminated from this site. Additionally, amaranth species such as red- root pigweed and water hemp have been almost entirely eliminated. Broadleaf control was good to excellent, with the weakest treatments being 3, 4, 5, and 22. The single weed species that appears most important in determining yield is Palmer amaranth. As Palmer amaranth pressure increased, yields decreased.

Of the seven top yielding treatments, one was total PRE (trt 4); three were total POST (trt 16, 17, 18); and three involved a combination of a PRE herbicide for initial control followed by a POST application.

One of the main purposes of this study is to determine the effectiveness of herbicide programs not involving PRE atrazine. As in previous years, treatments involving POST atrazine performed well. Small amounts of atrazine when added to newer products such as Aim, Basis (Basis Gold), and Axiom, greatly increase their effectiveness, while reducing the risk of contamination of surface or groundwater by atrazine.

Herbicide programs combining a PRE and POST application strategy overall exhibit the best and most consistent weed control and minimize producer risk.

This study continues to examine weed control options for corn on sandy soils. However, after 8 years, we can state safely that effective weed control is indeed possible without high use rates of PRE atrazine. The difficulty is comparing cost effectiveness, but with the advent of SU compounds with very low use rates and price reductions by manufacturers over the last 24 months, this appears to be less of a problem than in the past.

This is a research project and product evaluation. Note that the use of Epic and Balance are not allowed on coarse-textured soils, especially with shallow groundwater. Carefully read the label to determine if use of these and other products is permitted in your area.

Table 4. Corn herbicide treatments 1999, Sandyland Experiment Field, St. John, KS.

Trt No. & Product	Timing*	Product Rate/A#	Adjuvant+
1 Dual II	PRE	2 pints	
Atrazine	POST	2 pints	
2 Axiom (68 DF)	PRE	8 oz.	
Basis Gold	POST	14 oz.	
Clarity	POST	4 fl. oz.	
3 Dual II	PRE	2 pints	
Atrazine	PRE	2 pints	
4 Axiom	PRE	10 oz.	
Atrazine	PRE	2 pints	
5 Epic	PRE	6 oz.	
Atrazine	PRE	2 pints	
6 Axiom	PRE	9 oz.	
Balance	PRE	1 oz.	
Atrazine	PRE	2 pints	
7 Epic	PRE	8 oz.	
Atrazine	POST	2 pints	
8 Epic	PRE	8 oz.	
Atrazine	PRE	2 pints	
9 Guardsman	PRE	1.5 pints	1% v/v COC
Basis Gold	POST	14 oz.	2 lb/a Amsulf
Clarity	POST	4 fl. Oz.	
10 Guardsman	PRE	1.5 pints	1% v/v COC
Accent Gold	POST	2.9 oz.	2 lb/a Amsulf
Clarity	POST	4 fl oz.	
11 Basis	PRE	0.5 oz.	
Atrazine	PRE	2 pints	
12 Guardsman	PRE	1.5 pints	1% v/v COC
Basis Gold	POST	14 oz.	2 lb/a Amsulf
Banvel	POST	4 fl. oz.	
13 Basis	PRE	0.33 oz.	1% v/v COC
Basis Gold	POST	14 oz.	2 lb/a Amsulf
Clarity	POST	4 fl. oz.	
14 Balance	PRE	0.75 oz.	1% v/v COC
Basis Gold	POST	14 oz.	2 lb/a Amsulf
Clarity	POST	4 fl. oz.	

Table 4. Corn herbicide treatments 1999, Sandyland Experiment Field, St. John, KS.

Trt No. & Product	Timing*	Product Rate/A#	Adjuvant+
	(Continued)		
15 Axiom	PRE	8 oz.	1% v/v COC
Basis Gold	POST	14 oz.	2 lb/a Amsulf
Clarity	POST	4 fl. oz.	
16 Basis Gold	POST	14 oz.	1% v/v COC
Distinct	POST	4 fl.oz.	2 lb/a Amsulf
17 Aim	POST	0.33 oz.	1% v/v COC
Basis Gold	POST	14 oz.	2 lb/a Amsulf
18 Aim	POST	0.33 oz.	0.25% v/v NIS
Basis Gold	POST	14 oz.	2 lb/a Amsulf
19 Dual II	PRE	2 pints	0.25% v/v NIS
Aim	POST	0.33 oz.	
Atrazine	POST	1 pint	
20 Dual II	PRE	2 pints	1 qt/a COC
Aim	POST	0.33 oz.	
Atrazine	POST	1 pint	
21 Dual II	PRE	2 pints	
Aim	POST	0.33 oz.	
Atrazine	POST	1 pint	
Banvel	POST	4 fl. oz.	
22 Aim	POST	0.33 oz.	0.25% v/v NIS
Spirit	POST	1 oz.	
23 Dual II	PRE	2 pints	4% v/v Amsulf
Aim	POST	0.667 oz.	
24 Check			

* - PRE=preemergence; POST=postemergence

\# - rate of product applied per acre

\+ - NIS=nonionic surfactant; COC=crop oil concentrate; Amsulf=ammonium sulfate

Table 5. Corn herbicide evaluation 1999: weed control 17 and 44 days after planting and grain yield at 15.5% moisture, Sandyland Experiment Field, St. John, KS.

Trt No.	Grass 1[#]	Grass 2[#]	Broadleaf 1[#]	Broadleaf 2[#]	Yield
	% soil surface free of grasses		% soil surface free of broadleaves		bu/a
16	96	87	80	99	164
13	96	95	94	99	161
18	95	87	80	98	154
12	98	97	96	99	149
4	100	95	98	76	146
17	95	91	85	95	145
19	97	94	92	92	145
1	99	94	91	95	140
2	99	97	95	99	139
10	98	97	95	97	137
11	98	92	98	87	136
9	100	95	95	98	132
23	99	90	95	73	132
21	98	92	93	97	132
3	100	94	98	71	129
7	100	95	93	98	128
14	98	97	96	99	127
8	98	94	98	91	124
20	98	94	92	94	124
6	100	97	97	84	122
5	98	92	87	71	114
15	99	98	96	99	106
22	96	40	75	60	89
Check	92	76	83	5	35
LSD(.10)	0.98	3.2	3.4	6.3	10.9

- 1=17 days after planting; 2=44 days after planting

COTTON HERBICIDE EVALUATION

Victor L. Martin, Dallas E. Peterson, and Scott A. Staggenborg

Summary

Cotton acreage is increasing significantly in SC Kansas. A major difficulty is the lack of herbicides available for weed control labeled not only for use in Kansas, but overall. Sandy soils further compound the problem by increasing the risk of herbicide injury. Roundup Ready cotton helps, but application is limited to early in the growing season, because late application can cause boll abortion. This study was initiated to gather data on cotton herbicide strategies and on cotton herbicides not presently labeled for Kansas. Roundup was effective in controlling emerged weeds; however, new flushes of weeds presented problems and were not controlled. Treatments with residual activity provided better, longer control, especially for Palmer amaranth. After only 1 year, it is impossible to draw any conclusions regarding cotton herbicides.

Introduction

Cotton production increased markedly in SC Kansas during the 1990's. From 2,000 acres in 1991, cotton acreage increased to between 25,000 and 30,000 acres by the end of the decade. There are two primary reasons for this increase. First, low commodity prices for typical dryland crops such as wheat and grain sorghum have sparked interest in alternative crops. Second, cotton is able to withstand drought and heat much better than many other alternative dryland crops.

Presently, little cotton is grown in western SC Kansas, the sand hills region served by Sandyland. The coarse-textured soils of the region present challenges for successful cotton production. Additionally, the area is higher in elevation, receives less precipitation, and has a shorter growing season than areas in SC Kansas near the Oklahoma border. Perhaps the biggest obstacle for long-term cotton production is weed control.

Few herbicides are labeled for use in Kansas, and even fewer for coarse-textured soils. Weeds decrease cotton yield, make harvesting more difficult, and often result in decreased quality. Grass control options are more numerous and effective in Kansas than broadleaf weed control options. Roundup Ready cotton, while useful, is at best a partial answer because of severe restrictions based on cotton plant size and the prevalence of broadleaf weeds such as Palmer amaranth in the Great Bend Prairie. This study was initiated to determine the most effective weed control strategies on the coarse-textured soils of the Sandyland service area.

Procedures

A loamy fine sand (Pratt and Naron), which was cropped to Roundup Ready soybeans in 1998 and corn in 1997, was used for this study. The site was tandem disked once and packed prior to planting in the spring of 1999. Fertilization included 100 lb/a 18-46-0 and 50 lb/a N applied as urea (46-0-0) approximately 4 weeks after emergence. A Roundup Ready Paymaster cotton variety, 2145RR, was planted on May 26. No soil insecticides were used. Plots were 30 ft long and 10 ft wide (four 30-inch rows) with three replications in a randomized complete block.

There was a total of 16 treatments (Tabel 6). Preemergence (PRE) treatments were applied on May 28, and postemergence (POST) treatments on June 17 and July 1. Treatments were applied using a tractor-mounted compressed-air sprayer at 30 psi with 20 gal/a water. Crop injury and weed pressure were monitored throughout the

growing season and examined extensively immediately prior to POST treatments and 2 weeks after. Plots were irrigated to facilitate weed pressure with 13 inches of water from July 5 through August 31. Plots were not harvested because of the overall severe weed pressure in many plots and the inability to strip individual plots.

Results

Weed control results are listed in Table 7. Although we expected that some treatments would injure cotton plants when used on the light-textured, low organic matter soils of the Great Bend Prairie, no obvious signs of stunting were present. Reasons for the lack of crop injury are not readily apparent. The possibility of crop injury will be examined more closely over the next several years.

With the exception of trt. 4 (PRE application of Prowl and Staple), all other treatments provide good to excellent long-term control of crabgrass.

The two major broadleaf weeds were puncture vine and pigweed species, predominantly Palmer amaranth. Another problem was encountered with volunteer soybeans. The previous soybean study (1998) involved Roundup Ready varieties. The only effective way to control volunteer soybeans was hand weeding. Treatments providing greater than 80% broadleaf weed control were 2, 5, 8, 9, 10, 12, and 13. Two of the treatments were total PRE programs (2 and 5), whereas the rest included a PRE herbicide followed by a POST herbicide. Straight Roundup Ultra treatments were effective at killing all weeds present; however, new flushes of weeds would emerge several weeks after spraying, and this was accentuated by irrigation application. Roundup was more effective when used as a part of a sequential herbicide program. Application of Roundup Ultra past the cotton plant size restrictions on the label can result in boll abortion. A possible solution is to use a sprayer with shields to prevent Roundup Ultra from coming into contact with the cotton plant. Several more years of research are necessary before any major conclusions can be drawn from the study.

Remember that many of these products are not presently labeled for use in Kansas. Consult with your agrochemical representative or applicator regarding herbicides for use in your area. Follow label restrictions closely.

Table 6. Cotton herbicide treatments 1999. Sandyland Experiment Field, St. John, KS.

Trt No. & Product	Concentration & Form	Timing+	RateUnit/A@
1 Prowl	3.3 EC	PRE	2.4 pints
Cotoran 80	80 WP	PRE	2 lb.
2 Dual II	7.8 EC	PRE	2 pints
Cotoran 80	80 WP	PRE	2 lb.
3 Prowl	3.3 EC	PRE	2.4 pints
Karmex	80 DF	PRE	1.25 lb.
4 Prowl	3.3 EC	PRE	2.4 pints
Staple	85 SP	PRE	0.8 oz.
5 Prowl	3.3 EC	PRE	2.4 pints
Staple	85 SP	PRE	0.6 oz.
Karmex	80 DF	PRE	1 lb.
6 Prowl	3.3 EC	PRE	2.4 pints
Zorial	80 DF	PRE	1.5 lb.
7 Prowl	3.3 EC	PRE	2.4 pints
Caparol FL	4 F	PRE	3.2 pints
8 Prowl	3.3 EC	PRE	2.4 pints
Cotoran 80	80 DF	POST	2 lb.
NIS*	1 L	POST	0.25% v/v0
9 Prowl	3.3 EC	PRE	2.4 pints
Staple	85 SP	POST	1.2 oz.
NIS	1 L	POST	0.25% v/v
10 Prowl	3.3 EC	PRE	2.4 pints
Roundup Ultra	4 L	POST	2 pints
11 Prowl	3.3 EC	PRE	2.4 pints
MSMA	6 L	POST	2.7 pints
12 Cotoran 80	80 DF	PRE	2 lb.
Fusion	2.67 EC	POST	8 oz.
COC#	1 L	POST	1 qt.
13 Cotoran 80	80 DF	PRE	2 lb.
Roundup Ultra	4 L	POST	2 pints
14 Roundup Ultra	4 L	POST	2 pints
15 Rounup Ultra	4 L	POST	1.5 pints
Roundup Ultra	4 L	SEQ	1 pint
16 Check			

* - NIS=nonionic surfactant
# - COC=crop oil concentrate
+ - PRE=preemergence; POST=postemergence; SEQ=sequential treatment.
@ - Rate of product applied.
DF=dry flowable, EC=emulsifiable concentrate, F=flowable, L=liquid, SP=soluble powder, WP=wettable powerder

Table 7. Cotton herbicide evaluation 1999; weed control 16 and 75 days after planting. Sandyland Experiment Field, St. John, KS.

Trt No.	Grass 1#	Grass 2#	Broadleaf 1#	Broadleaf 2#
	% soil surface free of grasses		% soil surface free of broadleaves	
1	99	93	93	63
2	99	98	99	94
3	99	97	98	67
4	87	53	98	47
5	98	91	100	91
6	99	95	95	45
7	99	93	97	48
8	95	95	95	91
9	96	89	96	85
10	99	97	96	88
11	99	87	97	73
12	99	99	97	95
13	99	97	98	95
14	95	90	65	43
15	87	80	76	47
Check	92	92	43	3
LSD(.10)	NS	7.4	6	15.5

- 1=17 days after planting; 2=75 days after planting

EFFECTS OF PLANTING DATE, IRRIGATION RATE, AND TILLAGE ON PRODUCTION OF VARIED-MATURITY CORN

Victor L. Martin, Gary A. Clark, Richard L. Vanderlip, Gerald W. Warmann, and Dale L. Fjell

Summary

Planting date has had the most effect on yields, which decreased significantly with later planting, especially for full-season hybrids. No-tillage significantly reduced yields in hot, dry years but not in good years. Decreasing irrigation did not reduce yields in mild, wet years and reduced yields only for later planting in a hot, dry year. Increasing irrigation from 75% to 100% of ET provided a significant advantage in 1999.

Introduction

Corn is the most important cash crop in SC Kansas produced under irrigation, with 13% of the state's crop produced in the nine county area of the Great Bend Prairie. The sandy soils and climate of the region in combination with irrigation result in average yields of 150 to 160 bu/a most years. Under intensive management with favorable weather, producers expect yields of 190 to 200+ bu/a on their "better" ground. Typically, corn is planted from mid-April to mid-May with populations averaging 24,000 to 30,000 plants/a. Normally, producers plant a full- season hybrid (112 days or greater to black layer), although hybrids of shorter maturity are increasing in popularity.

Though irrigated corn production has been an economic boom to Kansas, it has not been without problems, especially in western Kansas where aquifer depletion is a major concern. Although vast improvements have and are being made in irrigation technology, many questions remain.

Decreases in water levels of the aquifer in SC Kansas in the region of the Great Bend Prairie have not been as dramatic as those in western Kansas. The structure of the aquifer and the soils of the region have allowed for lesser decreases, and years of high rainfall such as the mid-1970's, 1992, 1993, 1996, and 1997 have seen significant recharge of the aquifer in much of the region. Therefore, groundwater can be viewed as a sustainable resource, especially with careful management of irrigation and agronomic systems to maximize water use efficiency.

An additional factor complicates the view of sustainable irrigation, especially in the Rattlesnake Creek Watershed where the Quivira National Wildlife Refuge is and from which it receives its water. Although groundwater is viewed as renewable for irrigators, the lowering of water table levels associated with irrigation have diminished stream flow into Quivira and resulted in less water than needed to maintain the refuge during periods of below-normal precipitation, especially in the fall during the peak waterfowl migration period. Strategies are needed not only to manage for sustainable irrigation, but to develop practices ensuring adequate surface waters to maintain the Quivira Wildlife Refuge. Although switching hardware on pivots and using irrigation scheduling can help decrease irrigation inputs, the selection of proper agronomic practices (planting date, tillage, hybrid maturity) is potentially as or more important in reducing water usage. This study is one aspect of the solution.

The primary objective of this study is to determine the effect of no-tillage vs. conventional tillage, hybrid maturity, planting date, level of irrigation inputs, and their interactions on the yield, water usage, and

economic return of corn produced on the sandy soils of SC Kansas. This is the fourth year of a 5-year study. It involves the departments of Agronomy, Biological and Agricultural Engineering, and Agricultural Economics. Support for this project is provided by the Kansas Corn Commission.

Procedures

The soil for this study is predominantly loamy fine sand with some fine sandy loam. The site was cropped to grain sorghum in 1994 and 1995 and to wheat in the prior 2 years. Fertilization consisted of 100 lb/a 18-46-0 each year in March. Nitrogen was applied as granular urea (46-0-0) and was split into two 125 lb N/a increments, preplant and V6. All planting dates received 1 qt/a Dual II + 1 pt/a Atrazine preemergence followed by 1 qt/a Marksman postemergence. The first two planting dates also received 2/3 oz/a Accent to control crabgrass and volunteer grain sorghum in 1996. All plots were planted at 34,000 seeds/a with a John Deere no-till row planter.

