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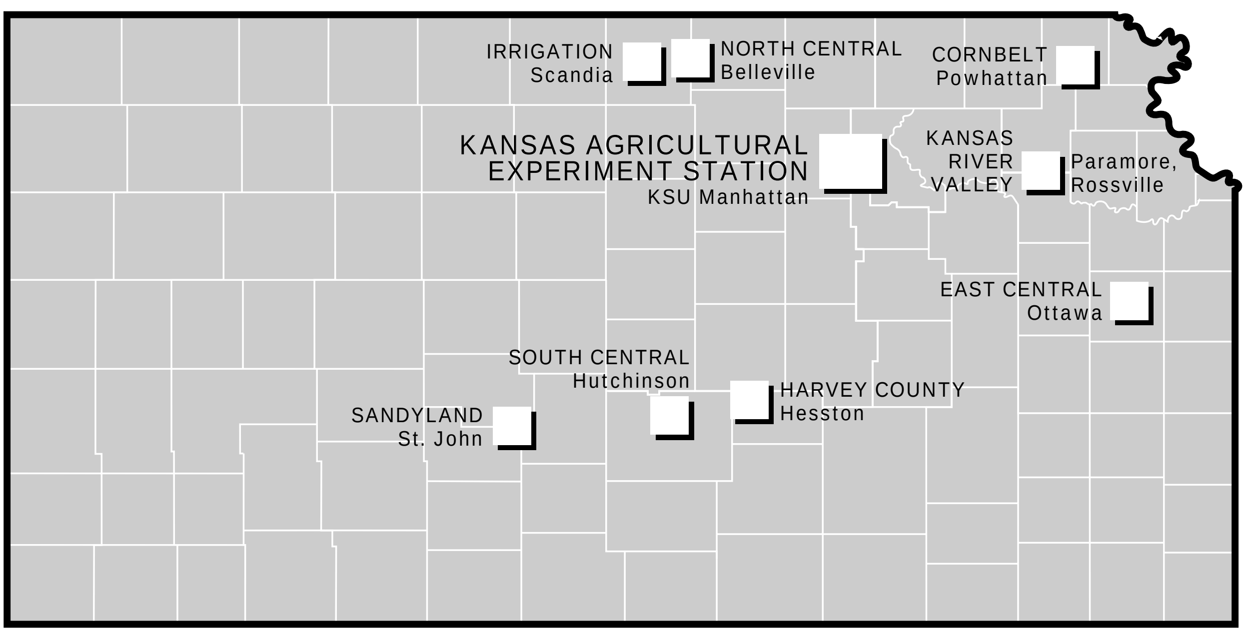
Kansas State University Agricultural Experiment Station and Cooperative Extension Service

FIELD RESEARCH 2001



Agronomy Experiment Fields

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CORNBELT EXPERIMENT FIELD

Introduction

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

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

Soil Description

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

2000 Weather

Precipitation during the growing season in 2000 was below normal except for June (Table 1). The 5.48 inch rainfall on June 24 and 2 timely rains of about an inch each in July resulted in corn and sorghum yields in the 90 - 100+ bushel range. However, soybean yields were greatly depressed by the hot dry weather during July and August.
The last killing frost was on April 12 (normal April 23), and the first killing frost was on October 6 (normal October 15). The frost-free period was 2 days longer than the 170-day average.

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

Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Total
October, 1999 - September, 2000												
0.31	1.68	0.36	0.14	1.90	1.49	1.44	1.87	7.62	3.02	1.08	2.47	23.38
43-Year Average												
2.80	1.91	1.03	0.75	0.83	2.23	3.17	4.74	5.07	4.44	3.99	4.36	35.32
Departure From Normal												
-2.49	-0.23	-0.67	-0.61	1.07	-0.74	-1.73	-2.87	2.55	-1.42	-2.91	-1.89	-11.94

WHITE FOOD-CORN PERFORMANCE TEST

Larry D. Maddux

Summary

The average yield of the 25 hybrids in the test was 78.2 bu/a, with a range of 65.0 to 91.0 bu/a. The LSD(.05) was 11.8 bu/a, meaning that two hybrids must differ in yield by 11.8 bu/a to be considered significantly different in yielding ability 95% of the time.

Introduction

The test at the Cornbelt Field is one of 11 locations in a regional fee test coordinated by Dr. L. L. Darrah with USDA-ARS at the University of Missouri. The 2000 test included 23 white corn hybrids submitted by 8 companies and two yellow corn hybrid checks. Five white hybrids were new to the test in 2000.

Procedures

Anhydrous ammonia at 120 lbs N/a was applied. Atrazine 4L at 0.5 qt/a plus Dual at 2.0 pt/a were incorporated with a field cultivator. The hybrids were planted April 24 at 24,390 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 EIII plot combine.

Results

Yields in this test averaged 78.2 bu/a, with a range of 65.0 to 91.0 bu/a (Table 2). Corn yields were low because of the hot, dry weather in July and August. The yellow corn performance test (planted in another field across the road) had an average yield of 113 bu/a, with a range from 81 to 121 bu/a. The yellow check B73xMo17 yielded 69.9 bu/a and the other yellow check (Pioneer Brand 3394) yielded 80.4 bu/a.

Table 2 Grain yield, stand, root and stalk lodging, ear height, moisture content, and days from planting to half-silk of the white food-corn hybrids, Powhattan, KS, 2000.

Brand	Hybrid	Yield	Stand	Stalk Lodged	Days to Flower	Moisture
		bu/a	%	%	no.	%
Asgrow	RX776W	75.8	104.5	0.5	80.0	14.1
Asgrow	RX792W	70.5	97.5	0.0	83.3	14.1
Asgrow	RX901W	79.2	87.4	0.6	84.3	16.3
Diener	D 114W	75.9	67.2	0.7	83.0	15.3
Diener	D 115W	75.3	82.8	0.0	84.7	14.4

Brand	Hybrid	Yield	Stand	Stalk Lodged	Days to Flower	Moisture
		bu/a	%	%	no.	%
IFSI	90-1	75.0	76.3	0.0	84.0	14.9
IFSI	95-1	74.0	80.8	0.7	84.3	20.4
IFSI	97-1	91.0	80.8	0.6	83.7	20.0
NC+	6990W	72.3	80.3	0.0	83.3	17.1
Pioneer Brand	32H39	74.3	91.4	0.0	79.7	13.0
Pioneer Brand	32K72	86.4	80.3	0.5	78.7	13.5
Pioneer Brand	32Y52	81.2	92.9	0.0	81.0	13.6
Pioneer Brand	33T17	89.7	80.3	0.0	81.7	13.2
Vineyard	V433W	78.0	84.8	0.0	83.7	14.2
Vineyard	V455W	76.3	80.3	0.0	81.7	13.4
Vineyard	V462W	74.1	92.9	0.0	85.0	14.6
Vineyard	Vx4359W	84.7	85.4	0.0	82.0	15.2
Whisnand	50AW	89.3	89.4	0.0	82.3	14.5
Whisnand	51AW	76.6	91.9	0.6	83.0	13.9
Zimmerman	1851W	82.4	93.9	0.0	85.0	15.9
Zimmerman	N71-T7	83.6	87.9	0.6	81.7	14.2
Zimmerman	Z62W	65.0	80.3	0.0	83.7	13.6
Zimmerman	Z64W	74.3	81.8	1.3	84.0	15.1
Yellow check	B73xMo17	69.9	68.2	0.0	80.7	12.4
Yellow check	Pioneer 3394	80.4	91.4	0.0	79.3	12.8
Mean		78.2	85.2	0.2	82.5	14.8
LSD 0.05		11.8	15.4	NS	2.9	1.6
CV%		9.3	11.1		2.2	6.7

Bt AND NON-Bt CORN HYBRID EVALUATION IN NORTHEAST KANSAS

S.A. Staggenborg and L.D. Maddux

Summary

Twenty corn hybrids (10 Bt and 10 non-Bt) were evaluated for grain yield and test weight during 2000 at the Cornbelt Experiment Field in Northeast Kansas. Grain yield for the non-Bt hybrids were 92 bu/acre whereas grain yields for the Bt hybrids were 103 bu/acre. Overall, there was no difference between the Bt and conventional corn yields when tested as two entire groups. There were, however, two individual instances where the Bt hybrid produced yields that were greater than the non-Bt counterpart.

Introduction

Bt corn for the control of European and Southwestern corn borer have had a tremendous impact on corn production in the U.S. In the southern corn growing areas of Kansas, this technology has been reported to be very effective in controlling these pests, resulting in yield increases over infested plants that exceeded 50 bu/acre. However, in the northern corn growing regions of Kansas, corn borer pressure varies annually from very light to moderate infestations. Under these infestation levels, the extra cost of Bt hybrids may not outweigh the benefits. The objective of this study is to evaluate Bt corn and their non-Bt counterparts under similar growing conditions.

Procedures

Corn plots were established at the Cornbelt Experiment Field near Powhattan, KS on April 21, 2000. Four corn hybrids from five companies (Dekalb, Garst, Novartis, Pfisters and Pioneer) were utilized. Each company was instructed to enter two Bt hybrids and two conventional hybrids adapted to the area. Hybrids included by each company in the trial are listed in Table 3

Grain weight, test weight and moisture were determined using a plot combine on September 12, 2000. Grain yields were adjusted to 15.5% moisture.

Results

Soil moisture at planting time was available in the upper 1 ft, but subsoil moisture was at record lows due to a dry winter and spring. Rainfall amounts during June were near normal with July and August showing below average rainfall and above average temperatures. These growing conditions reduced overall plot yields to 93 bu/acre.

Growing conditions resulted in few differences in grain yields among the 20 hybrids. Overall, the Bt hybrids averaged 103 bu/acre (58.7 lb/bushel test weight) and the non-Bt hybrids averaged 92 bu/acre (58.4 lb/bushel test weight). Only two Bt-Conventional pairs resulted in yields that were different, Garst '8363' Bt and Garst '8341' and Novartis '67T4' and Novartis '67H6'.

Test weights followed the same pattern as grain yields, in that only one Bt-Conventional pair had test weight that were different, Garst '8363' Bt and Garst '8341'.

Table 3. Bt and Conventional Corn Performance, Cornbelt Experiment Field, 2000.

Brand	Hybrid	Bt Event	Yield	Test Wt.
Garst	8342 GLS, IT, Bt	Mon810	87.2	61.1
Garst	8342 GLS, IT	None	87.1	60.2
Garst	8363 Bt	Mon810	101.2	62.5
Garst	8341	None	86.9	59.3
Novartis	79L3	Bt11	95.5	62.9
Novartis	79L4	None	96.1	64.4
Novartis	67T4	Bt11	109.5	58.2
Novartis	67H6	None	94.6	60.7
Pioneer	33G27	Mon810	88.2	61.1
Pioneer	33G26	None	87.7	60.4
Pioneer	31A13	Mon810	105.4	63.4
Pioneer	31A12	None	103.2	61.9
Dekalb	DK 647 BTY	Mon810	83.3	59.9
Dekalb	DK 647	None	91.0	59.2
Dekalb	DK 595BTY	Mon810	92.0	58.9
Dekalb	DK 595	None	85.9	58.8
Pfister	3977Bt	Mon810	91.1	60.6
Pfister	3977	None	95.6	61.1
Pfister	2655Bt	Mon810	89.9	62.3
Pfister	2655	None	89.6	60.7
LSD(0.05)			13.7	2.3
C.V. (%)			10.4	2.7
Contrasts[1]				
		Bt	102.5	61.1
		None	92.3	60.7
		Bt 11	102.5	60.6
		Mon810	92.3	61.3
		None	91.8	60.7

[1] To compare the conventional and Bt hybrids directly as two groups, an orthogonal contrast was used.
Bt vs Conventional Contrast - Prob > F - 0.3448 (ns).

THE IMPACT OF PLANTER SPEED ON CORN YIELDS

Scott Staggenborg, Randy Taylor, and Larry Maddux

Summary

A field study was conducted in 2000 to determine if seeding rate and planter speed affected corn plant spacings and subsequent grain yields. Corn was seeded at 23,525 and 27,330 seed/acre at speeds of 5, 8 and 11 mph. Planter speed and seeding rate had no effect on grain yield. Planter performance was not affected by seeding rate, but declined as planter speed increased. Both the miss and multiple indices increased as planter speed increased from 5 to 8 mph, with no difference between the 8 and 11 mph treatments. The miss and multiple indices indicate the number of skips and doubles. Correlation and multi variate regression indicates that establishing the appropriate plant population is more important to maximize grain yields than the distribution of the plants as measured by intra-row spacings.

Introduction

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

Materials and Methods

A field study was conducted at the Cornbelt Experiment Field in Brown County, Kansas. On April 12, 2000, the corn hybrid Novarits '79-P4' was planted at two seeding rates (23,525 and 27,330 seed/acre) and three speeds (5, 8, and 11 mph). Plots were four rows wide and approximately 350 feet long. Prior to grain harvest, plant spacings were measured between 20 consecutive plants in each of the center two rows.

Plant spacing distribution was characterized using four indices that utilize a theoretical plant spacing based on the expected seeding rate. These indices include the miss index, which is an indication of the number of times that the planter produced a skip; and the multiple index, which is an indication of the number of times that plants were established in close proximity. The quality of feed index is an indication of the number of times that plant spacings are within a range of 0.5 to 1.5 times the theoretical plant spacing. The precision index is the standard deviation of the plants included in the same range as those used to calculate the quality of feed index.

Grain yields were determined using an Gleaner F2 combine equipped with a AgLeader PF3000 yield monitor. Yields for each plot was calculated by summing the mass flow for each pass to determine grain weight harvested. Grain yields were calculated in an identical manner for the area where plant spacings were measured. These yields were used to determine the impact of plant spacings on grain yields.

Results and Discussion

Early season crop growth was slowed by above average temperatures and below average precipitation during April, May and early June. Corn yields averaged 102 bu/acre, approximately 15 to 20% below the long term field average.

Seeding rate and planter speed had no effect on whole plot grain yields (Table 4). Planter performance, as measured by plant spacing indices, was influenced by planter speed and seeding rates (Table 4).

The miss index increased as planter speed increased. Numerically, the greatest increase occurred as planter speed increased from 5 to 8 mph. The multiple index was influence by both planter speed and seeding rate. The multiple index increased as planter speed increased from 8 mph to 11 mph at the 23,525 seed/acre seeding rate. At the higher seeding rate, the overall multiple index was higher, with a less consistent response to planter speed, than the lower seeding rate. The quality of feed index also decreased and the precision index increased as planter speed increased.

The impact of average plant spacing and the four indices on grain yield was determined using correlation and multi variate regression analysis. Correlation analysis between grain yields and these five components indicate that average plant spacing was the only component that influenced grain yields (Table 5). Multi variate regression suggests that final plant stand (as indicated by average plant spacing) and the number of multiple seed drops (as indicated by the multiple index) affected grain yields (Table 6). It should be noted 75% of the plant spacings measured in this study fell within the acceptable range. The planter used was in above average condition and appropriate adjustments had been made prior to planting. Planter age, level of maintenance and level of adjustment can have a major impact on planter performance.

Table 4. Grain yield, miss index, multiple index, quality of feed index, and precision index for two plant populations and three planter speeds.

	Yield bu/acre		Miss Index		Multiple Index		Quality of Feed Index		Precision Index	
Population										
23,525	103.1	a	15.8	a	10.6	a	76.7	a	23.9	a
27,330	101.1	a	14.4	a	8.9	a	73.6	a	23.7	a
Speed										
5	104.1	a	10.0	b	5.4	b	84.6	a	21.0	b
8	102.3	a	16.7	ab	11.7	a	71.7	b	23.4	ab
11	100.0	a	18.8	a	12.1	a	69.2	b	26.9	a
Pop X Speed										
23,525										
5	103.5	a	7.5	a	4.2	c	88.3	a	21.3	a
8	104.5	a	19.2	a	8.3	c	72.5	a	24.2	a
11	101.1	a	16.7	a	14.2	ab	69.2	a	25.7	a
27,330										
5	101.1	a	12.5	a	6.7	c	80.8	a	20.8	a
8	103.7	a	14.2	a	15.0	a	70.8	a	22.7	a
11	98.7	a	20.8	a	10.0	abc	69.1	a	28.0	a
C.V. (%)	2.9		35.6		31.8		7.6		12.6	

Table 5. Correlation coefficients grain yield with average plant spacing, multiple index, miss index, quality of feed index; and precision index.

Source	Correlation Coefficient
Average Plant Spacing	0.57
Multiple Index	0.09
Miss Index	-0.01
Quality of Feed Index	-0.05
Precision Index	-0.01

Table 6. Multi variate regression results for average plant spacing, multiple index, miss index, and speed effects

Source	Parameter Estimate	Prob > T
Intercept	61.36	0.01
Average Plant Spacing	5.31	0.01
Multiple Index	0.57	0.06
Miss Index	-0.23	0.24
Speed	-0.59	0.34
R^2	0.55	

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 sorg 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 placeme methods for crop efficiency and environmental effects.

Soil Description

Soils on the fields, which encompass 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.

2000 Weather

Precipitation during 2000 totaled 24.20 inches, which was 13.18 inches below the 32-yr average (Table 1). Most of the moisture deficit occurred during the early and middle-to-late parts of the growing season. Rainfall during April and May was 5.03 inches below normal. July, August, and September rainfall was 7.51 inches below normal. The driest month was August with only 6 percent of the normal rainfall.

The coldest temperatures during 2000 occurred during the last nine days of January with 4 days in the single digits and during the last 21 days of December with 18 days in the single digits. The overall coldest temperature recorded was 13° F below zero on December 22. There were 58 days during the summer in which temperatures exceeded 90 degrees. The hottest period was August 22 through September 3 when daily temperatures exceeded 100° F every day. The overall highest temperature was 109° F. The last freeze of the winter was April 13 (average, April 18) and the first killing frost in the fall was October 7 (average, October 21). The number of frost-free days was 176 compared with the average frost free days of 185.

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

Month	2000	32-yr. avg.	Month	2000	32-yr. avg.
January	0.27	1.00	July	1.06	3.52
February	1.95	1.24	August	0.21	3.54
March	2.51	2.62	September	2.24	3.96
April	1.00	3.51	October	4.53	3.50
May	2.72	5.24	November	2.30	2.50
June	4.58	5.25	December	0.83	1.49
Annual Total				24.20	37.38

EFFECTS OF SUB-SOILING 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 tillage, shallower chisel plowing, and no-preplant tillage are being evaluated at the East Central Experiment Field with corn and soybean. Corn and soybean yields for 2000 were limited by dry conditions. Corn yields ranged from 86 to 112 bu/a and soybean yields ranged from 18.0 to 19.4 bu/a. Deep subsoil tillage did not increase corn or soybean yields compared to chisel plow, but for corn all tilled systems produced higher yield than no-till. Averaged across five years, deep subsoil tillage, at best, shows a slight yield advantage over chisel-plow. Additional years of testing will help verify these effects.

Introduction

Extensive acreage in the east-central part of Kansas have dense clay subsoils. These slowly permeable 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 soils. Some farmers deep chisel or subsoil their fields every year, others every other year, and some on a less frequent basis. The benefits from these deep tillage operations have not been fully evaluated. 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 of deep tillage on these types of soils 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 at the East Central Experiment Field on Woodson soil. Tillage treatments established were no-till (no-preplant tillage); chisel plowing every year (5-7" depth); and subsoil tillage at 8-14" depth yearly, every other year, and every 3 years. Treatments were established in two blocks, one for corn and one for soybean. Subsoil and chisel plow treatments were performed on February 16, 2000 for the 2000 growing season. All plots, except the no-till plots, were field cultivated before planting. Also, all corn plots were row-crop cultivated once for weed control. Corn (Hoegemeyer 2693) was planted on April 14, 2000 and soybean (Dyna-Gro DG-3388RR) was planted May 11, 2000. A mixture of 28-0-0 and 10-34-0 liquid fertilizer was coulter knifed to provide 111 lb N and 38 lb P_2O_5/a for corn. No fertilizer was applied for soybean.

Results

The corn and soybean crops in 2000 were stressed by insufficient moisture. Corn grain yields ranged from 86 to 112 bu/a with a test average of 102 bu/a and soybean yields ranged from 18.0 to 19.4 bu/a with a test average of 18.8 bu/a (Table 2). With corn, deep subsoil tillage did not increase yield compared to chisel-plow, but did produce higher yield than no-till. Early-season corn growth was slower with no-till compared to all of the tilled treatments. The slower growth in no-till in combination with the progressively drier available summer moisture, negatively affected no-till yield.

With soybean, the tillage treatments produced no statistically significant yield differences. All frequencies of deep subsoil tillage and chisel-plow treatments failed to yield any better than no-till. Five-year average yields for corn and soybean show a slight trend toward lower yield (5% less) for no-till, but, there were no consistent yield differences between deep subsoil tillage and chisel plow. Shallow tillage may be having a slight yield benefit, but deep tillage is having little effect.

Plans are to continue this study one more year, but evidence is growing that deep tillage and even chisel-plow depth tillage is not greatly benefitting soybean and corn yields on Woodson soil.

Acknowledgment
Appreciation is expressed to John Wray, Ottawa, KS for providing the subsoiler for this study.

Table 2. Sub-soiling effects on corn and soybean yield, Ottawa, KS.

	Yield			
	Corn		Soybean	
Tillage System and Frequency	2000	5-yr Avg	2000	5-yr Avg
	bu/a			
No-till [1]	86	108	18.0	36.0
Chisel [2] (every year)	112	113	19.4	37.8
Subsoil [3] (every year)	108	116	18.9	38.1
Subsoil (every other year)	102	111	18.2	38.2
Subsoil (every third year)	102	117	19.2	37.8
LSD.05	17		NS	
CV %	10.7		6.2	

[1] With one in-season cultivation
[2] 5-7 inch depth.
[3] 8-14 inch depth.

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

K.A. Janssen and D.A. Whitney

Summary

Research was continued during 2000 to determine the effects of repeated harvesting of crop residues on crop yields and soil properties in a soybean - wheat - grain sorghum/corn rotation, fertilized with different levels of N, P, and K. The 2000 crop was the 20th year of this long-term study. The residue treatments (residue removed, normal residue incorporated, and 2X normal residue incorporated) caused no statistically significant differences in grain or residue yields in 2000. Corn grain yields, when averaged across all fertilizer treatments, were 82 bu/a with annual crop residue harvesting, 81 bu/a with normal crop residue incorporated, and 80 bu/a with 2X normal crop residue incorporated. In contrast, the fertilizer treatments (zero, low, normal, and high levels of N, P, and K) produced highly significant yield differences. Yield of corn varied from 46 bu/a at the zero fertilizer rate to 106 bu/a at the highest level of fertilizer application. Soil test results show that soil properties are changing. Soil pH, soil exchangeable K, and soil organic matter are declining with crop residue harvesting.

Introduction

Crop residues are being harvested increasingly as a source of raw materials for various non-agricultural uses. In Kansas, two companies are currently manufacturing wheatboard from wheat straw. In Iowa, over 50,000 tons of corn residue was harvested during the 97-98 crop year for ethanol production. In Minnesota, a company is planning to introduce a BIOFIBER soy-based particle board. Other companies will likely soon join the market for the production of other bio-products (paper). All of this is in addition to the customary on farm use of crop residues for livestock feed and bedding. These new uses are welcomed new sources of revenue for crop producers. However, crop producers must be aware that crop residues also are needed for soil erosion protection and to replenish organic matter in the soil. Crop residues are the single most important source of carbon replenishment in soils.

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

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

Procedures

This study was started in the fall of 1980. The residue treatments were: (1) crop residue harvested each year, (2) normal crop residue incorporated, and (3) twice (2X) normal crop residue incorporated (accomplished by adding and spreading evenly the crop residue from the residue removal treatment). Superimposed over the residue treatments were four levels of fertilizer treatments; zero, low, normal, and high levels of N-P-K fertilizer as shown in Table 3. The crops planted were soybean, wheat, and grain sorghum in a three year rotation. Corn was substituted for grain sorghum beginning in 1994. Grain yields and residue yields were measured each year and soil samples (0 to 2-inch depth) were collected and analyzed after the 16th year to detect any changes in soil properties.

Results

Grain yields and residue yields for the last ten years of this 20-year study are summarized in Tables 4 and 5. The residue treatments caused no differences in grain or residue yields for any crop in any year since the study was initiated, except for 1987. In 1987, a year with hail, less residue was measured in the 2X normal residue incorporated treatment than with normal residue incorporated. This may have been the result of uneven hail damage rather than an effect of the residue treatments. Summed over all 20 years, 1981-2000, grain and residue yield for all residue treatments differ by less than 2 percent. In contrast, the fertilizer treatments have produced large grain and residue yield differences, averaging 37% and 40%, respectively, for all years. Highest grain and residue yields were produced with the normal and high fertilizer treatments and the lowest grain and residue yields with the zero and low fertilizer treatments.

Although there has been no significant differences in grain and residue yields with the addition or removal of crop residue, soil properties have changed. The effects of the residue and fertilizer treatments on soil properties are shown in Table 6. Soil pH, exchangeable K, and soil organic matter have decreased with crop residue harvesting. Effects on soil exchangeable K are most obvious. The harvesting of crop residue lowered exchangeable K in the soil by nearly 20%. This is because of the high K content in crop residue. Crop residue harvesting decreased soil organic matter 9%. Doubling crop residue increased soil organic matter 12%. The fertilizer treatments caused the expected increases in N, P, and K. Soil pH decreased with fertilizer application. Available P, exchangeable K, and organic matter all increased with fertilizer application.

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

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

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

Table 4. Mean effects of crop residue and fertilizer treatments on grain yields, East Central Experiment Field, Ottawa, KS, 1991-2000.

	Wht	GS	Soy	Corn	Wht	Soy	Corn	Soy	Wht	Corn	20-yr
Treatment	‘91	‘92	‘93	‘94	‘95	‘96	‘97	‘98	‘99	‘00	total
						bu/a					
Residue											
Removed	34	128	21	104	21	42	89	47	25	82	1178
Normal	37	127	22	108	19	46	88	47	24	81	1190
2X normal	39	130	21	107	17	48	82	46	22	80	1175
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Fertilizer											
Zero	26	120	19	89	12	43	46	44	17	46	982
Low	35	123	20	103	17	43	76	46	22	76	1146
Normal	41	135	22	114	22	47	99	47	26	96	1252
High	44	136	25	120	24	48	123	50	29	106	1343
LSD 0.05	2	7	2	5	2	2	9	2	2	7	

Table 5. Mean effects of crop residue and fertilizer treatments on residue yields, East Central Experiment Field, Ottawa, KS, 1991-2000.

Treatment	Wht '91	GS '92	Soy '93	Corn '94	Wht '95	Soy '96	Corn '97	Soy '98	Wht 99	Corn '00	20-yr total
	tons/a										
Residue											
Removed	0.92	1.80	0.38	1.63	1.22	0.48	1.46	1.00	0.63	2.85	27.40
Normal	1.00	1.85	0.39	1.73	1.22	0.52	1.49	1.03	0.59	2.74	27.78
2X normal	1.04	1.92	0.39	1.56	1.24	0.54	1.39	1.03	0.51	2.72	27.74
LSD 0.05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	
Fertilizer											
Zero	0.65	1.83	0.34	1.38	0.50	0.46	1.09	0.95	0.34	2.32	22.56
Low	0.93	1.74	0.35	1.46	1.02	0.52	1.35	0.97	0.49	2.79	26.54
Normal	1.10	1.95	0.40	1.91	1.71	0.53	1.57	1.07	0.68	2.88	29.60
High	1.27	1.90	0.45	1.81	1.67	0.54	1.78	1.08	0.80	3.09	31.48
LSD 0.05	0.11	0.17	0.03	0.26	0.16	0.04	0.19	0.06	0.08	0.33	

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

Treatment	Soil pH	Soil Available P	Soil Exchangeable K	Soil Organic Matter	Soil NO_3-N
		ppm	ppm	%	ppm
Residue					
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

K. A. Janssen

Introduction

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

Past weed control research shows that controlling weeds early is important for preventing yield loss. If a single application of Roundup is applied too early there can be germination and regrowth of weeds after application as Roundup has no residual control. If the Roundup application is delayed too long, weed competition can reduce soybean yield before weeds are killed.

This study evaluates the effects of timing of single applications of Roundup Ultra herbicide in comparison with sequential, and combination applications for weed control and yield of soybean planted in clean-till systems 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 was prepared by disking followed by field cultivation just prior to planting. Planting was June 10, 1999 and May 30, 2000. The variety of soybean planted both years was Dyna Gro DG-3388RR. The preemergence (PRE) herbicides were applied immediately following planting. All Roundup Ultra herbicide applications were applied at the 1.5 pt/a rate and at the times shown in Table 7. All herbicide applications were in 20 gallons of water per acre. All treatments were replicated four times. Weed control ratings were taken and soybean yields were measured.

Results

Planting and stand conditions were excellent both years. The preemergence herbicides were activated by 0.85 inches of rainfall the day following application in 1999 and 0.43 inches of rainfall the week following application in 2000. Total rainfall after planting (June through September) in 1999 was 19.76 inches and in 2000, 8.09 inches. Weed pressure was moderate both years. In 1999, highest yields occurred with Command plus Roundup, sequential Roundup (3 & 6 wks.), and a single application of Roundup at 4 and 5 wks. In 2000, yields were highest with Command plus Authority plus Roundup, sequential Roundup (3 & 6 wks.), and a single Roundup application at 4 and 5 wks. Squadron and Frontier produced intermediate yields both years. Lowest yields occurred with the checks.

Based on these data, the best timing for a single application of Roundup is somewhere between 4 to 5 weeks after planting. That is, with tilled soybeans and with all weeds controlled at the time of planting. For situations with heavier weed pressure or in no-till systems with weeds emerged or germinated at planting, timing of a single application of Roundup may need to be earlier.

Table 7. Timing of Roundup Herbicide for Soybean Weed Control, Ottawa, KS, 1999 and 2000

Treatment	Rate	Time after Planting	Yield, bu/a 1999	Yield, bu/a 2000	2000 Percent control Waterhemp	2000 Percent control Foxtail
Roundup Ultra	1.5 pt/A	2 wks	45.5	--	--	--
Roundup Ultra	1.5 pt/A	3 wks	46.0	9.4	49	94
Roundup Ultra	1.5 pt/A	4 wks	46.4	11.8	89	98
Roundup Ultra	1.5 pt/A	5 wks	46.7	11.1	94	98
Roundup Ultra	1.5 pt/A	6 wks	43.7	10.3	94	97
Roundup Ultra	1.5 pt/A	7 wks	43.8	7.9	89	98
Roundup Ultra	1.5 + 1.5 pt/A	3 wks & 6 wks	49.1	11.9	98	99
Command 3ME	1.0 qt/A	PRE	47.4	--	--	--
+ Roundup Ultra	1.5 pt/A	5 wks				
Command 3ME	1.0 qt/A	PRE	--	12.9	96	98
+Authority	3.0 oz/A					
+ Roundup Ultra	1.5 pt/A	4 wks				
Squadron	3.0 pt/A	PRE	42.7	10.7	52	95
Frontier 6EC	1.5 pt/A	PRE	42.3	10.8	45	94
Check 1			34.5	5.9	0	0
Check 2			36.0	5.0	0	0
L.S.D. 0.05			5.0	1.9	8	3

Planting dates: June 10, 1999; May 30, 2000

Variety: Dyna Gro DG-3388RR

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

K.A. Janssen and G.M. Pierzynski

Introduction

The Kansas Department of Health and Environment is developing Total Maximum Daily Loads (TMDLs) for various contaminants in Kansas streams and water bodies. The contaminants of most concern are sediment, nutrients, pesticides, and fecal coliform bacteria. The implementation of TMDLs will require information on runoff losses associated with different agricultural land uses and the impact of different agricultural management practices on contaminant loading.

Cropland systems that greatly reduce tillage and maintain 30% or more crop residue cover after planting have been shown to significantly reduce soil erosion and sediment in runoff. Among the conservation tillage systems, the no-till system is the most effective. This is because it incorporates very little crop residue and loosens the least amount of soil at the surface. Tillage/planting systems that significantly reduce tillage provide little opportunity for incorporating fertilizer, manure, and herbicides. When surface applied, these materials enrich the near-surface soil zone and increase runoff losses. Consequently, a more comprehensive management strategy other than just tillage reduction is needed. A system of cropping practices is needed that incorporates all best management practices (BMPs) for controlling all cropland runoff contaminates. The "Integrated Agricultural Management Systems" program has been under development to address this need. The purpose of this study was to evaluate, on a large, field-scale basis, combinations of tillage, fertilizer, and herbicide management practices for their balanced control of all cropland runoff contaminants.

Methods

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

Runoff from natural rainfall was collected by instrumentation of each of the between terraced treatment areas with weirs and automated ISCO samplers. The runoff water was analyzed for sediment, nutrient, and herbicide losses.

Results

<u>Rainfall and Runoff</u>

Rainfall amounts for the dates in which we collected runoff totaled 9.46 inches in 1998, 8.02 inches in 1999, and 5.00 inches in 2000. Averaged across all runoff collection dates and years, the amount of rainwater that ran off was 49% with the no-till system and 29% with the chisel-disk-field cultivate system (Figures 1, 2 and 3). Part of the reason that runoff was greater in no-till than in the chisel-disk-field cultivate system was that each time the soil was tilled in the chisel-disk-field cultivate system, it loosened and dried the soil, which then increased the soil's capacity to infiltrate and absorb rainwater.

<u>Soil Erosion and Sediment Losses</u>

Averaged across all of the runoff collection dates and years, the amount of soil loss in the runoff water was three times greater for the chisel-disk-field cultivate system than for no-till (Figures 4, 5 and 6). Soil losses did not not always parallel runoff losses. Differences in rainfall intensity and timing of individual rainfall events, differences in surface soil conditions because of tillage, and differences in the amount of canopy cover at the time the rainfall occurred, also influenced soil losses.

<u>Nutrient and Herbicide Losses</u>

Soluble P, atrazine, and metolachlor concentrations in the runoff water were highest with surface applications in no-till (Figures 7 through 13). Incorporation of fertilizer and herbicides with tillage decreased losses. Highest concentrations of soluble P and herbicides in runoff occurred during the first couple of runoff events after application. Much of the initial losses appeared to be direct losses before being absorbed by the soil.

Conclusions

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

Therefore, an important requirement for balancing cropland contaminant losses in no-till will be the need to subsurface apply P fertilizer. This could be in the form of pre-plant deep banding (which was used here), 2x2 inch band placement of fertilizer with the planter, or some combination of these.

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

Farming operations that use tillage also must be improved. Every effort should be taken to minimize soil erosion. Use of structures (terraces) and grass waterways are a given. Also, the use of tillage implements that are designed to leave more crop residue cover on the soil surface, but still allow for fertilizer and herbicide incorporation would be beneficial.

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

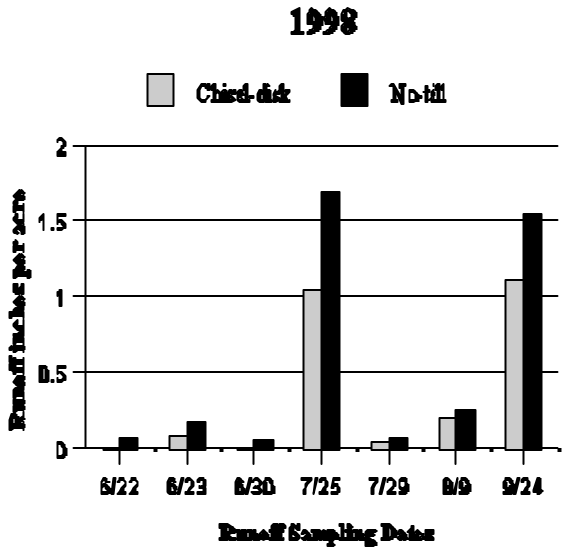


Figure 1. Tillage effects on volume of runoff, 1998.

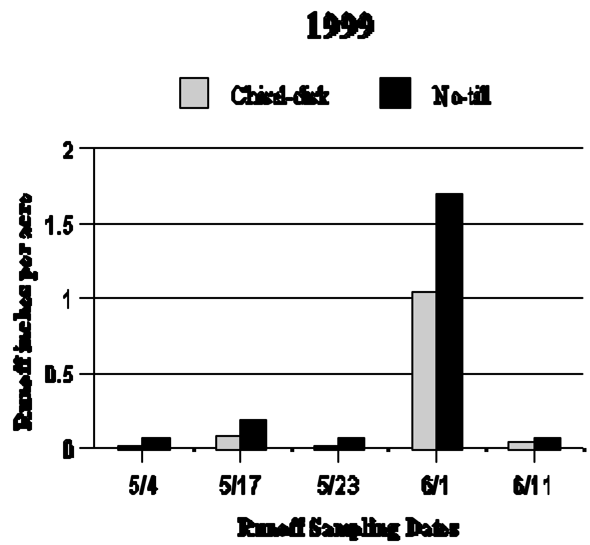


Figure 2. Tillage effects on volume of runoff, 1999.

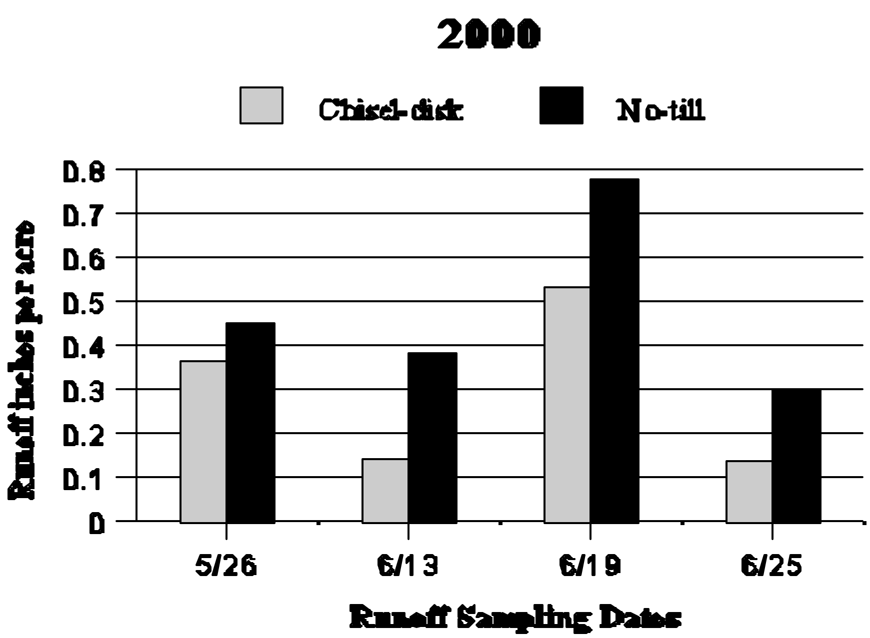


Figure 3. Tillage effects on volume of runoff, 2000.

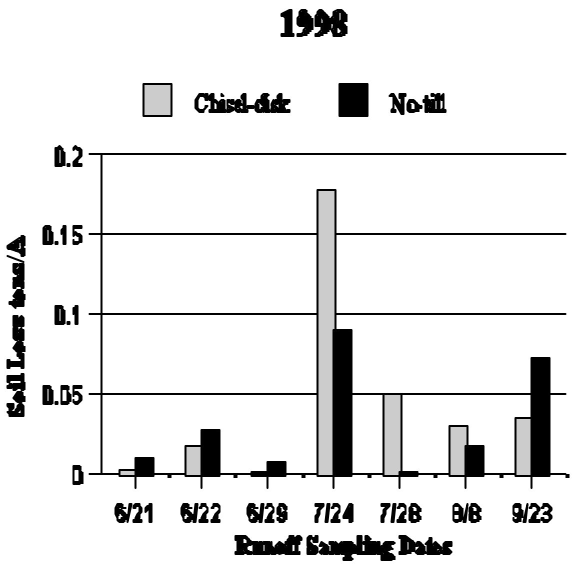


Figure 4. Tillage effects on sediment losses in runoff, 1998.

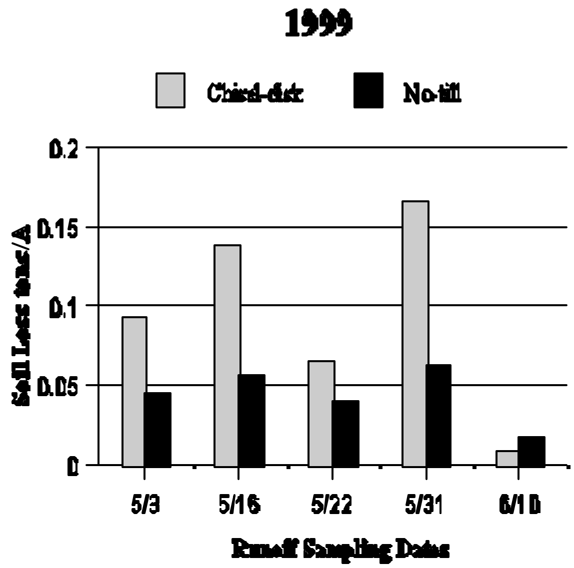


Figure 5. Tillage effects on sediment losses in runoff, 1999.

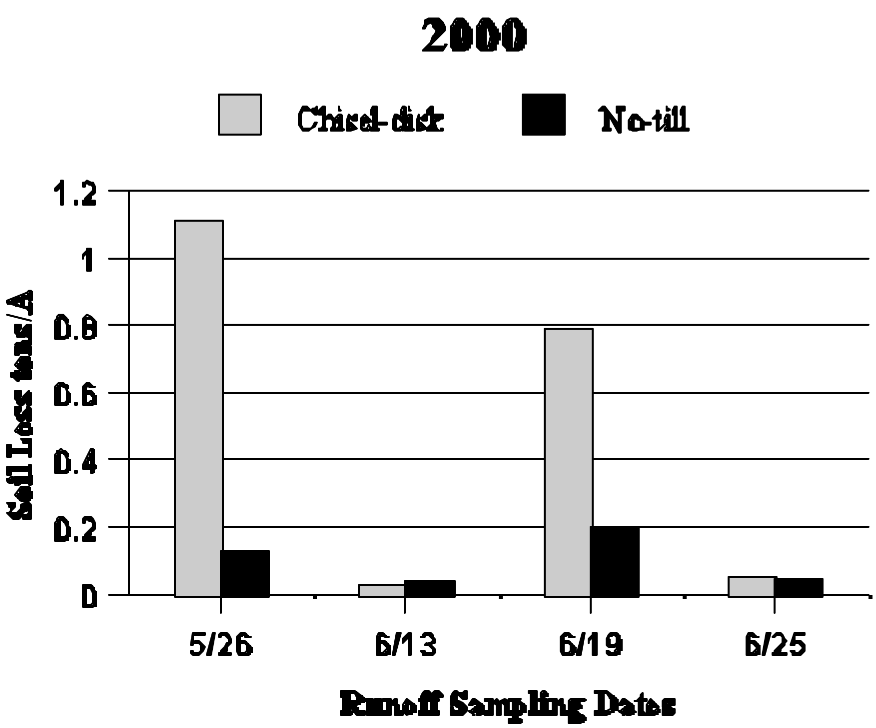


Figure 6. Tillage effects on sediment losses in runoff, 2000.

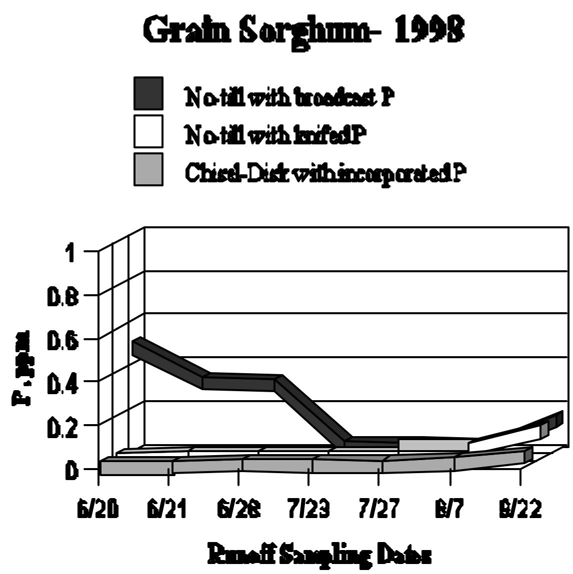


Figure 7. Effects of tillage and P fertilizer placement on soluble P concentrations in runoff, 1998.

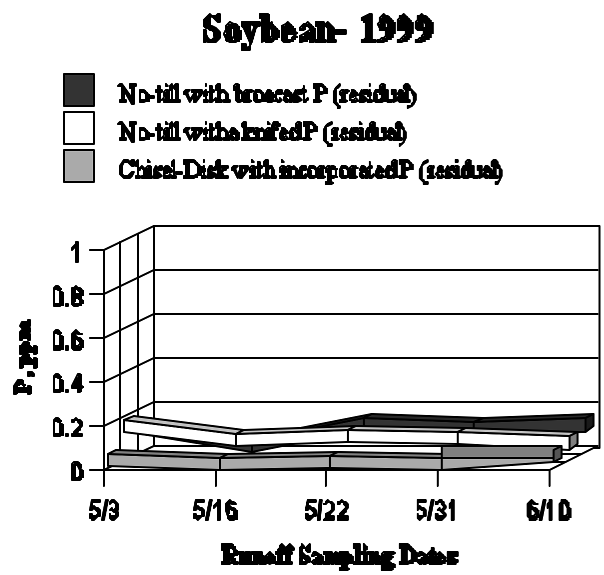


Figure 8. Effects of tillage and residual from P fertilizer placement on soluble P concentrations in runoff, 1999.

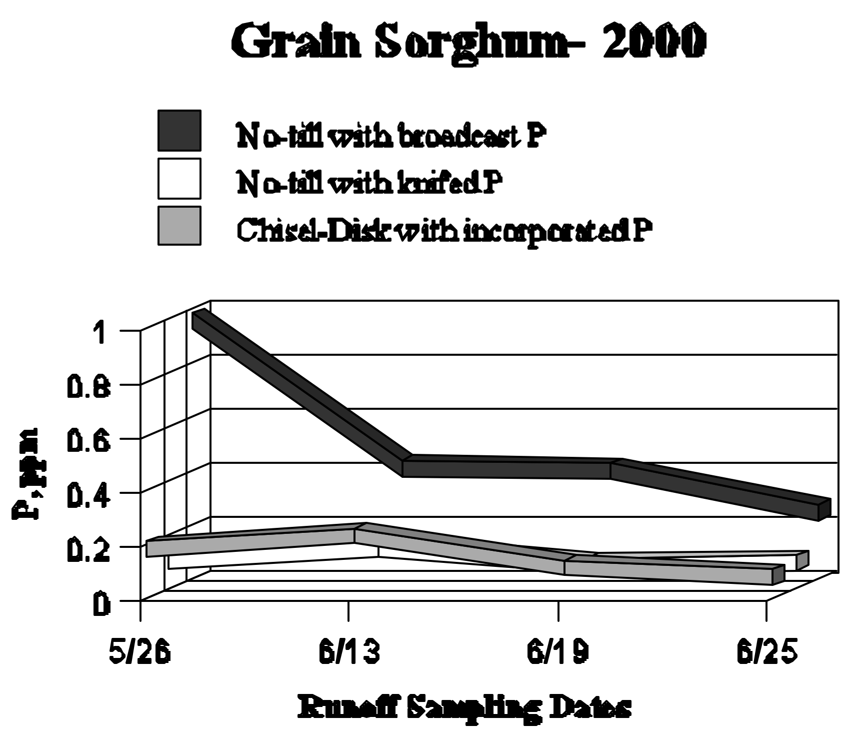


Figure 9. Effects of tillage and P fertilizer placement on soluble P concentrations in runoff, 2000.

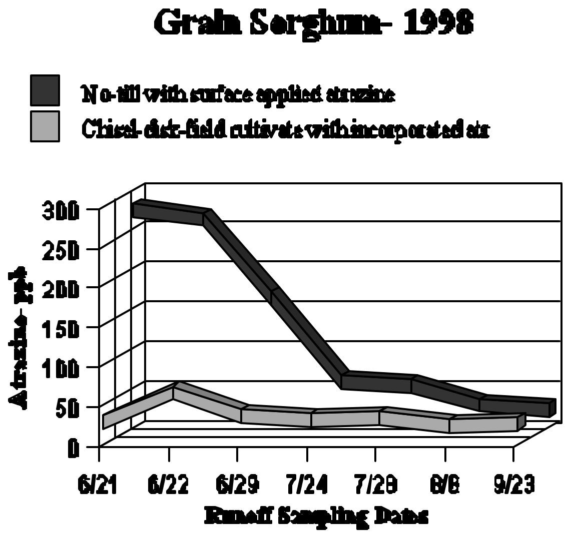


Figure 10. Effects of tillage and atrazine placement on atrazine concentrations in runoff, 1998.

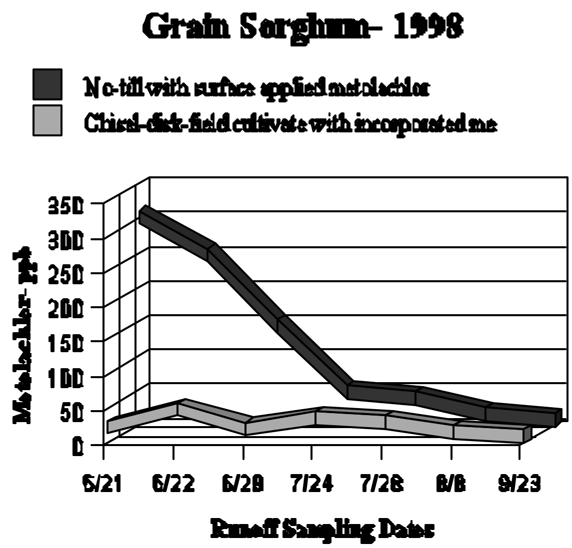


Figure 11. Effects of tillage and metolachlor placement on metolachlor concentrations in runoff, 1998.

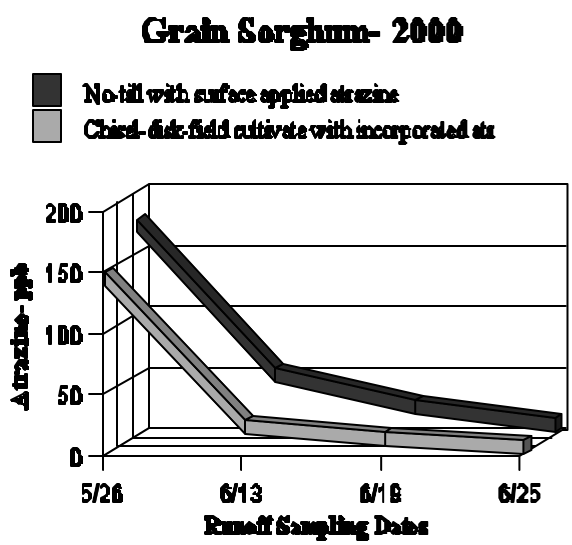


Figure 12. Effects of tillage and atrazine placement on atrazine concentration in runoff, 2000.

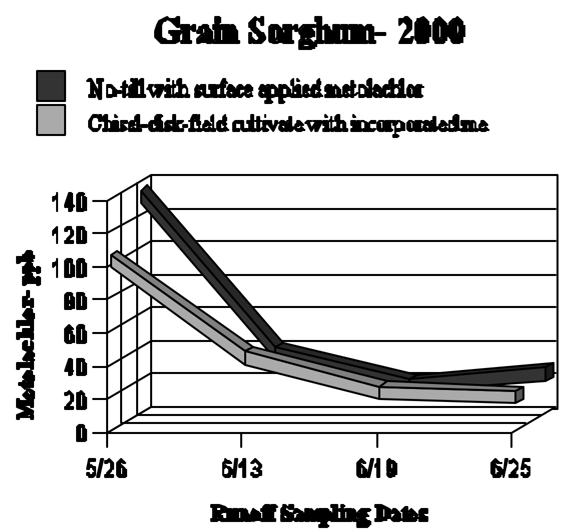


Figure 13. Effects of tillage and metolachlor placement on metolachlor concentration in runoff, 2000.

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

K. A. Janssen and B. Gordon

Introduction

Soybean producers in the east-central part of Kansas have a wide window in which they can plant soybean (late April - mid July) and a wide range of soybean maturity groups that they can plant (II, III, IV, and V). Very early plantings of soybean run the risk of reduced stand and injury by a late spring freeze, but tend to maximize the vegetative growth period before flowering, maximize differences between maturity groups, and increase yield potential if other factors are favorable. Delayed or very late plantings reduce the time for vegetative growth, reduce the effects of differences in maturity groups, reduce potential yield, and run the risk of a fall freeze killing the crop before it is mature. Numerous factors other than planting dates and maturity groups can interact and affect yield, such as differences in soil and air temperatures that occur with different planting dates, differences in disease and weed pressure, and most importantly differences in water availability during the pod fill period with the different soybean maturity groups. However, selection of soybean maturity groups and planting dates can be used to help manage these or other situations, or try 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 be able to plant another crop more quickly.

This study evaluates the effects of five soybean varieties having different maturities (groups II, early III, late III, IV, and V) planted at various planting dates under east-central Kansas conditions.

Procedures

This experiment was conducted at the East Central Experiment Field near Ottawa on a Woodson soil. The variety/maturity groups planted were IA2021 (II), IA3010 (early III), Macon (late III), KS4694 (IV) and Hutcheson (V). The seeding rate was 175,000 seeds per acre. Planting was in 7-inch rows. 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 were harvested for yield determination. All treatments were replicated four times.

Results

Grain yields for the 1999 and 2000 crop years are shown in Table 8. Averaged across all variety/maturity groups, highest soybean yields in 1999 were produced with the May 26-July 5 planting dates and in 2000 with the April 21-May 25 planting dates. Availability of moisture during pod development was the most significant factor affecting response to planting date and maturity group. In 1999, seasonal moisture favored medium to late planting dates and late maturity group soybeans. In 2000, seasonal moisture favored early planting dates and medium maturity group soybeans. The overall highest yield in 1999 was produced with Hutcheson (MGV), at 53.9 bu/a and in 2000 with Macon (MGIII) at 30.5 bu/a. August and September rainfall during 1999 totaled 11.53 inches. August and September rainfall in 2000 was only 2.45 inches.

Table 8. Effects of Planting Dates and Maturity Groups on Soybean Yield, Ottawa, 1999 & 2000.

			Yield bu/a		
Date of Planting x	Maturity/variety		1999	2000	2-yr Avg
April 21-May 5					
April 28, 2000	II	IA2021	--	18.4	--
	III	IA3010	--	28.4	--
	III	Macon	--	30.5	--
	IV	KS4694	--	15.2	--
	V	Hutcheson	--	14.3	--
May 6-May 25					
May 14, 1999	II	IA2021	13.8	19.6	16.7
May 17, 2000	III	I3010	31.4	26.8	29.1
	III	Macon	36.7	25.3	31.0
	IV	KS4694	46.3	15.2	30.8
	V	Hutcheson	53.9	12.2	33.0
May 26-June 14	II	IA2021	33.1	19.2	26.2
June 8, 1999	III	IA3010	41.6	19.1	30.4
May 31, 2000	III	Macon	44.0	12.1	28.0
	IV	KS4694	52.8	12.8	32.8
	V	Hutcheson	53.5	14.4	34.0
June 15-July 4	II	IA2021	34.1	7.6	20.8
June 15, 1999	III	IA3010	40.2	6.6	23.4
June 29, 2000	III	Macon	44.2	8.9	26.6
	IV	KS4694	45.9	9.5	27.7
	V	Hutcheson	53.2	11.4	32.3
July 5-July 18	II	IA2021	25.3	0.0	12.6
July 8, 1999	III	IA3010	23.9	0.0	12.0
July 17, 2000	III	Macon	28.6	0.0	14.3
	IV	KS4694	31.0	0.0	15.5
	V	Hutcheson	29.2	0.0	14.6
July 19-July 28	II	IA2021	12.3	--	--
July 23, 1999	III	IA3010	9.8	--	--
	III	Macon	14.4	--	--
	IV	KS4694	11.0	--	--
	V	Hutcheson	2.0	--	--
Date of Planting (means)					
April 21-May 5			--	21.4	--
May 6-May25			36.4	19.8	28.1
May26-June 14			45.0	15.5	30.2
June 15-July 4			43.5	8.8	26.2
July 5-July 18			27.6	0.0	13.8
July 19-July 28			9.9	--	--
LSD 0.05			4.0	3.0	--
Maturity/Variety (means)					
II	IA2021		23.7	16.2	20.0
III	IA3010		29.4	20.2	24.8
III	Macon		33.6	19.2	26.4
IV	KS4694		37.4	13.2	25.3
V	Hutcheson		38.3	13.1	25.7
LSD 0.05			2.1	1.8	

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 sunflower. 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, is comprised of 142 acres of Ladysmith, Smolan, Detroit, and Irwin silty clay loams, as well as Geary and Smolan silt loams. All have 0-3% slope. Soils on the two tracts are representative of much of Harvey, Marion, McPherson, Dickinson, and Rice Counties, as well as adjacent areas.

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

1999-2000 Weather

An unusually wet September delayed the planting of winter wheat. Then after planting in mid-October, wheat was adversely affected by the absence of rain during the next 5 weeks. However, fall growth was favored by late fall temperatures that were well above normal. Winter precipitation was very significant, with totals for December, February and March that were well above normal. Mean temperatures also were above average for January and February as well as near-normal in March. Both mean temperatures and precipitation were below average for the April-June period. Light to moderate BYD was the only wheat disease of consequence. Dry weather allowed for timely harvest and high grain test weights.

Spring conditions were favorable for timely or early planting of most row crops. Despite 5 days above 100° F in July, maximum air temperatures averaged about 3° F below normal. Unusually heavy rainfall in the last weeks of that month, coupled with favorable temperatures, presented an excellent outlook for row crop production. However, no meaningful rainfall occurred between July 28 and harvest. During this time, temperatures equaled or exceeded 100° F on 23 days, and the mean maximum temperatures were 6.5° F and 4.6° F above normal for the months of August and July, respectively. Soybean began to die in late August from severe drouth stress.

Frost occurred last in the spring on April 17. First killing temperatures occurred next on October 7. The frost-free season of 173 days was about 5 days longer than normal.

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

Month	N Unit	S Unit	Normal	Month	N Unit	S Unit	Normal
	1999				2000		
October	0.00	0.00	2.94	March	4.43	4.87	2.72
November	1.36	1.96	1.87	April	2.07	1.87	2.94
December	2.45	2.29	1.12	May	2.70	2.32	5.02
				June	4.10	3.33	4.39
	2000			July	5.84	7.89	3.71
January	0.61	0.47	0.69	August	0.06	0.06	3.99
February	2.97	2.96	0.93	September	0.36	0.34	2.93
Twelve-month total					26.95	28.36	33.25
Departure from 25-year Normal at N. Unit					-6.30	-4.89	

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

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

Mark M. Claassen

Summary

Tillage system effects on continuous wheat, continuous grain sorghum, and annual rotations of wheat with row crops were investigated a 4th consecutive year. Prior tillage for row crop did not consistently affect wheat in rotations. Soybean rotation produced highest wheat yields, averaging 59.6 bu/a. This represented a yield advantage of 14.5 and 24.4 bu/a over wheat in corn and grain sorghum rotations, respectively, as well as a 12.6 bu/a increase over the highest continuous wheat yields. Tillage systems did not meaningfully affect yields of row crops in rotation with wheat. However, wheat rotation increased sorghum yields by 27 bu/a in comparison with continuous sorghum. Tillage systems did not significantly affect continuous sorghum nor its response to planting date. Yields from May sorghum plantings exceeded those of the June plantings by 37.8 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. This provides an 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

<u>Wheat after soybean</u>

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

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

Continuous wheat

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

Corn after wheat

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

Sorghum after wheat

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

Soybean after wheat

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

Continuous sorghum

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

Continuous wheat no-till plots were sprayed with Roundup Ultra at 1 qt/a + ammonium sulfate (AMS) on July 19, September 7, and October 7. Variety 2137 was planted on October 12 in 8-inch rows at 90 lb/a with a CrustBuster no-till drill equipped with double disk openers. Wheat was fertilized with 107 lb N/a as preplant, broadcast ammonium nitrate. WW-C and WW-NT plots were sprayed for cheat control with Olympus 70 WG @ 0.62 oz/a + 0.5% nonionic surfactant (NIS) on April 12. [**Note:** *Application by Bayer for label registration of Olympus is in process. However, at this time Olympus is not labeled for use by wheat growers in Kansas.*] No herbicides were applied for broadleaf weed control in wheat during the growing season. Wheat was harvested on June 15, 2000.

No-till corn after wheat plots received the same herbicide treatments as WW-NT during the summer and fall. CW-NT plots also were sprayed with Roundup Ultra + 2,4-D_{LVE} + Banvel + AMS at 1.5 pt + 4 oz + 2 oz + 3.4 lb/a in mid-April. Weeds were controlled during the fallow period in CW-V plots with four tillage operations. Corn was fertilized with 111 lb/a N as ammonium nitrate broadcast prior to planting. An additional 14 lb/a N and 37 lb/a P_2O_5 were banded 2 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 April 14, 2000. Row cultivation was not used. Corn was harvested on August 29.

No-till sorghum after wheat plots received the same fallow and preplant herbicide treatments as no-till corn. GG-NT_{May} was sprayed with Roundup Ultra + 2,4-D_{LVE} + Banvel + AMS (1.5 pt/a + 1 qt/a + 2 oz/a + 3.4 lb/a) in mid-April. GG-NT_{June} received this treatment plus Roundup Ultra + 2,4-D_{LVE} + Banvel + Array (1 qt/a + 4 oz/a + 2 oz/a + 1.8 lb/a) 3 days before planting. GW-V plots were managed like CW-V areas during the fallow period between wheat harvest and planting. A sweep-treader was used for the final preplant tillage operation in GW-V. GG-C plots were tilled once each with a chisel, 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 12. A second set of continuous sorghum plots was planted on June 8. Dual II at 1 qt/a + AAtrex 4L at 1.5 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}, 1.5 pt/a of Roundup Ultra + 2 oz/a of Banvel were added to the tank mix to control emerged weeds. No row cultivation was necessary during the season. May and June-planted sorghum were harvested on August 31 and October 2, respectively.

Fallow weed control procedures for no-till soybean after wheat during the summer and fall were as described for CW-NT and GW-NT. Roundup Ultra + AMS (1.5 pt/a + 3.4 lb/a) applied April 22 controlled emerged weeds prior to planting. 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 qt/a + 2.8 oz/a). Roundup Ultra + NIS (1.5 pt/a + 0.5% v/v) was included with these herbicides on SW-NT. Resnik soybean was planted at 8 seeds/ft in 30-inch rows May 12 and harvested September 8.

Results

Wheat

A very wet September delayed wheat planting. In addition, no rain fell during the first 40 days afterward. Nevertheless, wheat stand establishment was very good, with no significant differences among cropping systems. Crop residue cover after planting averaged 77, 70, and 59% in no-till wheat after corn, sorghum, and soybean, respectively (Table 2). In continuous wheat, residue cover ranged from 1% in burned plots to 91% with no-till.

Above-normal late fall temperatures and winter precipitation were favorable for wheat, particularly in rotations. Broadleaf weed control was very good to excellent across cropping systems, but serious cheat infestation occurred in WW-NT. Mid-April application of Olympus (experimental herbicide) provided outstanding cheat control and prevented cheat seed production.

Heading dates differed slightly among treatments, with wheat after soybean tending to heads about 2 days earlier than WG-V, WW-C, and WW-NT.

Whole-plant N in wheat 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 produced the highest yield, averaging 12.6 bu/a more than the highest continuous wheat yield. Wheat after corn and continuous wheat yields were comparable, while wheat after sorghum produced about 10 bu/a less than after corn. This effect may have been accentuated by the absence of in-furrow starter fertilizer at planting. The apparent effect of prior tillage for row crop on yield of wheat in rotations was not consistent, favoring the V-blade system in wheat after corn and no-till in wheat after soybean.

Test weights were above average for wheat in all cropping systems, and differences among rotations were relatively small. Tillage systems generally had little effect on test weight within each cropping system, except that in continuous wheat, lowest values occurred with the chisel system.

Row Crops

Crop residue cover for row crops following wheat averaged 29% for V-blade and 88% for no-till systems (Table 3). Tillage did not significantly affect corn stands, maturity, or ears per plant. However, corn leaf N concentration was lower in no-till than in the V-blade system.

Crop sequence significantly affected sorghum in several ways. In comparison with monoculture sorghum (May planting), rotation with wheat increased the number of heads/plant, improved test weight slightly, and increased yields by 27 bu/a. Continuous sorghum planted in June had a slightly shorter period from planting to half bloom, lower test weight, and yield that averaged 37.8 bu/a less than when planted in May.

Continuous sorghum as well as sorghum after wheat generally were not significantly affected by tillage system. However, there were tendencies for a slight decrease in stands, a small delay in maturity (number of days from planting to half bloom), and a slight increase in heads/ plant in GW-NT versus GW-V and GG-NT_{May} versus GG-C_{May}. In June-planted continuous sorghum, tillage effects were not significant, but numerical trends were toward a no-till advantage in each of these parameters.