Treatments were as follows:

1. Main plots - Planting Date: April 16, May 2, May 15 (1996); April 21, May 5, May 19 (1997); April 24, May 8, May 19 (1998); April 20, May 3, May 17 (1999).

2. Split plots - Irrigation Level: 120% (0.92 in./application), 100% (0.78 in./application), 80% (0.62 in./application) from 1996 - 1998 and 125% (0.98 in./application), 100% (0.78 in./application), 75% (0.57 in./application) in 1999.

3. Sub-subplots - Tillage: No-tillage, Chisel-disk

4. Final split plots - Hybrid: Early (Pioneer 3563-103 day), Medium (Dekalb DK 591-109 Day), Full (Pioneer 3162-118 day) from 1996 - 1998 and Early (Pioneer 35No5-105 day), Medium (Pioneer 33R88-113 Day), Full (Pioneer 31B13-119 day) in 1999.

Plots were arranged in a randomized complete block with four replications. Irrigation level differences were achieved by replacing the overhead system with drops, pressure regulators, and three different nozzles resulting in the ability to apply differential irrigation rates. Nozzle packages were changed in 1999 to increase the difference in application rates and re-regulated to increase application uniformity.

Hybrids were changed in 1999 to all Bt hybrids to better reflect practices in the area, use new higher yielding hybrids, and eliminate concerns that yield decreases detected with later planting were due to European and southwestern corn pressure as a result of delayed planting

Measurements include final plant population, dates of 50% emergence and silking, grain yield, and grain moisture.

Results

The data show that part of the site where the medium irrigation rate was applied from 1996 - 1998 contained large variations in corn grain yield, most likely related to soil compaction. The differences were larger for 1996 than 1997 - 1999. This resulted in wide yield variation and lower than expected yields.

Growing season precipitation was much above normal during both 1996 and 1997 and resulted in the need for less irrigation than normal (Table 8). In 1998, except July, precipitation was much below normal, especially during August. In 1999, precipitation was above normal from June through early July and much below normal during the remainder of the growing season (Figure 1). The maximum differences in water applied were 2 inches in 1996, 2.1 inches in 1997, 4.8 inches in 1998, and 5 inches in 1999. Mid-May planting significantly decreased yields overall, increasing irrigation levels slightly increased

yields in 1996, had no effect in 1997, and increased yields in 1998 and 1999 (although not significantly) (Figure 2). No-tillage resulted in lower yields in 1996, had no significant effect in 1997, and significantly decreased yields overall in 1998 and 1999. The 108- and 103-day hybrids were competitive with the 118-day hybrid in 1996 and 1997; however, the 118-day hybrid was significantly damaged by growing season conditions in 1998. In 1999, yields were slightly lower overall for the 105-day hybrid and not significantly different for the 113- and 119- day hybrids.

Overall, yields of the two early hybrids were less affected by planting date, and yields decreased with increasing maturity and planting date (Figure 3). Yields of all three hybrids were lower overall with the no-tillage system in 1996, unaffected by tillage in 1997, and lower without tillage in 1998 and 1999 (Figure 4).

Figures 5, 6, 7, and 8 show overviews of all treatment variables. Four years into the study, several trends are becoming evident.

Overall, planting date has been the single most important variable in determining yields.

As planting is moved later, yields decrease significantly. This is true even under cold spring conditions. Overall, eliminating tillage did not result in significant yield reductions during good years, but significantly decreased yields in a hot, dry year. Note that the negative effect of eliminating tillage increased as planting date was moved later. This is partly contradictory to conventional wisdom. Earlier maturing hybrids are competitive with a full- season hybrid and are less sensitive to planting date. Finally, during the two mild, wet years, decreasing irrigation did not adversely affect yields. Even in a dry, hot year as in 1998, the low irrigation rate did not adversely affect yields for earlier planting, but did negatively impact yields for later planting. In 1999, increasing irrigation from the 75% to 100% of ET provided a significant advantage.

The fifth and final year of this study is 2000. After that, we will conduct an economic analysis of the relative incomes of each system and determine their costs. We will be able to discuss the agronomic consequences of the planting date, irrigation level, tillage and hybrid maturity interactions and make recommendations.

Table 8. 1996 - 1999 irrigations amounts and numbers in corn study, Sandyland Experiment Field, St. John, KS.

Planting Date	Irrigation Number	Irrigation Rate and Total (inches)		
		80%	100%	120%
April 16, 1996	9	3.7	4.0	4.3
May 2, 1996	11	4.3	4.8	5.3
May 15, 1996	12	4.6	5.2	5.7
April 21, 1997	7	4.3	5.5	6.4
May 5, 1997	7	4.3	5.5	6.4
May 19, 1997	7	4.3	5.5	6.4
April 24, 1998	11	6.2	7.8	9.2
May 8, 1998	11	6.2	7.8	9.2
May 19, 1998	13	7.4	9.4	11.0
		75%	100%	125%
April 20, 1999	11	6.8	9.4	11.3
May 3, 1999	11	6.8	9.4	11.3
May 17, 1999	10	6.3	8.6	10.3

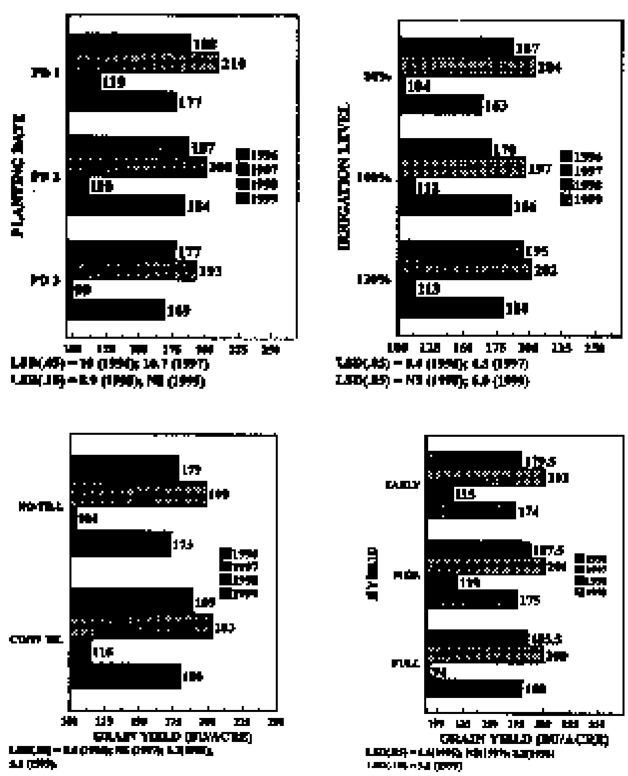
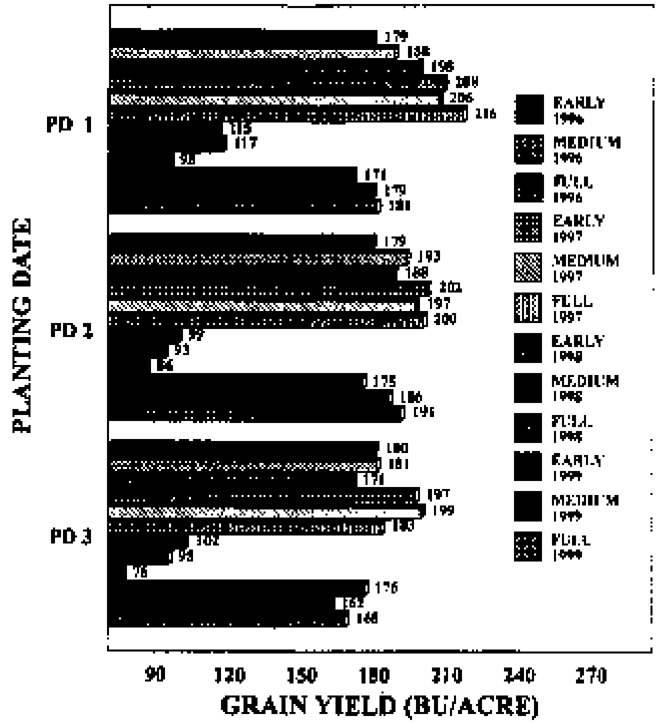
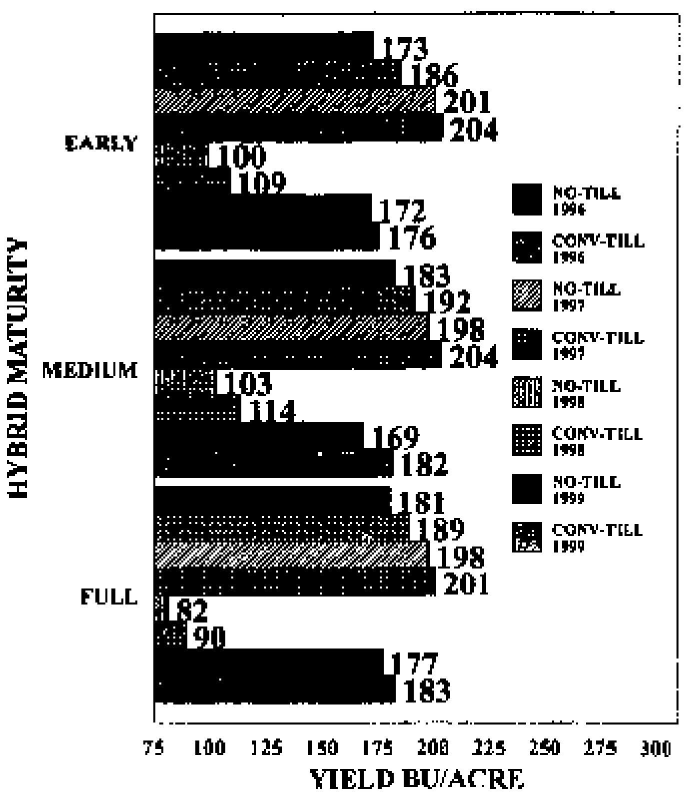


Figure 2. Corn grain yields in planting date X irrigation level X tillage X hybrid maturity study, Sandyland, 1996-1999



LSD(.05) = 7.1 (1996); 6.3 (1997)
LSD(.10) = 6.3 (1998); 5.8 (1999)

Figure 3. Interaction of hybrid with planting date in irrigated corn study, Sandyland, 1996-1999.



LSD(.10) = NS (1996 - 1999)

Figure 4. Interaction of hybrid with tillage in irrigated corn study, Sandyland, 1996-1999.

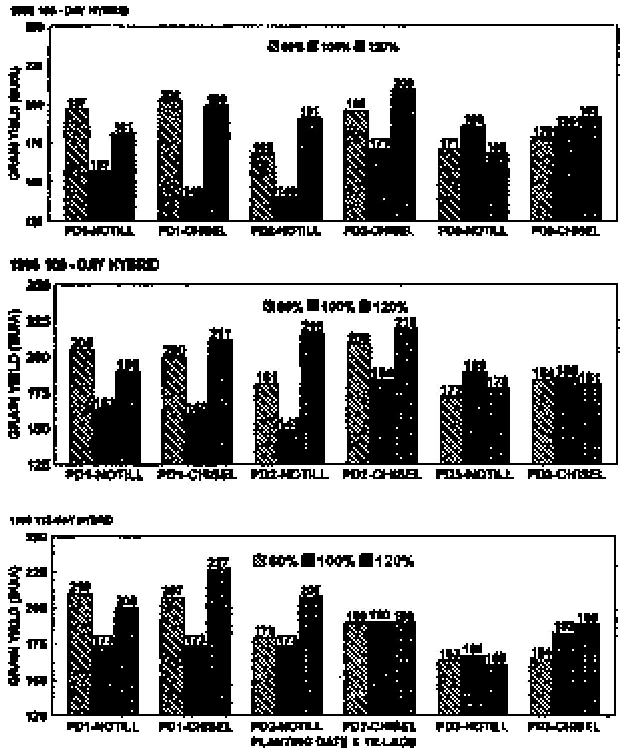


Figure 5. Corn grain yield by hybrid maturity using planting date X irrigation level X tillage interaction, Sandyland, 1996.

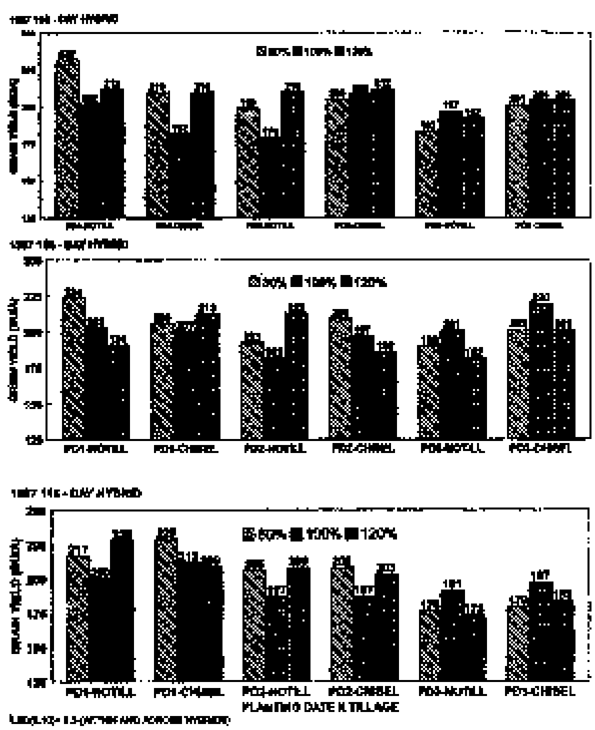


Figure 6. Corn grain yield by hybrid maturity using planting date X irrigation level X tillage interaction, Sandyland, 1997.

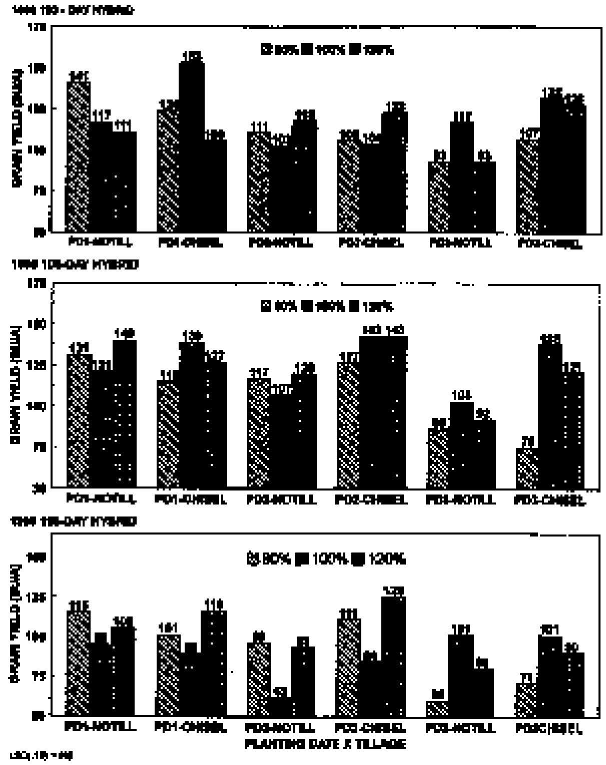


Figure 7. Corn grain yield by hybrid maturity using planting date X irrigation level X tillage interaction, Sandlyland, 1998.

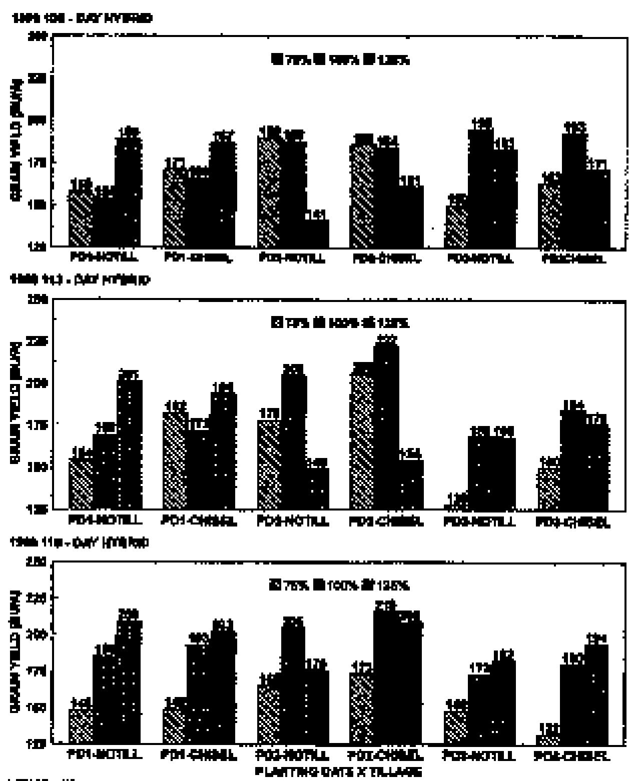


Figure 8. Corn grain yield by hybrid maturity using planting date X irrigation level X tillage interaction, Sandlyland, 1999.

UNIFORMITY OF LOW DRIFT NOZZLE IRRIGATION

Gary A. Clark, Ergun Dogan, Victor L. Martin, Danny H. Rogers, and Robert Stratton

Summary

Water application patterns from low drift nozzle (LDN) type sprinklers can result in nonuniform water distributions and low coefficients for uniformity with certain spacing and operating pressure arrangements. Increasing the operating pressure will help to breakup water patterns and improve uniformity. However, higher operating pressures can result in lower application efficiencies and reduced net depths of applied water. Results from 1999 studies with additional orifice/pressure combinations confirmed those relationships. However, climatic conditions should be considered when selecting a sprinkler nozzle system.