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, 2000.

Crop Sequence[1]	Tillage System	Crop Residue Cover [2]	Yield[3] 2000	Yield[3] 4-Yr	Test Wt	Stand	Heading[4]	Plant N[5]	Cheat Control[6] 4/6	Cheat Control[6] 6/10
		%	bu/a		lb/bu	%	date	%	----%----	
Wheat-corn	V-blade	72	48.0	56.6	62.5	99	5	1.16	95	99
(No-till)	No-till	83	42.2	56.4	62.4	99	5	1.16	94	99
Wheat-sorghum	V-blade	66	33.4	39.8	62.3	98	6	1.15	100	100
(No-till)	No-till	75	37.0	39.3	62.0	99	5	1.14	94	100
Wheat-soybean	V-blade	51	54.5	56.9	62.1	100	4	1.31	100	100
(No-till)	No-till	67	64.8	63.6	62.1	99	4	1.41	100	100
Continuous	Burn	1	47.0	49.0	62.0	100	5	1.21	100	100
wheat	Chisel	17	41.2	43.7	61.3	100	6	1.31	95	100
	No-till	91	43.6	44.0	62.1	99	6	1.25	36	97
LSD .05		11	5.8	----	0.5	NS	0.7	0.17	15	2
Main effect means:										
Crop Sequence										
Wheat-corn		77	45.1	56.5	62.4	99	5	1.16	94	99
Wheat-sorghum		70	35.2	39.6	62.1	98	5	1.14	97	100
Wheat-soybean		59	59.6	60.3	62.1	99	4	1.36	100	100
Continuous wheat		54	42.4	46.3	61.7	100	6	1.28	66	99
LSD .05		8	4.3	----	0.4	NS	NS	0.12	3	1
Rotation Tillage system										
No-till/V-blade		63	45.3	51.1	62	99	5	1.21	98	100
No-till/no-till		75	48.0	53.1	62	99	5	1.24	96	100
LSD .05		7	NS	----	NS	NS	NS	NS	NS	NS

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

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

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

[4] Date in May on which 50% heading occurred.

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

[6] Visual rating of cheat control before and after application of Olympus herbicide **(Not presently labeled for wheat in Kansas).**

Table 3. Effects of wheat rotation and reduced tillage on corn, grain sorghum, and soybean, Harvey County Experiment Field, Hesston, KS, 2000.

Crop Sequence	Tillage System	Crop Residue Cover [1]	Yield[2] 2000	Yield[2] Mult-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	34	---	81.5	---	20.4	119	1.04	2.55
	No-till	96	---	74.6	---	23.0	107	1.00	2.33
LSD .05		19	---	---	---	NS	NS	NS	0.18
Sorghum-wheat	V-blade	27	115.3	105.7	61.4	38.6	64	1.39	2.65
	No-till	89	109.2	109.0	61.5	35.0	66	1.63	2.58
Contin. sorghum	Chisel	44	83.8	86.0	61.0	38.5	65	1.17	2.46
	No-till	73	86.8	84.4	60.7	32.4	67	1.44	2.44
(May)									
Contin. sorghum	Chisel	27	44.1	65.9	57.6	34.8	65	1.02	2.52
	No-till	58	50.8	70.3	56.9	35.7	63	1.24	2.70
(June)									
LSD .05[5]		10	8.0		0.65	2.8	1.3	0.23	NS
Soybean-wheat	V-blade	26	25.3	33. 2	----	----	113	----	----
	No-till	80	20.4	31.8	----	----	113	----	----
LSD .05		4	NS	----			NS		
Main effect means for sorghum:									
Crop sequence									
Sorghum-wheat		58	112.3	107.4	61.4	36.8	65	1.51	2.61
Contin. sorghum		59	85.3	85.2	60.8	35.4	66	1.31	2.45
(May)		43	47.5	68.1	57.3	35.2	64	1.13	2.61
Contin. sorghum		7	5.7	----	0.46	NS	0.9	0.17	NS
(June)									
LSD .05									
Tillage system									
V-blade/chisel		33	81.1	85.9	60.0	37.3	65	1.19	2.54
No-till/no-till		73	82.3	87.9	59.7	34.4	65	1.43	2.57
LSD .05		6	NS	----	NS	1.6	NS	0.14	NS

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

[2] Means of four replications adjusted to 12.5% moisture (sorghum) or 13% moisture (soybean). Corn yield data lost by computer hardware failure. Multiple-year averages:1997-1999 for corn and 1997-2000 for sorghum and soybean.

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

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

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

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

Mark M. Claassen

Summary

Nitrogen response of sorghum grown in the third cycle of a wheat-vetch-sorghum rotation was compared with that of sorghum in a wheat-sorghum rotation at N rates of 0 to 90 lb/a. Vetch was terminated by tillage (disking) or herbicides (no-till). Hairy vetch planted in October established 25% ground cover by the end of November and produced an average of 1.97 ton/a of dry matter by May. The average potential amount of N to be mineralized for use by the sorghum crop was 105 lb/a.

At the zero N rate, hairy vetch resulted in higher sorghum leaf N levels than in sorghum not following the cover crop. The apparent N contribution by vetch was equivalent to approximately 57 lb/a and more than 120 lb/a of fertilizer N in no-till and disked plots, respectively. When averaged over N rates, yields of sorghum after disked vetch were 6.5 bu/a lower than either no-till sorghum after vetch or sorghum without a cover crop. N rates of 60 and 90 lb/a significantly increased sorghum grain yield by 9.9 and 13.2 bu/a in the absence of a cover crop. However, no significant yield increase occurred with fertilizer N in sorghum after 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

Wheat-grain sorghum and wheat-hairy vetch-grain sorghum rotations were established on a Geary silt loam soil in 1995. Hairy vetch was first planted as a winter cover crop after wheat on September 15 of that year. Sorghum was planted the following June after termination of the vetch and application of fertilizer N at rates of 0, 30, 60, and 90 lb/a. No-till winter wheat was planted in sorghum stubble shortly after harvest. The current data for 2000 represents the third cycle of the crop rotations.

Hairy vetch plots were no-till planted at 24 lb/a in 8-in. rows with a grain drill equipped with double-disk openers on October 8, 1999. One set of vetch plots was terminated by disking on May 8. Hairy vetch in a second set of plots was terminated at that time with Roundup Ultra + 2,4-D_{LVE} + Banvel (1 qt + 1.5 pt +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 May 8, 2000. Nitrogen fertilizer treatments were broadcast as ammonium nitrate on May 24. All plots received 35 lb/a of P_2O_5, which was banded as 0-46-0 at sorghum planting. Pioneer 8505, treated with Concep III safener and Gaucho insecticide, was planted after rain delay at approximately 42,000 seeds/a on June 7, 2000. Weeds were controlled with a preemergence application of Dual II + AAtrex 90 DF (1 qt + 0.55 lb/a). Grain sorghum was combine harvested on September 26.

Results

September rains delayed planting of hairy vetch several weeks. However, development of the crop resulted in an average ground cover of 25% by the end of November. Hairy vetch was beginning to bloom at the time of termination in May. Vetch dry matter yield averaged 1.97 ton/a, and N content was 2.67% (Table 4). The average potential amount of N to be mineralized for use by the sorghum crop was 105 lb/a.

Discing to terminate hairy vetch growth did not adversely affect soil moisture at the surface because of timely subsequent rains. Sorghum stands were relatively uniform across all treatments, with an average of 31,600 plants/a. Drought stress became progressively worse during August and September, when no meaningful rainfall occurred and temperatures were well above normal. At the zero N rate, hairy vetch resulted in higher sorghum leaf N levels than in sorghum not following the cover crop. The apparent N contribution by vetch was equivalent to approximately 57 lb/a and >120 lb/a of fertilizer N in no-till and disked plots, respectively. N rates increased leaf N up to 90 lb/a, most notably in sorghum without a cover crop and, to a lesser extent, in no-till sorghum after vetch. In sorghum after disked vetch, leaf N did not increase with the application of fertilizer N.

Grain sorghum maturity (days to half bloom) was delayed slightly by hairy vetch treatments. The number of heads per plant decreased slightly in sorghum after disked vetch in comparison with the other systems, and showed no consistent response to fertilizer. When averaged over N rates, yields of sorghum after disked vetch were 6.5 bu/a lower than either no-till sorghum after vetch or sorghum without a cover crop. In the absence of fertilizer N, sorghum after vetch produced yields not differing significantly from sorghum with no preceding cover crop. N rates of 60 and 90 lb/a significantly increased sorghum grain yield by 9.9 and 13.2 bu/a in the absence of a cover crop. However, no yield increase occurred with fertilizer N in sorghum after vetch.

Table 4. Effects of hairy vetch cover crop, termination method, and nitrogen rate on grain sorghum after wheat, Hesston, KS, 2000.

Cover Crop/ Termination	N Rate[1]	Vetch Yield[2] Forage	Vetch Yield[2] N	Grain Sorghum 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	--	--	76.1	57.2	29.7	63	1.4	2.36
	30	--	--	82.0	57.7	32.2	62	1.4	2.55
	60	--	--	86.0	58.4	31.3	63	1.4	2.75
	90	--	--	89.3	58.4	31.1	62	1.5	2.91
Vetch/Disk	0	2.19	109	73.8	57.8	30.8	64	1.4	3.12
	30	1.96	110	77.4	58.2	30.8	64	1.3	2.76
	60	2.05	104	79.9	58.5	32.8	64	1.3	2.95
	90	1.76	94	75.6	58.0	33.3	64	1.3	3.03
Vetch/No-till	0	2.26	116	82.2	58.0	31.2	64	1.5	2.72
	30	1.91	108	80.6	58.1	30.1	64	1.5	2.89
	60	1.84	98	85.5	58.5	32.6	64	1.4	2.85
	90	1.80	101	84.0	57.8	33.3	63	1.6	3.04
LSD .05		0.41	NS	9.5	0.82	NS	1.4	NS	0.19
LSD .10		NS	NS	----	----	NS	----	0.21	----
Means:									
Cover Crop/Termination									
None									
Vetch/Disk		----	----	83.3	57.9	31.1	63	1.4	2.64
Vetch/No-till		1.99	104	76.7	58.1	31.9	64	1.3	2.96
LSD .05		1.95	106	83.1	58.1	31.8	64	1.5	2.87
LSD .10		NS	NS	4.7	NS	NS	0.7	NS	0.10
		NS	NS	----	NS	NS	----	0.10	----
N Rate									
0		2.23	112	77.3	57.7	30.6	64	1.4	2.73
30		1.94	109	80.0	58.0	31.0	63	1.4	2.73
60		1.94	101	83.8	58.5	32.2	64	1.4	2.85
90		1.78	98	83.0	58.0	32.6	63	1.5	2.99
LSD .05		0.29	NS	NS	0.47	NS	NS	NS	0.11
LSD .10		----	NS	4.6	----	NS	0.7	NS	----

[1] N applied as 34-0-0 on May 24, 2000.
[2] Oven dry weight and N content on May 8, 2000.
[3] Days from planting (June 7, 2000) 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 and N fertilizer rates of 0 to 90 lb/a. Residual effects of hairy vetch did not increase wheat whole-plant N or grain protein at 0 lb/a of N fertilizer or when averaged over all N rates. Nitrogen fertilizer at 90 lb/a increased plant N and grain protein levels, but not in comparison with the zero N rate at which yields were very low. At 0 lb/a of N, wheat yields were significantly increased by hairy vetch only in the no-till system. Averaged over N rates, hairy vetch in disk and no-till systems accounted for wheat yield increases of 2.6 and 4.1 bu/a. In wheat after sorghum without vetch, each 30 lb/a increment of fertilizer N significantly increased yield. In wheat after vetch-sorghum, yields reflected less response to the highest increment of fertilizer 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 concluded the second cycle of a crop rotation in which the residual effects of vetch as well as N fertilizer rates were measured in terms of N uptake and yield of wheat.

Procedures

Wheat-grain sorghum and wheat-hairy vetch-grain sorghum rotations were established on a Geary silt loam soil in 1995. A second site was established one year later with the seeding of vetch in the fall. On this site, sorghum was grown in 1997 with or without the preceding cover crop and fertilized with N rates of 0, 30, 60, or 90 lb/a. Winter wheat was no-till planted into sorghum stubble in the fall of 1997. After wheat harvest, volunteer wheat and weeds were controlled with Roundup Ultra. In the second cycle of the rotation, hairy vetch plots were no-till planted at 31 lb/a in 8-in. rows 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 14. 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).

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, 1999. 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-in. rows on July 6, 1999. Weeds were controlled with preemergence application of Dual II + AAtrex 4L (1 qt + 0.5 pt/a). Grain sorghum was combine harvested on October 29. Fertilizer N treatments were broadcast as 34-0-0 on November 2, 1999, at rates equal to those applied to the prior sorghum crop. Variety 2137 winter wheat was no-till planted in 8-in. rows into sorghum stubble on the following day at 120 lb/a with 32 lb/a of P_2O_5 fertilizer banded in the furrow. Wheat was harvested on June 20.

Results

Hairy vetch terminated in mid-June, 1999, produced an average of 1.18 ton/a of dry matter, yielding 70 lb/a of N potentially available to the sorghum crop that followed (Table 5). However, vetch failed to increase sorghum leaf N concentration in the absence of N fertilizer and caused a yield loss of 8.3 bu/a when averaged over all N rates.

At 0 lb/a of fertilizer N, the residual effect of hairy vetch did not increase wheat whole-plant N or grain protein. Also, vetch treatments averaged over N rates had no significant residual effect on wheat test weight, plant N and grain protein. Nitrogen fertilizer at 90 lb/a versus 30 lb/a or 60 lb/a increased plant N and grain protein levels, but not in comparison with the zero N rate at which yields were very low.

In the absence of fertilizer N, the residual effect of vetch on wheat yield was significant only in the no-till system, where an increase of 8.1 bu/a occurred. Averaged over N rates, hairy vetch in disk and no-till systems accounted for yield increases of 2.6 and 4.1 bu/a. In wheat after sorghum without vetch, each 30 lb/a increment of fertilizer N significantly increased yield. The trend suggested that yields had not exceeded the maximum at 90 lb/a of fertilizer N. In wheat after vetch-sorghum, yields also increased with increasing fertilizer N but did not differ significantly between rates of 60 and 90 lb/a.

Table 5. Residual effects of hairy vetch cover crop, termination method, and nitrogen rate on no-till wheat after grain sorghum, Hesston, KS, 2000.

Cover Crop/ Termination[1]	N Rate[2]	Vetch Yield[3] Forage	Vetch Yield[3] N	Sorghum Yield 1999	Wheat Yield	Wheat Bushel Wt	Wheat Plant Ht	Wheat Plant N[4]	Wheat Grain Protein[5]
	lb/a	ton/a	lb	bu/a	bu/a	lb	in.	%	%
None	0	----	----	86.3	10.4	61.2	19	1.47	10.9
	30	----	----	90.2	24.8	61.2	25	1.14	9.8
	60	----	-----	99.1	41.3	60.9	30	1.19	9.4
	90	----	----	98.8	49.2	60.6	29	1.30	10.3
Vetch/Disk	0	0.90	55	86.8	13.0	61.1	20	1.39	10.1
	30	1.32	80	87.3	26.9	61.2	26	1.11	9.8
	60	1.26	70	88.1	45.8	60.9	29	1.25	9.8
	90	1.12	63	87.9	50.4	60.3	30	1.38	10.5
Vetch/No-till	0	1.50	92	72.8	18.5	61.9	23	1.34	11.0
	30	1.13	67	81.4	31.5	61.1	27	1.25	9.9
	60	1.26	71	91.6	43.6	61.1	29	1.20	9.8
	90	0.97	58	87.1	48.4	60.4	30	1.48	10.6
LSD .05		NS	NS	13.0	5.8	0.5	2.0	0.17	0.55
Means:									
Cover Crop/Termination									
		----	----	93.6	31.4	61.0	26	1.27	10.0
None		1.15	67	87.5	34.0	60.9	26	1.28	10.1
Vetch/Disk		1.21	72	83.2	35.5	61.1	27	1.32	10.3
Vetch/No-till		NS	NS	6.5	2.9	NS	1.0	NS	NS
LSD .05									
N Rate									
0		1.20	73	82.0	14.0	61.4	20	1.40	10.7
30		1.22	74	86.3	27.7	61.1	26	1.16	9.9
60		1.26	71	92.9	43.6	61.0	29	1.21	9.7
90		1.04	60	91.3	49.3	60.4	30	1.39	10.5
LSD .05		NS	NS	7.5	3.4	0.3	1.1	0.10	0.32

[1] Hairy vetch planted in late October, 1998 replanted in February, and terminated in June, 1999.
[2] N applied as 34-0-0 on June 30, 1999 for sorghum and on November 1, 1999 for wheat.
[3] Oven dry weight and N content just prior to termination.
[4] Whole-plant N concentration at early heading
[5] Protein calculated as %N x 5.7.

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

Mark Claassen, Gerald Wilde, and Kraig Roozeboom

Summary

The effects of Adage and Gaucho seed treatments were evaluated on two corn and two grain sorghum hybrids. Seedling vigor of both crops was improved by these insecticides. In corn, Gaucho provided slightly better control of moderate infestations of flea beetles and chinch bugs than Adage. Average yield increases were 22 and 27 bu/a for Adage and Gaucho, respectively. In grain sorghum, chinch bug control was comparable with both products. Yields increased by an average of 11 bu/a with no significant difference between insecticides.

Introduction

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

Procedures

The experiment was conducted on a Ladysmith silty clay loam soil previously cropped to wheat in 1999. Corn was fertilized with 125 lb N/a and 37 lb P_2O_5/a. Eight replications of two hybrids, Asgrow RX799Bt and Midland 798 with and without Gaucho and Adage, were planted on April 14, 2000, in 30-inch rows at 23,500 seeds/a. Weeds were controlled with preemergence application of Dual II + AAtrex 4L (1.5 pt + 1.5 qt/a). Multiple plant population counts and seedling vigor ratings were obtained during the first 32 days after planting (DAP). Flea beetle damage ratings and chinch bug counts were taken at 20 and 45 DAP, respectively. Corn was combine harvested on August 29.

Grain sorghum was fertilized the same as corn. Hybrids NC+ 271 and NK KS560Y with and without Adage and Gaucho were planted in eight replications on April 29 in 30-inch rows at 47,000 seeds/a. Weeds were controlled with preemergence application of Dual II + AAtrex 4L (1 qt + 1.5 qt/a). Stand counts were made at 10 and 31 DAP. Seedling vigor and chinch bug counts were obtained at 31 and 48 DAP, respectively. Grain sorghum was harvested on September 1, 2000.

Results

Corn

Insecticide treatments had no beneficial effect on initial stands (Table 6). However, stress factors associated with moderate flea beetle and chinch bug infestations resulted in some stand loss where no insecticide was used. Adage and Gaucho performed equally well in preventing 3% and 15% stand loss in Asgrow RX799Bt and Midland 798, respectively. Both products significantly reduced flea beetle injury and the number of chinch bugs per plant. However, Gaucho tended to result in slightly better control of these insects, particularly chinch bugs. Adage and Gaucho had equally favorable effects on corn in terms of improving early plant vigor, shortening the number of days to half-silk stage, increasing the number of ears per plant, and reducing lodging. Midland 798 yields increased dramatically with seed insecticides, but both hybrids had a significant positive response. Average increases were 22 and 27 bu/a for Adage and Gaucho, respectively.

Grain Sorghum

Early May plant populations were 5% higher with Adage and 14% lower with Gaucho than without insecticide (Table 7). At the end of May, plant populations remained about 5% higher in sorghum treated with Adage, while those treated with Gaucho improved to a level 8% lower than the check treatment. Both insecticides significantly reduced the number of chinch bugs per plant and increased early sorghum vigor comparably. Adage and Gaucho slightly decreased the number of days to half bloom of both hybrids and increased plant height of NC+ 271. A slight increase in the number of heads per plant was associated with the Gaucho treatment. In terms of yield benefit, there was no significant difference between the insecticides. Both increased the yield of NC+ 271 and NK KS 560Y by an average of 15 and 7 bu/a, respectively. NC+ 271 test weight increased very slightly with both insecticides, while NK KS 560Y showed no analogous response.

Table 6. Adage and Gaucho seed insecticide effects on corn, Harvey County Experiment Field, Hesston, KS, 2000.

Hybrid	Treat-ment	Grain Yield[1]	Bu Wt	Plant Vigor[2]	Final Stand[3]	Days to Silk[4]	Ears/ Plant	Lodg -ing	Flea[5] Beetle	Chinch Bug[6]
		bu/a	lb/bu	score	1000's/a			%	score	no./plt
Asgrow RX799Bt	None	97	58.3	2.6	19.4	79	0.97	0	3.2	5.8
Asgrow RX799Bt	Adage	102	58.4	1.1	20.1	78	0.99	0	0.4	4.7
Asgrow RX799Bt	Gaucho	108	58.2	1.0	20.0	77	0.99	0	0.1	1.7
Midland 798	None	57	54.6	3.2	17.0	84	0.76	15	3.3	13.0
Midland 798	Adage	95	55.3	1.0	19.8	81	0.95	2	0.8	4.1
Midland 798	Gaucho	100	54.7	1.0	19.9	81	0.98	2	0.3	3.3
LSD .05		7	0.79	0.22	0.6	0.6	.064	2.4	0.34	2.5
Main effect means:										
Hybrid										
Asgrow RX799Bt		102	58.3	1.5	19.8	78	0.98	0	1.2	4.0
Midland 798		84	54.9	1.7	18.9	82	0.89	6	1.5	6.8
LSD .05		4	0.46	0.13	0.4	0.3	.037	1	---	---
Treatment										
None		77	56.4	2.9	18.2	81	0.87	8	3.3	9.4
Adage		98	56.8	1.0	19.9	79	0.97	1	0.6	4.4
Gaucho		104	56.4	1.0	20.0	79	0.98	1	0.2	2.5
LSD		5	NS	0.16	0.4	0.4	.045	2	---	---

[1] Average of 8 replications adjusted to 56 lb/bu and 15.5% moisture.
[2] Vigor score on May 16: 1 = good; 5 = poor.
[3] Plant populations on August 29.
[4] Days from planting to 50% silking.
[5] Flea beetle damage rating on May 4: 0 = no damage; 5 = severe damage.
[6] Number of chinch bugs/plant on May 31.

Table 7. Adage and Gaucho seed insecticide effects on grain sorghum, Harvey County Experiment Field, Hesston, KS, 2000.

Hybrid	Treat-ment	Grain Yield[1]	Bu Wt	Plant Vigor[2]	Final Stand[3]	Days to Bloom[4]	Heads /Plant	Plant Ht	Chinch Bug[5]
		bu/a	lb/bu	score	1000's/a			in	no./plant
NC+ 271	None	98	60.7	3.1	36.7	78	1.23	43	8.1
NC+ 271	Adage	114	61.1	1.2	38.3	77	1.26	45	3.2
NC+ 271	Gaucho	113	61.1	1.2	36.8	76	1.33	45	4.4
NK KS 560Y	None	102	61.6	3.2	38.5	73	1.37	38	6.8
NK KS 560Y	Adage	109	61.4	1.1	40.8	72	1.34	38	4.4
NK KS 560Y	Gaucho	107	61.6	1.3	32.5	72	1.70	38	2.3
LSD .05		4	0.26	0.26	2.7	0.4	0.09	0.9	1.9
Main effect means:									
Hybrid									
NC+ 271		109	61.0	1.8	37.3	77	1.27	44	5.2
NK KS 560Y		106	61.5	1.8	37.3	72	1.47	38	4.5
LSD .05		2	0.15	NS	NS	0.2	0.05	0.5	---
Treatment									
None		100	61.1	3.2	37.6	75	1.30	40	7.4
Adage		112	61.2	1.1	39.6	74	1.30	41	3.8
Gaucho		110	61.4	1.2	34.6	74	1.51	41	3.4
LSD		3	NS	0.18	1.5	0.3	0.06	0.6	---

[1] Average of 8 replications adjusted to 56 lb/bu and 12.5% moisture.
[2] Vigor score on May 30: 1 = good; 5 = poor.
[3] Plant populations on May 30.
[4] Days from planting to 50% bloom.
[5] Number of chinch bugs/plant on June 16.

HERBICIDES FOR WEED CONTROL IN GRAIN SORGHUM

Mark M. Claassen

Summary

Fourteen herbicide treatments were evaluated for crop tolerance and weed control efficacy in grain sorghum. Weed competition consisted of moderate Palmer amaranth and large crabgrass populations. All preemergence treatments provided excellent control of these species. Paramount alone postemergence had no apparent activity on Palmer amaranth and very little activity on large crabgrass. When atrazine was tank mixed with Paramount, Palmer amaranth control was good, but large crabgrass control did not improve. Minor crop injury occurred with treatments involving Ally.

Introduction

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

Procedures

Spring oats were grown on the experiment site in 1999. The soil was a Geary silt loam with pH 6.7 and 2.6% organic matter. Fertilizer nitrogen was applied at 100 lb/a as 46-0-0 on June 12. 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, 2000. Seedbed condition was excellent. All herbicides were broadcast in 20 gal/a of water, in three replications per treatment (Table 8). Preemergence (PRE) applications were made shortly after planting with AI TeeJet 110025-VS nozzles at 32 psi. Postemergence treatments were applied with Turbo Tee 11003 nozzles at 20 psi on July 8 (POST 1), July 10 (POST 2), or July 15 (POST 3). POST 1 treatments were applied to 1- to 3-inch Palmer amaranth and 0.5- to 2-inch large crabgrass in 13-inch sorghum. POST 2 herbicides were applied to 0.5- to 4-inch Palmer amaranth in 17-inch sorghum. POST 3 herbicides were applied to 2- to 12-inch Palmer amaranth in 25-inch sorghum. Plots were not cultivated. Crop injury and weed control were rated twice during the growing season. Sorghum was harvested October 3.

Results

The first significant rainfall (1.06") occurred 9 days after planting and preemergence herbicide applications. An additional 1.08" of rain fell during the remainder of June. While the first half of July was dry, abundant rainfall in the second half of that month gave promise of an excellent sorghum crop. However, high temperatures and dry conditions prevailed throughout the remainder of the growing season. Nevertheless, sorghum persevered and produced a good yield.

Moderate populations of Palmer amaranth and large crabgrass developed. All preemergence treatments provided excellent control of these species. Evaluation of postemergence weed control efficacy in treatments 6-8 and 11-14 was limited by the fact that preemergence Dual II Magnum, Frontier, or BAS 656 had eliminated most or all of the Palmer amaranth. Paramount alone had no apparent activity on Palmer amaranth and very little activity on large crabgrass. When atrazine was tank mixed with Paramount, Palmer amaranth control was good, but large crabgrass control did not improve.

Minor crop injury occurred only with treatments involving Ally. Among these treatments, slightly more injury occurred when a nonionic surfactant was included in the tank mix. While herbicides increased sorghum yield by an average of 16 bu, meaningful comparisons among treatments were made difficult by drouth-induced yield variability. Paramount without atrazine resulted in reduced yield associated with poor weed control. Grain test weights averaged 59.1 lb/bu, and were negatively affected only by a lack of weed control in the Paramount and untreated check plots.

Table 8 . Weed control in grain sorghum, Harvey County Experiment Field, Hesston, KS, 2000.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 8/9	Lacg[3] Control 8/9	Paam[4] Control 8/9	Yield
					%	%	%	bu/a
1 Bicep II Magnum	5.5 F	1.6	Qt	PRE	0	99	100	98
2 Bicep Lite II Magnum	6 F	1.5	Qt	PRE	0	98	100	99
3 Guardsman	5 F	1.75	Qt	PRE	0	99	100	102
4 Bullet	4 F	3	Qt	PRE	0	95	100	100
5 Lariat	4 F	3	Qt	PRE	0	98	100	96
6 Dual II Magnum	7.62 EC	1.31	Pt	PRE	0	96	100	105
Peak +	57 WG	0.75	Oz	POST 3				
COC		1	Qt	POST 3				
7 Frontier	6 EC	1.67	Pt	PRE	0	98	99	100
Peak +	57 WG	0.75	Oz	POST 3				
COC		1	Qt	POST 3				
8 BAS 656	6 EC	1	Pt	PRE	0	98	100	100
Peak +	57 WG	0.75	Oz	POST 3				
COC		1	Qt	POST 3				
9 Paramount +	75 DF	5.33	Oz	POST 1	0	30	0	87
UAN +		1.25	% V/V	POST 1				
COC		1.25	% V/V	POST 1				
10 Paramount +	75 DF	5.33	Oz	POST 1	0	32	94	95
AAtrex +	4 F	2	Pt	POST 1				
UAN +		1.25	% V/V	POST 1				
COC		1.25	% V/V	POST 1				
11 Dual II Magnum	7.62 EC	1.31	Pt	PRE	1	99	100	96
Ally +	60 DF	0.05	Oz	POST 2				
2,4-D Amine	4 SC	4	Fl Oz	POST 2				

Table 8 . Weed control in grain sorghum, Harvey County Experiment Field, Hesston, KS, 2000.

Herbicide Treatment[1]	Product Form	Rate/a	Unit	Timing[2]	Injury 8/9	Lacg[3] Control 8/9	Paam[4] Control 8/9	Yield
					%	%	%	bu/a
12 Dual II Magnum	7.62 EC	1.31	Pt	PRE	1	99	100	87
Ally +	60 DF	0.05	Oz	POST 2				
2,4-D Amine +	4 SC	4	Fl Oz	POST 2				
AAtrex	4 F	2	Pt	POST 2				
13 Dual II Magnum	7.62 EC	1.31	Pt	PRE	2	99	100	93
Ally +	60 DF	0.05	Oz	POST 2				
2,4-D Amine	4 SC	4	Fl Oz	POST 2				
NIS		0.25	% V/V	POST 2				
14 Dual II Magnum	7.62 EC	1.31	Pt	PRE	4	96	100	92
Ally +	60 DF	0.05	Oz	POST 2				
2,4-D Amine +	4 SC	4	Fl Oz	POST 2				
AAtrex	4 F	2	Pt	POST 2				
NIS		0.25	% V/V	POST 2				
15 Hand Weed								
Bicep Lite II	6 F	1.47	Qt	PRE	0	100	100	94
Magnum								
24 No Treatment					0	0	0	80
LSD .05					1	3	2	15

[1] **Note: BAS 656 currently is not labeled for grain sorghum**.
COC = Farmland Crop Oil Plus.
NIS = Pen-A-Trate II nonionic surfactant.
UAN = 28% urea ammonium nitrate fertilizer.
[2] PRE= preemergence on June 15; POST 1 = early postemergence 23 DAP.; POST 2 = postemergence 25 DAP;
POST 3 = postemergence 30 DAP.
[3] Lacg =large crabgrass.
[4] 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 3- to 5-inch grain sorghum in June. Symptoms and their severity differed significantly among treatments. None of these herbicides at 1/33 of their labeled rates (LR) or less significantly affected sorghum. At 1/10 LR, Pursuit, Roundup, and Poast impacted yields with reductions of 20%, 10%, and 14%, respectively. The 1/3 LR of Pursuit and Roundup caused greatest injury and largest yield losses (74% and 82%, respectively). Liberty and Poast at 1/3 LR reduced yields by 22% and 53%, 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. Since grain sorghum is often grown in close proximity to soybean, the potential for soybean herbicide injury to sorghum 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 and 2000 to evaluate sorghum injury symptoms and yield following application of low rates of four soybean herbicides.

Procedures

The site was located on a Ladysmith silty clay loam soil. Pioneer 8505 grain sorghum was planted in 30-inch rows at 42,500 seeds/a on June 7, 2000. Weeds were controlled with preemergence application of Dual II + AAtrex 90 DF (1 qt/a + 1.1 lb/a). On June 22, sorghum with 3- to 5-inch height was subjected to 0, 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. These applications were based on an LR of 0.063, 0.36, 1.0, and 0.15 lb ai/a for the respective herbicides. Experimental design was a split-plot with 4 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 September 6 or September 20 (1/3 LR Poast, Pursuit, and Roundup)

Results

Moisture environment before and after application favored herbicide uptake by sorghum. Large herbicide and rate effects as well as herbicide x rate interactions were observed. (Table 9). Injury scores were highest at 2 WAT and declined over time with all treatments, but to a lesser extent with the highest rate of Pursuit and Roundup. Severe drouth stress caused premature termination of sorghum grain filling at the end of August. Significant lodging occurred in early September.

<u>Pursuit</u>

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 some stand reduction occurred with 1/3 LR. Pursuit at 1/10 and 1/3 LR caused major yield losses of 20% and 74%, respectively. Grain test weight decreased by 9% only at 1/3 LR.

<u>Liberty</u>

The 1/100 LR, 1/33 LR, and 1/10 LR Liberty treatments resulted in no injury symptoms in sorghum. The highest rate of Liberty produced slight stunting, leaf chlorosis and necrosis. While stands were not affected, plant height was reduced slightly (5%) with 1/3 LR. Also, yield loss was significant at 22%, and grain test weight declined by 2%.

<u>Roundup</u>

Roundup at 1/100 LR and 1/33 LR had no apparent effect on sorghum. The 1/10 LR treatment caused minor leaf chlorosis and necrosis, and had little or no effect on plant height and stands. However, yield declined by 10 % at this rate. At 1/3 LR, Roundup caused 38% stand loss, 31% plant height reduction, and 82% yield loss.

<u>Poast</u>

Poast had no significant effect on sorghum at the two lowest rates. Moderate injury in the form of leaf chlorosis occurred at 1/10 LR, but without impact on sorghum stands or plant height. Nevertheless, yield declined by 14%. Major leaf necrosis, 20% plant height reduction, and 53% yield loss occurred with 1/3 LR. Grain test weight was not affected significantly.

Table 9. Grain sorghum response to soybean herbicides, Harvey County Experiment Field, Hesston, KS, 2000.

Herbicide[1]	Relative Rate[2]	Injury Rating[3] 2 WAT	Injury Rating[3] 4 WAT	Injury Rating[3] 8 WAT	Plants/ Acre[4]	Plant Ht	Grain Yield	Yield Loss 2000	Yield Loss 2-Yr	Test Wt
		---------------%---------------			1000's	inch	bu/a	%	%	lb/bu
Pursuit	0	0	0	0	28.9	48	64	--	--	57.3
	1/100	0	0	0	30.6	48	66	0	0	57.1
	1/33	0	0	0	30.8	49	66	0	0	57.3
	1/10	35	21	10	29.2	45	51	20	25	57.1
	1/3	90	75	40	26.7	34	17	74	75	52.3
Liberty	0	0	0	0	28.5	49	66	--	--	57.3
	1/100	0	0	0	30.7	49	67	2	1	57.0
	1/33	0	0	0	29.8	48	65	3	2	57.3
	1/10	0	0	0	30.0	48	68	1	1	57.3
	1/3	21	10	3	30.1	47	51	22	30	55.9
Roundup	0	0	0	0	31.3	48	66	--	--	57.3
	1/100	0	0	0	29.8	48	64	5	3	56.9
	1/33	0	0	0	30.9	47	64	3	2	57.4
	1/10	2	1	0	29.8	48	59	10	13	57.2
	1/3	97	87	78	19.3	33	12	82	91	54.7
Poast	0	0	0	0	30.9	48	63	--	--	57.2
	1/100	0	0	0	32.3	48	65	0	0	57.4
	1/33	0	0	0	29.7	48	63	1	1	57.2
	1/10	20	9	1	30.1	49	54	14	7	56.8
	1/3	81	40	28	29.0	40	30	53	31	56.2
LSD .05 same herb.		2	3	3	2.7	2	5	7	--	1.9
LSD .05 diff. herb.		2	3	3	3.3	2	8	8	--	2.0

[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 Palmer amaranth and large crabgrass populations were present. All preemergence herbicide treatments provided excellent control of Palmer amaranth. Perfect overall weed control was achieved with preemergence Authority + Prowl or Canopy XL combinations followed by POST Roundup Ultra alone or in tank mixes with Classic or Synchrony STS. Dual II Magnum + Scepter alone PRE and Boundary PRE followed by Roundup Ultra were equally good. Ammonium sulfate and Array (adjuvant/drift retardant) were comparable to each other in terms of enhancing Roundup Ultra efficacy at reduced rates.

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. Additionally, Array adjuvant/drift retardant was compared for efficacy with sprayable ammonium sulfate when applied with low rates of Roundup Ultra.

Procedures

Spring oats were grown on the experiment site in 1999. The soil was a Smolan silt loam with pH 6.7 and 2.4% organic matter. To promote uniformity of weed populations, pigweed and crabgrass seed were broadcast and incorporated with a mulch treader at the last preplant tillage. Asgrow AG4101 Roundup Ready + STS soybean was planted at 105,000 seeds/a in 30-inch rows on June 15, 2000. Seedbed condition was excellent. All herbicide treatments were broadcast in 20 gal/a of water, with three replications per treatment. Preemergence (PRE) applications were made shortly after planting with AI TeeJet 110025-VS nozzles at 32 psi (Table 10). Postemergence treatments were applied with XR8003 flat fan nozzles at 18 psi on July 12 (POST 1) and on July 27 (POST 2). POST 1 treatments were applied when soybean was 9 inches tall with three trifoliate leaves. Palmer amaranth ranged from 2 to 12 inches, and large crabgrass height was 0.5 to 3 inches. Post 2 treatments were applied to 18-inch soybean with only a few Palmer amaranth ranging up to 24 inches in height and to moderate-density large crabgrass from 1 to 6 inches in height. Crop injury and weed control were evaluated twice during the growing season. Soybean was harvested on October 3.

Results

Several light showers at 5 to 8 days after planting preceded the first consequential rainfall of 1.06 in. at 9 days after planting and preemergence herbicide applications. An additional 1.08 in. of rain fell during the remainder of June. While the first half of July was dry, copious rainfall in the second half of that month gave promise of an excellent soybean crop. However, high temperatures and dry conditions prevailed throughout the remainder of the growing season. Soybean succumbed to severe drouth stress early, without reaching its yield potential.

Dense pigweed, primarily Palmer amaranth, and large crabgrass populations developed. All preemergence herbicide treatments provided excellent control of Palmer amaranth. Boundary alone as well as

Pursuit Plus and Squadron in tank mixes with Authority gave superior preemergence control of large crabgrass. However, the performance of Boundary and Pursuit Plus was better than Squadron at approximately 8 weeks after treatment. All other preemergence treatments produced fair control of large crabgrass, with efficacy deteriorating between 4 and 8 weeks after application. Roundup Ultra alone or in tank mixes with Classic or Synchrony STS following preemergence Authority + Prowl and Canopy XL combinations resulted in perfect weed control. A follow-up treatment with Roundup Ultra after Boundary (treatments 14-15) was inconsequential because of excellent overall preemergence weed control.

A single application of Roundup Ultra at 1.5 pt/a with ammonium sulfate (AMS) resulted in only fair control of both Palmer amaranth and large crabgrass. Lower rates of Roundup Ultra (0.5 and 1 pt/a) alone and in combination with ammonium sulfate or Array (adjuvant/ drift retardant) gave less than satisfactory results. However, these additives were comparable to each other in terms of enhancing Roundup Ultra efficacy at reduced rates. AMS and Array increased Palmer amaranth control by 48% with 0.5 pt/a Roundup Ultra, but failed to improve control at the 1 pt/a rate. On the other hand, both additives resulted in a 10 fold increase in large crabgrass control with 0.5 pt/a Roundup Ultra and a 24% increase in control when the Roundup Ultra rate was doubled.

No significant soybean injury occurred from herbicide treatments. Drouth stress severely reduced yields and caused variation in yields within treatments. While herbicides numerically increased soybean yields, no meaningful conclusions could be made concerning the significance of yield differences among treatments.

Table 10. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 2000.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/14	Lacg[3] Control 8/9	Paam[4] Control 8/9	Yield
					%	%	%	bu/a
1 Canopy XL	56 DF	6.8	Oz	PRE	1	77	99	5.7
Prowl	3.3 EC	2	Pt	PRE				
2 Canopy XL +	56 DF	2.5	Oz	PRE	0	71	99	5.9
Authority	75 DF	2.5	Oz	PRE				
3 Canopy XL +	56 DF	2.5	Oz	PRE	1	75	100	4.8
Authority +	75 DF	2.5	Oz	PRE				
Prowl	3.3 EC	2	Pt	PRE				
4 Authority +	75 DF	4	Oz	PRE	0	73	98	3.9
Lorox	50 DF	12	Oz	PRE				
5 Authority +	75 DF	4	Oz	PRE	1	76	97	6.2
Lorox +	50 DF	12	Oz	PRE				
Prowl	3.3 EC	2	Pt	PRE				
6 Authority +	75 DF	4	Oz	PRE	0	71	100	5.3
Lorox	50 DF	16	Oz	PRE				
7 Authority +	75 DF	4	Oz	PRE	0	77	99	5.8
Lorox +	50 DF	16	Oz	PRE				
Prowl	3.3 EC	2	Pt	PRE				
8 Authority +	75 DF	4	Oz	PRE	1	97	100	7.5
Pursuit Plus	2.9 L	2.6	Pt	PRE				
9 Authority +	75 DF	4	Oz	PRE	0	87	100	5.2
Squadron	2.33 EC	3	Pt	PRE				
10 Authority +	75 DF	4	Oz	PRE	0	100	100	5.5
Prowl	3.3 EC	1	Pt	PRE				
Classic +	25 DF	0.33	Oz	POST 2				
Roundup Ultra +	4 L	1.5	Pt	POST 2				
NIS +		0.25	% V/V	POST 2				
AMS		2	Lb	POST 2				
11 Authority +	75 DF	4	Oz	PRE	1	100	100	6.5
Prowl	3.3 EC	1	Pt	PRE				
Synchrony STS +	42 DF	0.25	Oz	POST 2				
Roundup Ultra +	4 L	1.5	Pt	POST 2				
NIS +		0.25	% V/V	POST 2				
AMS		2	Lb	POST 2				
12 Canopy XL +	56 DF	2.5	Oz	PRE	0	100	100	5.9
Authority	75 DF	2.5	Oz	PRE				
Classic +	25 DF	0.33	Oz	POST 2				
Roundup Ultra +	4 L	1.5	Pt	POST 2				
NIS +		0.25	% V/V	POST 2				
AMS		2	Lb	POST 2				

Table 10. Weed control in soybean, Harvey County Experiment Field, Hesston, KS, 2000.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/14	Lacg[3] Control 8/9	Paam[4] Control 8/9	Yield
					%	%	%	bu/a
13 Canopy XL	56 DF	4.5	Oz	PRE	1	100	100	5.5
Classic +	25 DF	0.33	Oz	POST 2				
Roundup Ultra +	4 L	1.5	Pt	POST 2				
NIS +		0.25	% V/V	POST 2				
AMS		2	Lb	POST 2				
14 Boundary	7.8 EC	1.25	Pt	PRE	2	100	100	5.0
Roundup Ultra +	4 L	1.5	Pt	POST 2				
AMS		2	Lb	POST 2				
15 Boundary	7.8 EC	1.5	Pt	PRE	1	100	100	7.9
Roundup Ultra +	4 L	1.5	Pt	POST 2				
AMS		2	Lb	POST 2				
16 Roundup Ultra +	4 L	1.5	Pt	POST 1	0	80	80	5.6
AMS		2	Lb	POST 1				
17 Roundup Ultra	4 L	0.5	Pt	POST 1	0	7	48	4.8
18 Roundup Ultra +	4 L	0.5	Pt	POST 1	0	69	74	5.2
AMS		2	Lb	POST 1				
19 Roundup Ultra +	4 L	0.5	Pt	POST 1	0	68	68	5.1
Array		1.8	Lb	POST 1				
20 Roundup Ultra	4 L	1	Pt	POST 1	0	59	73	4.8
21 Roundup Ultra +	4 L	1	Pt	POST 1	0	73	74	4.4
AMS		2	Lb	POST 1				
22 Roundup Ultra +	4 L	1	Pt	POST 1	0	73	74	5.9
Array		1.8	Lb	POST 1				
23 Dual II Magnum +	7.62 EC	1.33	Pt	PRE	0	100	100	5.6
Scepter	70 DG	2.8	Oz	PRE				
24 Hand Weed								
Dual II Magnum	4 L	1.57	Pt	PRE	0	100	100	6.4
25 No Treatment					0	0	0	3.8
LSD .05					2	7	6	1.8

[1] **Note:** NIS = Pen-A-Trate II nonionic surfactant. AMS = sprayable ammonium sulfate.
[2] PRE= preemergence to soybeans and weeds on June 15; POST 1 = postemergence 27 DAP;
POST 2 = postemergence 42 DAP.
[3] Lacg =large crabgrass.
[4] Paam = Palmer amaranth. Weed population included some redroot pigweeds.

HERBICIDES FOR WEED CONTROL IN SUNFLOWER

Mark M. Claassen and Dallas E. Peterson

Summary

Preplant incorporated Treflan alone and the preemergence Spartan + Partner tank mix best controlled Palmer amaranth. Spartan alone at 3 oz/a provided good, but somewhat less consistent control of Palmer amaranth than at rates of 4 or 5 oz/a. Treflan, Partner, and postemergence Poast all gave superior control of large crabgrass, but only fair control occurred with Prowl and Spartan alone. No significant sunflower injury from Spartan was observed.

Introduction

Sunflower growers have had very few herbicide options for their weed control program. Spartan is a new herbicide being developed by FMC for preemergence weed control in sunflower. Spartan has not yet received a federal label for use on sunflowers, but recently gained a Section 18 registration for use on sunflowers in Kansas for the 2001 growing season. However, some concerns have been raised about crop safety with Spartan on sunflowers. This experiment was initiated to evaluate Spartan alone and in combination with other herbicides for weed control efficacy and crop response.

Procedures

Roundup Ready soybean was grown on the experiment site in 1999. The soil was a Ladysmith silty clay loam with 1.9 % organic matter. Fertilizer application consisted of 81lb N/a and 38 lb P_2O_5/a broadcast in late April. Weed seed was broadcast over the area to enhance the uniformity of weed populations. Mycogen Cavalry was planted at approximately 25,300 seeds/a in 30-inch rows on June 1, 2000. Seedbed condition was excellent. All herbicides were broadcast in 20 gal/a of water, with three replications per treatment (Table 11). Preplant incorporated (PPI) Treflan was applied just before planting and incorporated by double pass with a field cultivator. Preemergence (PRE) treatments, made shortly after planting, as well as Treflan were applied with XR 8003 flat fan nozzles at 18 psi. Postemergence treatments (POST) were applied with Turbo Tee 11003 nozzles at 21 psi on June 29 to large crabgrass from 0.5 to 4 inches in height with moderate density. Plots were not cultivated. Crop injury was evaluated in early July and weed control was rated at that time as well as near mid-August. Sunflower was harvested on September 18.

Results

Highest level of Palmer amaranth control occurred with preplant incorporated Treflan and preemergence application of the Spartan + Partner tank mix. Very good control was also achieved with Spartan alone at 4 or 5 oz/a and with Spartan at 3 oz/a + Prowl preemergence. Spartan alone at 3 oz/a provided good, but somewhat less consistent control of Palmer amaranth, while Prowl alone preemergence gave only fair control. Treflan, Partner, and Poast all gave superior control of large crabgrass, but only fair control occurred with Prowl and Spartan alone. None of the herbicide treatments caused any visual injury to sunflower or caused any stand reduction. Stand variation unrelated to treatments accounted for about 10% of the variation in sunflower yields. While most treatments increased sunflower yields numerically, drouth stress accentuated yield variability and diminished the meaningful relationship between weed control and yield.

Table 11. Weed control in sunflower, Harvey County Experiment Field, Hesston, KS, 2000.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/8	Stand	Lacg[3] Control 8/19	Paam[4] Control 8/19	Yield
					%	1,000's/a	%	%	lb/a
1 Treflan	4 EC	1.5	Pt	PPI	0	14.4	100	100	1703
2 Prowl	3.3 EC	3	Pt	PRE	0	15.2	83	75	1555
3 Partner	65 DF	3.85	Lb	PRE	0	13.7	99	92	1304
4 Spartan	75 DF	3	Oz	PRE	0	13.1	79	81	1397
5 Spartan	75 DF	4	Oz	PRE	2	14.1	86	90	1222
6 Spartan	75 DF	5	Oz	PRE	0	11.5	84	89	1597
7 Spartan Prowl	75 DF 3.3 EC	3 3	Oz Pt	PRE PRE	0	13.5	88	90	1702
8 Spartan Partner	75 DF 65 DF	3 3.1	Oz Lb	PRE PRE	1	12.7	99	98	1341
9 Spartan Poast COC	75 DF 1.53 EC	3 1.5 2	Oz Pt Pt	PRE POST POST	0	12.3	100	85	1351
10 Spartan Poast COC	75 DF 1.53 EC	4 1.5 2	Oz Pt Pt	PRE POST POST	0	12.3	100	84	1456
11 Spartan Poast COC	75 DF 1.53 EC	5 1.5 2	Oz Pt Pt	PRE POST POST	0	12.5	100	88	1659
12 Hand Weed					0	13.5	100	100	1474
13 No Treatment					0	13.1	0	0	1134
LSD .05					1	3.9	4	6	NS

[1] **Note: Partner currently is not labeled for sunflower**. COC = Farmland Crop Oil Plus.
[2] PPI = preplant incorporated with field cultivator on June 1.
PRE= preemergence to sunflower and weeds on June 1; POST = postemergence on June 29.
[3] Lacg = large crabgrass.
[4] Paam = Palmer amaranth.

HERBICIDES FOR WEED CONTROL IN COTTON

Mark M. Claassen, Stewart R. Duncan, and Dallas E. Peterson

Summary

Fourteen herbicide treatments were evaluated for weed control and crop tolerance in cotton. Weed competition consisted of dense large crabgrass and a few Palmer amaranth. All treatments completely controlled existing Palmer amaranth. Dual II Magnum provided best grass control. Dual II Magnum presently is not labeled for use on cotton in Kansas, but Syngenta will be applying for a Kansas label in the future. Preemergence Prowl as well as a single postemergence application of Roundup Ultra at 2 pt/a provided only fair control of large crabgrass. None of the herbicide treatments caused visual symptoms of foliar injury to cotton. While the untreated check produced no cotton yield, differences in yield among herbicide treatments were not associated with weed control efficacy.

Introduction

Cotton production in Kansas expanded from 3,000 acres in 1996 to over 40,000 acres in 2000. Weed control is imperative for successful cotton growing. Weeds not only compete for water, light and nutrients during the growing season, but they can seriously interfere with harvest. Cotton harvest machine efficiency is severely impaired with the presence of weeds. Cotton lint yield losses are increased, and quality can be adversely affected, too, as weed populations increase in the field. No record of ratings exists for the limited number of cotton herbicides registered for use in Kansas. This experiment was established to evaluate cotton herbicide efficacy and the subsequent effect on cotton lint yields.

Procedures

Soybean was grown on the experiment site in 1999. The soil was a Geary silt loam. Cotton was fertilized with 54 lb N/a broadcast as 46-0-0 in late April. Weed seed was broadcast over the area to enhance the uniformity of weed populations. Paymaster 2280 BG/RR was planted at approximately 76,200 seeds/a in 30-inch rows on May 25, 2000. Seedbed condition was good, but somewhat dry. All herbicides were broadcast in 20 gal/a of water, with three replications per treatment (Table 12). Preemergence (PRE) treatments were applied shortly after planting with XR 8003 flat fan nozzles at 18 psi. Postemergence treatments (POST) were applied with Turbo Tee 11003 nozzles at 20 psi on June 21 to sparse Palmer amaranth ranging from 0.5 to 4 inches in height and large crabgrass from 0.5 to 3 inches in height with high density. Application of Sequential Roundup (SEQ treatment 14) was made in the same way on July 19 to plots with low-density large crabgrass with 0.5 to 4 inches of growth and no Palmer amaranth. Plots were not cultivated. Crop injury was evaluated near mid-July, and weed control was rated at that time as well as one month later. Cotton was harvested September 18.

Results

Despite overseeding, Palmer amaranth infestation was very light, and control was complete with all herbicide treatments. Dual II Magnum provided excellent preemergence control of large crabgrass and was superior to Prowl. A single postemergence application of Roundup Ultra at 2 pt/a provided fair control of large crabgrass similar to that achieved with preemergence Prowl. Sequential application of 1 pt/a Roundup Ultra following an earlier treatment with 1.5 pt/a Roundup Ultra completely controlled large crabgrass.

However, the sequential application of Roundup Ultra was applied to 8-leaf cotton, which is beyond the maximum recommended application stage of 4-leaf cotton. Broadcast applications of Roundup after the 4-leaf growth stage can result in fruit abortion.

None of the herbicide treatments caused visual foliar injury to cotton. Yields ranged from 240 to 392 lb/a among these treatments, whereas the untreated check produced nothing. Differences in yields among herbicides were not related to stands or weed control efficacy.

Table 12. Weed control in cotton, Harvey County Experiment Field, Hesston, KS, 2000.

Herbicide Treatment[1]	Product Form	Product Rate/a	Product Unit	Timing[2]	Injury 7/19	Stand	Lacg[3] 8/19	Paam[4] 8/19	Yield
					%	1,000's/a	--control, %--		lb/a
1 Prowl	3.3 EC	2.4	Pt	PRE	0	71.4	80	100	305
Cotoran	4 F	3.2	Pt	PRE					
2 Dual II Magnum	7.64 EC	1.33	Pt	PRE	0	57.5	97	100	334
Cotoran	4 F	3.2	Pt	PRE					
3 Dual II Magnum	7.64 EC	1.33	Pt	PRE	0	74.9	93	100	392
Karmex	80 DF	1.25	Lb	PRE					
4 Dual II Magnum	7.64 EC	1.33	Pt	PRE	0	71.4	96	100	365
Staple	85 SP	0.9	Oz	PRE					
5 Dual II Magnum	7.64 EC	1.33	Pt	PRE	0	65.3	98	100	301
Staple	85 SP	0.6	Oz	PRE					
Cotoran	4 F	3.2	Pt	PRE					
6 Dual II Magnum	7.64 EC	1.33	Pt	PRE	0	61.0	98	100	315
Caparol	4 F	2.4	Pt	PRE					
7 Dual II Magnum	7.6 EC	1.33	Pt	PRE	0	65.3	95	100	240
Cotoran	4 F	3.2	Pt	POST					
NIS		0.25	% V/V	POST					
8 Dual II Magnum	7.6 7EC	1.33	Pt	PRE	0	72.6	93	100	315
Staple	85 SP	1.2	Oz	POST					
NIS		0.25	% V/V	POST					
9 Dual II Magnum	7.64 EC	1.33	Pt	PRE	0	70.3	99	100	276
Roundup Ultra	4 L	2	Pt	POST					
AMS		2	Lb	POST					

Herbicide Treatment[1]	Product Form	Rate/a	Unit	Timing[2]	Injury 7/19	Stand	Lacg[3] 8/19	Paam[4] 8/19	Yield
					%	1,000's/a	--control, %--		lb/a
10 Dual II	7.64 EC	1.33	Pt	PRE	0	65.6	99	100	329
Magnum	85 SP	0.6	Oz	POST					
Staple	4 L	1.5	Pt	POST					
Roundup Ultra		2	Lb	POST					
AMS									
11 Cotoran	4 F	3.2	Pt	PRE	0	64.5	100	100	341
Fusion	2.67 EC	0.5	Pt	POST					
COC		1	Qt	POST					
12 Cotoran	4 F	3.2	Pt	PRE	0	70.9	100	100	319
Roundup Ultra	4 L	2	Pt	POST					
AMS		2	Lb	POST					
13 Roundup Ultra	4 L	2	Pt	POST	0	68.5	77	100	324
AMS		2	Lb	POST					
14 Roundup Ultra	4 L	1.5	Pt	POST	0	68.5	100	100	303
AMS		2	Lb	POST					
Roundup	4 L	1	Pt	SEQ					
Ultra		2	Lb	SEQ					
AMS									
15 No Treatment					0	54.6	0	0	0
LSD .05					NS	9.9	6	NS	0

[1] **Note: Dual II Magnum currently is not labeled for cotton in Kansas**. Roundup Ultra treatments should not be applied after the 4-leaf stage due to the risk of fruit abortion. AMS = sprayable ammonium sulfate; COC = Farmland Crop Oil Plus concentrate; NIS = Agriliance Activate Plus nonionic surfactant.

[2] PRE = preemergence to cotton and weeds on May 25; POST = postemergence on June 21; SEQ = sequential on July 19.

[3] Lacg =large crabgrass.

[4] Paam = Palmer amaranth.

IRRIGATION AND NORTH CENTRAL KANSAS EXPERIMENT FIELDS

Introduction

The 1952 Kansas legislature provided a special appropriation to establish the Irrigation Experiment Field in order to serve expanding irrigation development in North-Central Kansas. The original 35-acre field was located 9 miles northwest of Concordia. In 1958, the field was relocated to its present site on a 160-acre tract near Scandia in the Kansas-Bostwick Irrigation District. Water is supplied by the Miller Canal and stored in Lovewell Reservoir in Jewell County, Kansas and Harlen County Reservoir at Republican City, Nebraska. A 5-acre site in the Republican River Valley on the Mike Brazon Farm is also utilized for irrigated crop research. In 1997 there were 125,000 acres of irrigatec cropland in north-central Kansas. Current research on the field focuses on managing irrigation water and fertilizer in reduced tillage and crop rotation systems.

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

Soil Description

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

2000 Weather

The 2000 growing season was the hottest and driest since 1934. Growing season rainfall averaged only 38% of normal. Temperatures of over 100° F were recorded in May (Table 1). July temperatures were near normal but temperatures in August and September were much above normal. The abnormal heat and lack of rainfall caused many of the dryland experiments to fail. Irrigated crop yields also were below normal due to the unfavorable weather conditions.

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

	Rainfall, inches			Temperature °F		Growth Units	
Month	Scandia 2000	Average	Belleville 2000	Daily Mean 2000	Average Mean	1998	Average
April	0.7	2.4	1.4	51	52	241	235
May	1.2	3.7	1.4	66	64	487	419
June	2.2	4.8	2.9	73	73	637	711
July	1.8	3.3	1.4	79	79	810	834
August	1.3	3.3	1.6	83	77	842	751
Sept.	0.9	3.5	1.9	70	68	578	528
Total	8.1	20.9	10.6	71	69	3595	3478

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

Barney Gordon, D.A. Whitney, and D.L. Fjell

Summary

Grain yields in the 2000 growing season were limited by the severe drought. The overall test average was only 62 bu/a. When averaged over all N rates, yield of continuous grain sorghum and sorghum grown in rotation with soybeans were statistically equal.

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 19-year soybean yield average was 34 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 1996-2000, 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 non-legume crop. Other benefits of legume rotations include breaking disease and insect cycles, helping weed control programs, and decreasing the toxic effects of crop residues. This study evaluates N rates for continuous grain sorghum and grain sorghum grown in annual rotation with soybeans in a no-tillage production system.

Procedures

This study was established in 1980 at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Data are reported 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). In 1982-1989, the two N sources anhydrous ammonia and urea- ammonium nitrate solution (28% UAN) were evaluated. Both N sources were knife applied in the middle of rows from the previous year's crop. After 1989, anhydrous ammonia was used as the sole N source. In each year, N was knife applied 7-14 days prior to planting. Grain sorghum was planted at the rate of 60,000 seed/a, and 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 2000, yields were limited due to much below normal rainfall. When averaged over all N rates, continuous grain sorghum yield was not significantly different from yield of grain sorghum rotated with soybean. Rotated sorghum yields were higher than continuous sorghum at the 0 and 30 lb/a N rates.

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 (Table 3). Addition of N alone did not make up yield losses in a continuous sorghum production system. Over the 19-year period (1982-2000), soybean yields averaged 34 bu/a and were not affected by N applied to the previous sorghum crop (Table 4). Two knife-applied N sources, anhydrous ammonia and 28% UAN, were evaluated from 1982-1989. When averaged over cropping system and N rate, yields were 60 and 59, bu/a for anhydrous ammonia and UAN, respectively. When averaged over N rates, the number of days from emergence to mid-bloom was 7 days shorter in the rotated system than in the continuous system (Table 2).

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

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

Table 3. Effects of cropping system and N rate on grain sorghum yields, 1996-2000

N Rate	**Cropping System**	**Yield**					
		1996	1997	1998	1999	2000	Avg
lb/a		bu/a					
0	Continuous	92	51	55	73	37	62
	Rotated	120	88	87	112	46	91
30	Continuous	110	71	75	95	40	78
	Rotated	137	108	115	119	62	96
60	Continuous	131	110	118	115	68	108
	Rotated	164	128	142	127	66	125
90	Continuous	143	121	126	125	69	117
	Rotated	163	141	144	126	68	128
120	Continuous	148	122	128	123	69	118
	Rotated	162	144	145	128	65	129
150	Continuous	148	120	127	123	69	117
	Rotated	162	143	145	129	65	129
180	Continuous	148	121	128	126	68	118
	Rotated	162	144	145	129	65	129
210	Continuous	148	122	128	126	66	118
	Rotated	162	145	145	129	64	129
System	Means						
	Continuous	134	105	111	113	61	105
	Rotated	154	130	134	125	63	121
N Rate	Means						
0		106	70	71	92	42	76
30		124	90	95	107	51	93
60		148	119	130	121	67	117
90		153	131	135	126	69	123
120		155	133	137	126	67	124
150		155	132	136	126	67	123
180		155	133	137	127	67	124
210		155	134	137	127	65	124
LSD (0.05)		8	6	6	6	8	

Table 4. Yield of soybeans grown in rotation with grain sorghum, 1982-2000

Year	Yield	Year	Yield
	bu/a		bu/a
1982	38	1992	58
1983	15	1993	56
1984	20	1994	32
1985	28	1995	41
1986	48	1996	61
1987	48	1997	36
1988	18	1998	38
1989	25	1999	42
1990	30	2000	8
1991	12	Avg	34

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

Barney Gordon and David A. Whitney

Summary

This experiment was conducted at the North Central Kansas Experiment Field, located near Belleville, on a Crete silt loam soil. Soil test P was in the "high" range. Treatments consisted of tillage systems and starter fertilizer placement and composition. Tillage systems consisted of no-tillage and minimum tillage (spring disc and harrow treatment). Methods of starter fertilizer application included placement 2 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/acre and 30 lb P_2O_5/acre. Starter treatments containing either 30 lb N or 30 lb P_2O_5/acre applied alone and a no starter check also were included. In both tillage systems, yields were maximized by application of 2x2 placed starter fertilizer containing either 30 or 45 lb N/acre with 30 lb P_2O_5/acre. Starter fertilizer containing 30 lb N and 30 lb P_2O_5/a decreased the number of days from emergence to mid-bloom by 9 days compared to the no-starter check treatment. Although dribble applications greatly 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 rate of root growth and P uptake by plants. Starter fertilizers can be applied to place nutrient elements within the rooting zone of young seedlings for better availability, which will hasten maturity and avoid late-season damage by low temperatures. Some experiments that have evaluated crop response to N and P starter fertilizers have demonstrated improved early growth and increased yield and attributed those responses to the P component of the combination. Other studies have indicated that N is the most critical element in the N-P starter on soils not low in P. Many producers do not favor 2x2 placement of starter fertilizer due to high initial cost of application equipment and problems associated with knife applications in high residue situations. This research is aimed at minimizing fertility problems that arise with reduced tillage systems, thus making conservation tillage more attractive to producers.

Methods

The experiment was conducted at the North Central Kansas Experiment Field on a Crete silt loam soil. Analysis by the K-State Soil Testing Lab 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 discing and harrowing operation in the spring 3 weeks prior to planting. Starter fertilizer was placed either two inches to the side and two 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/acre with 30 lb P_2O_5/acre. Treatments consisting of either 30 lb N/acre or 30 lb P_2O_5/acre 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/acre. Grain sorghum (NC+ 7R83) was planted at the rate of 60,000 seed/acre on May 17, 2000. At the V6 stage of growth, 20 plants were randomly selected from the 1st or 4th row of each plot and analyzed for dry weight and N and P concentration. At first bloom 20 flag leaves/plot were harvested and analyzed for N and P concentration. Plots were harvested on September 21, 2000.

Results

Although surface dribble applied starter fertilizer increased grain yield over the no-starter check, yields were higher when fertilizer was placed 2x2 (Table 5). When averaged over tillage and starter combinations, yields were 8 bu/acre 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/acre with 30 lb P_2O_5/acre. 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 starters that contained both N and P. The treatment containing only 15 lb N/acre with 30 lb P_2O_5/acre also was not as effective as starters containing more N. Use of starter fertilizer resulted in greater yields in both tillage systems. All starter fertilizer treatments increased V6-stage whole plant dry matter over the no starter check. Dribble placement was not quite as effective in increasing early season dry matter as was 2x2 placement. The starters containing either 30 or 45 lb/a N with 30 lb/a P_2O_5 resulted in the greatest V-6 whole plant dry matter accumulation. Early season dry matter was greater in the reduced tillage system than in the no-tillage blocks. Grain yield, days from emergence to mid-bloom, and V6-stage whole plant dry matter were not affected by tillage system.

Table 5. Tillage system and starter fertilizer placement and composition effects on grain sorghum yield, number of days from emergence to mid-bloom, and V6-stage whole plant dry matter accumulation, Belleville 2000.