Introduction

Irrigation systems and nozzle packages should be designed to apply water uniformly to all areas of the irrigated field. Nonuniform applications of water occur when some areas of the system apply more or less water than other areas. These application differences may occur regularly throughout all of the system or just within portions of the system because of nozzle application problems, or they may occur at specific locations within the system as a result of improper nozzle sizing or improper pressure distribution. All irrigation systems will have some nonuniform water applications at levels that are acceptable. As irrigation events are scheduled to provide "just in time" water to the crop, effects of irrigation nonuniform water applications on yield can become substantial. This work was conducted to evaluate the uniformity of water applications from low drift nozzles (LDN).

Procedures

These studies were conducted at the Sandyland Experiment Field, St. John, Kansas during the summer of 1999. The irrigation system was a T-L linear with four, 160-ft long spans. Each span had 16 nozzle outlets outfitted with gooseneck pipes, flexible hose drops, and poly weights for the sprinkler drop pipes. On the end of each flexible drop pipe was a pressure regulator and an LDN type sprinkler. The resultant sprinkler drops were on a 10-ft spacing.

Three of the spans were each arranged with #13 (13/64-in., low rate), #16 (16/64-in., medium rate), and #19 (19/64-in., high rate) nozzle orifices on Senninger fixed plate LDN sprinklers. These were all pressure regulated to 15 psi, and each of the three spans had one of the three nozzle sizes, respectively. The fourth span was arranged with two groups of eight LDN sprinklers. One group had #12 (12/64-in.) orifice nozzles with 20-psi regulators, and the other group had #16 (16/64-in.) orifice nozzles with 6-psi regulators. The resultant water application rates from these two combinations and the #13 orifice at 15-psi sprinkler were similar. This comparison was used to evaluate the effect of operating pressure on water distribution patterns and crop yield.

Large-diameter (17-in.) plastic catch pans were placed on 2.5-foot centers parallel to the direction of travel of each span. The system was operated at a speed that would apply approximately 0.80 inches of water to the medium application rate zones. Collected water was weighed, and data were analyzed

statistically and plotted. Five separate tests were conducted during the 1999 summer. The uniformity tests were conducted on June 1, July 6, July 15, July 30, and August 9.

Results

Water application distribution patterns from the #13, #16, and #19 orifice size LDN sprinklers at 15 psi of pressure are shown in Figures 9, 10, and 11, respectively. They show the average measured depths for each pan along with +/- 1 standard deviation error bars, average depth from all measurements, and the Christiansen coefficient of uniformity (CU). The CU values for each of these patterns were 94%, 92%, and 95%, respectively. These uniformities are higher than those reported in earlier studies (71%-79%) at the site that had similar sprinkler discharge rates but used 6 psi pressure regulators.

The distribution patterns for the low application rate (Figure 9) that resulted from the higher (20-psi) and lower (6-psi) operating pressures are shown in Figures 12 and 13, respectively. The higher pressure sprinkler system resulted in a high CU of 95%, whereas the CU with the lower operating pressure system was 82%. Thus, the higher operating pressures used in these studies resulted in higher application uniformities.

Table 9 summarizes the CU values; gross applied depth (based on sprinkler discharge, sprinkler spacing, and system speed); net measured depth; and application efficiency as the ratio of net to gross depth. The higher operating pressures resulted in higher CU values. However, the application efficiencies were lower than expected for all sprinkler combinations (80.3 – 88.5%). In addition, the higher operating pressures resulted in lower application efficiencies. This usually results from the smaller droplet sizes and greater distances of droplet travel associated with higher pressure sprinklers. Although, 15-20 psi is not typically considered to be a “high” pressure range, the 6-psi sprinkler had a better application efficiency in spite of its lower CU.

In 1999, 12 water applications were made with this system. The #12 nozzles at 20-psi applied a net depth of 5.88 inches, whereas the #16 nozzles at 6-psi applied 6.48 inches. Although this difference of 0.60 inches is slight, it could become important in years when higher irrigation requirements exist and result in substantial yield differences. Climatic conditions of wind, air temperature, humidity, and within-season rain all should be considered when selecting a sprinkler nozzle system. At times, a lower uniformity sprinkler package may be a better choice than a higher uniformity package depending upon the crop, climatic, and soil conditions that exist for the site.

Acknowledgements

This work was supported in part by the State Water Plan Fund of the Kansas Water Office and the Kansas Corn Commission. Sprinklers and parts were donated by Senninger Irrigation Inc.

Table 9. Sprinkler system characteristics for the linear irrigation system, Sandyland Experimental Field, St. John, KS, 1999.

Sprinkler Combination	Coefficient of Uniformity	Gross Depth (in.)	Net Depth (in.)	Application Efficiency
#12 @ 20 psi	95%	0.61	0.49	80.3%
#16 @ 6 psi	82%	0.61	0.54	88.5%
#13 @15 psi	94%	0.62	0.51	82.3%
#16 @ 15 psi	92%	0.95	0.81	85.3%
#19@ 15 psi	95%	1.31	1.14	87.0%

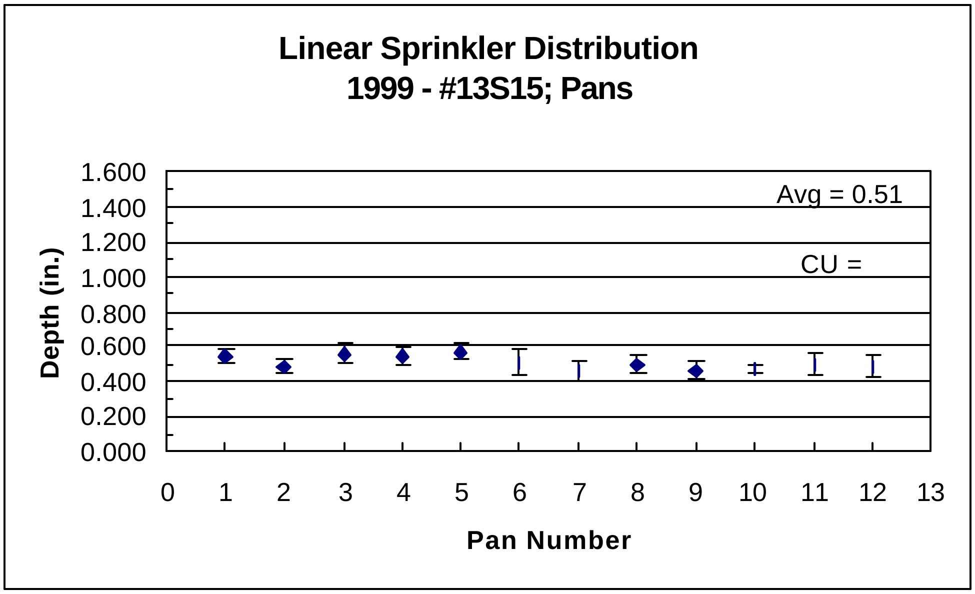


Figure 9. Average sprinkler distribution pattern from the low irrigation rate using #13 Senninger LDN sprinklers operated at 15 psi of pressure – 1999. The data show the average and +/- one standard deviation from five measurements. The average net depth of application is shown along with the coefficient of uniformity.

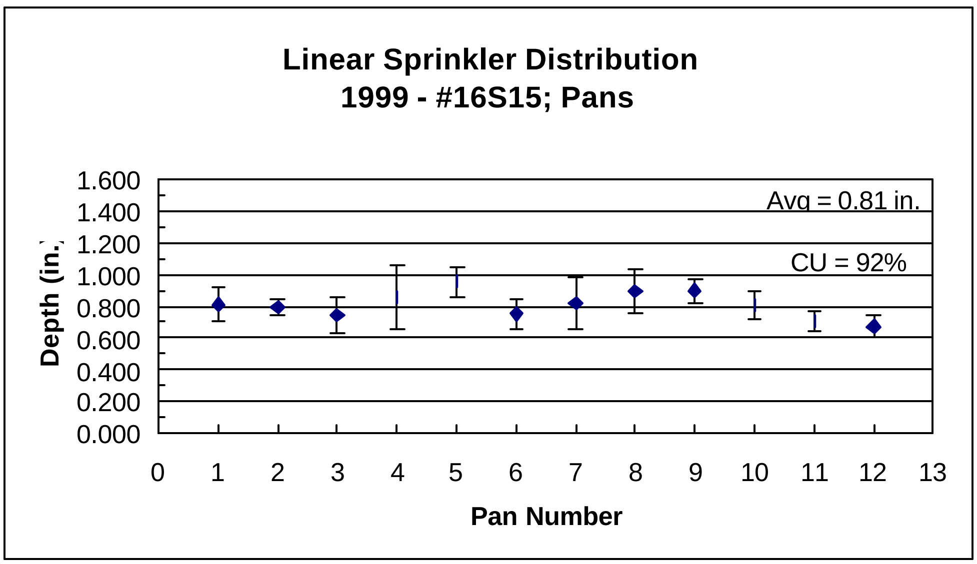


Figure 10. Average sprinkler distribution pattern from the medium irrigation rate using #16 Senninger LDN sprinklers operated at 15 psi of pressure – 1999. The data show the average and +/- one standard deviation from five measurements. The average net depth of application is shown along with the coefficient of uniformity.

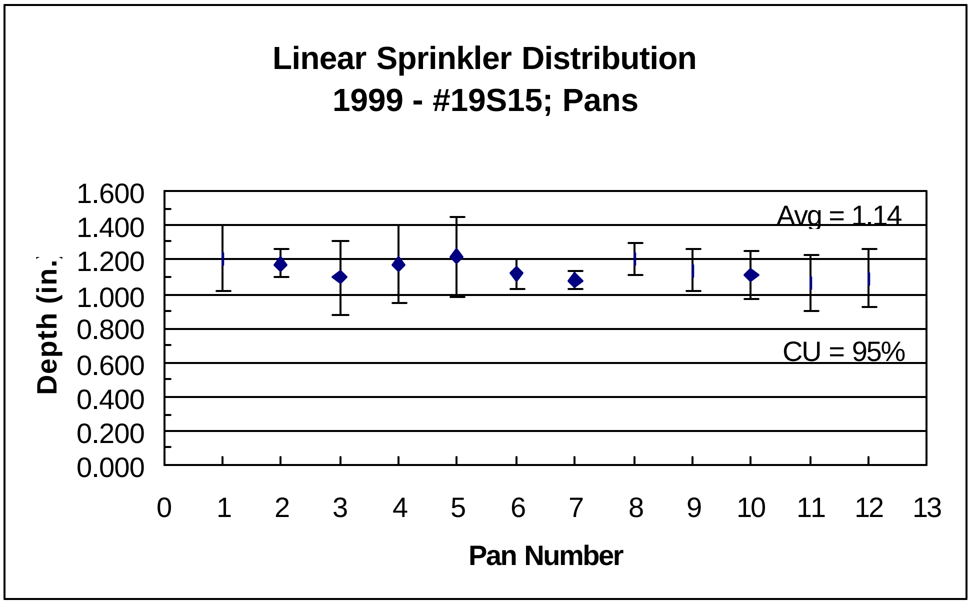


Figure 11. Average sprinkler distribution pattern from the high irrigation rate using #19 Senninger LDN sprinklers operated at 15 psi of pressure – 1999. The data show the average and +/- one standard deviation from five measurements. The average net depth of application is shown along with the coefficient of uniformity.

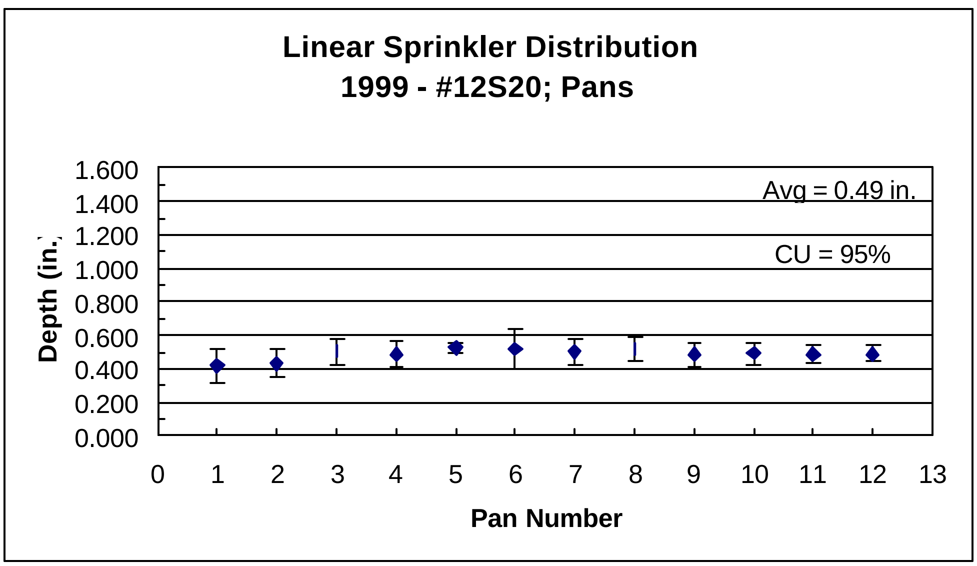


Figure 12. Average sprinkler distribution pattern from the low irrigation rate using #12 Senninger LDN sprinklers operated at 20 psi of pressure – 1999. The data show the average and +/- one standard deviation from five measurements. The average net depth of application is shown along with the coefficient of uniformity.

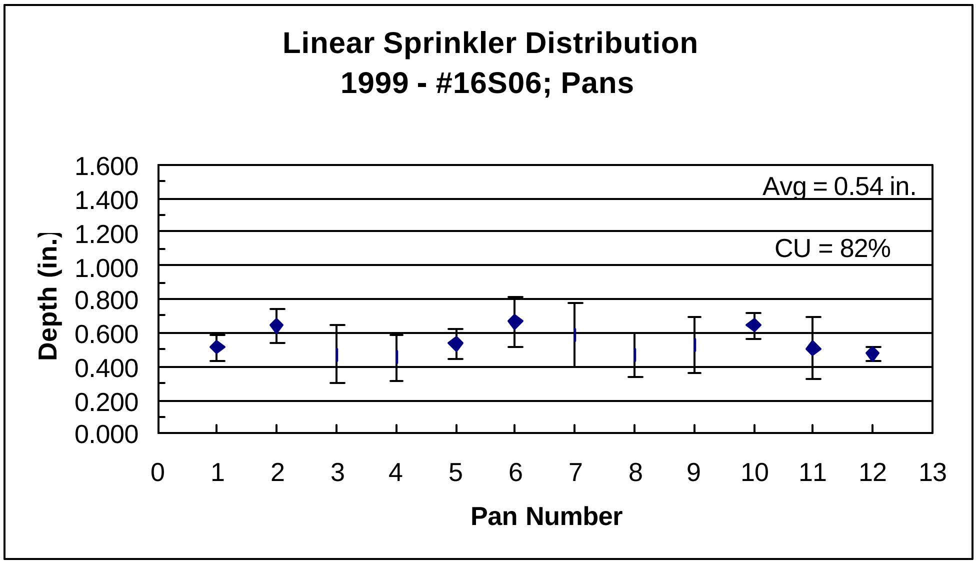


Figure 13. Average sprinkler distribution pattern from the low irrigation rate using #16 Senninger LDN sprinklers operated at 6 psi of pressure – 1999. The data show the average and +/- one standard deviation from five measurements. The average net depth of application is shown along with the coefficient of uniformity.

VARIABLE IRRIGATION RATES AND CROP YIELD

Gary A. Clark, Ergun Dogan, Victor L. Martin, Danny H. Rogers, and Robert Stratton

Summary

Studies were conducted to evaluate the effects of variable irrigation rates and nonuniform irrigation distributions on crop yield. Within-plot irrigation variability did not reduce corn yield, and yields were high (190 to 197 bu/a). Variable irrigation rates resulted in mixed results with corn yield from site to site. However, the average of all sites showed minimal yield effects. The sites with heavier soils had higher rainfall amounts and lower yields (132 to 170 bu/a) as compared to the sandy soil sites, which had yields that ranged from 171 to 209 bu/a with irrigation inputs of 6 to 16 inches and rainfall of 10 to12 inches.

Introduction

Irrigation systems are used to provide water to crops when rainfall is not sufficient to meet their evaporative demands. Variable application rates of irrigation water can occur within fields that are irrigated by systems with nonuniform water distributions. However, improper irrigation scheduling results in water application rates that vary from the optimum by either applying too much water, too little water, or poor timing. In addition, nonuniform applications of water can result from poor sprinkler system design, improper sprinkler installation, or certain combinations of sprinkler spacing and pressure. This work involved field evaluations of variable water application amounts and the effects on crop yield.

Procedures

These studies were conducted at the Sandyland Experiment Field, St. John, Kansas, during the 1999 summer crop production period. The irrigation system was a T-L linear irrigation machine with four, 160-ft long spans. Each span had 16 nozzle outlets outfitted with gooseneck pipes, flexible hose drops, and poly line weights. On the end of each flexible drop pipe was a pressure regulator and a low drift nozzle (LDN) type fixed plate sprinkler. The sprinkler drops were on a 10-ft spacing. Soil at the site was a loamy fine sand.