Tillage	Placement	Starter		Yield 2000	Yield 1999-2000	Days to Mid-bloom	V6 Dry Matter
		lb/acre		------- bu/a---------			lb/a
		N	P_2O_5				
Reduced		0	0	41	83	65	590
	2x2	0	30	52	92	59	700
		30	0	68	99	57	790
		15	30	70	106	57	820
		30	30	78	114	54	1080
		45	30	79	115	54	1078
	Dribble	0	30	46	90	61	688
		30	0	58	96	59	700
		15	30	61	98	59	782
		30	30	66	101	57	878
		45	30	72	104	56	910
No-Tillage		0	0	42	80	64	582
	2x2	0	30	51	98	58	710
		30	0	73	107	56	788
		15	30	73	109	57	828
		30	30	83	119	53	1089
		45	30	83	119	53	1095
	Dribble	0	30	45	90	61	690
		30	0	64	99	59	721
		15	30	65	98	59	788
		30	30	73	104	56	880
		45	30	78	106	56	892

Table 5. Tillage system and starter fertilizer placement and composition effects on grain sorghum yield, number of days from emergence to mid-bloom, and V6-stage whole plant dry matter accumulation, Belleville 2000.

Tillage	Placement	Starter		Yield 2000	Yield 1999-2000	Days to Mid-bloom	V6 Dry Matter
		lb/acre		------- bu/a---------			lb/a
		N	P_2O_5				
Means							
Reduced Till				65	102	57	843
No-Till				69	105	57	848
LSD (0.05)				NS		NS	NS
	Means						
	2x2			71	108	56	898
	Dribble			63	99	58	793
	LSD (0.05)			7		1	58
		Means					
		0	30	49	93	60	687
		30	0	66	101	58	750
		15	30	67	103	58	805
		30	30	75	110	55	982
		45	30	78	111	55	994
		LSD (0.05)		6		1	55

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

Barney Gordon

Summary

Field studies were conducted at the North Central Kansas Experiment Field, located near Scandia, on a Crete silt loam soil. The study consisted of 4 methods of starter fertilizer application (in-furrow with the seed, 2 inches to the side and 2 inches below the seed at planting (2 x 2), dribble on the soil surface 2 inches to the side of the seed, and banded over the row on the soil surface) and 5 starter fertilizer combinations. The starters consisted of combinations that included either 5, 15, 30, 45, or 60 lb/a N with 15 lb/a P_2O_5 and 5 lb/a K_2O. A no-starter check plot also was included in the experiment. Nitrogen was balanced so that all plots received 220 lb/a N, regardless of starter treatment. Starter fertilizer combinations were made using liquid 10-34-0 ammonium polyphosphate, 28% UAN, and potassium thiosulfate (KTS). When starter fertilizer was applied in-furrow with the seed, plant populations were reduced by over 7,500 plants/acre when compared with the other 3 application methods. Corn yield was 34 bu/a lower when starter fertilizer was applied in-furrow than when applied 2x2. Dribble application of starter fertilizer in a surface band 2 inches to the side of the seed row resulted in yields equal to 2x2 applied starter. Grain yield and V-6 dry matter was lower in the starter treatment that included 5 lb N/a.

Introduction

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

Procedures

Irrigated ridge-tilled experiments were conducted at the North Central Kansas Experiment Field on a Crete silt loam soil. Analysis by the KSU Soil Testing Laboratory showed that initial soil pH was 6.2; organic matter content was 2.4%; and Bray-1 P and exchangeable K in the top 6 inches of soil were 40 and 420 ppm, respectively. The study consisted of 4 methods of starter fertilizer application methods (in-furrow with the seed, 2 inches to the side and 2 inches below the seed at planting, dribble in a narrow band on the soil surface 2 inches to the side of the seed row, and banded over the row on the soil surface). In the row-banded treatment, fertilizer was sprayed on the soil surface in a 8 inch band centered on the seed row immediately after planting. Starter consisted of combinations that included either 5, 15, 30, 45, or 60 lb N/a with 15 lb P_2O_5/a and 5 lb K_2O/a. Nitrogen as 28% UAN was balanced so all plots received 220 lb/a, regardless of starter treatment. Starter fertilizer combinations were made using liquid 10-34-0 ammonium polyphosphate, 28% UAN, and KTS.

Results

When starter fertilizer was applied in-furrow with the seed, plant populations were reduced by over 7,500 plants/a when compared with the other application methods (Table 6). Corn yield was 34 bu/a lower when starter fertilizer was applied in-furrow with the seed than when applied 2 inches beside and 2 inches below the seed. Dribble application of starter fertilizer in a narrow surface band 2 inches to the side of the seed row resulted in yields equal to the 2x2 applied starter. In this year, surface band application was equal to sub-surface starter placement. The band over the row treatment resulted in yields greater than the in-furrow treatment but less than the 2x2 or surface band treatments. Grain yield and V6 dry matter accumulation was lower in the starter treatment that included 5 lb N/a.

Table 6. Starter application method and composition effects on corn grain yield, plant population and V6-stage dry whole plant dry matter.

Application method	Starter	Yield	Population	V-6 Dry Matter
	lb/a	bu/a	plants/a	lb/a
	Check 0-0-0	136.0	30,884	230
In-furrow	5-15-5	139.6	24,260	309
	15-15-5	156.5	23,142	321
	30-15-5	147.1	23,307	327
	45-15-5	147.8	23,197	326
	60-15-5	138.7	22,747	331
2x2	5-15-5	169.2	31,266	402
	15-15-5	171.7	30,729	403
	30-15-5	187.3	31,266	470
	45-15-5	184.8	30,976	549
	60-15-5	184.8	30,686	570

Table 6. Starter application method and composition effects on corn grain yield, plant population and V6-stage dry whole plant dry matter.

Application method	Starter	Yield	Population	V-6 Dry Matter
	lb/a	bu/a	plants/a	lb/a
Dribble 2x	5-15-5	167.2	31,170	357
	15-15-5	175.0	31,655	429
	30-15-5	180.3	30,492	482
	45-15-5	181.9	30,392	446
	60-15-5	182.8	30,613	474
Row band	5-15-5	149.5	31,266	329
	15-15-5	154.4	31,557	345
	30-15-5	154.5	30,589	459
	45-15-5	165.1	30,492	456
	60-15-5	180.0	30,298	460
Method Means				
In-furrow		146.0	23,330	323
2x2		179.6	30,985	479
Dribble 2x		177.4	30,864	438
Row band		160.7	30,840	410
LSD (0.05)		10.9	840	32
	Starter Means			
	5-15-5	156.4	31,266	349
	15-15-5	164.4	31,557	375
	30-15-5	167.3	30,589	435
	45-15-5	169.9	30,492	444
	60-15-5	171.5	30,298	459
	LSD (0.05)	10.2	849	33

EFFECTS OF NITROGEN RATES AND SOURCES ON RIDGE-TILLED IRRIGATED CORN

Barney Gordon

Summary

The increased use of urea and urea-based fertilizers along with an increase in crops grown under no or reduced-tillage practices may require changes in fertilizer management practices. Surface application of urea-based fertilizer risks the loss of some N by volatilization of ammonia. There is research that suggests that calcium added to urea-based fertilizer can reduce ammonia losses and increase plant growth by increasing plant absorption of applied ammonium. This research was initiated in 1999 to evaluate an experimental N fertilizer, UCAN-21, applied in various starter and sidedress combinations in a ridge-tillage production system. UCAN-21 is a mixture of 2/3 UAN solution and 1/3 liquid calcium nitrate. Yields of corn were higher at the 50 and 100 lb/a N rate when UCAN-21 was dribbled on the soil surface as compared to the same rates of dribble applied UAN. There were no differences between UCAN-21 and UAN at the higher N rates. Corn yields were higher when UCAN-21 was used as a dribble applied starter than when UAN alone was used.

Introduction

The most common liquid nitrogen source is the urea-ammonium nitrate solution (UAN) commonly sold in the Midwest as a solution containing 28% nitrogen. Approximately half of the nitrogen in UAN is urea. Urea applied to soil reacts with water and the soil enzyme urease and is rapidly converted to ammonium. In this reaction, hydrogen ions are consumed, which causes the soil pH near the fertilizer to rise. If the pH rises above 7, a significant amount of ammonia can form in soil following urea application. When urea is surface applied, the formation of ammonia at the soil surface from urea hydrolysis may allow loss of N as ammonia. There is research data to suggest that calcium applied with a urea-based N fertilizer may limit N loss. The objective of this research was to compare an experimental N fertilizer (UCAN-21) that contains UAN and calcium nitrate to UAN alone.

Procedures

This experiment was conducted at the North Central Kansas Experiment Field, near Scandia, Kansas on a Crete silt loam site. The study was ridge-tilled and furrow irrigated. Treatments consisted of combinations of starters and sidedress N rates. Dribble sidedress N was applied in a surface band when corn was 12-15 inches in height. Initial soil test values in the experimental area showed that soil pH was 6.4, organic matter was 2.5%, Bray-1 P was 40 ppm and exchangeable K was 320 ppm in the top 6 inches of soil. Dribble sidedress applications of 50, 100, 150 and 200 lb N/acre as UCAN-21 or UAN were evaluated. Additional treatments consisted of 50, 100, 150 and 200 lb N/acre (UAN) subsurface knife applied. Starter treatment (30 lb N/acre) consisted of UCAN-21 dribbled on the soil surface 2 inches to the side of the row. Additional treatments compared UCAN-21 as a dribbled starter to UAN alone as a starter with 200 lb/a N as a dribble sidedress application. A no-N check plot was also included.

Results

Good responses to applied N were achieved in 2000. The no N check yielded only 78 bu/a (Table 7). At the lower N rates (50 and 100 lb N/a), dribble application of

UCAN-21 resulted in greater yields than UAN dribbled on the soil surface. At the 50 and 100 lb/acre N rates, whole plant N content at the V6 stage of growth was greater when UCAN-21 was dribble applied than when UAN was used as a dribble applied sidedress treatment (Table 8). At the two lower N rates, mid-silk earleaf N concentration was greater with dribbled UCAN 21 than dribbled UAN and equal to knife applied UAN (Table 9). With the lower N rates, UCAN-21 dribbled applied on the soil surface was as effective as subsurface knife applied N. No differences were seen at the higher N rates among dribble applied UCAN 21, dribbled UAN, and subsurface knifed UAN. As a dribble applied starter UCAN-21 was slightly better than surface applied UAN.

Table 7. Evaluation of calcium nitrate for irrigated, ridge-tilled corn production.

No N check				78.3, bu/a
Starter	Sidedress			
	Source	Rate	Method	Yield, bu/a
UCAN-21	UAN	50	dribble	130.5
UCAN-21	UAN	100	dribble	139.9
UCAN-21	UAN	150	dribble	177.3
UCAN-21	UAN	200	dribble	176.3
UCAN-21	UCAN-21	50	dribble	147.2
UCAN-21	UCAN-21	100	dribble	149.7
UCAN-21	UCAN-21	150	dribble	174.5
UCAN-21	UCAN-21	200	dribble	176.5
UAN	UAN	200	dribble	160.5
UAN	UCAN-21	200	dribble	165.8
UCAN-21	UAN	50	knife	132.3
UCAN-21	UAN	100	knife	149.5
UCAN-21	UAN	150	knife	178.8
UCAN-21	UAN	200	knife	178.4
LSD (0.05)				4.8

N-Rate Means (avg over treatments) lb/a	Yield, bu/a
0	78
50	137
100	146
150	177
200	177

Table 8. Evaluation of urea-ammonium nitrate plus calcium nitrate for irrigated, ridge-tilled corn production; V6 stage whole plant dry weight and N concentration.

Starter	Sidedress	Rate	Method	V6 Whole Plant	
				Dry Weight	N
		lb/acre		lb/acre	%
No N Check				328	2.22
UCAN 21	UAN	50	dribble	420	3.05
UCAN 21	UAN	100	dribble	540	3.55
UCAN 21	UAN	150	dribble	578	3.71
UCAN 21	UAN	200	dribble	575	3.69
UCAN 21	UCAN 21	50	dribble	579	3.54
UCAN 21	UCAN 21	100	dribble	580	3.75
UCAN 21	UCAN 21	150	dribble	574	3.78
UCAN 21	UCAN 21	200	dribble	588	3.79
UAN	UAN	200	dribble	519	3.31
UAN	UCAN 21	200	dribble	528	3.58
UCAN 21	UAN	50	knife	410	3.48
UCAN 21	UAN	100	knife	530	3.75
UCAN 21	UAN	150	knife	590	3.71
UCAN 21	UAN	200	knife	588	3.77
LSD (0.05)				44	0.08

Table 9. Evaluation of urea-ammonium nitrate plus calcium nitrate for irrigated, ridge-tilled corn production; earleaf N concentration at mid-silk and grain N concentration.

Starter	Sidedress	Rate	Method	Earleaf N	Grain N
		lb/acre		---------------%	-------------
No N Check				1.11	1.06
UCAN 21	UAN	50	dribble	1.22	1.18
UCAN 21	UAN	100	dribble	1.50	1.22
UCAN 21	UAN	150	dribble	1.58	1.25
UCAN 21	UAN	200	dribble	1.56	1.26
UCAN 21	UCAN 21	50	dribble	1.54	1.24
UCAN 21	UCAN 21	100	dribble	1.61	1.26
UCAN 21	UCAN 21	150	dribble	1.58	1.28
UCAN 21	UCAN 21	200	dribble	1.63	1.29
UAN	UAN	200	dribble	1.56	1.22
UAN	UCAN 21	200	dribble	1.62	1.27
UCAN 21	UAN	50	knife	1.56	1.23
UCAN 21	UAN	100	knife	1.60	1.26
UCAN 21	UAN	150	knife	1.61	1.28
UCAN 21	UAN	200	knife	1.61	1.26
LSD (0.05)				0.07	0.06

WHITE FOOD-CORN PERFORMANCE TEST

Barney Gordon

Summary

In 2000, 23 white corn hybrids and 2 yellow hybrid checks were evaluated. The test averaged 183 bu/a with 13 white hybrids yielding more than 180 bu/a. Lodging averaged 1.3% and grain moisture at harvest averaged 15.8%.

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 18 April at the rate of 30,000 seed/a. Starter fertilizer (30 lb N + 30 lb P_2O_5/a) was applied 2 inches to the side and two inches below the seed at planting. Furrow-irrigations were applied on 15 June, 30 June, 10 July, 24 July, and 2 August. Three inches of water were applied at each irrigation. The test was harvested on 8 October using a modified E Gleaner combine.

Results

Overall grain yield in this test was 183 bu/a and ranged from 148 to 227 bu/a (Table 10). Yield of white corn hybrids (23 hybrids) averaged 184 bu/a. The average of the 2 yellow corn hybrids included in the test (Pioneer 3394, and B73xMo17) was 163 bu/a. Thirteen of the white corn hybrids (Asgrow RX792W, Asgrow RX901W, Pioneer 32H39, Pioneer 32K72, Pioneer 32Y52, Pioneer 33T17, Vineyard V433W, Vineyard V455W, Whisnard 50AW, Zimmerman 1851W, Zimmerman N71-T7, Zimmerman Z62W, and Zimmerman Z64W) yielded more than 180 bu/a. Five of these hybrids (Pioneer 32K72, Pioneer 32Y52, Pioneer 33T17, Zimmerman 1851W, and Zimmerman N71-T7) yielded more than 200 bu/a. Stalk lodging was minimal and ranged from 0 to 5%. Grain quality information for all entries (average of 5 test locations) is given in Table 11.

Table 10. Grain yield and agronomic data from 2000 Late White Food Corn Performance Test at Scandia, KS.

Entry	Yield 2000	Yield 1999	Yield 2000 Average*	Stalk Lodging	Ear Height	Days to Mid-silk	Moist.
	--------------bu/a------------			%	inches		%
Asgrow RX776W	174.9		155.1	0.4	38.7	83.0	15.4
Asgrow RX792W	199.3		151.7	0.0	45.0	83.0	15.7
Asgrow RX901W	182.1	183.4	156.1	1.7	40.3	84.0	16.5
Diener D 114W	164.4	173.9	144.3	0.4	41.0	81.0	15.9
Diener D 115W	163.9		151.5	3.9	45.0	81.3	17.3
IFSI 90-1	147.7	187.0	147.1	5.5	48.7	83.3	15.2
IFSI 95-1	177.8	162.4	155.1	0.8	46.0	84.0	17.4
IFSI-97-1	161.0	181.4	161.4	1.2	45.7	83.0	16.7
NC+ 6990W	179.8		153.4	4.6	49.0	82.7	16.7
Pioneer 32H39	185.6	206.9	159.1	0.8	46.0	82.0	15.0
Pioneer 32K72	227.2	203.5	176.0	0.4	43.7	83.3	14.8
Pioneer 32Y52	206.8	191.7	172.7	0.0	46.7	83.0	16.2
Pioneer 33T17	211.3	228.0	174.2	0.4	41.7	83.0	14.3
Vineyard V433W	185.4	189.9	166.9	0.4	44.7	83.3	15.9
Vineyard V455W	185.0		162.8	0.9	48.0	82.7	15.8
Vineyard V462W	153.9		152.1	1.5	41.7	83.3	16.9
Vineyard VX4359W	178.0		170.1	1.2	42.0	83.7	15.7
Whisnard 50AW	198.5	182.5	163.9	1.7	45.0	82.7	14.9
Whisnard 51AW	163.6	165.1	155.7	0.8	46.0	84.0	14.6
Zimmerman 1851W	204.8		174.2	1.2	43.0	83.3	17.6
Zimmerman N71-T7	214.2	213.8	167.7	0.4	47.0	82.7	16.1
Zimmerman Z62W	182.0	166.1	155.8	0.0	41.7	84.3	14.8
Zimmerman Z64W	191.1		163.0	1.2	48.3	84.3	17.3
B73 x Mo17 (yellow)	156.9	183.9	144.9	2.9	40.0	83.0	14.8
Pioneer 3394 (yellow)	169.1	172.1	153.8	0.0	42.3	81.0	12.8
Mean	182.6	180.0	159.5	1.3	44.3	83.0	15.8
LSD(0.05)	10.0	11.6	11.2	1.9	0.8	1.2	1.5
CV%	3.4	4.0	9.3		1.1	0.9	5.7

* Average of Champaign, IL, Winchester, IL, Powhattan, KS, Scandia, KS, Lexington, KY, Columbia, MO, Novelty, MO, Tipton, MO, Knoxville, TN, Union City, TN, Halfway, TX, and Springlake, TX)

Table 11 . Combined grain quality data from the 2000 Late White Food Corn Performance Test.

Entry	Test weight	100-Kernel Weight	Kernel Size	Thins*	Kernel Density	Horny Endosperm
	lb/bu	grams	cc	%	g/cc	%
Asgrow RX776W	61.9	31.8	0.24	55.1	1.33	89
Asgrow RX792W	63.7	29.6	0.22	63.6	1.34	90
Asgrow RX901W	63.9	33.7	0.25	43.2	1.34	91
Diener D 114W	61.3	33.0	0.25	17.8	1.30	85
Diener D 115W	61.6	33.9	0.26	18.8	1.31	85
IFSI 90-1	62.8	35.5	0.27	22.5	1.32	86
IFSI 95-1	64.1	35.6	0.27	20.6	1.34	91
IFSI 97-1	63.4	31.9	0.24	51.5	1.32	90
NC+ 6990W	64.6	33.7	0.25	25.9	1.35	91
Pioneer 32H39	62.9	34.5	0.26	43.9	1.33	90
Pioneer 32K72	63.1	37.4	0.28	30.4	1.32	91
Pioneer 32Y52	63.3	40.0	0.30	14.7	1.33	90
Pioneer 33T17	62.5	35.3	0.27	38.4	1.31	91
Vineyard V433W	62.6	35.2	0.27	61.8	1.31	88
Vineyard V435W	63.6	36.1	0.28	42.1	1.32	89
Vineyard V462W	61.5	38.5	0.30	24.1	1.30	88
Vineyard VX4359W	61.6	35.0	0.27	64.5	1.30	86
Whisnard 50AW	62.8	35.4	0.27	31.9	1.32	86
Whisnard 51AW	63.4	36.4	0.27	24.5	1.33	88
Zimmerman 1851W	61.5	39.5	0.30	9.1	1.33	88
Zimmerman N71-T7	62.6	32.0	0.24	51.2	1.31	84
Zimmerman Z62W	61.6	37.7	0.29	9.7	1.32	90
Zimmerman Z64W	61.5	37.1	0.28	11.4	1.32	90
B73 x Mo17 (yellow)	59.4	35.0	0.28	34.7	1.27	79
Pioneer 3394 (yellow)	61.8	38.8	0.30	21.7	1.31	86
Mean	62.5	35.3	0.26	33.3	1.32	88
LSD (0.05)	0.9	2.3	0.02	14.8	0.01	4
CV%	1.0	4.7	4.8	31.4	0.8	3.1

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

COMPARISON BETWEEN GRAIN SORGHUM AND CORN GROWN IN A DRYLAND ENVIRONMENT

Barney Gordon and Scott Staggenborg

Summary

This experiment was conducted at the North Central Kansas Experiment Field at Belleville, KS on a Crete silt loam soil. The test directly compares grain sorghum and corn planted in the same environment. Treatments consisted of two grain sorghum hybrids (Dekalb 47 and NC+7R83) and two corn hybrids (Pioneer 34K77 and NC+5018) planted no-till into wheat stubble. Hybrids were chosen on the basis of past performance in the KSU Hybrid Performance tests. Additional treatments consisted of nitrogen rates (0, 40, 80, 120 and 160 lb/acre). N as ammonium nitrate was side dressed after planting. Corn and grain sorghum were planted at optimal dates based on past research at the North Central Experiment Field. At Belleville, it was the driest and warmest season since 1934. Growing season rainfall averaged only 45% of normal and crop yields were much below normal. When averaged over hybrid and N rate, grain sorghum yielded 25 bu/acre greater than corn. Water used efficiency was greater in grain sorghum than corn. In general, there was little response to applied nitrogen due to the very low yield levels. Grain yields of Dekalb 47 were high enough to respond to application of 80 lb/acre N.

Introduction

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

Procedures

Both corn and grain sorghum were planted into wheat stubble without tillage. Corn (NC+5018 and Pioneer 34K77) was planted on April 12 at the rate of 24,000 seed/acre. Final population averaged 21,000 plants/acre. Grain Sorghum was planted on May 15 at the rate of 62,000 seed/acre. Final population averaged 48,000 plants/acre. Corn and grain sorghum hybrids were selected based on their superior performance in previous KSU Crop Performance Tests. The experiment also included nitrogen rates. Nitrogen rates of 40, 80, 120, and 240 lb/acre were applied as ammonium nitrate after planting but before emergence. A no N check also was included. Corn was harvested on September 11 and grain sorghum was harvested on September 15. Soil moisture measurement were taken when each crop was planted and again immediately after each crop was harvested.

Results

Due to the very hot and dry conditions, yields of both corn and grain sorghum were much below normal. Although NC+5018 had performed well under dryland conditions in previous years, the heat interfered with pollination and kernel set was extremely poor. Kernel set of Pioneer 34K77 was better than NC+5018 but ears were only partially filled and ear size was very small. When averaged over N rates and hybrids, grain sorghum yielded 25 bu/acre greater than corn (Table 12). The full season grain sorghum hybrid, NC+7R83, yielded 8 bu/acre less than the mid-season hybrid, Dekalb 47. Mid-season hybrids develop fewer leaves and reach anthesis sooner than full season hybrids. In 2000, the shorter season grain sorghum hybrid probably used somewhat less water during the vegetative stage than the full season hybrid and had more stored soil water available for the reproductive phase of development. In general, there was little response to applied N due to the very low yield levels. Grain yield of Dekalb 47, however, did respond to application of 80 lb acre N. Water use efficiency (lbs of grain/inch of water) was greater for the grain sorghum hybrid Dekalb 47 than for the corn hybrid Pioneer 34K77.

Table 12. Nitrogen rate effects on yield of grain sorghum and corn hybrids, 2000.

N-Rate, lb/acre	Grain Yield, bu/acre			
	NC+7R83	Dekalb 47	NC+5018	Pioneer 34K77
0	42.6	43.5	11.6	30.3
40	42.7	44.5	12.0	33.5
80	48.2	58.6	13.2	36.1
120	48.7	59.9	15.4	35.4
160	46.2	59.5	15.0	36.0
Average	*45.7*	*53.2*	*13.4*	*34.3*

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.

2000 Weather

The frost-free season was 10 days shorter than the 173-day average at the Paramore Unit and 9 days shorter at the Rossville Unit. The last 32° F frosts in the spring were on April 14 at the Rossville and Paramore Units and on (average, April 21), and the first frost in the fall was on October 9 at the Rossville Unit and on October 8 at the Paramore Unit (average, October 11). Precipitation was below normal in all months except November, May, June, and September (Table 1). June precipitation was more than 2 inches above normal. Precipitation totals for October, 1999 through September, 2000 were 15.72 and 10.28 inches below normal for the Paramore and Rossville Units, respectively. Corn yields were about normal but soybean yields were below normal. Several days above 100 °F was most likely the contributing factor to low irrigated soybean yields.

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

Month	Rossville Unit		Paramore Unit	
	1999-2000	30-Yr. Avg.	1999-2000	30-Yr. Avg.
	Inches		Inches	
October	0.28	0.95	0.38	0.95
November	1.77	0.89	1.46	1.04
December	1.61	2.42	1.71	2.46
January	0.12	3.18	0.00	3.08
February	1.41	4.88	1.89	4.45
March	2.28	5.46	2.59	5.54
April	1.28	3.67	0.63	3.59
May	3.75	3.44	1.80	3.89
June	6.93	4.64	4.62	3.81
July	2.86	2.97	1.36	3.06
August	1.83	1.90	1.45	1.93
September	1.24	1.24	1.62	1.43
Total	25.36	35.64	19.51	35.23

EFFECT OF PLACEMENT OF STARTER FERTILIZERS ON CORN

Larry D. Maddux, David Whitney, and Scott Staggenborg

Summary

The effect of P placement was evaluated at two sites in Northeast Kansas. Seed placed starters had no effect on plant population. 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 but results were variable. Yields at both sites were higher than the 0 N, 0 P check with almost all treatments. Seed placed and 2x2 starters tended to increase N and P uptake at the 6-leaf stage of growth, but didn't carry through to yield.

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 the effect of phosphorus (P) 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 fertilizer, 6-24-6, as a seed-placed starter.

Procedures

The study was conducted for two years on two sites: (1) Cornbelt Experiment Field near Powhattan, on a dryland Grundy silty clay loam site previously cropped to soybeans with a pH of 6.5, an organic matter content of 3.2 percent, 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 percent, and a P test level of 12 ppm.

All treatments were balanced for nitrogen (N), 120 lbs N/a at Powhattan and 180 lbs N/a at Rossville. Urea ammonium nitrate solution (UAN) was knifed approximately 6 inches deep on 30 inch centers. A randomized complete block statistical design was used with 11 treatments: (1) 0 N, 0 P check; (2) 0 P check with N; (3) 0-46-0 surface, broadcast, 40 lbs P_2O_5/a; (4&5) 6-24-6 at 3 and 6 gpa (supplied by Na-Churs Alpine), applied in the seed row; (6&7) 10-34-0 at 2 and 4 gpa (same P rate as the 6-24-6), applied in the seed row ; (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 2x2 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. In 2000, two additional treatments consisted of 10-34-0 dribbled over the top of the seed row at 6 and 8 gpa.

The N, surface, broadcast P, and dual placement treatments were applied May 3, 1999 and April 18, 2000 at Rossville and May 26, 1999 and April 14, 2000 at Powhattan. The starter treatments were applied at planting. Pioneer Brand 3335 (May 7, 1999) and Garst 8543IT (April 19, 2000) were planted at 30,000 seeds/a in 30-inch rows at Rossville and Garst 8541IT (May 27, 1999) and Garst 8543IT (April 14, 2000) were planted at 26,000 seeds/a in 30-inch rows at Powhattan. Whole plant samples (5 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 weighed and analyzed for N and P. Plant weights at Rossville were inadvertently not taken in 1999. In 2000, plant counts were made at harvest to calculate plant populations. The plots were harvested using a plot combine on October 1, 1999 and September 19, 2000 at Rossville and October 28, 1999 and September 9, 2000 at Powhattan. Grain samples were collected and analyzed for N and P.

Results

The 1999 and 2000 growing seasons were stressful and probably limited yield responses in these studies. In 1999, planting was delayed at both locations, but more so at the Powhattan location by wet weather. After the wet spring, the weather turned drier than normal. In 2000, the spring was exceptionally dry and continued drier than normal throughout the growing season. A couple of timely rains were received at Powhattan to help keep corn yields in the 100 bu/a range.

Plant populations in 2000 were variable at both locations (Table 2). There was no indication that the 6-24-6 or 10-34-0 seed placed treatments had any effect on germination and the resulting plant population. The dry weather at planting was most likely responsible for the large variation in plant populations and the lack of any meaningful significant differences.

Seed placed and 2x2 starter treatments had the highest 6-leaf plant weights (Table 3), N content, and N uptake (Table 4) of all treatments. The 1:1 ratio 2x2 starter was slightly better than the 1:3 ratio starter. P content at 6-leaf was variable, but the 2x2 starters tended to be the highest, especially in 2000. The slightly higher P content of the 2x2 over the seed placed starter was likely a result of the exceptionally dry spring, which would favor the deeper placement of the 2x2 starters from a moisture availability standpoint. This advantage was also evident in P uptake, especially with the 1:1 ratio (30-30-0) 2x2 starter, which tended to have the greatest uptake of all treatments, although not statistically different from all treatments even at the 10% level of probability.

All treatments had a significantly higher P content in leaf tissue at tasseling than the 0 N, 0 P treatment, except at Powhattan in 1999 (Table 4). Dual placement tended to have the highest leaf P content at tasseling and broadcast 0-46-0 tended to have the lowest. The 0 N, 0P treatment had the lowest grain P content with very little significant differences between treatments observed. However, the 2x2 starters tended to have the highest grain P content. Total P uptake in the grain was lowest with the 0 N, 0 P treatment with no significant differences observed between the other treatments (Table 5).

All treatments at both locations, both years, had significantly higher yields than the 0 N, 0 P check except for the broadcast P at Powhattan in 1999 (Table 5). Dual placement of N and P was the highest yielding treatment at both sites in 1999, but the difference was only significantly greater than the 0 N, 0 P check because of the high variability at both sites.

Table 2. Effect of starter P placement and source on 6-leaf corn plant weight, P content, and P uptake.

		Plant Weight			P Content				P Uptake		
		Pow		Ross	Pow		Ross		Pow		Ross
Treatment[1]	Rate	1999	2000	2000	1999	2000	1999	2000	1999	2000	2000
		----------lbs/a---------			-----------------%----------------				---------lbs/a----------		
0 N, 0 P	---	311	328	68	0.221	0.260	0.537	0.328	0.70	0.84	0.24
N, 0 P	---	264	314	109	0.213	0.283	0.456	0.320	0.56	0.91	0.35
Broadcast P	40# P_2O_5	297	243	135	0.201	0.255	0.464	0.312	0.61	0.61	0.42
6-24-6, w/seed	3 gpa	341	300	188	0.232	0.256	0.407	0.285	0.79	0.78	0.54
6-24-6, w/seed	6 gpa	429	381	237	0.233	0.254	0.391	0.310	1.00	0.95	0.74
10-34-0, w/seed	2 gpa	382	441	155	0.231	0.277	0.447	0.301	0.88	1.24	0.46
10-34-0, w/seed	4 gpa	317	436	252	0.237	0.234	0.407	0.310	0.75	1.01	0.79
10-34-0, 2x2	7.6 gpa[2]	402	448	193	0.254	0.294	0.434	0.384	1.03	1.29	0.74
15-15-0, 2x2	18 gpa[2]	432	573	233	0.259	0.317	0.420	0.401	1.14	1.81	0.94
N-30-0[3], Dual		258	376	121	0.207	0.259	0.426	0.298	0.53	0.97	0.37
N-30-0[3], Dual+Seed	3 gpa[3]	370	530	187	0.226	0.274	0.421	0.377	0.84	1.46	0.71
Row Dribble	6 gpa		360	312		0.274		0.313		0.98	0.98
Row Dribble	8 gpa		410	176		0.254		0.338		1.05	0.58
LSD(0.10)		94	135	75	0.026	0.049	0.060	0.044	0.29	0.43	0.26

[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 (ie. 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).

Table 3. Effect of starter P placement and source on 6-leaf corn plant weight, N content, and N uptake.