Three of the spans were each arranged with #13 (13/64-in., low rate), #16 (16/64-in., medium rate), and #19 (19/64-in., high rate) nozzle orifices on Senninger fixed plate LDN sprinklers. These were all pressure regulated to 15 psi, and each of the three spans had one of the three nozzle sizes, respectively. The fourth span was arranged with two groups of eight LDN sprinklers. One group had #12 (12/64-in.) orifice nozzles with 20-psi regulators, and the other group had #16 (16/64-in.) orifice nozzles with 6-psi regulators. The resultant water application rates from these two combinations and the #13 orifice at 15-psi sprinkler were similar.

Corn (NC+ 5445) was planted on April 27 at 30,500 seeds/a in a no-till field. Rows were on 30-inch centers and were parallel to the direction of travel of the linear irrigation system. The field was fallowed in 1998 and planted to wheat in the fall of 1998, and the wheat cover was killed in March and early April 1999 with two applications of Roundup Ultra at 1 qt/a. Preplant fertilizer was applied at 100 lb/a of 18-46-0 and K-Mag and 100 lb N/a as urea (46-0-0). Postemergence N was applied at V6 as 150 lb/a as urea. Herbicide applications were 1 qt/a Dual II and 1 pt/a Atrazine 4L on April 28 and 1 qt/a of Marksman on May 24.

The irrigation system was scheduled to apply water in response to crop need. Real- time weather data were used from a nearby automated weather station that generated Penman-Monteith grass reference evapotranspiration values. Those values were entered into a spreadsheet water balance model. A summary of the sprinkler characteristics and applied water is provided in Table 10. Corn was hand harvested by row on September 21, 1999. Harvest plots included 20 ft of row and 12 rows per water treatment.

Commercial irrigated corn studies were conducted on three center pivot irrigated fields with systems that irrigated 110-130 acres. Fields were designated as Sites 2, 5, and 8. Site 2 had a sandy soil, site 5 had a silt loam soil, and Site 8 had a sandy loam soil. Sprinklers on each of these center pivot systems were modified to provide three different application depth zones. Each modified zone consisted of five sprinklers that were pressure regulated at 25 psi and had preselected nozzle orifice inserts to provide the desired application rate. Water from the center sprinkler drop of each zone was measured throughout the season using an in-line, precision flow meter. These modified zones were located on the second and third spans of the center pivot systems. Plots from each of these systems were hand harvested at crop maturity. Table 11 summarizes these systems.

Results

The Sandyland water balance is summarized in Figure 14. June had higher than normal rainfall, and July was a drier month. Most of the irrigation occurred in July and August. Seasonal water applications are summarized in Table 10. Corn yield results from the Sandyland variable irrigation uniformity site are summarized in Figures 15 (each of the 12 rows) and 16 (average of each 12 row block). Yields were not significantly different and were relatively uniform within each plot. Seasonal rainfall (May through August) totaled 12.0 inches. However, the July 16 rain event of 2.47 inches exceeded the estimated available soil water storage on that date which was approximately 0.8 inches. Thus, only 1/3 of that rainfall event was probably effective (USDA, SCR, TR21, 1970), so effective seasonal rainfall was estimated to be 10.3 inches.

Water balance results of the irrigation rate studies at Sandyland (S) and at field sites 2, 5, and 8 are summarized in Figures 17 and 18. Figure 17 shows the individual site values of applied irrigation and measured rain. Figure 18 shows the sum of irrigation plus rain and estimated seasonal crop ET.

Corn plot yields are summarized in Figure 19. Yields ranged from 132 to 209 bu/a. Water-use-efficiency (WUE) defined as the ratio of yield to water input (irrigation + rain) is shown in Figure 20. In general, WUE declined with higher irrigation inputs but averaged about 8 bu/acre-inch of water input.

Acknowledgments

This work was supported in part by the State Water Plan Fund of the Kansas Water Office and the Kansas Corn Commission. Senninger Irrigation Inc. and Nelson Irrigation provided some of the supplies used in this work

Table 10. Design and performance characteristics of the linear irrigation system at Sandyland, 1999.

Span	Nozzle Size (1/16-in.)	Operating Pressure (psi)	Flow Rate (gpm)	Measured Coefficient of Uniformity (CU) (%)	Net Applied Water (in.)
E	#19	15	9.54	95%	13.7
EC	#16	15	6.91	92%	9.72
WC	#13	15	4.50	94%	6.12
W1	#16	6	4.48	82%	6.48
W2	#12	20	4.45	95%	5.88

Sandyland within season rainfall was 12.0 in.; effective rain was estimated to be 10.3 in.

Table 11. Characteristics of the center pivot field sites, St. John, KS, 1999.

System	Crop	Sprinklers	Spacing (ft)	Operating Pressure (psi)	Applied Depth (in.) Low	Medium	High	Rain
Site 2	C orn	Nelson Rotators	Var.	25	8.6	11.6	16.2	9.93
Site 5	Corn	Nelson Rotators	17	25	2.8	4.6	6.3	19.31
Site 8	Corn	Nelson Rotators	18	25	5.6	7.3	10.0	12.93

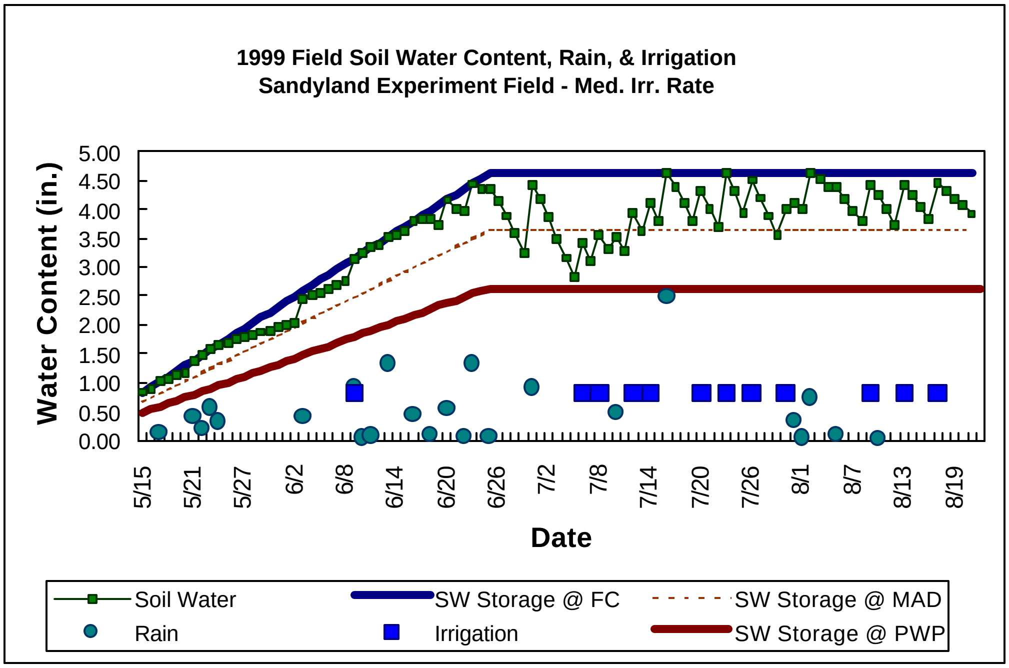


Figure 14. 1999 Sandyland field water balance chart (medium irrigation rate).

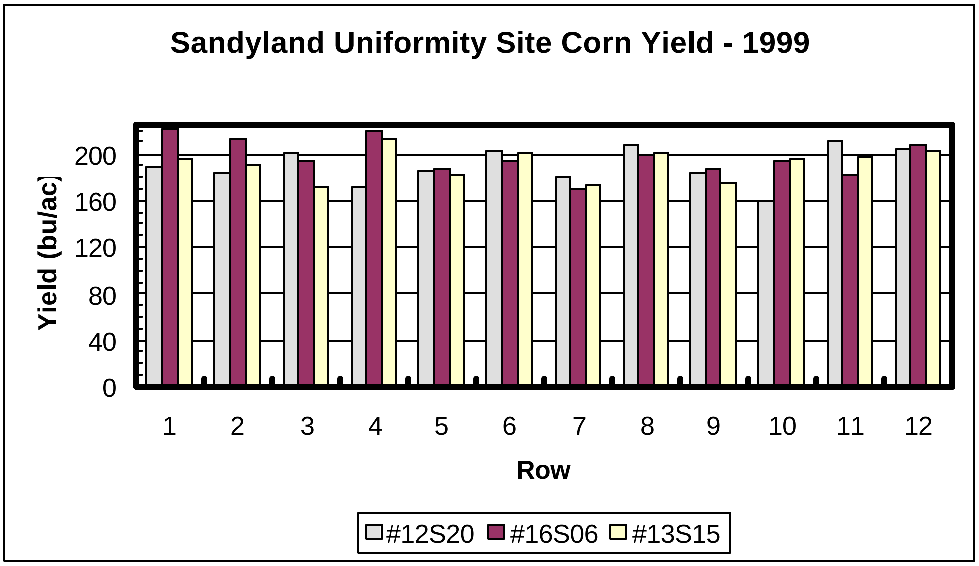


Figure 15. Corn yield by row for the 1999 within-plot irrigation uniformity study at the Sandyland Experiment Field.

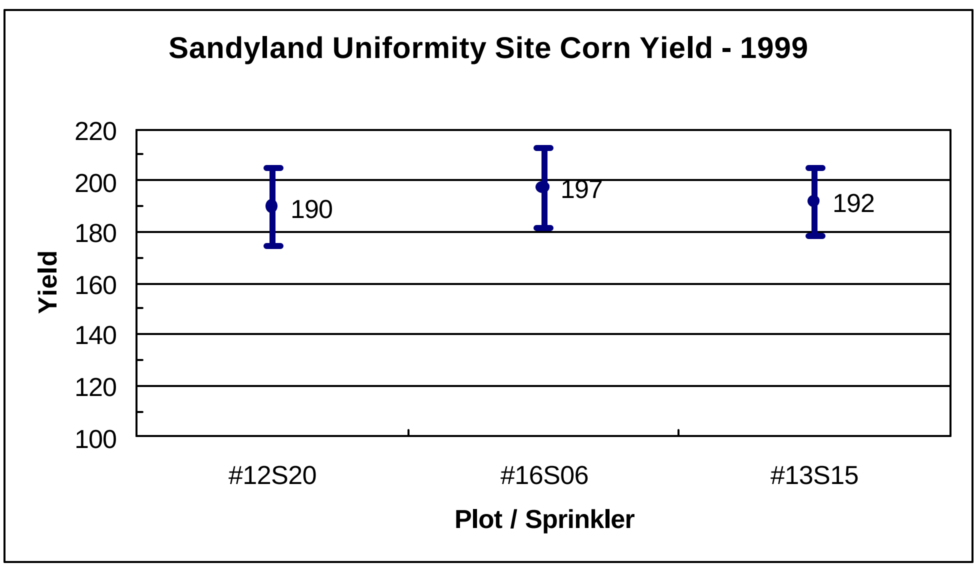


Figure 16. Average corn yield and +/- one standard deviation for the within-plot irrigation uniformity study at the Sandyland Experiment Field.

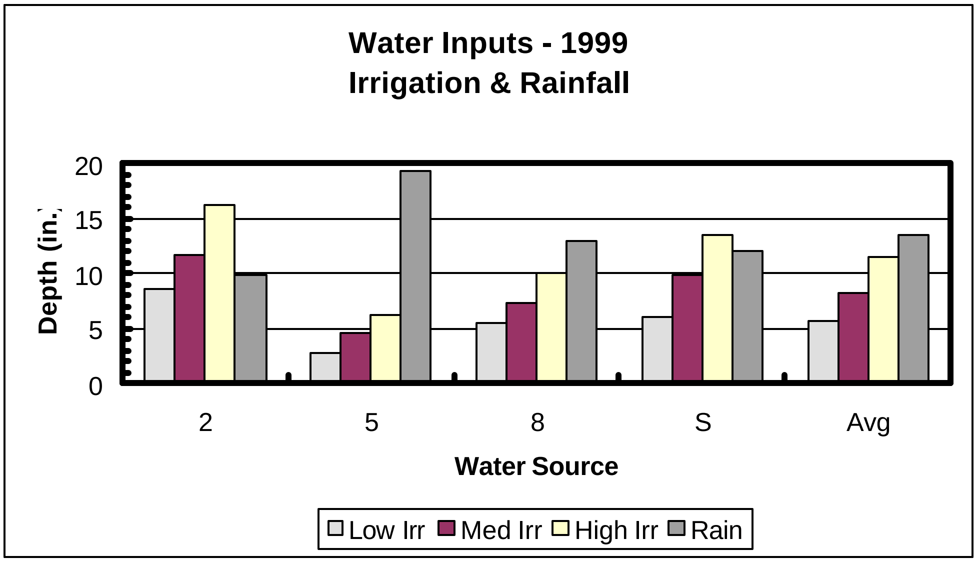


Figure 17. Water input amounts for the variable irrigation rate studies on commercial fields and at the Sandyland Experiment Field, 1999.

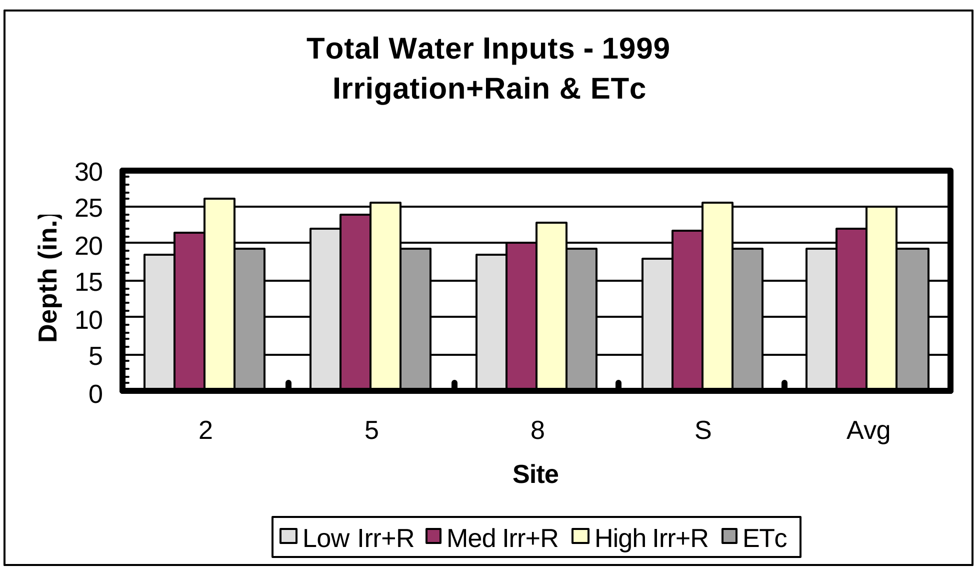


Figure 18. Water inputs (irrigation plus rainfall) and estimated crop ET for the variable irrigation rate studies on commercial fields and at the Sandyland Experiment Field, 1999.

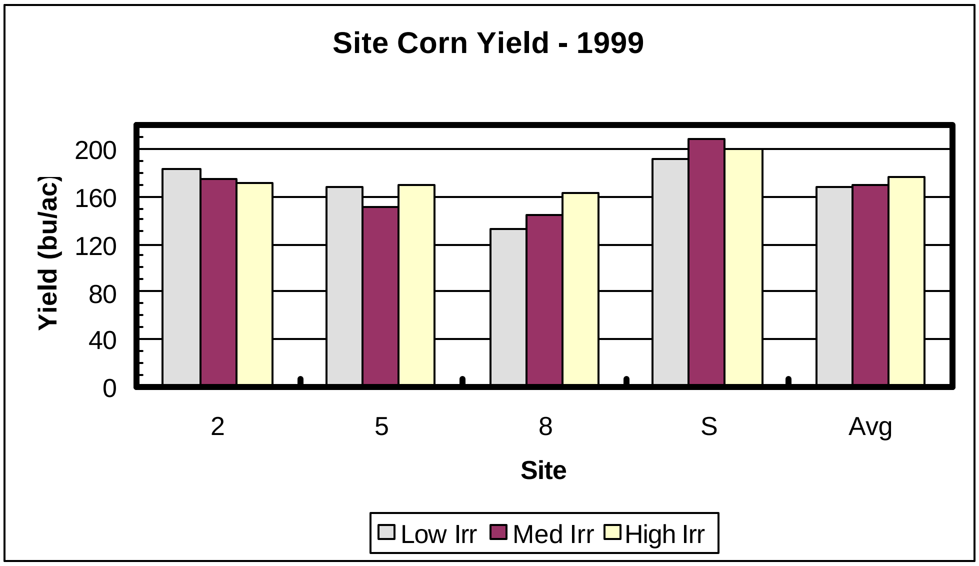


Figure 19. Corn yield for the variable irrigation rate studies on commercial fields and at the Sandyland Experiment Field, 1999.