		Plant Pop.		N Content				N Uptake		
		Pow	Ross	Pow		Ross		Pow		Ross
Treatment[1]	Rate	2000	2000	1999	2000	1999	2000	1999	2000	2000
		------Plts/a-----		----------------%----------------				---------lbs/a----------		
0 N, 0 P	---	23426	22361	2.58	2.59	1.80	2.15	8.1	8.6	1.59
N, 0 P	---	23716	25047	2.56	3.21	2.06	2.54	6.8	10.2	2.93
Broadcast P	40# P_2O_5	23813	22797	2.72	3.25	2.17	3.18	8.0	8.0	4.29
6-24-6, w/seed	3 gpa	22167	23378	2.80	3.32	2.30	3.22	9.5	10.2	6.31
6-24-6, w/seed	6 gpa	25072	24104	2.70	3.27	2.22	3.29	11.6	12.5	7.94
10-34-0, w/seed	2 gpa	22071	24249	2.86	3.19	2.23	2.91	11.0	14.1	4.66
10-34-0, w/seed	4 gpa	22748	24031	2.80	3.22	2.17	2.81	8.9	14.0	7.14
10-34-0, 2x2	7.6 gpa[2]	23716	24031	2.71	3.49	2.31	3.36	11.0	15.7	6.46
15-15-0, 2x2	18 gpa[2]	23813	24104	2.90	3.51	2.34	3.18	12.5	20.1	7.52
N-30-0[3], Dual		23329	22434	2.81	3.18	2.37	2.69	7.3	12.1	3.56
N-30-0[3], Dual+Seed	3 gpa[3]	22748	23377	2.76	3.42	2.24	3.50	10.1	18.2	6.53
Row Dribble	6 gpa	23910	24979		3.45		3.13		12.4	9.86
Row Dribble	8 gpa	23716	25120		3.31		3.27		13.6	5.82
LSD(0.10)		NS	NS	0.21	0.26	0.22	0.60	2.8	5.0	3.10

[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 (ie. 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).

Table 4. Effect of starter P placement and source on P content in leaf at tasseling and in the grain.

		P Content, Tasseling				P Content, Grain			
		Pow		Ross		Pow		Ross	
Treatment[1]	Rate	1999	2000	1999	2000	1999	2000	1999	2000
		---------------%--------------				--------------%---------------			
0 N, 0 P	---	0.187	0.172	0.252	0.251	0.242	0.247	0.315	0.296
N, 0 P	---	0.132	0.211	0.290	0.259	0.210	0.211	0.272	0.318
Broadcast P	40# P_2O_5	0.199	0.252	0.277	0.261	0.237	0.222	0.323	0.312
6-24-6, w/sd	3 gpa	0.199	0.230	0.293	0.262	0.235	0.236	0.362	0.316
6-24-6, w/sd	6 gpa	0.203	0.236	0.268	0.274	0.238	0.228	0.341	0.315
10-34-0, w/sd	2 gpa	0.203	0.214	0.294	0.261	0.224	0.239	0.291	0.292
10-34-0, w/sd	4 gpa	0.197	0.226	0.312	0.255	0.241	0.211	0.309	0.335
10-34-0, 2x2	7.6 gpa[2]	0.199	0.220	0.294	0.261	0.239	0.264	0.271	0.332
15-15-0, 2x2	18 gpa[2]	0.188	0.239	0.296	0.266	0.228	0.269	0.357	0.272
N-30-0[3], Dual		0.210	0.240	0.270	0.279	0.232	0.251	0.313	0.280
N-30-0[3], Dual+Seed	3 gpa[3]	0.215	0.245	0.304	0.276	0.239	0.241	0.340	0.321
Row Dribble	6 gpa		0.236		0.258		0.219		0.293
Row Dribble	8 gpa		0.250		0.269		0.249		0.296
LSD(0.10)		0.027	0.024	0.027	0.027	NS	0.042	0.080	NS

[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 (ie. 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).

Table 5. Effect of starter P placement and source on grain yield and P uptake.

		Yield				P Uptake in Grain		
		Pow		Ross		Pow		Ross
Treatment[1]	Rate	1999	2000	1999	2000	1999	2000	2000
		--------------lbs/a------------				---------lbs/a---------		
0 N, 0 P	---	63	66	71	56	7.2	3.6	8.7
N, 0 P	---	87	103	149	132	8.6	3.8	16.4
Broadcast P	40# P_2O_5	82	107	164	128	9.5	2.5	19.8
6-24-6, w/sd	3 gpa	97	104	189	133	10.9	3.3	28.8
6-24-6, w/sd	6 gpa	98	110	169	149	11.0	3.8	34.1
10-34-0, w/sd	2 gpa	99	102	167	134	10.7	5.2	22.2
10-34-0, w/sd	4 gpa	96	113	167	135	10.6	4.3	39.7
10-34-0, 2x2	7.6 gpa[2]	93	110	169	136	10.6	5.3	30.3
15-15-0, 2x2	18 gpa[2]	89	112	150	123	9.6	7.2	29.7
N-30-0 [3], Dual		106	109	199	118	11.6	4.4	16.1
N-30-0 [3], Dual+Seed	3 gpa[3]	97	107	185	130	10.9	6.0	28.2
Row Dribble	6 gpa		114		139		3.5	42.0
Row Dribble	8 gpa		108		135		4.6	24.4
LSD(0.10)		17	12	38	22	3.6	1.5	11.4

[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 (ie. 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).

SOYBEAN PLANTING DATE AND MATURITY GROUP EFFECTS

Larry D. Maddux

Summary

Four soybean varieties of maturity groups II, mid III, late III, and mid IV were planted at 4 dates from mid-April to late June/early July in 1999 and 2000. No significant yield differences among the soybean varieties were observed. In 1999, there were no significant differences in yield due to planting date, but in 2000, yields of the first two planting dates were higher than the last two planting dates. At least part of this yield difference was attributed to poor stands attained at the 3rd and 4th planting dates because of dry weather.

Introduction

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

Procedures

This study included varieties in maturity groups II, mid-III, late III, and mid-IV. Varieties used at this location were: Grp. II - Midland 8250 (1999) and IA 2021 (2000); mid-III - Pi 93B54; late III - Macon; mid-IV - KS 4694. Macon has been used at all sites. Four planting dates were used beginning in mid-April and spaced on approximately 3 week intervals. Actual planting dates were: 4/21/99, 4/18/00; 5/13/99, 5/5/00; 6/4/99, 5/25/00; 7/2/99, 6/23/00. Data collected were grain yield, maturity date, and plant height. Yields were determined by harvesting with a plot combine and corrected to 13% moisture.

Results

Planting dates were delayed by wet weather in 1999. Planting dates in 2000 were closer to the planned dates. However, somewhat poor stands were obtained with the 3rd and 4th plantings because of dry soil conditions. Results for the two years are summarized in Table 6. The first frost in 1999 occurred on Oct. 4 and hastened maturity of the 4th planting of the group III and IV varieties. However, there were no significant differences between planting dates in yield of soybean in 1999. Neither were there differences in yield of the 4 varieties of the different maturity groups in either year. However, in 2000, yields of the two earlier planting dates were higher than the last two planting dates. The poor stands obtained at the 3rd and 4th planting dates likely had a large influence on the lower yields. Plants were generally tallest when planted the first part of May, and shortest with the 4th planting date. The group II soybeans were shortest and the group IV soybean was tallest, with the group III soybeans both being about the same. Yields were lower than normal both years of this study. Irrigated soybean yields are usually in the 70 bu/a range in the Kansas River Valley. This study will be continued to get a better evaluation of planting date and maturity group effects.

Table 6. Effect of planting date and maturity group on soybean yield, maturity, and height.

Planting Date	Variety	Yield		Maturity		Plant Height	
		1999	2000	1999	2000	1999	2000
		--------bu/a ------		Days after 9/1		----Inches----	
4/21/99; 4/18/00	Grp. II*	52.1	39.8	7	6	28	28
	Pi 93B54	39.4	49.3	15	17	32	38
	Macon	53.0	45.3	17	13	31	34
	KS4694	53.4	37.3	36	24	32	44
5/13/99; 5/5/00	Grp. II*	44.6	46.3	13	9	32	35
	Pi 93B54	38.7	45.2	26	17	36	42
	Macon	40.9	43.9	29	19	35	39
	KS4694	36.1	31.2	39	22	38	46
6/4/99; 5/25/00	Grp. II*	47.0	20.6	26	9	31	30
	Pi 93B54	38.7	19.7	34	23	35	32
	Macon	49.4	24.8	36	23	34	31
	KS4694	41.3	20.9	42	31	38	35
7/2/99; 6/23/00	Grp. II*	52.0	26.3	39	24	24	24
	Pi 93B54	44.2	22.4	43	33	25	27
	Macon	49.4	28.4	43	32	23	27
	KS4694	40.8	26.2	43	36	29	34
LSD (0.05)		NS	NS	1	2	NS	NS
Planting Date Means:							
4/21/99; 4/18/00		49.5	42.9	19	15	31	36
5/13/99; 5/5/00		42.6	41.7	27	17	35	41
6/4/99; 5/25/00		44.1	21.5	34	22	34	32
7/2/99; 6/23/00		46.6	25.8	42	31	25	28
LSD (0.05)		NS	5.3	1	1	2	2
Variety Means:							
	Grp. II*	48.9	33.2	21	12	29	29
	Pi 93B54	42.8	34.2	29	23	32	35
	Macon	48.2	35.6	31	22	31	33
	KS4694	42.9	28.9	40	28	34	40
LSD (0.05)		NS	NS	1	1	2	2

Grp. II: 1999 - Midland 8250; 2000 - IA 2021.

CORN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux

Summary

Tests were conducted on conventional and glyphosate resistant corn tests were conducted. All preemergence herbicide treatments reported gave good control of large crabgrass, Palmer amaranth and common sunflower. Timing of glyphosate applications was found to be critical. Single applications of glyphosate applied early and late postemergence resulted in lower yields than the mid-postemergence treatment. However, all three application times gave excellent weed control and comparable yields when applied over the top of a half rate of a preemergence herbicide, Bicep II Magnum at 1.05 qt/a.

Introduction

Chemical weed control and cultivation have been used to control weeds in row crops to reduce weed competition that can reduce yields. A preemergence (PRE) test included 26 herbicide treatments and the results of 12 of these treatments are discussed. In a second test (GR), 22 herbicide treatments were evaluated on glyphosate resistant corn and results of 14 treatments are discussed. 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 Eudora silt loam soil previously cropped to soybeans. The PRE test site had a pH of 6.8 and an organic matter content of 1.5% while the GR test site had a pH of 6.9 and an organic matter content of 1.4%. Both tests were planted at 30,000 seeds/a in 30-inch rows. Corn hybrids were Garst 8342 BT IT planted April 25 in the PRE test and Asgrow 770RR planted April 21 in the GR test. Anhydrous ammonia at 150 lbs N/a was applied preplant, and 10-34-0 fertilizer was banded at planting at 120 lbs/a. PRE test herbicides were applied: preemergent (PRE) - April 26 and postemergent (POST) - June 1. In the GR test, Bicep II Magnum at 2.1 qt/a, preemergence, was included as a standard. Three timings of glyphosate , Roundup Ultra, were included, early post (EP), mid-post (MP), and late post (LP), both as stand alone treatments and over the top of a half rate of the standard (Bicep II Magnum, 1.05 qt/a). GR test herbicides were applied: PRE = April 22; EP - May 19, MP - June 1, and LP - June 8. Plots were not cultivated. The crop injury and weed control ratings reported for the PRE test were made on May 26 and the weed control ratings for the GR test were made on June 26. The first significant rainfall after PRE herbicide application was on April 23 (0.28 inches) and April 30 (0.42 inches). Both tests were harvested on September 7 using a modified John Deere 3300 plot combine.

Results

Preemergence Test

A small amount of corn injury was observed with the 2 treatments containing Balance. All herbicides gave good control of large crabgrass, Palmer amaranth, and common sunflower. There was a large variation in yields, but most of the differences observed were due to plot to plot variability, not because of treatment differences. All treatments increased grain yield over that of the untreated plots (Table 7).

Table 7. Effects of preemergence herbicides on corn injury, weed control, and grain yield, Kansas River Valley Experiment Field, Rossville, KS, 2000.

Treatment	Rate	Appl Time	Corn Inj. 30 DAT[1]	Weed Control, 30 DAT[2] Lacg	Paam	Cosf	Grain Yield
	prod./a		---%---	-------------%------------			bu/a
Untreated check	—	---	0	0	0	0	60
Bicep II Magnum	2.1 qt	PRE	0	93	93	100	164
Guardsman	2.0 qt	PRE	0	82	100	100	170
Harness Xtra	2.0 qt	PRE	0	92	100	98	170
Degree Xtra	3.0 qt	PRE	0	95	98	97	147
Fultime	2.75 qt	PRE	0	87	98	95	150
Axiom AT	42 oz	PRE	3	90	100	100	150
Balance Pro/Atraz.	2.0 pt	PRE	3	90	100	100	138
Bicep II Magnum	2.1 qt	PRE	0	93	100	100	138
+ Balance 75 WG	1.0 oz	PRE					
Harness Xtra	2.0 qt	PRE	0	78	100	100	122
+ Hornet	3.0 oz	PRE					
Epic	10.0 oz	PRE	2	88	98	92	141
Epic	8.0 oz	PRE	0	92	98	100	148
+ Atrazine	1.0 qt	PRE					
LSD(.05)			3	10	8	3	49

[1] Crop injury rated - 5/26/00; DAT = days after preemergence treatment application.
[2] Lacg = large crabgrass; Paam = Palmer amaranth; Cosf = common sunflower.

Glyphosate Resistant Test

No corn injury was observed in this test. The preemergence standard, Bicep II Magnum, 2.1 qt/a, gave good control of large crabgrass (lacg), Palmer amaranth (paam), and common sunflower (cosf). Timing was critical with the single treatments of Roundup Ultra. Only the MP treatment resulted in good weed control and good yield. Crabgrass control was poor with the single EP treatment of Roundup Ultra. The LP treatment had good weed control ratings, but the lowest yield of treated plots in the test, most likely a result of early weed competition. Weed control and yields were good with all three application times of Roundup Ultra over the top of a half rate of Bicep II Magnum. The untreated check yielded only 27 bu/a (Table 8).

Table 8. Effects of herbicides on weed control and grain yield of Roundup-Ready corn, Kansas River Valley Experiment Field, Rossville, KS, 2000.

Treatment[1]	Rate	Appl Time[2]	Weed Control, 25 DAT[3] Lacg	Paam	Cosf	Grain Yield
	prod./a		-----------------	%	-----------------	bu/a
Untreated check	—	—	0	0	0	27
Bicep II Magnum	2.1 qt	PRE	83	97	87	162
Bicep II Magnum	1.05 qt	PRE	75	100	92	132
Bicep II Magnum +	1.05 qt	PRE	82	97	100	152
Roundup Ultra	1.5 pt	EP				
Bicep II Magnum +	1.05 qt	PRE	95	100	100	159
Roundup Ultra	1.5 pt	MP				
Bicep II Magnum +	1.05 qt	PRE	93	100	100	178
Roundup Ultra	1.5 pt	LP				
Roundup Ultra	1.5 pt	EP	68	98	95	147
Roundup Ultra	1.5 pt	MP	88	98	100	168
Roundup Ultra	1.5 pt	LP	82	93	93	131
Roundup Ultra +	1.5 pt	EP	97	100	100	151
Roundup Ultra	1.5 pt	LP				
Bicep II Magnum +	1.05 qt	PRE	75	100	100	149
Northstar[4]	5.0 oz	MP				
Harness +	1.33 pt	PRE	77	93	100	146
Hornet +	3.0 oz	EP				
Glyphomax Plus[4]	1.5 pt	EP				
LSD(.05)			7	5	7	49

[1] Roundup Ultra treatments have Ammonium Sulfate added at 1.7 lb/a.
[2] PRE = preemergence; EP = early postemergence; MP = mid-postemergence; LP = late postemergence.
[3] Lacg = large crabgrass; Paam = Palmer amaranth; Cosf = common sunflower (Rated 6/26/00); DAT = days after mid-post (MP) treatment.
[4] Plus non-ionic surfactant (NIS), 0.25% + AMS, 2.5%, POST.

SOYBEAN HERBICIDE PERFORMANCE TESTS

Larry D. Maddux

Summary

A conventional test and a glyphosate test were conducted. Many of the preemergence herbicides had poor control of large crabgrass, Palmer amaranth, and common sunflower due to dry weather. The best treatments in the glyphosate test were glyphosate over the top of a preemergence herbicide.

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 preemergence, and postemergence herbicides and the glyphosate test included various preplant incorporated, preemergence and postemergence herbicides with or without glyphosate. The major weeds evaluated in these tests were large crabgrass (lacg), Palmer amaranth (paam), common sunflower (cosf), and ivyleaf morningglory (ilmg).

Procedures

Both tests were conducted on a Eudora silt loam soil with a pH of 7.0 and 6.9 and organic matter contents of 1.3% and 1.2%, 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 3 at 144,000 seeds/a in 30-inch rows. Fertilizer (10-34-0) was banded at 120 lbs/a at planting. There were 18 treatments in the conventional test and 26 treatments in the glyphosate test. The herbicides were applied as follows: PPI & PRE - May 3; early postemergent (EP) - June 8; mid-postemergent (MP) - June 19; and late postemergent (LP) - June 27. The first significant rainfall after the PPI and PRE treatments was on May 11 (1.92 inch). The plots were not cultivated. Ratings for crop injury were made on June 15 and 25, 7 & 14 days after EP treatment. Ratings reported for weed control were made on July 11, 33 days after EP treatment. Harvest was on November 2 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 in 7 treatments (Table 9). Python + Pendimax resulted in very poor control of lacg and paam. Poor control of lacg was also obtained with Command + Authority. Poor control of paam was also obtained with the EP treatment of FirstRate + Flexstar, + Select. The best treatments were Prowl, PRE, followed by Pursuit + Flexstar, EP, Prowl, PRE, followed by Raptor + Flexstar, EP, and Flexstar + Fusion, EP. Yields tended to follow weed control fairly closely. There appeared to be no effect of injury on yield.

Glyphosate Test

Treatments with Cobra or Flexstar had significant injury (Table 10). The Valor is a new PRE herbicide that gives good paam control as seen from the combination treatments with Squadron, PRE, and Cobra + Select + FirstRate, EP. Roundup Ultra applied LP gave poor weed control. Glyphosate treatments have given poor control of ilmg in tests conducted on this site. The 2 best treatments on all 4 weeds at this location were Canopy XL, PRE, followed by Classic + Roundup Ultra, MP, and Command + Authority, PRE, followed by Roundup Ultra, MP. The use of a PRE herbicide, even at a reduced rate, allows greater flexibility of application time of the glyphosate and generally results in better control. Early season weed competition resulting in delayed application of glyphosate can result in loss of yield.

Table 9. Effects of herbicides on conventional soybean injury, weed control, and grain yield, Kansas River Valley Experiment Field, Rossville, KS, 2000.

Treatment	Rate	Appl Time	Soybean Injury[1]		Weed Control, 33 DAT[2]			Grain Yield
			7 DAT	14 DAT	lacg	paam	cosf	
	prod./a		----------%----------		----------------%---------------			bu/a
Untreated check	---	---	0	0	0	0	0	0.0
Python + Pendimax	1.0 oz 3.0 pt	PRE PRE	0	0	46	42	80	6.3
Canopy XL + Prowl	6.8 oz 2.0 pt	PRE PRE	3	2	75	77	100	12.1
Authority + Pursuit Plus	4.0 oz 2.6 pt	PRE PRE	0	0	72	82	92	25.8
Command + Authority	2.0 pt 0.75 pt	PRE PRE	22	13	43	82	70	6.6
Command + Authority + FirstRate	2.0 pt 0.5 pt 0.6 oz	PRE PRE PRE	8	7	80	85	100	33.1
Pendimax + FirstRate + Flexstar[3]	3.0 pt 0.3 oz 12.0 oz	PRE EP EP	0	12	80	83	97	34.3
Prowl + Pursuit + Flexstar[4]	2.5 pt 1.44 oz 16.0 oz	PRE EP EP	18	7	92	88	100	36.9
Prowl + Raptor + Flexstar[4]	2.5 pt 4.0 oz 16.0 oz	PRE EP EP	15	5	90	90	100	27.8
FirstRate + Flexstar + Select[4]	0.3 oz 12.0 oz 6.0 oz	EP EP EP	15	5	92	58	100	25.1
Flexstar + Fusion[5]	16.0 oz 10.0 oz	EP EP	17	5	87	88	100	40.6
LSD(0.05%)			7	5	28	25	29	16.0

[1] DAT = days after EP treatment application - Injury rated on 6/11/00 & 6/26/00.
[2] lacg = large crabgrass; paam = palmer amaranth; cosf = common sunflower - Rated on 7/11/00.
[3] Plus urea ammonium nitrate (UAN), 1.0 qt/a + non-ionic surfactant, 0.125%.
[4] Plus urea ammonium nitrate (UAN), 1.0 qt/a + non-ionic surfactant, 0.25%.
[5] Plus urea ammonium nitrate (UAN), 2.5% + methylated sunflower oil (MSO), 1.0%.

Table 10. Effects of postemergent herbicides on glyphosate soybean injury, weed control, and grain yield, Rossville, KS, 2000.

Treatment	Rate	Appl Time	Soybean Injury[1] 7DAT	Soybean Injury[1] 14DAT	Weed Control, 33 DAT[2] lacg	paam	cosf	ilmg	Grain Yield
	prod./a		%		%				bu/a
Untreated Check	—	—	0	0	0	0	0	0	8.9
Valor + Squadron	2.5 oz 3.0 pt	PRE PRE	0	0	32	93	88	88	30.9
Valor + Cobra + Select + FirstRate	2.0 oz 8.0 oz 8.0 oz 0.3 oz	PRE EP EP EP	20	7	93	93	100	85	32.6
Cobra + Select + FirstRate	8.0 oz 8.0 oz 0.3 oz	EP EP EP	13	8	92	70	100	87	25.0
Roundup Ultra[3]	1.5 pt	LP	0	0	45	67	67	50	21.3
Valor + Roundup Ultra[3]	2.5 oz 1.0 qt	PRE MP	0	0	90	100	100	82	38.8
Boundary + Roundup Ultra[3]	1.25 pt 1.5 pt	PRE LP	0	0	82	100	95	72	39.4
Flexstar + Fusion	16.0 oz 10.0 oz	EP EP	20	7	78	83	93	98	30.6
Touchdown + Flexstar	1.2 pt 1.2 pt	EP EP	20	8	92	95	100	78	32.5
Pendimax + Glyphomax Plus	3.0 pt 1.5 pt	PRE MP	0	0	90	98	100	80	34.4
FirstRate + Glyphomax Plus	0.3 oz 1.5 pt	MP MP	0	0	62	100	100	68	44.1
Extreme	3.0 pt	EP	8	2	90	98	100	82	35.4

Table 10. Effects of postemergent herbicides on glyphosate soybean injury, weed control, and grain yield, Rossville, KS, 2000.

Treatment	Rate	Appl Time	Soybean Injury[1]		Weed Control, 33 DAT[2]				Grain Yield
			7DAT	14DAT	lacg	paam	cosf	ilmg	
	prod./a		%		%				bu/a
Canopy XL + Classic + Roundup Ultra[3]	4.5 oz 0.33 oz 1.5 pt	PRE MP MP	0	0	98	100	100	93	46.8
Command + Authority + Roundup Ultra[3]	0.8 pt 0.3 pt 1.5 pt	PRE PRE MP	0	0	97	100	100	93	47.0
Authority + FirstRate + Roundup Ultra[3]	0.372 pt 0.44 oz 1.5 pt	PRE PRE MP	0	0	95	100	100	83	40.6
LSD(.05)			4	4	27	30	28	27	20.3

[1] Injury ratings - 6/11/00 & 6/26/00; DAT = days after EP treatment application.
[2] lacg = large crabgrass; paam = palmer amaranth; cosf = common sunflower; ilmg = ivyleaf morningglory;
Rated - 7/11/00.
[3] Plus ammonium sulfate (AMS), 2.55 lb/a.
[4] Plus nonionic surfactant (NIS), 0.25% + AMS, 2.55 lb/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 helped define adapted varieties/hybrids of wheat, soybeans, alfalfa, grain sorghum, and corn. As irrigated corn, soybean, wheat, and alfalfa production grew in importance, research determined proper management strategies for irrigation, fertilizer, pest control, and related cultural practices. Presently research focuses on variety/hybrid evaluation, the evaluation of new pesticides for the area, the practicality of dryland crop rotations, 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, initiated in 1996, determining cultural practices to maximize the efficiency of irrigation inputs from both an engineering agronomic standpoint was completed in 2000. In 1999, a project was initiated to examine cotton production variables and agronomic potential in the area and work was begun examining the long-term feasibility of dryland soybean production. Winter forage studies for cattle, initiated in 1999, involving planting of wheat, rye, and Triticale were expanded in 2000.

Soil Description

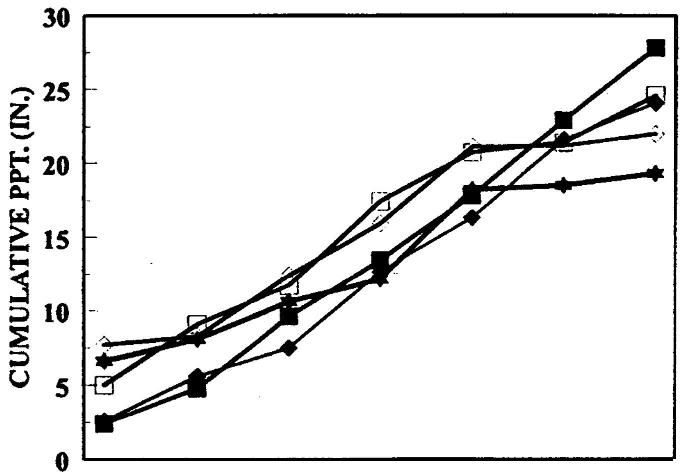
Soil surface horizons range from Pratt, Carwile, and Naron loamy fine sands to Farnum, Naron, and Tabler fine sandy loams. Subsoils are much more varied, ranging from loamy fine sand to clay. These soils are productive under dryland conditions with intensive management and favorable precipitation patterns.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

2000 Weather

The growing season was characterized by extremely hot conditions from mid-June through September. In 2000, over 22 days experienced temperatures in excess of 100^{o} F and over 60 in excess of 90^{o} F. Growing season length was on the average of 185 days. Precipitation was well over the long-term average of 26.2 inches (Table 1) although rainfall from March through September was the second lowest over the last five-year period (Figure 1). Without an extremely wet period during mid-July, rainfall for July and August was only 0.25 inches (Figure 2). Of the 31.3 inches received in 2000, 17.5 inches (56%) was received in March, four consecutive days in July and five in October.

Table 1. Precipitation at the Sandyland Experiment Field, St. John, 19-year average, 1999, 2000.

Month	19-Year Average	1999	2000
		inches	
January	0.7	2.7	1.3
February	0.9	0.0	2.5
March	2.4	2.4	7.7
April	2.5	4.0	0.6
May	3.8	2.7	4.1
June	4.0	5.7	3.6
July	3.1	3.3	5.2
August	2.5	0.7	0.05
September	2.1	3.2	0.8
October	2.1	0.2	4.6
November	1.1	0.0	0.5
December	1.0	0.2	0.6
Annual Total	26.2	25.9	31.3



MONTH	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1996 ■	2.40	4.80	9.60	13.40	17.80	22.90	27.80
1997 ◆	2.60	5.60	7.50	12.60	16.30	21.60	24.10
1998 ✦	6.60	8.10	10.60	12.10	18.20	18.50	19.30
1999 □	5.00	9.10	11.70	17.40	20.70	21.40	24.60
2000 ◇	7.70	8.30	12.40	15.90	21.10	21.15	22.00

Figure 1 - Cumulative Precipitation from March through September; Sandyland Experiment Field, St. John, KS, 1996-2000

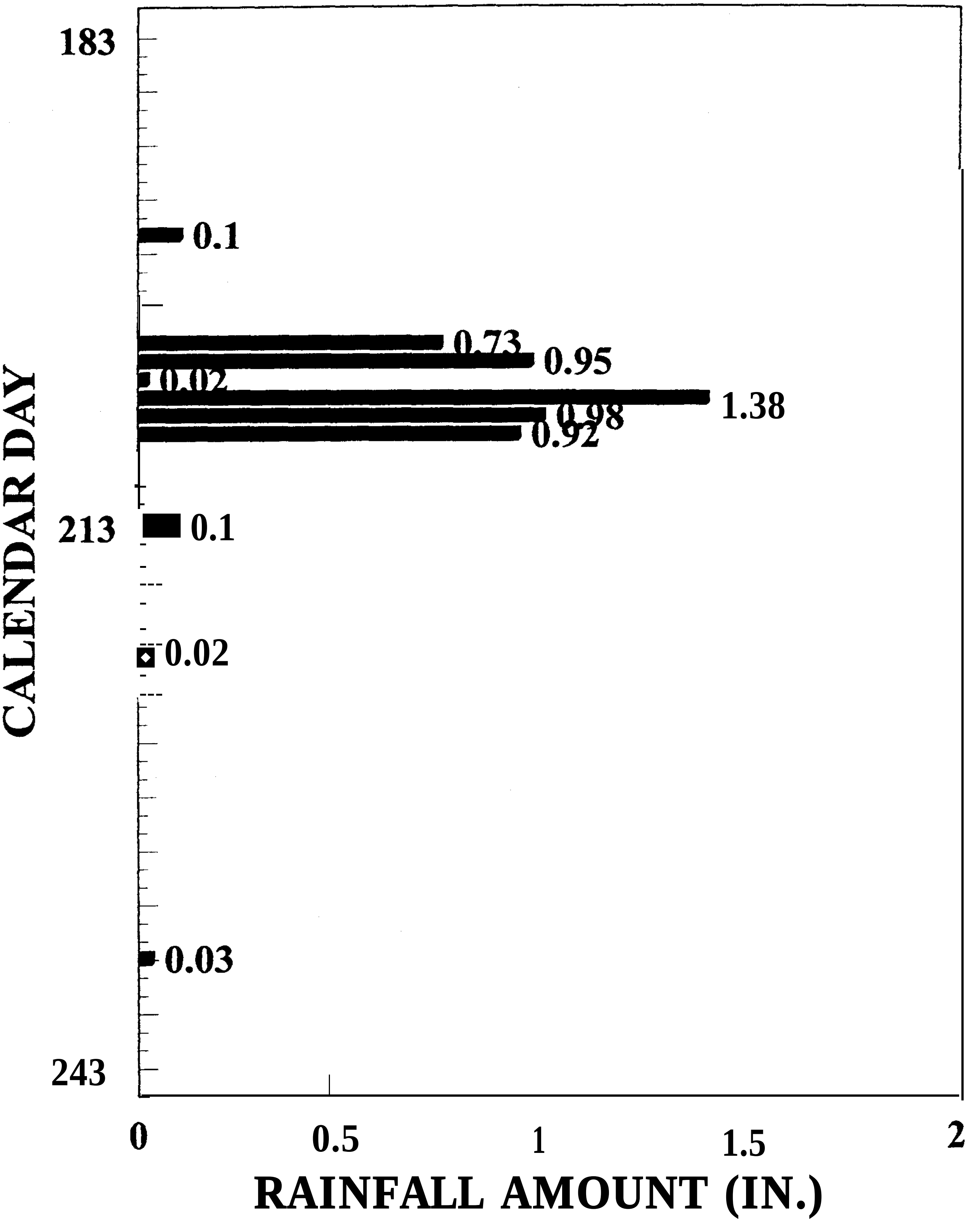


Figure 2. Daily Rainfall amounts from July 1 (day 183) through August 31, Sandyland Experiment Field, St. John, KS, 2000

DRYLAND NO-TILL CROP ROTATIONS ON SANDY SOILS

Victor L. Martin, Kent McVay, and Dale L. Fjell

Introduction

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

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

Procedure

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

The rotations are as follows:

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

Fertility will be maintained with the following yield goals:

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

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

CROP PERFORMANCE TESTING AND NEW PROJECTS

Victor L. Martin

During the 2000 cropping season, performance tests were conducted on dryland wheat corn, cotton, and grain sorghum, as well as irrigated wheat, soybeans, grain sorghum, cotton, and both full and short season corn hybrids. 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.

The sorghum breeding program implemented a breeding site at Sandyland to assist the program in developing grain sorghum hybrids better adapted to the extreme heat and drought stress typical of the region.

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

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 may also contact the Sandyland Experiment Field if your local extension office does not possess this information.

In 2000, the Sandyland Field had to close its irrigated quarter as K-State lost the lease. During 2001, crop performance testing will be conducted on cooperator sites in the area for irrigated corn, soybeans, and grain sorghum. Long-term plans are to locate and develop a site for future irrigation research.