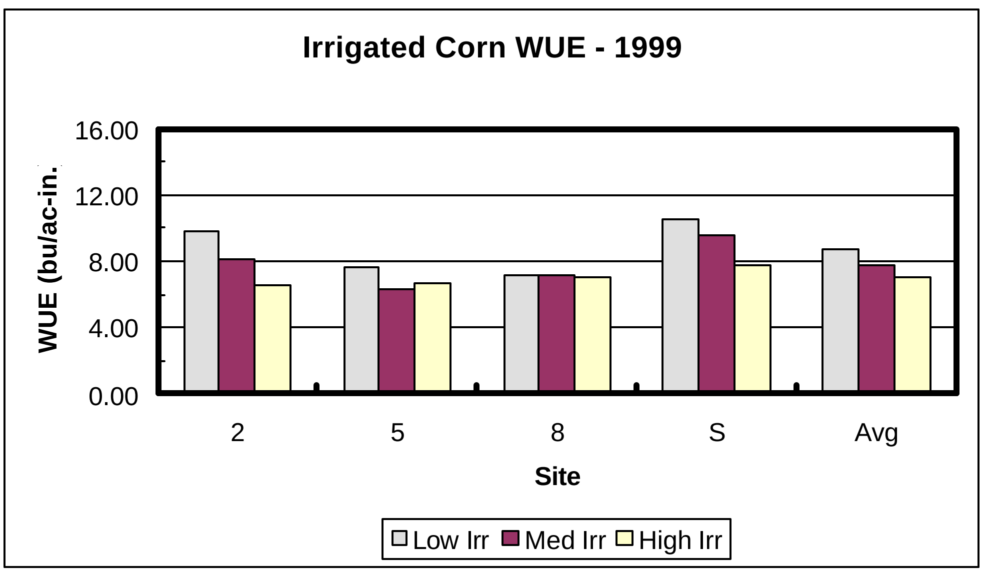


Figure 20. Water use efficiency (WUE) based on the ratio of corn yield to total water (irrigation plus rainfall) for the variable irrigation rate studies on commercial fields and at the Sandyland Experiment Field, 1999.

EVALUATION OF CORN BORER RESISTANCE AND GRAIN YIELD FOR BT AND NON-BT CORN HYBRIDS

Randall A. Higgins, Larry L. Buschman, Phillip E. Sloderbeck, Steven R. Hayden, and Victor L. Martin

Summary

Fifteen corn hybrids (9 Bt and 6 non-Bt) were evaluated for corn borer resistance and grain yield performance at the Sandyland Experiment Field in St. John, Kansas. Second generation European and southwestern corn borer pressures averaged 0.05 and 0.53 larvae per plant, respectively, in the non-Bt plots. Corn borer tunneling averaged 15 cm per plant in the non-Bt corn hybrids. No tunneling was recorded in hybrids containing Bt events Bt11, MON810 and CBH351; however, both hybrids with event 176 suffered noticeable tunneling. The yield loss from lodging caused by corn borers averaged 29.9 bu/a for the non-Bt hybrids. Hybrids with events Bt11, MON810, and CBH351 generally had no lodged plants at harvest time. Standing corn yields averaged 81.4 bu/a for the six non-Bt hybrids and 102.0, 133.8, 121.0, and 115.3 for hybrids with events 176, Bt11, MON810, and CBH351, respectively. The best non-Bt hybrid (Pioneer 3162IR) had a standing yield of 101.2 bu/a, whereas the best Bt hybrid (Novartis 7590Bt) had a standing yield of 142.1 bu/a.

Procedures

Corn plots were machine-planted on 5 May at 26,000 seeds/a at the Sandyland Experiment Field in St. John, Kansas. Pre-emergence herbicides were atrazine (1 qt/a) and Dual (1 qt/a). Postemergence herbicide application was made on 20 May using 1 qt/a of Marksman. No insecticides were applied. The soil was a Carwile sandy loam. The field was sprinkler-irrigated with 1.0, 5.1 and 1.8 inches of water in June, July, and August, respectively. Monthly rainfalls are shown in Table 1. The plots were four rows wide (10 ft) by 30 ft long. Two rows (5 ft) of Bt corn were planted between the plots as border rows, and 10-ft alleyways at the end of each plot were left bare. The border rows and alleyways were included to reduce larval migration between plots. The experimental design was a randomized block design with four replications. The 15 hybrids had a relative maturity ratings of 110 to 118 days.

Second generation corn borer infestations were entirely native. Data for second-generation corn borers were taken on 21 September from five plants selected at random from one of the center rows of each plot. The plants were dissected to record corn borers larvae and tunneling. Yield was determined by hand harvesting the ears from the other center row (30 row-ft) in late September. The ears from standing plants and from plants lodged because of corn borer damage were harvested separately. Grain yield was calculated for standing and fallen corn and corrected to 15.5% moisture.

The data were analyzed by an analysis of variance, and means were separated using the least significant difference test. To simplify discussion, results are averaged across non-Bt hybrids and the hybrids with the four Bt events.

Results

First generation corn borer pressure was light, and no data were collected. Second generation European (ECB) and southwestern corn borer (SWCB) pressures averaged 0.05 and 0.53 larvae per plant, respectively, in the non-Bt plots (Table 12). Corn borer tunneling averaged 15 cm per plant in the non-Bt corn hybrids. No tunneling was recorded in hybrids containing Bt events Bt11, MON810, and CBH351; however, both hybrids with

event 176 suffered noticeable tunneling. In hybrids with events 176, Bt11, MON810, and CBH351, second generation ECB larvae were reduced by 50, 100, 100, and 100%, respectively (Figure 21); second generation SWCB larvae were reduced by 77, 100, 100, and 100% (Figure 22); and corn borer tunneling was reduced by 66, 100, 100, and 100% (Figure 23).

Standing corn yields averaged 81.4 bu/a for the six non-Bt hybrids and 102.0, 133.8, 121.0, and 115.3 for hybrids with events 176, Bt11, MON810, and CBH351, respectively. (Table 13). The best non-Bt hybrid (Pioneer 3162IR) had a standing yield of 101.2, whereas the best Bt hybrid (Novartis 7590Bt) had a standing yield of 142.1 bu/a. These were two of the longest maturity hybrids in the trial. The yield losses from lodging because of corn borers averaged 29.9 bu/a for the non-Bt hybrids and 27.7 for the two hybrids with event 176. Hybrids with Bt11, MON810, and CBH351 had no yield losses from lodging (Table 13). Yield losses from corn borer lodged plants were reduced by 7, 100, 100, and 100% for events 176, Bt11, MON810, and CBH351, respectively (Figure 24).

Acknowledgements

This research was supported in part by industry and the Kansas Corn Commission Check-Off Funds through the Kansas Department of Agriculture.

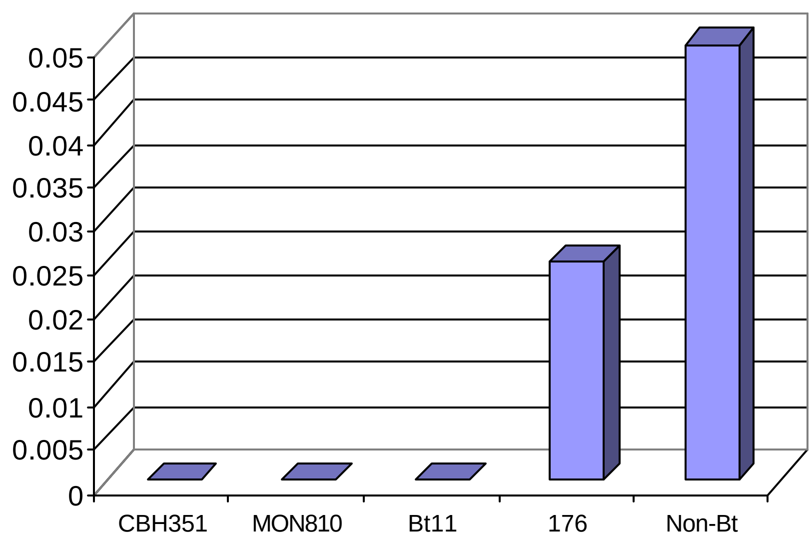


Figure 21. Second-generation European corn borer larvae per plant, St. John, KS, 1999.

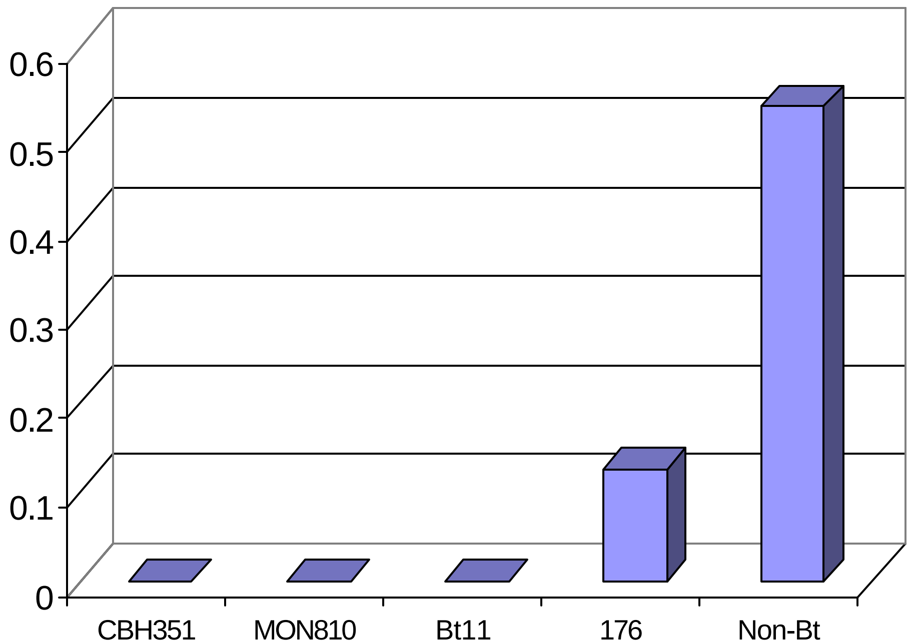


Figure 22. Second generation Southwestern corn borer larvae per plant, St. John, KS, 1999.

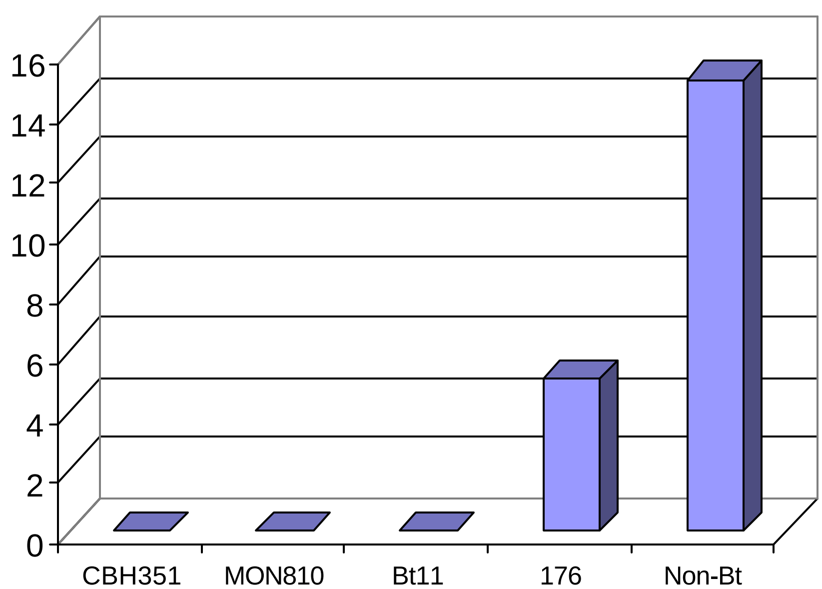


Figure 23. Corn borer tunneling in cm per plant, St. John, KS, 1999.

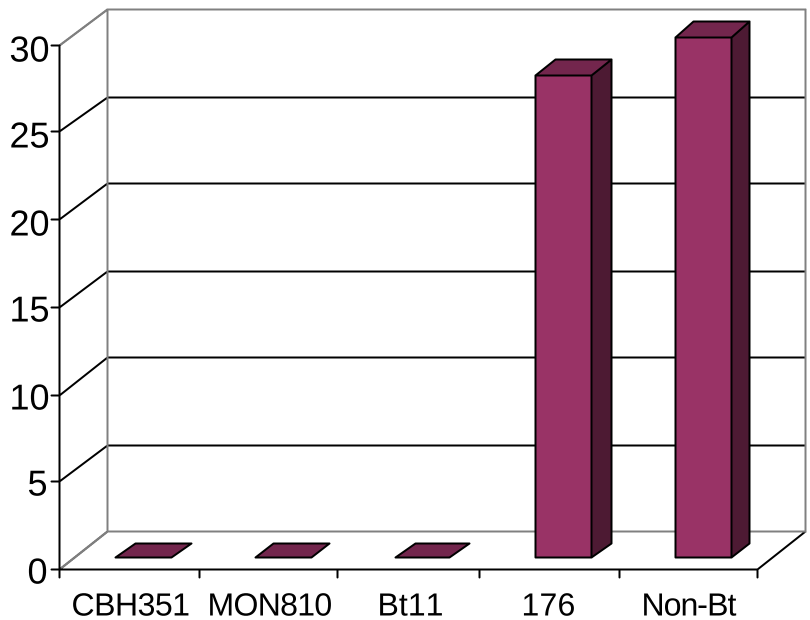


Figure 24. Fall grain yields of corn, St. John, KS, 1999.

Table 12. Corn borer damage to Bt and non-Bt corn hybrids, Sandyland Experiment Field, St. John, KS, 1999.

Hybrid	Bt Event	Company	Relative Maturity Rating	2nd Gen. Corn Borer: ECB Larvae per Plant	SWCB Larvae per Plant	# of Tunnels per Plant	Cm of Tunneling per Plant
4494		Novartis Seeds	110	0.15 a	0.65 a	2.30 ab	19.15 ab
MAX454	176	Novartis Seeds	111	0.05 b	0.05 c	0.45 d	4.40 de
2787	176	Mycogen	113	0.00 b	0.20 bc	0.65 d	5.70 cde
7590		Novartis Seeds	114	0.00 b	0.45 ab	1.50 c	11.00 cd
7590Bt	Bt11	Novartis Seeds	115	0.00 b	0.00 c	0.00 d	0.00 e
7639Bt	Bt11	Novartis Seeds	115	0.00 b	0.00 c	0.00 d	0.00 e
3162IR		Pioneer	118	0.00 b	0.65 a	2.85 a	22.80 a
32J55		Pioneer	116	0.05 b	0.50 a	1.70 bc	12.45 bc
33A14	MON81	Pioneer	113	0.00 b	0.00 c	0.00 d	0.00 e
7821BT	MON81	Cargill	115	0.00 b	0.00 c	0.00 d	0.00 e
H-2547		Golden Harvest	112	0.05 b	0.40 ab	1.45 c	12.20 bc
H-9230Bt	MON81	Golden Harvest	113	0.00 b	0.00 c	0.00 d	0.00 e
8481		Garst	112	0.05 b	0.55 a	1.45 c	12.50 bc
8481Bt/LL	CBH35	Garst	112	0.00 b	0.00 c	0.00 d	0.00 e
8366Bt/LL	CBH35	Garst	113	0.00 b	0.00 c	0.00 d	0.00 e
		LSD value p=0.05		0.08	0.26	0.69	7.09
		F-test Prob.		0.0372	<0.0001	<0.0001	<0.0001

Table 13. Effects of corn borers on yield of Bt and non-Bt corn hybrids, Sandyland Experiment Field, St John, KS, 1999.

Hybrid	Bt Event	Company	Relative Maturity Rating	Yield Standing Plts. bu/a	Yield Fallen Plts. bu/a	Total Yield bu/a
4494		Novartis Seeds	110	63.6 f	26.5 bc	90.1 c
MAX454	176	Novartis Seeds	111	76.3 def	42.1 a	118.4 abc
2787	176	Mycogen	113	127.8 ab	13.3 d	141.1a
7590		Novartis Seeds	114	64.9 f	41.4 a	106.3 bc
7590Bt	Bt11	Novartis Seeds	115	142.1 a	0.0 e	142.1 a
7639Bt	Bt11	Novartis Seeds	115	125.5 ab	0.0 e	125.5 ab
3162IR		Pioneer	118	101.2 b-e	40.3 a	141.6 a
32J55		Pioneer	116	74.6 ef	15.4 cd	90.0 c
33A14	MON81	Pioneer	113	139.3 a	0.0 e	139.3 ab
7821BT	MON81	Cargill	115	112.7 abc	0.0 e	112.7 abc
H-2547		Golden Harvest	112	87.7 c-f	36.9 ab	124.6 ab
H-9230Bt	MON81	Golden Harvest	113	111.0 a-d	0.0 e	111.0 abc
8481		Garst	112	96.4 b-f	18.7 cd	115.2 abc
8481Bt/LL	CBH351	Garst	112	122.4 abc	0.0 e	122.4 abc
8366Bt/LL	CBH351	Garst	113	108.1 a-e	0.0 e	108.1 abc
		LSD value p=0.05		35.27	12.88	34.34
		F-test Prob.		0.0001	<0.0001	0.0395

SOUTH CENTRAL KANSAS EXPERIMENT FIELD

Introduction

The South Central Kansas Experiment Field was established in 1951 on the US Coast Guard Radio Receiving Station located southwest of Hutchinson. The first research data were collected with the harvest of 1952. Prior to this, data for 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, soybeans, rapeseed/canola, and 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

The soil survey for the South Central Field shows 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.

1998-99 Weather Information

Precipitation in 1999 totaled 30.7 inches, 0.87 inches above the 30-year average of 29.83 inches (Table 1). As in previous years, precipitation in 1999 was not distributed evenly through the year. However, rainfall distribution within a given month was spread more evenly than in past years. The highest monthly total was recorded in July (10.22 inches). When the monthly totals were high, (January, April, and July), most of the precipitation was not received in one or two high rainfall events except for the 4.22 inches received on July 16. Therefore, most of the water received did not run off and was considered beneficial to crop production. The soil conditions at planting of the 1999 winter wheat crop (October 1998) were good because of the above-normal rainfall received in September and early October. After planting, precipitation was considerably above the

long-term average for November. These conditions resulted in excellent wheat growth and a considerable number of fall tillers. Even though moisture was below normal in December, February, and March, it was timely, and the temperatures were not extreme. These conditions allowed for near-normal to above-normal wheat yields. The quality of the wheat was affected by the rainfall that occurred after the wheat had matured.

The summer annuals (grain sorghum sunflowers, and soybeans) also yielded well considering the precipitation and temperatures during the growing season. August was dry and extremely hot. September and October precipitation was below normal, but temperatures were near to slightly above normal. Soil moisture and seed bed condition at wheat seeding time for the 2000 crop were considered fair to poor. A frost-free growing season of 169 days (April 18 - October 4, 1999) was recorded. This is 14 days less than the average frost-free season of 183 days (April 19 - October 17).

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

Month	Rainfall (inches)	30-Yr Avg* (inches)	Month	Rainfall (inches)	30-Yr Avg (inches)
1998			April	5.35	2.89
September	3.68	3.14	May	1.99	4.15
October	3.76	2.50	June	3.76	4.09
November	5.29	1.40	July	10.22	3.17
December	0.36	0.99	August	1.83	3.07
1999			September	2.18	3.18
January	1.66	0.60	October	0.03	2.44
February	0.09	1.03	November	0.59	1.49
March	1.50	2.51	December	1.47	0.97
			1998 Total	30.7	29.83

* Most recent 30 years.

CROP PERFORMANCE TESTS

William F. Heer, Kraig L. Roozeboom, and Charlie L. Rife

Introduction

Performance tests for winter wheat, grain sorghum, alfalfa, canola, and sunflower were conducted at the South Central Kansas Experiment Field. Results of these tests can be found in the following publications.

1999 Kansas Performance Tests with Winter Wheat Varieties. KAES Report of Progress 839.

1999 Great Plains Canola Research. KAES Report of Progress 851.

1999 Kansas Performance Tests with Grain Sorghum Hybrids. KAES Report of Progress 844.

1999 Kansas Performance Tests with Sunflower Hybrids. KAES Report of Progress 849.

1999 Kansas Performance Tests with Alfalfa Varieties. KAES Report of Progress 848.

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

William 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 performed to control diseases and weeds. In the wheat- sorghum-fallow system, only two crops are produced every 3 years. Other crops (corn, soybean, sunflower, winter cover crops, and canola) can be placed in the above cropping systems. To determine how winter wheat yields are affected by these crops, winter wheat was planted in rotations following them. Yields were compared to those of continuous winter wheat under conventional (CT) and no-till (NT) practices. Initially, the CT continuous wheat yields were greater than those from the other systems. However, over time, wheat yields following soybeans have increased, reflecting the effects of reduced weed and disease pressures and increased soil nitrogen. However, continuous CT winter wheat seems to outyield NT winter wheat, regardless of the previous crop.

Introduction

In South Central Kansas, continuous hard red winter wheat and winter wheat - grain sorghum - fallow are the predominate cropping systems. The summer-fallow period following sorghum is required, because the sorghum crop is harvested in late fall, after the optimum planting date for wheat in this region. Average annual rainfall is only 29 inches, with 60 to 70% occurring between March and July. Therefore, soil moisture is often not sufficient for optimum wheat growth in the fall. No-tillage (NT) systems often increase soil moisture by increasing infiltration and decreasing evaporation. However, higher grain yields are not always associated 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 are often greater under NT than conventional tillage (CT). Increased immobilization and denitrification of inorganic soil N and decreased mineralization of organic soil N have been related to the increased N requirements under NT. Therefore, evaluation of N rates on hard red winter wheat in continuous wheat and in cropping systems involving "alternative" crops for the area have been evaluated at the South Central Field. The continuous winter wheat study was established in 1979 and restructured to include a tillage factor in 1987. The first of the alternative cropping systems in which 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 soybeans. 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 cropping systems. The research was replicated five times using a randomized block design with a split plot arrangement. The main plot was crop, and the subplots were 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 in 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 and then disked 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 plots and seeding of the NT plots. The plots are cross-seeded to winter wheat. As a result of an infestation of cheat in the 1993 crop, the plots were planted to oats in the spring of 1994. The fertility rates were maintained, and the oats were harvested in July. Winter wheat has been planted in the plots since the fall of 1994. New herbicides have aided in the control of cheat in the NT treatments.

Wheat after Corn/Grain Sorghum Fallow

In this cropping system, winter wheat is planted after a short-season corn has been harvested in late August to early September. This early harvest 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 peas, 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.

Wheat after Soybeans

Winter wheat is planted after the soybeans have been harvested in early to mid September in this cropping system. As with the corn, this early harvest again allows the soil profile water to be recharged 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 1999, a maturity group III soybean was used. This delayed harvest to October 5, effectively eliminating the potential recharge time before the wheat was planted on October 12.

Winter wheat also is planted after canola and sunflowers to evaluate the effects of these two crops on yield. Uniform N fertility is used; therefore, the data are not presented.

Results

Continuous Wheat

Grain yield data for continuous winter wheat are summarized by tillage and N rate in Table 2. Wheat yields in the CT and NT treatments were comparable for the first 4 years. In the fifth year (1992), cheat started to become a serious yield-limiting factor in the NT treatments. By 1993, it had almost completely taken over the NT treatments. As a result of the cheat problem, the plots were planted to oats in the spring of 1994. This allowed for a significant reduction in cheat. The results for 1995 were not affected by cheat but more by the climatic conditions of the year. The cool wet winter with lush growth was followed by a warm period. This then was followed by cold wet weather during seed setting and grain filling. The yield data reflected these conditions. The yield increases that occurred with increasing N rate did not materialize that year. These weather conditions contributed to the NT having greater yield reductions than CT. 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 CT and NT treatments within N rates.

Wheat after Corn

Wheat yield increases with increasing N rates were observed in wheat following corn in 1988 and 1990 (Table 3). The extremely dry conditions from planting through early May of 1989 caused the complete loss of the wheat crop in the rotation for this year. In 1988, 1990, 1991, 1992, and 1993, when timely precipitation occurred in both germination and spring regrowth periods, wheat yields following corn were comparable to those of wheat following wheat. Though not as apparent with sorghum, the effect of reduction in soil N in the 0 N plots also was seen in the yields. Wheat yields in 1994 showed the benefits of the cool wet April and early June. Had it not been for these conditions occurring at the right time of the plants' development, yields would have been considerably less. Weather conditions were quite different for the 1995 wheat crop in the rotation. These conditions caused considerable variability and reductions in yields compared to 1994. However, the yields in the rotation were higher than those of continuous wheat. Also, the test weights for the wheat in the rotation averaged 60 lb/bu, whereas the average for the continuous wheat was only 53 lb/bu. This points out the necessity to use some type of rotation in the farming operation to produce high quality crops. In 1996, the corn prior to wheat was dropped and cover crops were added to this cropping system to provide two cash crops in 3 years. Wheat yields are increasing compared to the continuous NT wheat and the wheat after soybeans, which provide three cash crops in 3 years.

Wheat after Soybeans

Wheat yields after soybeans also reflect the differences in N rate. However, a comparison of wheat yields from this cropping system with those of wheat following corn shows the effects of residual N from soybean production in the previous year. This is especially true for the 0 to 75 lb N rate in 1993 and the 0 to 125 lb rate in 1994 (Table 4). Yields in 1995 reflected the added N from the previous soybean crop, and yield increases with N rates were similar to those in 1994. The 1996 yields for spring wheat reflect the lack of response to N fertilizer. Yields for 1997 and 1998 both leveled 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 wheat yields after soybeans to express the differences in N rate up to 100 lb/a. In the past, those differences stopped at the 75 lb N/a 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. As the rotation continues to cycle, the differences at each N rate probably will stabilize after four to five cycles, so fertilizer N applications could be reduced by 25 to 50 lbs/a where wheat follows soybeans.

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

Table 2. Wheat yields by tillage and nitrogen rate in a continuous wheat cropping system, South Central Kansas Experiment Field, Hutchinson, KS.

	Yield bu/a																							
	1988		1989[1]		1990		1991		1992		1993[2]		1994[3]		1995		1996		1997		1998		1999	
N Rate[4]	CT[5]	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT	CT	NT
0	39	32	35	12	58	50	53	53	40	26	28	2	34	25	26	16	46	23	47	27	52	19	49	36
25	44	41	38	28	60	57	72	70	42	40	31	3	55	52	28	12	49	27	56	45	61	37	67	51
50	40	39	35	27	57	57	74	60	45	38	28	3	59	63	30	9	49	29	53	49	61	46	76	61
75	48	46	37	27	60	58	66	62	45	51	31	11	72	73	30	16	49	29	50	46	64	53	69	64
100	46	50	37	31	58	61	65	56	45	42	27	10	66	76	23	15	46	28	51	44	55	52	66	61
125	41	48	36	30	55	59	67	57	44	44	26	4	64	76	23	12	45	25	48	42	56	50	64	58
LSD* $_{(0.01)}$	NS	10	NS	11	NS	NS	9	9	NS	13	NS	5	17	17	NS	6	NS	NS	8	8	5	5	13	13

* 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] ANOVA for three replications.

[2] Severe cheat infestation in NT treatments.

[3] Yields for oat crop.

[4] Nitrogen rate in lb/a

[5] CT= conventional, NT= no-tillage

Table 3. Wheat yields after corn by nitrogen rate, South Central Kansas Experiment Field, Hutchinson, KS

N Rate	Yield						
	1988	1990	1991	1992	1993	1994	1995
lb/a	bu/a						
0	9	21	44	34	18	13	17
25	13	31	71	47	24	27	26
50	17	43	76	49	34	40	24
75	19	53	61	47	37	48	36
100	17	54	62	47	47	48	41
125	19	55	62	44	49	42	37
LSD* $_{(0.01)}$	5	4	7	5	9	4	4
CV $_{(\%)}$	27	8	10	8	15	10	18

* 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.

Table 4. Wheat yields after soybeans by nitrogen rate, South Central Kansas Experiment Field, Hutchinson, KS

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

* 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.

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

William F. Heer and Rhonda R. Janke

Summary

The effects of the cover crop most likely were not expressed in the grain sorghum harvest for the first year (1996). Limited growth of the cover crop (winter peas) because of weather conditions produced limited amounts of organic nitrogen (N). 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 then were planted and terminated in the following spring. Then the N rate treatments were applied, and the grain sorghum was planted on June 11, 1999.

Introduction

There is a renewed interest in the use of winter cover crops as a means of soil and water conservation, as 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 pea. It is established in the fall, and after overwintering and producing sufficient spring foliage, it is returned to the soil prior to planting of a summer annual. Because winter pea is a legume, it has a potential for adding nitrogen (N) to the soil system. With this in mind, research projects were established at the South Central Experiment Field to evaluate winter pea, sweet clover, and hairy vetch for their ability to supply N to the succeeding grain sorghum crop in comparison to commercial fertilizer N.

Procedures

The research was conducted at the KSU South Central Experiment Field, Hutchinson. The soil in the experimental area was an Ost loam. The site had been planted to wheat previously. The research used a randomized block design and was replicated four times. Cover crop treatments consisted of fall-planted Austrian winter pea with projected termination dates in April and May and no cover crop (fallow). The winter peas were planted on September 14, 1995 at a rate of 35 lb/a in 10-inch rows with a double disk opener grain drill. Actual dates of termination (DOT) were May 16, 1996 (DOT1) and June 4, 1996 (DOT2). Prior to termination of the cover crop, aboveground biomass samples were taken from a 1 sq meter area. These samples were used to determine forage yield (winter pea and other), and forage N and phosphorus (P) contents for the winter pea portion. Fertilizer treatments consisted of four N levels (0, 30, 60, and 90 lb N/a). Nitrogen treatments were broadcast applied as NH_4NO_3 (34-0-0) prior to planting of grain sorghum on June 17, 1996. Phosphate was applied at a rate of 40 lbs P_2O_5 in the row at planting. Grain sorghum plots were harvested on November 25 (reps 1 and 2) and December 8, 1996 (reps 3 and 4) to determine grain yield, moisture, and test weight, and grain N and P contents. In preperation for the 1999 grain sorghum crop, winter peas were planted on September 15, 1998. These plots were terminated on April 21 (DOT199) and May 19 (DOT299) 1999. Grain sorghum was planted on June 11, 1999.

Results

Winter pea cover crop and grain sorghum results are summarized in Tables 5 and 6, respectively.

Soil conditions at planting of the winter peas in 1995 were excellent with good moisture. However, the mid-September planting date was later than desired because of above-normal rainfall in late August and early September. Cool temperatures after planting limited fall growth of the winter peas.

Fall ground cover in 1996 ranged from 26 to 36% with no significant differences across treatments (Table 5). This compares to a range of 36 to 46% for 1999. The winter months of 1996 were cool and dry. This limited growth and delayed DOT1 from early April to May 16. Wet conditions in May also delayed DOT2 to June 4. Winter conditions in 1999 were more favorable, growth of the winter peas was much better, and termination dates were earlier. Winter pea aboveground biomass at DOT1 (1998) was about one-half that of DOT2 (Table 5). However, no significant differences occurred in dry matter (DM) production within DOTs. Differences in the percent N in the DM existed in the treatments for DOT2. These differences were not related to the treatment but to natural occurrence (no treatments were applied to the cover crop plots prior to termination). In 1999, the differences in DM production by termination date were not as great as those in 1996 (Table 6). However, DOT299 had significantly more DM production than DOT199.

Large amounts of N were not produced by the winter pea cover crop in 1996. Nitrogen credited to the cover crop ranged from 9.48 to 30.70 lb/a. The larger amounts of DM produced in 1999 added considerable amounts of N from the winter pea biomass (Table 6).

In 1996, the low levels of N from the winter peas did not carry forward to increase grain yield of the grain sorghum crop. However, only the no-N treatments with and without the cover crop and the DOT1 no cover crop and cover crop plus 90 lb/a N treatments had significantly lower grain yields (Table 6). Flag leaf N (%) and whole plant N (%) were decreased in the no-N treatments with or without cover crop. The highest flag leaf N and whole-plant N occurred in the April cover crop plus 90 lb/a N treatment. Thus, the overall effect of the cover crop and N fertilizer on flag leaf and whole plant N and grain yield in 1996 was not always significant or consistent.

The increased biomass N and the available water (Table 1) during the growing season resulted in excellent grain sorghum yields for 1999 (Table 6). Yields ranged from a low of 40.5 bu/a to a high of 112.3 bu/a. The lowest yield came from the 0 N no cover crop treatment, and the highest from the 60 lb/a N with cover crop (139 lb/a N in biomass) treatment.

As with other N rate studies on the South Central Field, the first increment of fertilizer N had the greatest effect on grain yield. Sorghum yields for DOT1 were not significantly different by treatment. For DOT2, approximately 30 lb/a N as fertilizer were needed to produce sorghum yield comparable to that for the cover crop with no added N. The highest sorghum yields occurred in the DOT1 no-cover crop plus 30 lb/a N and DOT2 cover crop plus 30 and 60 lb/a N treatments. In 1999, the same effect was present. However, for DOT199, yields with cover crop and fertilizer N evened out at the 30 lb/a N, and for DOT299, it took 60 lbN/a to match the yield with winter peas alone.

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

Table 5. Effects of winter pea cover crop and termination date on grain sorghum after winter wheat-cover crop: winter pea growth, KSU South Central Field, Hutchinson, KS, 1996 and 1999.

Termination Date	N Rate[1]	Fall Ground Cover[2]		Nitrogen from Winter Pea		Winter Pea[3] DM Yield	
		1996	1999	1996	1999	1996	1999
	lb/a	%		lb/a		%	
April[4]	0	33	46	9.48	103	302	3061
	30	28	36	12.43	94	413	2796
	60	30	36	10.26	83	342	2825
	90	36	40	22.68	109	717	3317
May[5]	0	36	40	19.71	128	900	4590
	30	34	39	32.40	148	1200	4674
	60	33	41	23.98	139	1110	4769
	90	26	43	30.70	100	1279	3850
LSD (P=0.05)		NS	7			812	1200

1 Nitrogen applied as 34-0-0 after pea termination prior to planting grain sorghum (see Table 2)
2 Winter pea cover estimated by 6 inch intersects on one 44-foot line transect per plot.
3 Winter pea oven dry weight determined from samples taken just prior to termination.
4 Actual termination dates May 16, 1996 and April 21, 1999.
5 Actual termination dates June 4, 1996 and May 19, 1999.

Table 6. Effects of winter pea cover crop and termination date on grain sorghum after winter wheat-cover crop: sorghum yield, KSU South Central Field, Hutchinson KS, 1996 and 1999.