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

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

Summary

Planting date was the single most important factor in determining grain yield. Delaying planting significantly decreased grain yield and the reduction increased as hybrid maturity increased. No-tillage provided no yield benefit over the chisel-disk tillage system, even during hot, dry conditions. Scheduling irrigation at 100% ET provided optimal yields overall.

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/acre most years. Under intensive management with favorable weather, producers expect yields of 190 to 200+ bu/acre on producers "better" ground. Typically, corn is planted from mid-April to mid-May with plant populations averaging 24,000 to 30,000 plants/acre. 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.

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

An additional factor compounds 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, lowering of water table levels associated with irrigation has 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 manage irrigation , but to develop practices insuring adequate surface waters to maintain the Quivira Wildlife Refuge. Although switching hardware on pivots and using irrigation scheduling will potentially 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 for corn produced on the sandy soils of SC Kansas. This is the fourth year of a five-year study.

The study involves the departments of Agronomy, Biological and Agricultural Engineering, and Agricultural Economics.

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 was in wheat the prior two years. Fertilization consisted of 100 lb/acre 18-46-0 each year in March. Nitrogen was applied as granular urea (46-0-0). Nitrogen application was split in two 125 lb N/acre increments, preplant and V6. All planting dates received 1 qt/acre Dual II + 1 pt/acre Atrazine pre-emergence followed by 1 qt/acre Marksman post emergence. The first two planting dates also received 2/3 oz/acre accent to control crabgrass and volunteer grain sorghum in 1996. All plots were planted at 34,000 seeds/acre with a John Deere no-till row planter. Treatments were as follows:

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);
April 20, May 4, May 16 (2000).
Split plots - Irrigation Level:
120% (0.92"/application),
100% (0.78"/application),
80% (0.62"/application) from 1996 - 1998;
and 125% (0.98"/application),
100% (0.78"/application),
75% (0.57"/application) in 1999 and 2000.
Sub-subplots - Tillage:
No-tillage, Chisel-disk
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 35N05-105 day), Medium (Pioneer 33R88-113 Day), Full (Pioneer 31B13-119 day) in 1999 and 2000.

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

As will be noted when examining the data presented, 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 are larger for 1996 than 1997 - 2000. This resulted in wide yield variation and lower than expected yields.

During the five years of the study growing season conditions varied markedly and required wide variation in the amount irrigation water applied (Table 2). The first two years 1996-1997 were almost ideal in both precipitation and temperature patterns and distribution, with 1998-2000 being more extreme with extended periods of extreme high temperatures during July and August and little precipitation (Table 3).

For easier comparison across years all grain yield data are converted to relative yield (RY). %RY= (AY/AVG. Y) X 100 where AY = Actual grain Yield in bushels per acre, AVG. Y = Average grain Yield in bushels per acre for the entire study for a given year. The %RY indicates whether a given factor or interaction of factors resulted in grain yields higher or lower than the overall study average.

Examining the effect of main treatment factors averaged across all other factors (planting date, irrigation level, tillage, and hybrid maturity), planting date was the single most important factor in determining yield. (Figure 3). Delaying planting past the end of April decreased yields on average 8% with the largest decrease of 18% occurring in 1998 and 2000 and the smallest (5%) in 1996. Irrigation in excess of ET did not significantly increase yield except 1996 and 2000 (Figure 4). Deficit irrigating (less than ET) did only decreased yields on average by 3% compared to irrigating at 100% ET.

Even after five-years no-till yields were significantly less than yields under the convention tillage (chisel-disk) system (Figure 5). Over five years, no-tillage yields averaged 8% less than under conventional tillage and no-tillage was of no benefit even during periods of extreme heat and moisture stress (1999 and 2000). Remember this study was conducted with continuous corn as the cropping system as this represents the typical irrigated cropping practice of the area. The corn under no-tillage would likely have responded much differently under a corn-soybean or other rotation.

Even with hybrid maturities varying by almost 14 days, yields were affected little by decreasing maturity (Figure 6). The most consistent yields were achieved with the shorter maturity corn hybrids and the widest variation using full season maturity. The implication of this after five years is important as producers should be able to use less water while maintaining yields simply by moving to earlier maturing hybrids. This fact also has implications for crop rotations and marketing of grain.

As planting was delayed, the efficiency of irrigation applied decreased (Figure 7). Delaying planting until mid-May decreased yield significantly for the full season hybrids and the effect decreased as hybrid maturity decreased (Figure 8). Even where yields were comparable Water Use Efficiency (WUE) was much lower as planting was delayed.

Interestingly, the negative effects of no-tillage on yield were greater as planting was delayed (Figure 9). No-tillage also decreased yields more overall during hot, dry conditions. Decreased yields may be due to poorer soil conditions under five years of no-till corn production (more dense with less pore space) not allowing for root growth and therefore moisture/nutrient uptake. Again, this is a continuous corn system and the effects of no-tillage may be much different under a rotation.

Examining actual yields for 2000 indicates that overall, ET scheduling worked well in supplying adequate water to optimize crop yields (Figure 10). In 2000, a year of extreme heat and moisture stress during pollination and grain development there was some advantage to the 130% ET rate, particularly for the second planting date.

The average yield over the last two years (1999-2000) indicates that the 105 and 113 day hybrids were much less sensitive to the amount of irrigation applied than the full season (119-day) hybrid (Figure 11).

The data from the period 1996 - 2000 indicate that to optimize/minimize irrigation inputs, producers on the sandy soils of SC Kansas under continuous corn should:

1. Finish planting by the end of April. This is true regardless of spring conditions or conditions during the remainder of the growing season.

2. Use a tillage system which maintains 30 - 50% surface residue but no-tillage is not recommended under continuous corn.

3. Select a short season hybrid (103 to 114 days) based upon its performance in the area.

4. Schedule irrigation using an ET-based scheduling program in conjunction with weather station or other daily ET source. In addition, all inputs (rainfall + irrigation) must be monitored closely. Kansched was used here, however, there are other satisfactory programs available.

Following these recommendations in conjunction with testing your irrigation system for output and uniformity should allow most producers to reduce their irrigation inputs by two to four inches while maintaining productivity.

Acknowledgment - Support for this project is provided by the Kansas Corn Commission.

Table 2. Sandyland. 1996 - 2000 irrigations amounts and number. Sandyland Experiment Field.

Planting Date and Irrigation Level	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"
April 20, 2000	14	7.1"	11.5"	15.8"
May 4, 2000	15	7.7"	12.3"	17.0"
May 16, 2000	16	8.2"	13.1"	18.1"

Table 3. Monthly precipitation totals for 1996 - 2000 and the 19 year long-term average. Sandyland Experiment Field.

Month	1996	1997	1998	1999	2000	19-yr avg
	------------------------ inches -----------------------					
January	0.16	0.01	1.66	2.68	1.25	0.73
February	0.07	2.46	0.49	0.00	2.48	0.91
March	2.05	0.05	4.42	2.35	7.68	2.41
April	2.39	2.96	1.51	4.02	0.60	2.48
May	4.83	1.90	2.46	2.67	4.08	3.79
June	3.76	5.06	1.52	5.66	3.56	3.99
July	4.39	3.67	6.12	3.32	5.18	3.07
August	5.05	5.33	0.32	0.69	0.05	2.46
September	4.88	2.50	0.84	3.20	0.84	2.13
October	1.37	3.99	5.55	0.18	4.58	2.13
November	2.78	0.48	1.67	0.03	0.49	1.08
December	0.03	2.62	0.18	0.20	0.55	1.00
Total	31.76	31.03	26.74	25.00	31.34	26.19

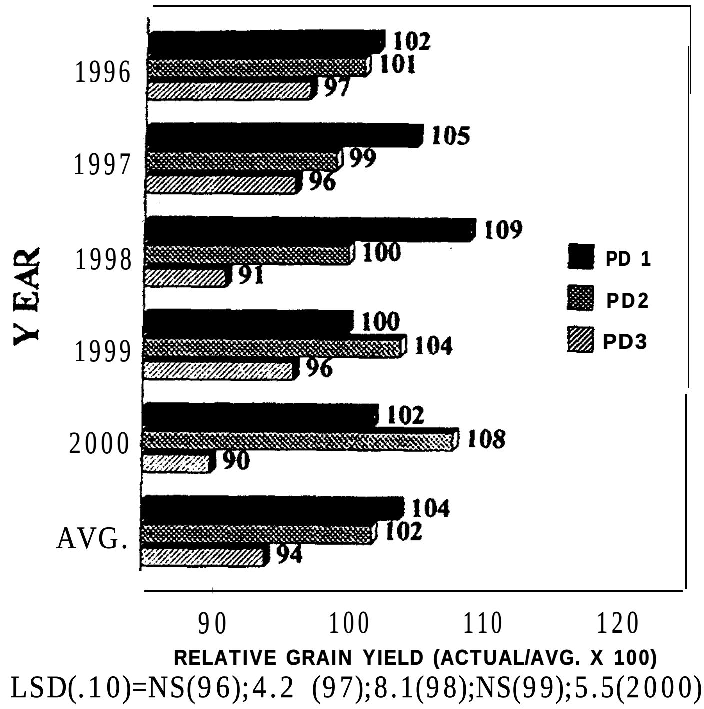


FIG. 3. SANDYLAND. 1996 - 2000 IRRIGATED CORN STUDY. EFFECT OF PLANTING DATE ON CORN WELD.

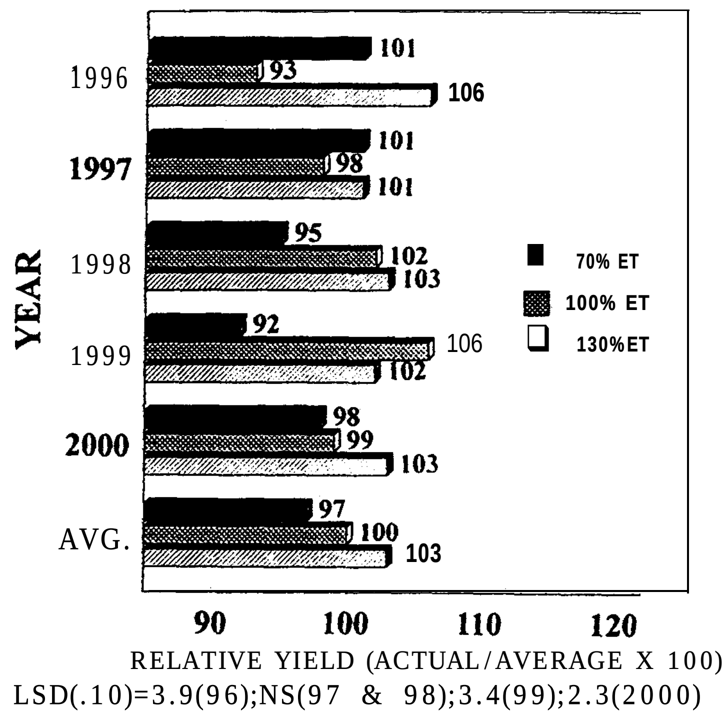
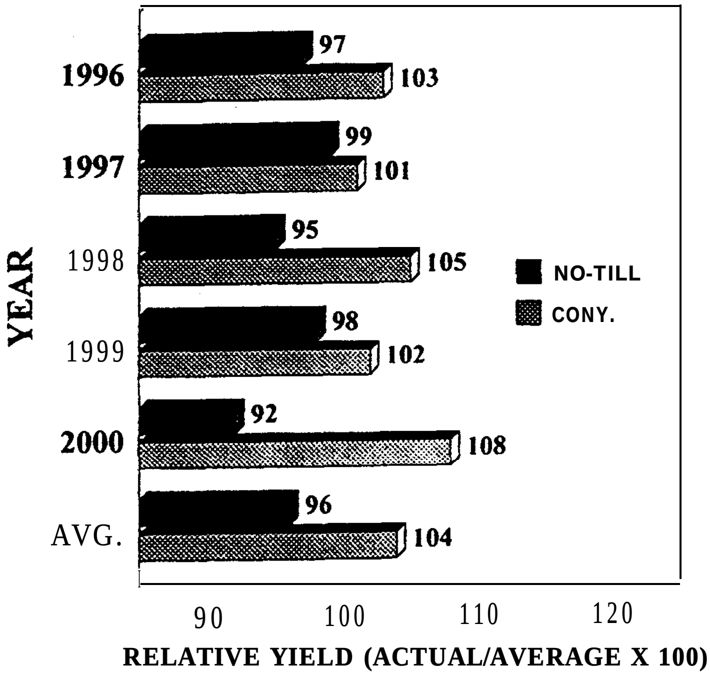
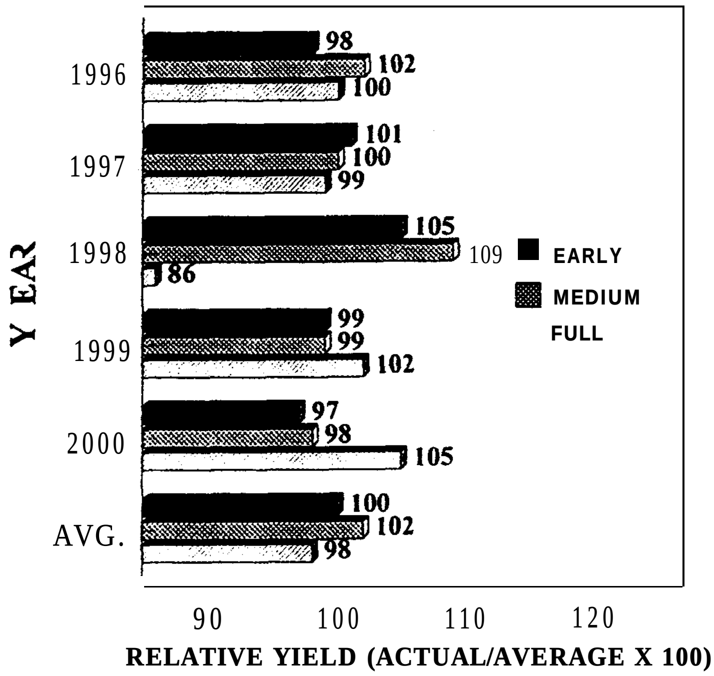


FIG. 4. SANDYLAND. 1996 - 2000 IRRIGATED CORN STUDY. EFFECT OF IRRIGATION LEVEL ON CORN YIELD.



LSD(.10)=3.0(96);NS(97);4.7(98);2.6(99);2.8(2000)

FIG. 5. SANDYLAND. 1996 - 2000 IRRIGATED CORN STUDY. EFFECT OF TILLAGE ON CORN YIELD.



LSD(.l0)=3.2(96);NS(97);6.3(98);3.3(99);3.4(2000)

FIG. 6. SANDYLAND. 1996 - 2000 IRRIGATED CORN STUDY. EFFECT OF HYBRID MATURITY ON CORN YIELD.

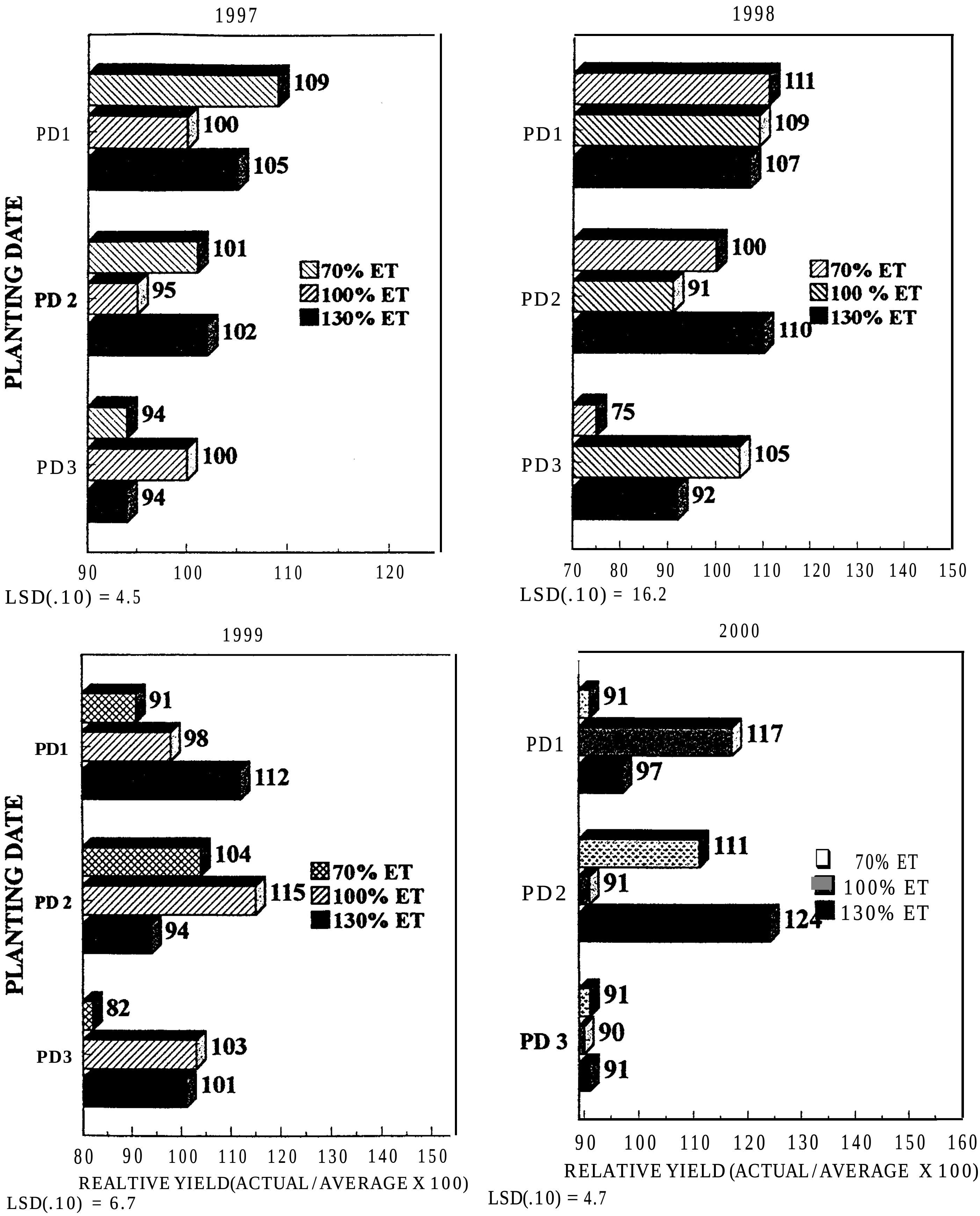


FIG. 7. SANDYLAND. 1997 - 2000. PLANTING DATE X IRRIGATION LEVEL RELATIVE GRAIN YIELDS.

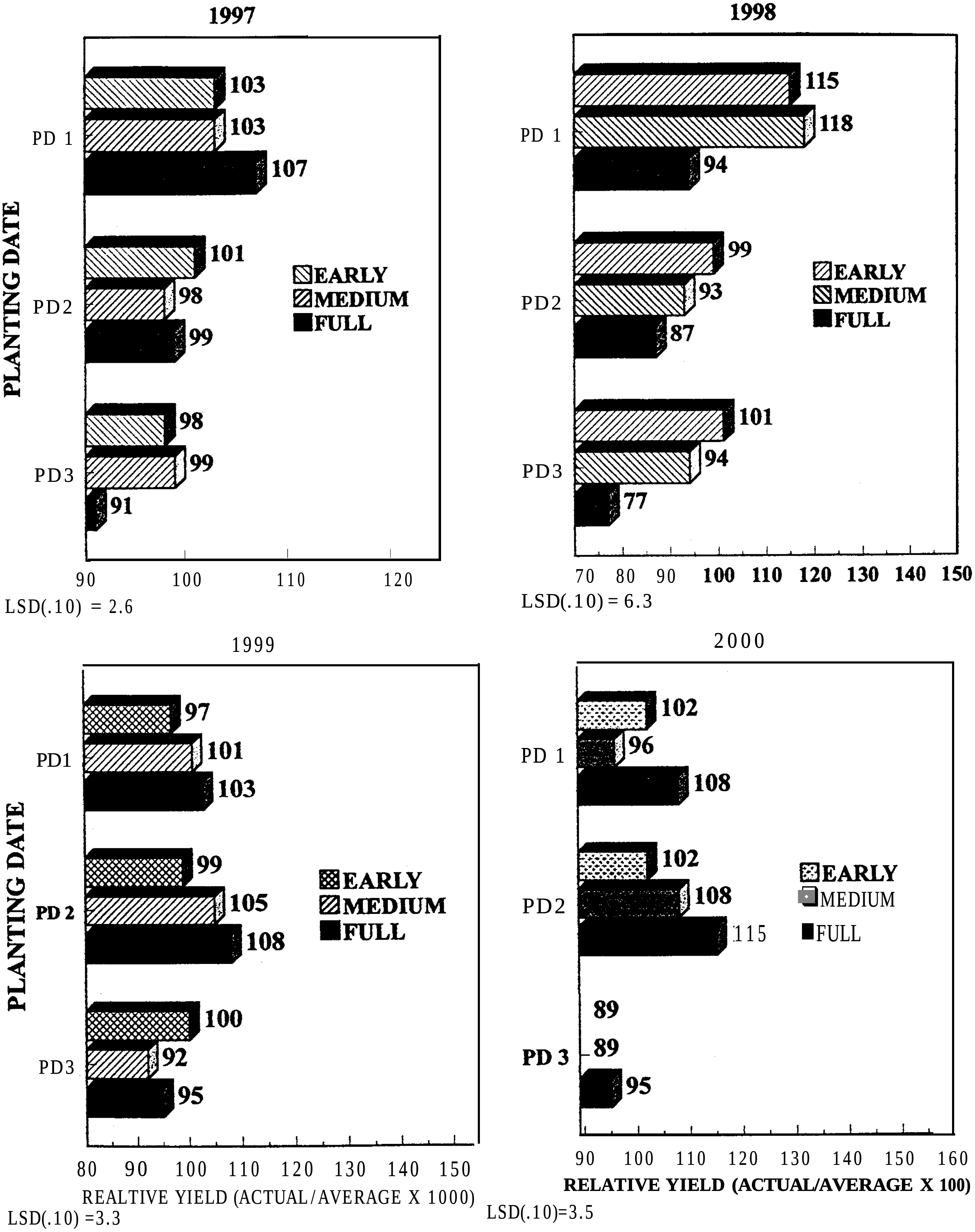


FIG. 8. SANDYLAND. 1997 - 2000. PLANTING DATE X HYBRID MATURITY RELATIVE GRAIN YIELDS.

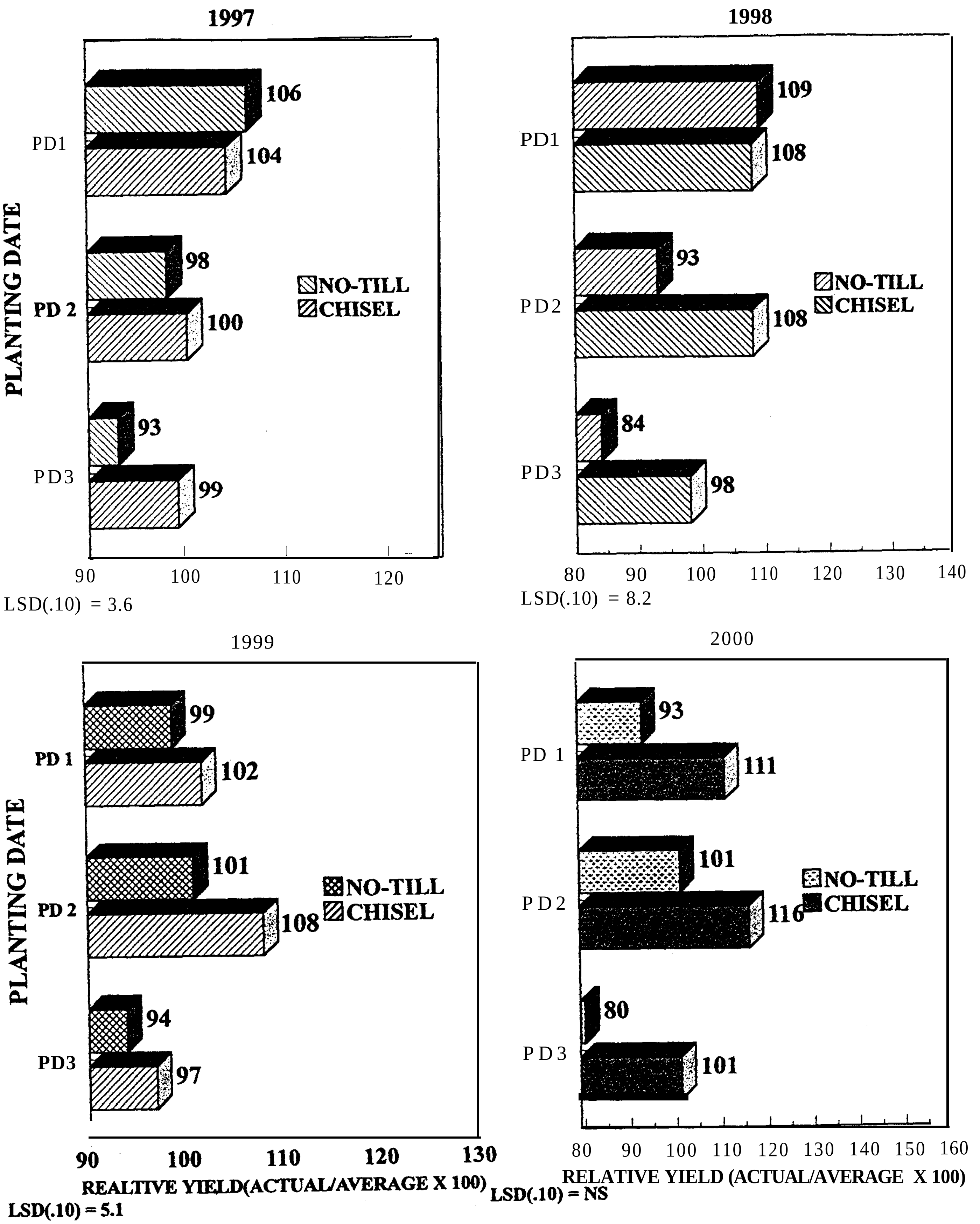


FIG. 9. SANDYLAND. 1997 - 2000. PLANTING DATE X TILLAGE RELATIVE GRAIN YIELDS.

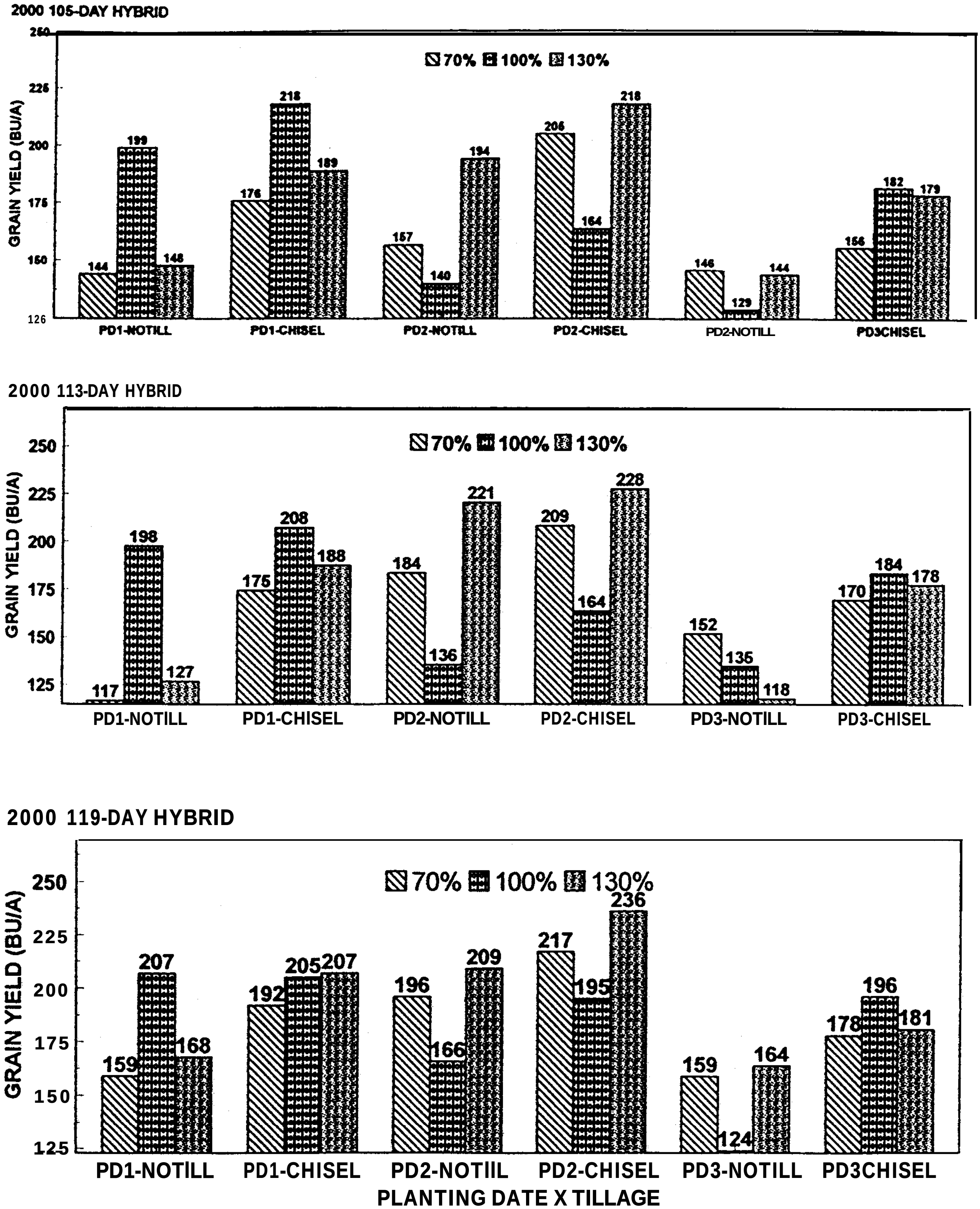


Fig. 10. 2000 Corn Grain Yield by Hybrid Maturity Using Planting Date x Irrigation Level x Tillage Interaction. Sandyland

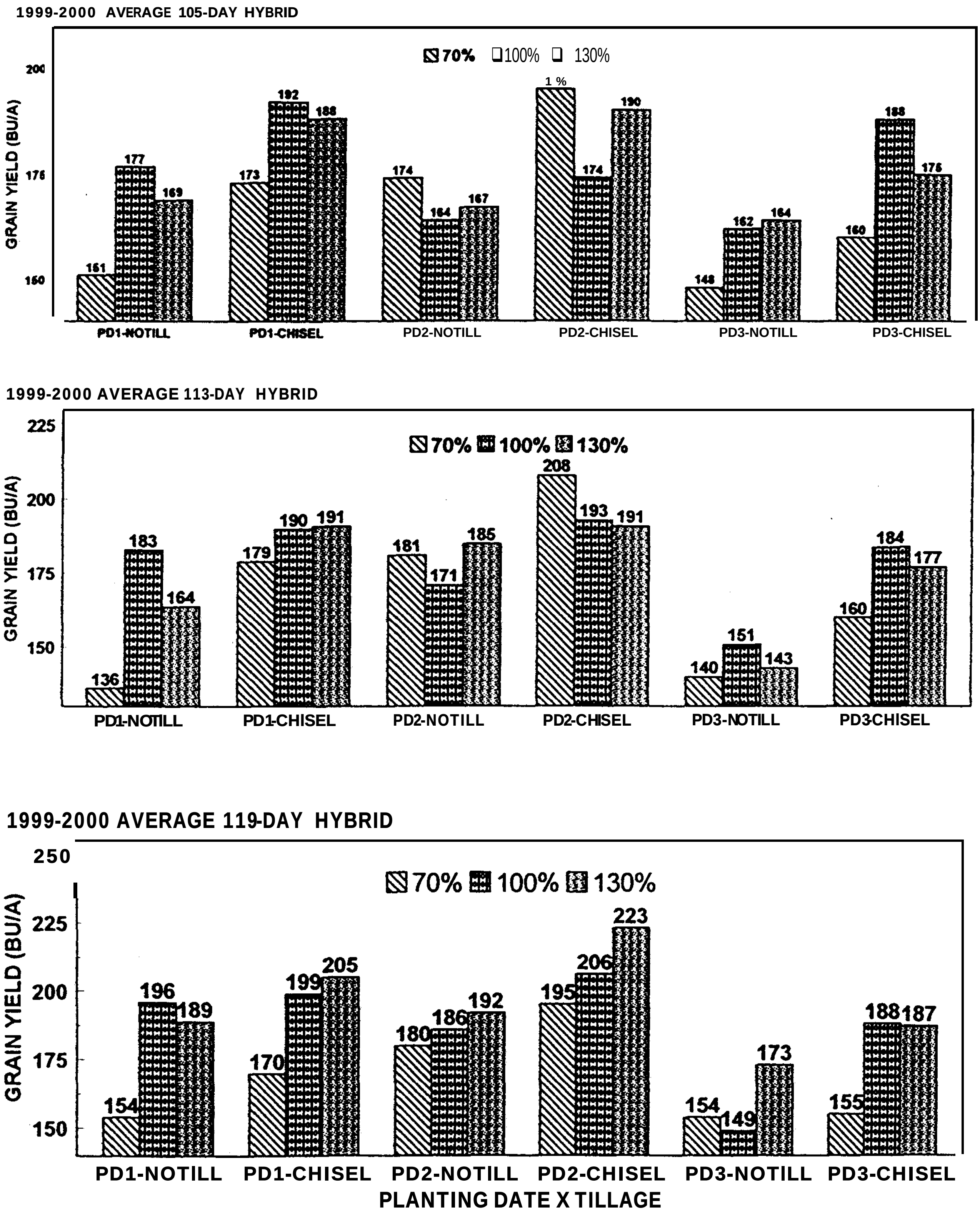


Fig. 11. Average of 1999 and 2000 Corn Grain Yield by Hybrid Maturity Using Planting Date x Irrigation Level x Tillage Interaction. Sandyland.