Termination Date	N Rate[1]	Flag leaf 1996 N	Flag leaf 1996 P	Grain Sorghum 1996 N	Grain Sorghum 1996 P	Grain Sorghum 1996 Yield	Grain Sorghum 1999 N	Grain Sorghum 1999 P	Grain Sorghum 1999 Yield
	lb/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
	30	2.7	0.44	1.6	0.27	93.9	1.2	0.29	90.9
	60	2.8	0.43	1.7	0.27	82.6	1.5	0.32	106.4
	90	2.8	0.44	1.7	0.25	90.4	1.7	0.34	101.8
April[2] /pea	0	2.4	0.40	1.5	0.29	80.2	1.3	0.31	93.5
	30	2.7	0.39	1.6	0.26	85.7	1.3	0.32	97.4
	60	2.7	0.38	1.7	0.27	90.0	1.5	0.33	105.1
	90	2.9	0.41	1.8	0.23	83.8	1.8	0.32	97.9
May[3] N/pea	0	2.1	0.39	1.4	0.30	81.4	1.1	0.34	40.5
	30	2.4	0.39	1.5	0.28	88.1	1.1	0.32	66.6
	60	2.6	0.40	1.6	0.27	90.7	1.2	0.30	93.3
	90	2.6	0.40	1.6	0.26	89.6	1.4	0.31	105.9
May[3] /pea	0	2.3	0.40	1.4	0.29	85.0	1.2	0.31	92.4
	30	2.5	0.40	1.5	0.31	92.4	1.3	0.31	97.7
	60	2.6	0.38	1.6	0.26	92.9	1.5	0.30	112.3
	90	2.7	0.41	1.6	0.25	90.5	1.5	0.32	108.7
LSD (P=0.05)		0.2	0.02	0.1	NS	8.9	0.2	0.04	16.0

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

[2]Actual terminations 16 May 1996 due to limited growth and 21 April 1999.

[3] Actual terminations 4 June 1996 due to delay in April termination and 19 May 1999.

SIMULATED SOYBEAN HERBICIDE DRIFT

Stewart R. Duncan and William F. Heer

Summary

The effects of soybean herbicide drift on nearby grain sorghum was evaluated in 1999. This study was designed with 1/3, 1/10, 1/33, and 1/100 of the normal rates of four soybean herbicides. Ratings were taken to determine the amount of damage to the grain sorghum plant, and plot yields were calculated. The 1/3 rates generally reduced yields the most. Effects on test weight and height and damage ratings varied.

Introduction

Over the years and with the advent of newer soybean herbicides, the question of how drift from application affects grain sorghum has been asked several times. A multilocation study was initiated to determine the effects of low rates of common soybean herbicides when applied to grain sorghum.

Procedures

The study was planted on an Ost silt loam soil at the South Central Field. Approximately 45,000 seeds/a of Pioneer 8505 were planted on June 15. Constant winds in excess of 10 mph delayed spray applications from the planned timing at the 2-to 4-leaf stage until July 11, when plants were at the V6-V8 stage of growth. The wind speed was 2-5 mph, relative humidity was 78%, air temperature was 60°F, and skies were clear. Four soybean herbicides were used at 1/3, 1/10, 1/33, and 1/100 of normal rates. The treatments were applied with a compressed CO_2 backpack sprayer at 3 mph with 35 psi, through 8003VS nozzles delivering 20 gal/a of spray solution to each 10 ft x 30 ft plot. The plot design was a randomized complete block with four replications. Herbicide damage assessments were made at 2 and 8 weeks after treatment (WAT) on a scale of 0-100, with 0 being no damage and 100 being complete kill.

Results

Grain yields and test weight from plots treated with 1/3 of recommended rates were reduced significantly versus those from plots treated with 1/10, 1/33, 1/100 and the check with all herbicides except Liberty (Table 7). However, grain yields tended to be less at the 1/3 rate than at lower rates of Liberty. The 1/3 rates of Poast Plus, Pursuit, and Roundup Ultra reduced yields to 89%, 62% and 46%, respectively, of the check plot yields. The other lower herbicide rates did not reduce grain yields significantly. The highest rates reduced plant height in comparison to lower rates of the same herbicide. Increasing rates of Pursuit and Poast Plus tended to inversely affect plant height, but only the higher rates of Roundup Ultra and Liberty shortened plants. At 2 WAT, all treatments exhibited some damage, including the check, which was treated with surfactant. By 8 WAT, the visual symptoms had all but disappeared in the 1/10, 1/33, and 1/100 rate-treated plots, though the 1/10 rate plots of Roundup Ultra and Pursuit still showed some visual damage. At harvest, these symptoms were still evident in the form of delayed maturity (though no moisture differences existed) and a greater number of tillers to be harvested. Liberty-treated plants (1/3 rate) were stunted and late, too, but yields were not reduced. Though light visual damage was still evident at 8 WAT over most rates in Roundup Ultra, Liberty, and Pursuit d plots, no visual damage was noted in Poast Plus plots treated with 1/10, 1/33 and 1/100 rates. Application of 1/10 rates of all herbicides did not affect yields or test weights of grain sorghum. At the 6- to 8-leaf stage of growth, 1/3 rates of Poast Plus were the most

detrimental to grain yields, followed by Pursuit and Roundup Ultra. Applications of selected soybean postemergence herbicides to grain sorghum did not reduce yields, if rates used were 1/10 of the recommended rate or less. Pursuit at 1/10 rates tended to reduce plant height more than comparable rates of the other herbicides.

Table 7. Grain sorghum herbicide drift study, South Central Experiment Field, 1999

Herbicide	Rate	Yield	Test Wt.	Height	Damage 2 WAT†	Damage 8 WAT
	lb/a	bu/a	lb/bu	in.		
Check		82.3 ab	60.60 ab	46.75 abcd	5.00 ef	1.25 fg
Roundup	0.33	44.2 c	60.55 b	40.50 f	70.00 b	66.25 c
	0.10	83.7 ab	60.98 a	47.00 abcd	2.50 f	6.25 d
	0.033	88.5 ab	60.83 ab	47.50 abc	11.25 ef	1.25 fg
	0.01	93.7 ab	60.80 a	46.50 abc	10.00 ef	1.25 fg
Liberty	0.12	79.6 b	60.88 ab	43.00 e	66.25 b	26.25 d
	0.036	88.6 ab	60.93 a	47.50 abc	31.25 cd	3.75 efg
	0.011	91.8 ab	60.98 a	46.75 abcd	20.00 de	1.25 fg
	0.0036	86.7 ab	60.63 ab	47.00 abcd	10.00 ef	0.00 g
Pursuit	0.021	31.6 c	59.78 c	34.75 g	80.00 b	80.00 b
	0.0063	77.3 b	60.68 ab	45.50 d	37.50 c	7.50 e
	0.0019	86.9 ab	60.93 a	46.25 dc	2.50 f	0.00 g
	0.00063	92.3 ab	60.90 ab	48.25 ab	5.00 ef	1.25 fg
Poast	0.05	9.1 d	59.68 c	33.75 g	97.25 a	95.50 a
	0.015	80.4 ab	60.73 ab	46.00 cd	20.00 de	0.00 g
	0.0045	96.4 a	60.98 a	47.00 abcd	3.75 f	0.00 g
	0.0015	93.0 ab	60.93 a	48.50 a	1.25 f	0.00 g
$LSD_{(0.05)}$		16.6	0.36	1.81	15.35	6.02
c.v.%		15.2	0.42	2.83	38.8	24.7

† Weeks after treatment

MULTIPLE-SITE EXPERIMENTS

HIGH-OIL CORN HYBRID PERFORMANCE

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Summary

A study was conducted to assess the performance of 11 high-oil corn hybrids and their grain parents under dryland and irrigated conditions. Grain yields ranged from 62 to 110 bu/a for the high-oil hybrids under dryland, and oil contents ranged from 6.2 to 7.7%. These hybrids also produced higher levels of lysine, protein, and energy. Yields of the grain parents ranged from 44 to 122 bu/a under the same conditions. Under irrigation, grain yields ranged from 130 to 212 bu/a for the high oil hybrids, and oil contents ranged from 6.5 to 6.9%. Yields of the grain parents ranged from 145 to 202 bu/a under the same conditions. In 1999, temperature stress during pollination at Belleville reduced grain yields in the grain parents compared to the high-oil hybrids. As a result, the high-oil hybrids produced 5% higher grain yields under dryland conditions. Under irrigation, the grain parents produced 4% higher yields than the high-oil hybrids.

Introduction

Interest in high-oil corn performance has increased in northeast Kansas. Dupont Optimum Quality Grains estimated that approximately 1 million acres of high-oil corn were produced in the U.S. in 1997, with approximately 70% being used as livestock feed and the remainder for cash sales. Because of isolation requirements and small market areas, these hybrids are not entered routinely into university performance trials. The objective of this study was to evaluate the performance of several high oil corn hybrids and compare them to their non-high oil counterparts.

Procedures

Fourteen high-oil corn hybrids were evaluated in 1999 under irrigation at the Paramore Unit of the Kansas River Valley Experiment Field. These same hybrids were also tested under dryland at the Cornbelt Experiment Field and the North Central Experiment Field. All hybrids utilized "Top Cross" pollinators to achieve elevated oil levels. For each high-oil hybrid used, its grain parent also was included. Appropriate isolation was utilized between the grain parent hybrid block and each high-oil hybrid group of the same pollinator. All plots at the Paramore Unit were planted on May 8, 1999. All plots were planted at the North Central Field on April 29, 1999 and at the Cornbelt Field on May 25, 1999.

Statistical analyses of these hybrids pose a unique problem in that isolation groups have a set of unique treatments. Variances were compared between each high-oil hybrid group. Because variances were different, the high-oil corn hybrids were analyzed within each company only. The normal corn hybrids also were analyzed as a complete group in a randomized block design.

Results

Grain yields were average to below average for both dryland and irrigated conditions. Under irrigation at the Paramore Unit, the high-oil hybrids produced grain yields that averaged over 7 bu/a lower than of the grain parents (Table 1). The high-oil hybrids yield ranged from 131 to 212 bu/a, whereas those of the grain parents ranged from 145 to 202 bu/a.

Dryland high-oil corn yields ranged from 62 to 110 bu/a (Tables 2 & 3). Yields for the grain parents followed a similar pattern, ranging from 44 to 122 bu/a. Previous research with high-oil corn at other universities and at Kansas State indicated an 8 to 15% yield decline compared to conventional yellow corn. However, under dryland conditions in 1999, the high-oil corn hybrids produced grain yields that averaged 4 bu/a (~5%) higher than those of their grain parents.

As in 1998, a large difference occurred between the high-oil and conventional grain parents. In 1998, plot layout and design were such that it was difficult to determine if spatial variability with the plot region the reason or if the high-oil hybrids truly had an advantage. In 1999, the grain parent blocks were repeated at the front and back of the plots, so that field difference could be accounted for on some level.

Overall under dryland, grain yields were lower than average, because above-average temperatures and lower than average rainfall prevailed during July. Under these conditions, performance of high-oil corn hybrids compared to their grain parents varied by location. At the Cornbelt Experiment Station, the high oil hybrids produced grain yields that were either equal to or lower than those of their grain parents. At the North Central Experiment Field, the grain parents produced grain yields that were either equal to or lower than those of the high-oil counterparts. We believe that the longer pollination period of the high- oil hybrids may have resulted in greater pollination percentages during the stressful period that was encountered around the tassel and silk stages.

These results also indicate that differences exist among the high-oil hybrids as well as between the high-oil and conventional hybrids concerning many of the grain quality components measured. In the high-oil hybrids, oil contents ranged from 6.2 to 7.7%. The high-oil hybrids were approximately 2.9 percentage points higher than the conventional hybrids in oil contents. Lysine levels ranged from 0.29 to 0.36% in the high- oil hybrids. These levels were 0.04 percentage points higher than the lysine levels of the conventional corn hybrids. The high-oil hybrids were 0.59 percentage points higher in protein and 527 Mcal/a higher in energy than their conventional counterparts. Price premiums averaged $0.18/bu for the high-oil corn hybrids.

Tables 4 and 5 contain the period of years summaries for all hybrids evaluated in the past 3 years. Data are segregated by irrigation and dryland.

Conclusions

High-oil corn hybrids illustrated the ability to produce average grain yields under dryland conditions. At one location, the extended pollination period often encountered with high-oil hybrid blends resulted in greater grain yields as a result of a higher pollination percentage. Overall, the high-oil hybrids produced oil contents of 6.9%, an oil premium of 0.18 $/bu, protein levels of 10%, starch levels of 59.7, energy levels of 10 575 Mcal/a, lysine levels of 0.323% and total values of $238.35/a.

Table 1. Grain yield, quality, and value for irrigated high-oil (TC) and conventional (Con) corn grown at the Paramore Unit, Kansas River Valley Experiment Field, near Silver Lake, KS.

Hybrid	Corn Type	Grain Yield	Oil	Premium	Protein	Starch	Energy	Lysine	Total Value
		(bu/a)	(%)	($/bu)	(%)	(%)	(kcal/a)	(%)	($/acre)
DK595	Con	178.5	4.5	0.00	8.17	61.77	15313	0.269	$347.98
DK595TC	TC	160.2	6.9	0.19	8.80	58.93	14436	0.302	$331.71
DK621	Con	170.2	4.5	0.00	8.35	61.95	14688	0.272	$331.93
DK621TC	TC	154.8	6.5	0.14	8.43	59.80	13803	0.292	$313.51
DK6326	Con	201.7	3.9	0.00	8.40	62.50	17181	0.267	$393.27
DK6326TC	TC	156.3	6.8	0.17	8.13	60.10	14028	0.292	$320.81
Dekalb LSD(0.10)		26.6	0.5	0.01	ns	1.23	ns	0.011	ns
8366	Con	176.0	4.5	0.00	7.90	61.90	15057	0.266	$343.18
8366TC2	TC	212.3	6.7	0.17	8.17	59.00	18684	0.288	$438.82
8546	Con	173.9	4.3	0.00	8.47	62.43	14996	0.273	$339.04
8546TC2	TC	192.7	6.7	0.16	8.23	60.10	17258	0.292	$396.63
8509TC2	TC	156.7	6.8	0.17	8.20	59.53	13856	0.290	$322.14
Garst LSD(0.10)		ns	0.8	0.05	0.56	1.04	3039	0.012	$71.59
2550	Con	145.3	4.3	0.00	8.50	62.15	12410	0.271	$283.39
SKX 2550-19	TC	130.9	6.8	0.17	8.77	59.17	11767	0.300	$267.50
3049	Con	180.3	4.3	0.00	8.13	62.47	15444	0.267	$351.63
SKX 3049-19	TC	147.2	6.7	0.17	8.40	59.23	13037	0.293	$301.08
3977	Con	159.6	3.9	0.00	8.17	62.10	13570	0.264	$311.32
SKX 3977-19	TC	168.5	6.5	0.15	8.95	60.30	15238	0.302	$342.48
Pfisters LSD(0.10)		17.3	0.6	0.05	ns	0.63	1590	0.021	$33.20
34K77	Con	177.0	4.3	0.00	7.85	62.20	15633	0.264	$345.17
34K82	TC	177.3	6.6	0.16	9.10	59.70	15454	0.305	$362.71
34K79	TC	162.7	6.7	0.16	8.70	59.60	14607	0.298	$333.37
Pioneer LSD(0.10)		ns	0.7	0.08	1.21	0.91	1164	0.038	ns
W1792	Con	172.7	4.2	0.00	8.23	62.40	14845	0.268	$336.67
W6606ED	TC	152.8	6.9	0.18	8.30	59.30	13625	0.294	$315.52
W2330	Con	169.4	4.5	0.00	8.20	62.03	14405	0.268	$330.28
W30ED	TC	192.4	6.8	0.17	9.20	58.87	17309	0.306	$397.42
W6607ED	TC	157.1	6.7	0.16	8.63	59.50	13980	0.295	$321.51
Wilson LSD(0.10)		ns	0.9	0.04	0.58	0.70	ns	0.013	ns
Average	Con	173.1	4.3	0.00	8.22	62.17	14867	0.268	$301.34
Average	TC	160.8	6.7	0.17	8.55	59.49	14764	0.296	$329.91

Table 2. Grain yield, quality, and value for dryland high-oil (TC) and conventional (Con) corn grown at the Cornbelt Experiment Field near Powhattan, KS.

Hybrid	Corn Type	Grain Yield	Oil	Premium	Protein	Starch	Energy	Lysine	Total Value
		(bu/a)	(%)	($/bu)	(%)	(%)	(kcal/a)	(%)	($/acre)
DK595	Con	103.1	4.0	$0.00	9.22	64.27	9207	0.286	$201.11
DK595TC	TC	79.9	6.3	$0.09	10.20	61.10	7439	0.321	$163.22
DK621	Con	102.2	4.0	$0.00	8.93	64.77	9167	0.283	$199.28
DK621TC	TC	94.4	7.2	$0.22	10.20	59.80	8913	0.331	$204.55
DK6326	Con	102.7	4.2	$0.00	8.60	64.27	9217	0.280	$200.26
DK6326TC	TC	96.1	7.3	$0.22	10.03	59.70	9025	0.329	$208.81
Dekalb LSD(0.10)		14.4	0.6	$0.08	0.57	0.91	ns	0.010	$29.02
8366	Con	101.5	4.1	$0.00	8.78	64.34	9105	0.282	$198.00
8366TC2	TC	102.0	7.1	$0.21	9.37	60.33	9594	0.319	$219.91
8546	Con	98.8	4.1	$0.00	8.78	64.33	8835	0.281	$192.67
8546TC2	TC	95.6	7.2	$0.22	9.63	60.13	8997	0.324	$207.11
8509TC2	TC	103.0	7.2	$0.22	9.50	60.03	9707	0.322	$223.14
Garst LSD(0.10)		ns	0.4	$0.04	0.40	0.61	ns	0.008	ns
2550	Con	119.3	4.5	$0.00	9.03	63.93	10817	0.289	$232.65
SKX 2550-19	TC	98.4	6.6	$0.13	9.77	60.70	9275	0.322	$204.73
3049	Con	85.6	4.0	$0.00	8.85	64.60	7650	0.281	$166.96
SKX 3049-19	TC	75.3	6.9	$0.19	10.03	60.00	7046	0.325	$160.89
3977	Con	104.0	4.5	$0.00	8.77	63.50	9270	0.283	$202.72
SKX 3977-19	TC	102.7	7.5	$0.24	9.87	59.50	9711	0.329	$225.31
Pfisters LSD(0.10)		24.8	0.5	$0.08	0.21	0.87	ns	0.004	ns
34K77	Con	110.9	4.3	$0.00	9.07	64.22	9962	0.286	$216.23
34K82	TC	109.6	7.2	$0.22	10.90	59.43	10295	0.340	$237.83
34K79	TC	101.6	7.3	$0.22	10.65	59.37	9503	0.330	$220.53
Pioneer LSD(0.10)		ns	0.3	$0.02	0.43	0.80	ns	0.006	ns
W1792	Con	114.8	4.0	$0.00	8.81	64.43	10245	0.281	$223.85
W6606ED	TC	88.3	7.1	$0.21	9.77	59.93	8285	0.324	$190.78
W2330	Con	122.1	4.0	$0.00	8.34	64.61	10874	0.274	$238.10
W30ED	TC	94.9	7.0	$0.20	9.93	59.80	8873	0.324	$203.64
W6607ED	TC	98.7	7.4	$0.23	9.57	60.10	9327	0.324	$215.54
Wilson LSD(0.10)		7.1	0.3	$0.03	0.37	0.66	662	0.006	$15.85
Average	Con	105.9	4.1	$0.00	8.83	64.30	9486	0.282	$206.53
Average	TC	95.8	6.9	$0.18	9.93	60.30	8966	0.323	$203.67

Table 3. Grain yield, quality, and value for dryland high-oil (TC) and conventional (Con) corn grown at the North Central Experiment Field near Belleville, KS.

Hybrid	Corn Type	Grain Yield	Oil	Premium	Protein	Starch	Energy	Lysine	Total Value
		(bu/a)	(%)	($/bu)	(%)	(%)	(kcal/a)	(%)	($/acre)
DK595	Con	74.5	3.7	$0.00	11.40	63.20	6716	0.313	$145.19
DK595TC	TC	89.1	7.3	$0.22	11.03	59.47	8521	0.345	$193.74
DK621	Con	75.7	3.7	$0.00	11.27	64.13	6805	0.311	$147.62
DK621TC	TC	97.5	7.6	$0.25	10.83	59.27	9341	0.346	$214.41
DK6326	Con	73.4	3.8	$0.00	11.23	63.47	6615	0.312	$143.16
DK6326TC	TC	95.6	7.1	$0.21	11.30	59.40	9103	0.346	$206.53
Dekalb LSD(0.10)		16.5	0.4	$0.03	ns	0.52	1574	0.007	$36.28
8366	Con	44.4	4.0	$0.00	11.23	63.00	3999	0.313	$86.66
8366TC2	TC	68.6	7.1	$0.20	11.60	59.47	6511	0.349	$147.75
8546	Con	63.9	3.8	$0.00	11.27	63.40	5752	0.312	$124.55
8546TC2	TC	66.9	6.9	$0.19	11.63	59.70	6358	0.349	$142.85
8509TC2	TC	66.4	7.1	$0.20	11.43	59.30	6305	0.347	$143.02
Garst LSD(0.10)		ns	0.5	$0.04	ns	0.78	ns	0.004	ns
2550	Con	83.4	4.2	$0.00	11.47	62.57	7566	0.319	$162.54
SKX 2550-19	TC	87.3	7.7	$0.27	11.87	58.47	8367	0.359	$193.70
3049	Con	45.1	3.8	$0.00	11.07	63.57	4040	0.308	$87.94
SKX 3049-19	TC	74.3	7.2	$0.22	11.43	59.37	7058	0.348	$160.93
3977	Con	49.6	3.8	$0.00	10.90	63.77	4440	0.306	$96.68
SKX 3977-19	TC	61.9	7.0	$0.19	11.93	59.37	5857	0.352	$132.68
Pfisters LSD(0.10)		19.8	0.5	$0.05	0.25	0.80	1792	0.006	$38.47
34K77	Con	84.6	3.9	$0.00	10.80	63.87	7632	0.306	$165.05
34K82	TC	95.9	7.0	$0.19	12.00	59.63	9155	0.355	$205.27
34K79	TC	96.1	7.0	$0.20	11.67	59.47	9155	0.350	$206.39
Pioneer LSD(0.10)		ns	0.7	$0.05	0.42	1.15	ns	0.005	ns
W1792	Con	46.0	3.8	$0.00	11.80	63.37	4143	0.319	$89.66
W6606ED	TC	104.5	7.0	$0.20	11.33	59.60	9932	0.346	$224.40
W2330	Con	74.3	3.9	$0.00	11.43	62.73	6649	0.313	$144.90
W30ED	TC	84.2	7.1	$0.21	11.97	58.83	7976	0.354	$181.78
W6607ED	TC	87.2	7.1	$0.21	11.50	59.43	8300	0.349	$187.97
Wilson LSD(0.10)		19.7	0.4	$0.03	ns	0.91	1773	0.006	$39.26
Average	Con	65.0	3.9	$0.00	11.26	63.37	5851	0.312	$126.72
Average	TC	84.0	7.2	$0.21	11.54	59.34	7996	0.350	$181.46

Table 4. Grain yield, oil content, oil premium, total value, and entry number for high oil (TC) and grain parent (Con) corn hybrids for four dryland location-years.

Company	Hybrid	Corn Type	Grain Yield (bu/a)	Oil (%)	Oil Premium ($/bu)	Total Value ($/bu)	Entries
Dekalb	DK595	Con	108.6	3.9	0.00	247.05	4
Dekalb	DK595TC	TC	109.8	6.6	0.15	261.79	4
Dekalb	DK621	Con	88.9	3.8	0.00	173.45	2
Dekalb	DK621TC	TC	95.9	7.4	0.23	209.48	2
Dekalb	DK6326	Con	88.1	4.0	0.00	171.71	2
Dekalb	DK6326TC	TC	95.8	7.2	0.22	207.67	2
Garst	8366	Con	73.0	4.1	0.00	142.33	2
Garst	8366TC2	TC	85.3	7.1	0.21	183.83	2
Garst	8546	Con	81.3	4.0	0.00	158.61	2
Garst	8546TC2	TC	81.2	7.0	0.20	174.98	2
Garst	8509TC2	TC	84.7	7.2	0.21	183.08	2
Novartis	N6423	Con	126.1	4.1	0.00	315.25	2
Novartis	N6423TC	TC	132.7	6.6	0.16	340.44	2
Novartis	N62K8	TC	113.9	6.8	0.18	291.94	2
Novartis	N7333bt	Con	141.5	4.1	0.00	353.75	2
Novartis	N7376	TC	130.7	6.9	0.19	338.96	1
Novartis	N7590bt	Con	155.6	4.3	0.00	388.92	2
Novartis	N7577	TC	129.2	7.0	0.20	336.27	2
Novartis	N66U6	TC	117.8	7.1	0.21	306.51	2
Pfisters	P2550	Con	101.3	4.4	0.00	197.60	2
Pfisters	SKX 2550-19	TC	92.8	7.2	0.20	199.22	2
Pfisters	P2652	Con	141.5	4.0	0.00	353.67	2
Pfisters	SKX 2652-19	TC	136.1	7.3	0.23	359.29	2
Pfisters	P2680	Con	134.9	4.2	0.00	337.29	2
Pfisters	SKX 2680-19	TC	121.0	7.0	0.20	312.79	2
Pfisters	P3049	Con	98.2	4.1	0.00	227.60	4
Pfisters	SKX 3049-19	TC	100.4	7.0	0.20	244.34	4
Pfisters	P3977	Con	117.5	4.2	0.00	276.95	5
Pfisters	SKX 3977-19	TC	112.9	7.4	0.24	283.97	5
Pioneer	2345	Con	181.3	4.2	0.00	453.17	1
Pioneer	32R90	TC	128.3	6.9	0.19	332.64	3
Pioneer	34K77	Con	97.8	4.1	0.00	190.64	2
Pioneer	34K79	TC	98.8	7.1	0.21	213.46	2
Pioneer	34K82	TC	102.8	7.1	0.21	221.55	2
Wilson	W1792	Con	80.4	3.9	0.00	156.76	2
Wilson	W6606ED	TC	96.4	7.1	0.20	207.59	2
Wilson	W2330	Con	98.2	3.9	0.00	191.50	2
Wilson	W30ED	TC	89.5	7.1	0.20	192.71	2
Wilson	W6607ED	TC	92.9	7.2	0.22	201.76	2
Average		Con	111.4	4.1	0.00	253.95	42
Average		TC	107.0	7.1	0.20	256.20	51

Table 5. Grain yield, oil content, oil premium, total value, and entry number for high oil (TC) and grain parent (Con) corn hybrids for three irrigated location-years.

Company	Hybrid	Corn Type	Grain Yield (bu/a)	Oil (%)	Oil Premium ($/bu)	Total Value ($/bu)	Entries
Dekalb	DK595	Con	154.2	4.2	0.00	336.41	2
Dekalb	DK595TC	TC	149.4	6.7	0.16	342.50	2
Dekalb	DK621	Con	170.2	4.5	0.00	331.93	1
Dekalb	DK621TC	TC	154.8	6.5	0.14	313.51	1
Dekalb	DK6326	Con	201.7	3.9	0.00	393.27	1
Dekalb	DK6326TC	TC	156.3	6.8	0.17	320.81	1
Garst	8366	Con	176.0	4.5	0.00	343.18	1
Garst	8366TC2	TC	212.3	6.7	0.17	438.82	1
Garst	8546	Con	173.9	4.3	0.00	339.04	1
Garst	8546TC2	TC	192.7	6.7	0.16	396.63	1
Garst	8509TC2	TC	156.7	6.8	0.17	322.14	1
Novartis	N6423	Con	153.9	3.9	0.00	384.69	2
Novartis	N6423TC	TC	161.8	6.7	0.16	417.47	2
Novartis	N62K8	TC	131.7	6.9	0.18	340.33	1
Novartis	N7333bt	Con	145.8	3.8	0.00	364.45	2
Novartis	N7376	TC	200.2	6.4	0.14	515.05	1
Novartis	N7590bt	Con	164.2	4.0	0.00	410.39	2
Novartis	N7577	TC	183.6	7.1	0.20	482.12	2
Novartis	N66U6	TC	140.6	7.2	0.22	369.71	1
Pfisters	P2550	Con	145.3	4.3	0.00	283.39	1
Pfisters	SKX 2550-19	TC	130.9	6.8	0.17	267.50	1
Pfisters	P2652	Con	161.1	4.9	0.00	402.70	2
Pfisters	SKX 2652-19	TC	176.6	7.0	0.20	463.39	3
Pfisters	P2680	Con	149.1	4.7	0.00	372.82	2
Pfisters	SKX 2680-19	TC	162.9	7.3	0.23	430.57	2
Pfisters	P3049	Con	145.7	4.2	0.00	314.56	2
Pfisters	SKX 3049-19	TC	147.6	7.1	0.20	347.07	2
Pfisters	P3977	Con	133.2	4.2	0.00	289.16	2
Pfisters	SKX 3977-19	TC	159.3	6.9	0.18	368.97	2
Pioneer	32R90	TC	101.6	5.8	0.00	241.46	1
Pioneer	34K77	Con	177.0	4.3	0.00	345.17	1
Pioneer	34K79	TC	162.7	6.7	0.16	333.37	1
Pioneer	34K82	TC	177.3	6.6	0.16	362.71	1
Wilson	W1792	Con	172.7	4.2	0.00	336.67	1
Wilson	W6606ED	TC	152.8	6.9	0.18	315.52	1
Wilson	W2330	Con	169.4	4.5	0.00	330.28	1
Wilson	W30ED	TC	192.4	6.8	0.17	397.42	1
Wilson	W6607ED	TC	157.1	6.7	0.16	321.51	1
Average		Con	160.0	4.3	0.00	363.76	29
Average		TC	162.8	6.7	0.16	382.46	33

EFFECTS OF PLACEMENT OF STARTER FERTILIZERS ON CORN

Larry D. Maddux, David A. Whitney, and Scott A. Staggenborg

Summary

The effects of phosphorus (P) placement and source were evaluated at two sites in northeast Kansas. Most of the placement methods and both P sources were effective in increasing plant P concentration over that of the 0 N, 0 P check at one site but not the other. Yields at both sites with almost all treatments were higher than those of the 0 N, 0 P check.

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. Previous research has shown that starter fertilizers can increase corn yield. This research was designed to evaluate effects of phosphorus (P) application and placement on the uptake of P by corn plants and corn yield. It was supported in part by a grant from Na-Churs Alpine Solutions and included their 6-24-6 fertilizer as a seed placement treatment.

Procedures

The study was conducted at two sites: (1) Cornbelt Experiment Field near Powhattan, on a dryland Grundy silty clay loam site previously cropped to soybeans with a pH of 6.5, an organic matter content of 3.2%, and a P test level of 6 ppm and (2) Kansas River Valley Experiment Field, Rossville Unit, on an irrigated Sarpy fine sandy loam site previously cropped to grain sorghum with a pH of 6.7, an organic matter content of 1.2%, and a P test level of 12 ppm.

Nitrogen (N) was applied at 120 lbs/a at Powhattan and at 180 lbs/a at Rossville using a urea ammonium nitrate solution (UAN). Eleven treatments were used: (1) 0 N, 0 P check; (2) 0 P check with N; (3) 18-46-0 surface, broadcast; (4&5) in the seed row application of 6-24-6 at 3 and 6 gpa (supplied by Na-Churs Alpine); (6&7) in the seed row application of 10-34-0 at 2 and 4 gpa (same P rate as the 6-24-6); (8) 10-34-0 at 7.6 gpa in a 2x2 placement (to supply 8.8-30-0); (9) 15-15-0 at 18 gpa in a 2 x2 placement (made with UAN and 10-34-0 to supply 30-30-0); (10) dual placement (mixture of UAN and 10-34-0 to supply the N-30-0); and (11) dual placement (N-30-0) + seed row placement of 6-24-6 at 3 gpa.

The N, surface, broadcast P, and dual placement treatments were applied on May 3 at Rossville and May 26 at Powhattan. The starter treatments were applied on May 7 at Rossville and May 27 at Powhattan. Pioneer Brand 3335 hybrid corn was planted at 30,000 sds/a in 30-inch rows on May 7 at Rossville and Garst 8541IT hybrid corn was planted at 26,000 sds/a in 30-inch rows on May 27 at Powhattan. Whole-plant samples (five plants) were taken at the 6-leaf stage of growth, and 10 leaves opposite and below the ear leaf were sampled at tasseling. These plant samples were analyzed for N and P. The plots were harvested using a plot combine on October 1 and 28, at Rossville and Powhattan, respectively. Grain samples were collected and analyzed for N and P. Not all samples have been analyzed yet.

Results

No differences in P concentration of 6-leaf plant tissue was observed at Powhattan. At Rossville, plants in the 0 N, 0 P check had a higher P concentration than those in all other treatments, probably because of their smaller size from lack of N. No differences between any other treatments were observed at the 6-

leaf stage of growth. Tassel leaf P concentration data were not available for Powhattan. Significant differences in the leaf P concentration at tasseling were observed at Rossville, but no consistent trends for P placement were observed.

Most of the treatments that received starter resulted in higher P concentrations than did the 0 N, 0 P check. However, so did the N, 0 P check.

All treatments except broadcast P at Powhattan gave higher yields than the 0 N, 0 P check. The dual placement of N and P was the highest yielding treatment at both sites. However, because of the high variability at both sites, no significant differences occurred among any of the other treatments. This study will be continued in 2000.

Table 1. Effect of starter P placement and source on phosphorus content and yield of corn, northeast Kansas, 1999.

		6-Leaf P		Tassel Leaf P		Yield	
Treatment[1]	Rate	Pow.	Ross.	Pow.	Ross.	Pow.	Ross.
		%		%		%	
0 N, 0 P	---	0.221	0.537		0.252	63	71
N, 0 P	---	0.213	0.456		0.290	87	149
Surface P Appl'n	40# P_2O_5	0.201	0.464		0.277	83	164
6-24-6, w/seed	3 gpa	0.232	0.407		0.293	97	189
6-24-6, w/seed	6 gpa	0.233	0.401		0.264	98	160
10-34-0, w/seed	2 gpa	0.231	0.447		0.294	99	167
10-34-0, w/seed	4 gpa	0.237	0.421		0.312	96	167
10-34-0, 2x2	7.6 gpa[2]	0.254	0.434		0.294	93	169
15-15-0, 2x2	18 gpa[2]	0.251	0.420		0.296	90	150
N-30-0[3], Dual		0.216	0.426		0.270	105	199
N-30-0[3], Dual+Seed	3 gpa[3]	0.226	0.421		0.304	97	185
LSD(0.05)		NS	0.071		0.032	21	46

[1] N rates: 120 lbs N/a at Powhattan; 180 lbs N/a at Rossville; All treatments adjusted to same N.[2] 7.6 gpa of 10-34-0 = 8.8-30-0; 18 gpa of 15-15-0 = 30-30-0 (i.e. 1:3 and 1:1 ratio N:P starters).[3] 6-24-6 used at 3 gpa for seed treatment, 10-34-0 used with UAN to make the solution that was dual placed (N rate + 30 lbs P_2O_5).

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