SOUTH CENTRAL KANSAS EXPERIMENT FIELD

HUTCHINSON LOCATION

Introduction

The South Central Kansas Experiment Field was established in 1951 on the US Coast Guard Radio Receiving Station located southwest of Hutchinson. The first research data were collected with the harv 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 mil south and east of the old Hutchinson location on the Walter Pierce farm.

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

Soil Description

The soil survey for the South Central Field has approximately 120 acres classified as nearly level to gently sloping Clark/Ost loams with calcareous subsoils. This soil requires adequate inputs of phosphate and nitrogen fertilizers for maximum crop production. The Clark soils are well drained and have good water-holding capacity. They are more calcareous at the surface and less clayey in the subsurface than th 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 spo occur on the north edge of the Field. This soil requires special management and timely tillage, because i puddles when wet and forms a hard crust when dry. A 10-acre depression on the south edge of the Field is a Tabler-Natrustolls Complex (Tabler slick spot complex). This area is unsuited for cultivated crop production and has been seeded to switchgrass. Small pockets of the Tabler-Natrustolls are found throughout the Field.

1999-2000 Weather

Precipitation in 1999 totaled 30.7 inches, 0.87 inches above the 30-year average of 29.83 inches. In 2000 the Field rain gauge measured 33.4 inches of precipitation, 3.4 inches above the 30-year (most recent) average of 30.0 inches. As in previous years, precipitation in 2000 was not distributed evenly through the year. A more normal pattern of large amounts of precipitation over a two or three day perioc returned in 2000. The highest monthly totals were recorded in March (7.22), July (6.23), and October (6.92). After the wet July, no precipitation was received in August and 0.6 inches September. This was tl first time since 1939 (the first year for records at the South Central location) that no precipitation was recorded in August. In 1956 there was no precipitation recorded in September. There have been several years that less than 0.5 inches of rain was recorded for each month.   The lack of moisture continued into the middle of October. This delayed the planting of wheat fo the 2001 harvest year with most of the wheat on the Field being planted in November. The soil conditions at planting for the 2000 wheat crop were less than ideal. Following a July that had above normal precipitation the months of August, September, October, and November were considerably below norma This left the soil somewhat dry at and after planting. Emergence was very poor and erratic. Winter precipitation and temperatures were above normal and the wheat evened out over these months. Good growing conditions in April, May and early June allowed for near-normal to above normal wheat yields. The quality of the wheat was affected, however, by the late May heat and the rainfall that occurred after th wheat had matured.

The summer annuals (grain sorghum sunflower, and soybean also yielded well considering the precipitation and temperatures during the growing season. July was wet and somewhat cool; August was dry and extremely hot; September and October precipitation was below normal and temperatures were above normal. This made the early planted (mid-April to early May) crops look very good when compare to those planted a few weeks later. A frost-free growing season of 184 days (April 5 - October 7, 2000) was recorded. This is 1 day more 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)
1999			April	0.84	2.93
September	2.18	3.18	May	2.67	4.13
October	0.03	2.44	June	3.40	4.07
November	0.59	1.49	July	6.23	3.44
December	1.47	0.97	August	0.00	3.01
2000			September	0.60	3.18
January	1.21	0.64	October	6.92	2.38
February	2.91	0.99	November	1.00	1.51
March	7.22	2.51	December	0.35	1.00
			2000 Total	33.35	30.00

* Most recent 30 years.

CROPS PERFORMANCE TESTS AT THE SOUTH CENTRAL FIELD

William F. Heer and Kraig L. Roozeboom

Introduction

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

2000 Kansas Performance Tests with Winter Wheat Varieties.
KAES Report of Progress 857.

2000 Great Plains Canola Research
KAES Report of Progress 862.

2000 Kansas Performance Tests with Grain Sorghum Hybrids.
KAES Report of Progress 865.

2000 Kansas Performance Tests with Sunflower Hybrids.
KAES Report of Progress 871.

2000 Kansas Performance Tests with Alfalfa Varieties.
KAES Report of Progress 870.

These publications are available at the local County Extension Office or on the World Wide Web at www.ksu.edu/kscpt.

EFFECTS OF NITROGEN RATE AND PREVIOUS CROP ON GRAIN YIELD IN CONTINUOUS WHEAT AND 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 three years. Other crops (corn, soybean, sunflower, winter cover crops and canola) can be placed in the above cropping systems. To determine how winter wheat yields are affected by these crops, winter wheat was planted in rotations following them. Yields were compared to continuous winter wheat under conventional (CT) and no-till (NT) practices. Initially, the CT continuous wheat yields were greater then those from the other systems. However, over time, wheat yields following soybeans have increased, reflecting the effects of reduced weed and disease pressure and increased soil nitrogen. However, continuous CT winter wheat seems to out-yield 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 inch/yr, 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 associated with increased soil water in NT have not always been observed. 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) requirement for many crops is often greater under NT than CT. Increased immobilization and denitrification of inorganic soil N and decreased mineralization of organic soil N have been related to the increased N requirements under NT. Therefore, evaluation of N rates on hard red winter wheat in continuous wheat and in cropping systems involving "alternative" crops for the area have been evaluated at the South Central Field. The continuous winter wheat study was established in 1979. It was restructured to include a tillage factor in 1987. The first of the alternative cropping systems where wheat follows short season corn was established in 1986 and modified in 1996 to a wheat-cover crop-grain sorghum rotation. The second (established in 1990) has winter wheat following 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 starting 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 subplot six N levels (0, 25, 50, 75, 100, and 125 lbs/a). Nitrogen treatments were broadcast-applied as NH_4NO_3 prior to planting. Phosphate was applied in the row at planting. All crops were produced each year of the study. Crops are planted at the normal time for the area. Plots are harvested at maturity to determine grain yield, moisture, and test weight.

Continuous wheat

These plots were established in 1979. The conventional tillage treatments are plowed immediately after harvest then 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 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 no-till treatments.

Wheat after corn/grain sorghum fallow

In this cropping system, winter wheat was planted after a short-season corn had been harvested in late August to early September. This early harvest of short-season corn allows the soil profile water to be recharged, by normal late summer and early fall rains, prior to planting of winter wheat in mid October. Fertilizer rates are applied with the Barber metered screw spreader in the same manner as for the continuous wheat. In 1996, the corn crop in this rotation was dropped and three legumes (winter 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. Yield data can be found in Field Research 2000, KSU Report of Progress 854.

Wheat after soybeans

Winter wheat is planted after soybeans have been harvested in early to mid September in this cropping system. As with the corn, this early harvest 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 group III soybean was used. This delayed harvest to October 5, 1999 effectively eliminating the potential recharge time as the wheat was planted October 12.

Wheat after grain sorghum in cover crop/fallow - grain sorghum - wheat

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

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

Results

Continuous wheat

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

Table 2. Wheat Yields by Tillage and Nitrogen Rate in a Continuous Wheat Cropping System. Hutchinson.

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

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

[1] Nitrogen rate in lb/a.
[2] CT conventional NT no-tillage.

<u>Wheat after soybeans</u>

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

As the rotation continues to cycle, the differences at each N-rate will probably stabilize after four to five cycles, with a potential to reduce fertilizer N applications by 25 to 50 lbs/a where wheat follows soybeans.

Table 3. Wheat Yields after Soybeans in a Soybean-Wheat-Grain Sorghum Rotation with Nitrogen Rates. Hutchinson.

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

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

[1] Spring wheat yields.

Wheat after grain sorghum/cover crop

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

Other Observations

Nitrogen application significantly increased grain N contents in all crops. Grain phosphate levels did not seem to be affected by increased N rate.

Loss of the wheat crop after corn can occur in years when fall and winter moisture is limited. This loss has not occurred in continuous winter wheat regardless of tillage or in the wheat after soybeans. Corn will have the potential to produce grain in favorable years (cool and moist) and silage in non favorable (hot and dry) years. In extremely dry summers, extremely low grain sorghum yields can occur.

The major weed control problem in the wheat after corn system is with the grasses. This was expected, and work is being done to determine the best herbicides and time of application to control grasses.

Soybean and Grain Sorghum In the Rotations

Soybeans were added to intensify the cropping system in the South Central area of Kansas. They also have the ability, being a legume, to add nitrogen to the soil system. For this reason the nitrogen rates are not applied during the time when soybeans are planted in the plots for the rotation. This gives the following crops the opportunity to utilize the added N and to check the yields against the yields for the crop in other production systems. Yield data for the soybeans following grain sorghum in the rotation are given in Table 5. The soybean yields are more affected by the weather for a given year than by the previous crop. In three out of the five years there was no effect of the N rates applied to the wheat and grain sorghum crops in the rotation. In the two years that N application rate did affect yield it was only at the lower N rates. This is a similar affect that is seen in a given crop.

The yield data for the grain sorghum after wheat in the soybean-wheat-grain sorghum rotation is in Table 6. As with the soybeans, weather in the main factor affecting yield. It can also be seen that the addition of a cash crop (soybeans) intensifying the rotation will reduce the yield of grain sorghum in the rotation - soybean-wheat-grain sorghum vs wheat-cover crop-grain sorghum. More uniform yields are obtained in the soybean-wheat-grain sorghum rotation (Table 6) than in the wheat-cover crop-grain sorghum rotation (Table 7).

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

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

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

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

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

Table 5. Soybean Yields after Grain Sorghum in Soybean-Wheat-Grain Sorghum Rotation with Nitrogen Rates. Hutchinson.

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

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

Table 6. Grain Sorghum Yields after Cover Crop-Grain Sorghum-Wheat Rotation with Nitrogen Rates. Hutchinson.

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

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

Table 7. Grain Sorghum Yields after Wheat in a Soybean-Wheat-Grain Sorghum Rotation with Nitrogen Rates. Hutchinson.

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

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

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

SPRING-SEEDED SMALL GRAINS/CEREALS

W.F. Heer and K.L. Roozeboom

Summary

There are several years when the winters in South Central Kansas are severe enough that some winter kill of the winter wheat crop occurs. When this happens the producer has to decide if interseeding in the spring is feasible. The data in Table 8 shows the results of seeding 5 varieties of winter and spring wheats and spring oat.

Introduction

Through the years producers need information that will assist them in making decisions when winter kill occurs in winter wheat or other fall seeded crops. To assist with decision making, a spring seeded small grains study was conducted at the South Central Field in 2000. Studies have been conducted to simulate thin stands by planting at reduced rates in the fall and by chemically removing a percentage of the plants in the early spring. These however, did not address the question of alternative spring cereals such as oat or spring wheat.

Procedures

The study was conducted on an Ost silt loam soil at the South Central Field. On February 9, 2000 five varieties of winter wheat, spring wheat, and spring oat were planted at the rate of two bushels per acre. The research used a randomized block design with each variety replicated four times in a crop block. Plots were harvested on July 11, 2000. Grain samples were taken for test weight and moisture. Yields were determined using a 5x29 Ft. harvest plot.

Results

Spring wheat yields were two to three times those of winter wheats (Table 8). Winter wheat yields were similar to those obtained when seeding winter wheat into existing stands that had been either thinned chemically or planted thin in the fall. As to variety, the winter wheats planted in the spring ranked themselves identical to their ranking in the winter wheat variety performance test. With the heat and lack of moisture in late May, test weights for both the winter and spring wheats were in the mid 50s. The winter wheats that were planted in the fall and harvested prior to the rains of mid-June had test weights in the low 60s. As we have seen before, test weight is affected by planting date. Of the five spring oat varieties Rodeo had the highest yield. This again is consistent with the rankings from previous oat variety tests done on the Field. Test weights were good when the effects of the weather and harvest date are taken into consideration.

As in the past, it is recommended that winter wheat be used to fill in for winter kill in winter wheat. This will not necessarily generate the highest yields but will keep the market channels flowing properly. If an alternative crop is needed and oats can be used in the farming operation either as grain or forage they would be the best option.

Table 8. 2000 Spring Planted Small Grains Winter Wheat, Spring Wheat, and Spring Oat. Hutchinson.

Variety/crop[1]	Yield bu/a	Test Weight lb/bu	Grain Moisture %	Plant Height inches
7853 ww	8	55	10.5	27
Custer ww	10	54	10.5	25
Jagger ww	8	52	10.3	27
Heyne ww	7	54	10.2	24
Betty ww	7	52	9.9	24
2375 sw	18	55	10.5	31
Forge sw	20	55	10.0	34
Ingot sw	21	57	10.9	34
Oxen sw	28	53	10.2	30
Russ sw	21	52	10.4	33
LSD* (p= 0.01)	5	2	NS	3
Bates so	30	32	9.6	33
Blaze so	38	31	10.1	34
Jim so	32	32	10.3	35
Larry so	34	31	9.4	30
Rodeo so	40	30	10.0	34
LSD (p= 0.01)	10	NS	NS	3

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

[1] ww = winter wheat, sw = spring wheat, so = spring oat.

SIMULATED SOYBEAN HERBICIDE DRIFT AT HUTCHINSON

Stewart R. Duncan and William F. Heer

Summary

The effects of soybean herbicide drift on nearby grain sorghum was evaluated in 1999 and 2000. This study was designed with low rates (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. Results are summarized in Table 9.

Introduction

Over the years and with the advent of newer soybean herbicides the question of their affect on grain sorghum due to drift has been asked several times. A multi-location study was initiated to determine the effects of lowrates 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, 1999 and June 12, 2000. In 1999 constant winds in excess of 10 mph delayed spray applications from the planned timing of 2-4 leaf grain sorghum until July 11, when plants were at the V6-V8 stage of growth (10 to 12 inches in height). The wind speed was 2-5 mph, relative humidity was 78%, air temperature was 60°F and skies were clear. In 2000 the herbicide treatments were applied at the 2-4 leaf stage (June 12) with calm winds. The treatments were applied both years with a compressed CO_2 backpack sprayer at 3 mph with 35 psi, through 8003VS nozzles delivering 20 gallons per acre (gpa) of spray solution to each 10' x30' plot. The plot design was a randomized complete block with four replications in 1999. In 2000 a split plot design was used (main plot was herbicide and sub plot was rate). Herbicide damage assessments were made at 2 and 8 weeks after application in 1999 and 2, 4, and 8 in 2000 using a scale of 0-100 with 0 being no damage and 100 being complete kill.

1999 Results

Grain yields from plots treated with 1/3 of recommended herbicide rate were reduced significantly with all herbicides except Liberty (Table 9). The 1/3 rate of Liberty did reduce yields but not significantly (P = 0.05). The 1/3 rate of Poast Plus, Pursuit and Roundup Ultra reduced yields, an average of 89%, 62% and 46%, respectively, when compared to the check. The other reduced herbicide rates did not reduce grain yields significantly. The 1/3 rate of herbicides resulted in reduced plant height, but the lower rates had no significant effect on plant height. At 2 weeks after treatment (WAT), all treatments exhibited some damage, including the check which was treated with surfactant. By 8 WAT most of the visual symptoms had all but disappeared in the check, 1/10, 1/33 and 1/100 rate treated plots except for the 1/10 rate plots of Roundup Ultra, Liberty, and Pursuit, all of which still had some visual damage evident. At harvest, these symptoms were still evident in the form of delayed maturity and a greater number of heads. Concentrations of 1/10 or less of the recommended rate of herbicides for soybeans did not affect grain yields or test weights of grain sorghum. When applied at the 6-8 leaf stage of growth, the 1/3 rate of Poast Plus was the most detrimental to grain yields, followed by Pursuit and Roundup Ultra.

2000 Results

Grain yields from plots treated with 1/3 the recommended herbicide rate (except for Liberty) were reduced significantly (Table 9). Liberty at any rate did not significantly (P =

0.05) reduce yields. The 1/3 rates of Poast Plus, Pursuit and Roundup Ultra reduced yields and average of 85%, 14% and 81%, respectively, of the check plot. Thus, Pursuit had less of an effect and Roundup Ultra more of an effect when applied earlier (2000) than at a later growth stage (1999). Of the other reduced herbicide rates, only Poast Plus at the 1/10 rate reduced grain yields significantly (23%) as compared to the untreated check.

Final plant height and heads per acre response was similar to the yield pattern. The 1/3 rates of Poast Plus and Roundup Ultra resulted in reduced plant height (9.75" and 11.25", respectively), and heads per acre (83% and 77%, respectively) compared to the untreated check. None of the other rates of Poast Plus and Roundup Ultra, or any rates of Liberty or Pursuit reduced heads per acre at harvest. Grain test weight was unaffected by any herbicide at any rate. Grain moisture at harvest was four percent higher in the 1/3 rate of Poast Plus and Roundup Ultra when compared to the check.

At 2 WAT, the 1/3 rate of Poast Plus and Roundup Ultra exhibited near total kill of the plots. The 1/3 rate of Pursuit and 1/10 rate of Poast Plus resulted in a medium range of damage. Roundup Ultra at 1/10 rate and Poast Plus at the 1/33 rate did light, but measurable damage to the grain sorghum. At 4 WAT, the plots treated with 1/3 rate of Roundup and Poast Plus still showed severe damage, but the crop was recovering in the other plots where injury was reported at 2 WAT. By 8 WAT, heavy damage was still evident in the plots with heavy rates of Roundup Ultra and Poast Plus, but only light to moderate injury was visible in the 1/10 rate plots of Roundup Ultra and Poast Plus and the 1/3 rate Pursuit plots. Liberty treated plots showed no visual damage from herbicide application through 8 WAT in the study. However, at 8 WAT, the 1/3, 1/10 and 1/33 rate Liberty treated plots showed a slight visual delay in development. The delay, however, did not affect grain yields. Plant lodging at harvest was least in the plots treated with 1/3 the recommended rate of herbicide. The 1/10 rate treated plots had more lodging (14% vs 7%) than the 1/3 rate plots but less than the 1/33, 1/100 and untreated checks (20% to 26%).

Summary

When applied at the 6-8 leaf stage, applications of selected soybean post emergence herbicides to grain sorghum to simulate drift did not reduce grain yields if rates were 1/10 or less of the recommended rate. Pursuit at 1/10 rate tended to reduce plant height more than comparable rates of the other herbicides. When applied at the 2-4 leaf stage of growth, 1/3 rates of Poast Plus and Roundup Ultra were the most detrimental to grain yields, followed by Pursuit. With the exception of Poast Plus, applications of selected soybean postemergence herbicides to grain sorghum did not reduce sorghum yields if rates used were 1/10 of the recommended rate or less. Thus, the stage of growth of neighboring grain sorghum becomes critical when applying herbicides to nearby soybeans.

Table 9. 1999 and 2000 Simulated Soybean Herbicide Drift on Grain Sorghum. Hutchinson.

Herbicide	Rate		Yield		Damage[1]				
	lb/a	fraction[2]	bu/a		2 WAT[3]		4 WAT	8 WAT	
			1999	2000	1999	2000	2000	1999	2000
Check	0.00	0	82	55	0	0	0	0	0
Roundup	0.33	1/3	44	10	70	98	96	66	87
	0.10	1/10	84	50	3	15	1	6	9
	0.033	1/33	88	52	11	0	0	1	0
	0.01	1/100	94	56	10	0	0	1	0
Liberty	0.12	1/3	80	56	66	0	0	26	9
	0.036	1/10	89	56	31	0	0	4	7
	0.011	1/33	92	60	20	0	0	1	7
	0.0036	1/100	87	56	10	0	0	0	0
Pursuit	0.021	1/3	32	47	80	58	15	80	28
	0.0063	1/10	77	57	38	0	0	8	0
	0.0019	1/33	87	52	3	5	0	0	1
	0.00063	1/100	92	55	5	0	0	1	0
Poast	0.05	1/3	9	8	97	99	98	96	93
	0.015	1/10	80	44	20	53	14	0	14
	0.0045	1/33	96	55	4	11	0	0	3
	0.0015	1/100	93	56	1	0	0	0	0
LSD* $_{(0.05)}$			17	6	15	6	4	6	5
c.v.%			15	9	39	27	26	25	33

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

[1] A scale of 0-100 with 0 being no damage and 100 being complete kill.
[2] The fractional amount of recommended application rate.
[3] Weeks After Treatment.

MULTIPLE-SITE EXPERIMENTS

SOYBEAN INOCULANT EVALUATION 2000

Scott Staggenborg, Barney Gordon, and Chuck Rice

Summary

Inoculating soybeans with *Bradyrhizobium* is necessary when planting soybeans in fields that have not produced soybeans in numerous years. A study was conducted to evaluate several commercially available soybean inoculants in two irrigated soybean fields that had not produced soybeans in over four years. The untreated controls yields averaged 41 bu/acre. Yield of inoculant treated seed ranged from 50 to 65 bu/acre with three inoculants producing yields that were different than the control. These data continue to support the recommendation of using inoculants when a field has not produced soybeans for several years.

Introduction

Soybeans are not native to the United States therefore when soybeans are planted in fields that have not been in soybeans, the bacteria need to be added to the soil. In some cases, soybean yields can be improved when *Bradyrhizobium* are applied to the seed coat at planting. Commercial inoculants vary in the type of bacteria strains; carrier; and other characteristics. The objective of this study was to evaluate the performance of selected commercial soybean inoculants on soybean yield in Kansas.

Materials and Methods

Ten treatments (Table 1) were utilized to assess the impact of seed applied *Bradyrhizobium japonicum* on irrigated soybean yields in a field in Geary County and at the North Central and Irrigation Experiment Field near Scandia, KS in Republic County. The soybean variety Midland '8390' was used in Geary County and the soybean variety 'Macon" was used in Republic County. Soybean seed was coated with inoculant just prior to planting as directed by commercial suppliers. All planting and treating equipment was flushed between treatments with ethanol to avoid cross contamination.

A randomized complete block resign with four replications was used at both locations. In Geary County, plots were planted May 16, 2000 in a creek bottom field containing a Muir silty clay loam with center pivot irrigation. In Republic County, plots were planted May 11, 2000 in a field containing a Crete silt loam with furrow irrigation. The Geary County field had not been planted to soybeans since 1996 and the Republic County field had not been planted to soybeans since 1990. All plots at both locations were four 30-in. rows wide and 30 ft in length. Soil temperature at planting depth (2 in.) was approximately 76°F.

Grain yields were determined on September 28, 2000 in Geary County and September 27, 2000 in Republic County by harvesting the middle two rows of each plot. Grain yields were adjusted to 13% moisture. Analysis of variance was used to determine treatment differences.

Results and Discussion

Soybean yields in northeast Kansas were extremely low in 2000 as a result of less than 2 in. of precipitation and 18 days with maximum temperatures over 100°F during July and August (data not shown). Supplemental irrigation alleviated much of the moisture stress experienced in the area as indicated by plot yields over 50 bu/acre (Table 1).

The importance of inoculants in a crop rotation that has not recently included soybeans is illustrated by the low yields of the untreated control. There were no clear differences between the inoculant treatments, with all except the Cell-Tech 2000 + Genstein + Nod-Factor (rate 2) and Cell-Tech 2000 alone having yields greater than the control in Geary County. In Republic County, all had yield that was significantly greater than the other inoculants.

Table 1. Grain yields for nine commercial soybean inoculants and the control from two irrigated fields in 2000.

Company	Treatment	Yield			
		Geary Co.		Republic Co.	
		bu/acre			
	Control (Untreated)	44.7	f†	39.1	c†
Nod-Factor	Nod-Factor Rate 2	55.3	bcde	54.7	b
Nod-Factor	Cell-Tech 2000	50.0	def	52.2	b
Nod-Factor	Cell-Tech 2000 + Nod-Factor Rate 1	61.7	abc	52.3	b
Nod-Factor	Cell-Tech 2000 + Nod-Factor Rate 2	58.2	abcd	51.4	b
Nod-Factor	Cell-Tech 2000 + Genstein	64.9	a	50.4	b
Nod-Factor	Cell-Tech 2000 + Genstein + Nod-Factor Rate 2	46.5	ef	53.9	b
Urbana	Liquid Prep XT	64.1	ab	65.4	a
Urbana	Rizo-stick	63.5	abc	53.2	b
Urbana	MegaPrep	54.9	cde	54.1	b
	$LSD_{(0.05)}$	8.9		7.3	
	C.V. (%)	8.6		9.7	
	Grand Mean	56.3		51.8	

† Means followed by the same letter are not significantly different at a 0.05 level.

SOYBEAN ROW SPACING STUDY

Scott Staggenborg, Randy Taylor, and Bill Wood

Summary

As seed costs increase with new soybean technology, the concern over seeding rates and planting units has increased. Producers are attempting to determine if planting soybeans in narrow rows with a split row planter is more economical than using a grain drill. A study was conducted to compare soybean emergence and yield between soybeans planted with a drill and a planter at various row spacings and seeding rates. Soybeans were planted in 7.5, 15, and 30-in. rows with a grain drill and 15 and 30-in. rows with a planter. Seeding rates of 160,000, 190,000, and 210,000 seed/acre were used at each row spacing. Due to drought conditions in August, soybean yields averaged 13 bu/acre and there were no yield differences between planting units or seeding rates. However, the emergence rate for the planter was approximately 84% compared to 66% with the drill.

Introduction

Planting soybeans with a grain drill gained acceptance over a decade ago. This acceptance was based mostly on the higher field efficiency due to greater seed box capacity and width as compared to planters owned by the same individual. However, grain drills are typically less accurate in both metering and placing soybean seed when compared to row crop planters. These two deficiencies resulted in the need for higher seeding rates to establish similar stands compared to planters. Research also indicated that as row spacings were reduced, higher plant densities were required to maximize yield in the higher yielding environments compared to planters. The introduction of genetically modified seed has increased soybean costs by nearly 60%. The increased seed cost and the introduction of split-row planters have renewed interest in the impact of soybean row spacings, seeding rates and planting equipment.

Materials and Methods

A study was conducted in 2000 to assess the impact of soybean row spacing, seeding rate and planting equipment in a conventionally tilled field in Douglas County, Kansas. Treatments consisted of three target seeding rates: 160,000, 190,000 and 210,000 seed/acre; and four primary row spacing-equipment combinations. These four equipment treatments consisted of 7.5 and 15 in. rows planted with a grain drill and 15 and 30 in. rows planted with a planter. An additional treatment consisted of 30 in. rows planted with the grain drill. Due to grain drill metering limitations, this treatment was only conducted at the low plant density. A John Deere 455 Drill and a John Deere 1780 split-row planter were used. All planting equipment was adjusted by the producer to fit planting conditions.

Asgrow 'AG3701RR' soybean variety was planted on May 23, 2000 into a conventional till system. There was little crop residue remaining from the previous corn crop and the surface 2 inches of soil were fairly dry. The farmer adjusted both pieces of planting equipment to plant into similar conditions. The study was conducted in southern Douglas County, KS. A randomized complete block design with three replications was used. Each plot was 30 ft wide by approximately 900 ft long. Plant stands were taken on three transects across each plot on August 24, 2000 by counting the number of plants in 20 ft of row for each treatment. Plots were harvested on September 19, 2000 by harvesting the center 20 ft from each treatment using a John

Deere 9600 combine equipped with a Greenstar™ yield monitor. All plots were harvested in the same direction and at approximately the same speed. Grain yields were determined by weighing the grain from each treatment using a weigh wagon as well as utilizing the mass flow information from the yield monitor. For simplicity, only the weigh wagon results are reported here. Analysis of variance was used to determine treatment effects with orthogonal contrasts utilized to determine differences between treatment pairs of interest.

Results and Discussion

Emergence rate (expressed as percent of seed drop) and established stand were most affected by planting equipment used (Table 1). Overall, the emergence was over 17 percentage points higher with a planter than with the drill. The planter also established plant stands that had over 35,000 more plants per acre than the drill at similar seed rates.

Growing conditions in July and August were not conducive to high soybean yields as indicated by the plot average yield of 13 bu/acre. No significant differences between the individual treatments occurred based on the analysis of variance procedures for either method of measuring grain yield (Table 1).

Orthogonal contrast analysis indicated some individual differences between pairs of treatments. When planted in 15 in. rows, the planter produced grain yields that were 6.4 bu/acre greater than when planted with a grain drill. Across all row spacings (30 in. - drilled were excluded), the planter produced yields that were 3.7 bu/acre greater than the drill. Previous research has indicated that in lower yielding environments when significant water stress was encountered, wide rows had a slight advantage over narrow rows. This could be a possible reason for the planter yields being higher than the drill, since the planter treatments were at wider row spacings, although the yields from 7.5 in. row with a drill are higher than 15 in. rows with a drill when measured with a weigh wagon. As expected, plant density had little effect on soybean grain yields. This may not have been the case if grain yield had exceeded 50 bu/acre, as previous research has indicated that at that yield level, higher plant densities are required to maximize yields when utilizing narrow rows.

Conclusions

The results of the first year of this study indicate that soybean plant establishment is greater with a row crop planter than with a grain drill. Grain yields from the planter were approximately 5 bu/acre higher than yield from the grain drill when planted in 15 in. row. These results further support previous work indicating that in low yielding environments, plant density and row spacings have little impact on soybean yields.

Table 1. Plant emergence, established stands and grain yield for soybeans planted with a row crop planter and grain drill in several different rows spacings and seeding rates in Douglas County, KS, 2000.

Planting Equipment	Row Spacing (in)	Population[†]	Establishment (%)		Established stand (plts/a)		Grain Yield (bu/a)	
Planter	30	Low	86.2	a[‡]	144,813	bc	15.9	
Planter	30	Medium	82.8	a	155,654	b	14.0	
Planter	30	High	84.9	a	177,531	a	15.9	
Planter	15	Low	83.9	a		c	15.2	
Planter	15	Medium	80.2	a	154,880	b	13.5	
Planter	15	High	85.8	a	182,758	a	13.0	
Drill	30	Low	69.9	bc	113,256	de	14.7	
Drill	15	Low	63.3	cd	102,608	e	11.6	
Drill	15	Medium	59.1	d	113,450	de	11.9	
Drill	15	High	63.1	cd	134,358	c	11.8	
Drill	7.5	Low	71.9	b	116,547	d	13.3	
Drill	7.5	Medium	69.2	bc	132,810	c	13.7	
Drill	7.5	High	71.6	b	152,557	c		
Main	**Effect**	**Means**						
Equipment								
Planter			84.0		158,719		14.6	
Drill			66.9				13.0	
	Spacing							
	7.5		70.9		133,971		13.6	
	15		72.6		137,456		12.8	
	30		81.0		147,813		15.1	
		Population						
		Low	75.0		122,781		14.1	
		Medium	72.3		139,198		13.3	
		High	76.4		161,801		13.6	
X vs. Y Contrasts			X-Y		X-Y		X-Y	
Planter 15 vs. Drill 15			21.4	**	41,301	**	2.1	0
Planter 30 vs. Drill 30			16.3	**	31,557	**	1.2	ns
Planter vs. Drill			17.6	**	33,331	**	1.9	0
Drill 7.5 vs. Drill 15			9.1	**	17,166	**	1.9	0
Drill 7.5 vs. Planter 15			-12.4	**	-24,135	**	-0.2	ns
Planter 15 vs. Planter 30			-1.3	ns	-1,226	ns	-1.4	ns
Low vs. Medium seeding rate			3.5	*	-14,036	**	0.7	ns
Low vs. High seeding rate			-0.1	ns	-36,639	**	0.3	ns
Medium vs. High seeding rate			-3.5	*		**	-0.4	ns

†Target populations were Low=160,000 seed/acre, Medium=190,000 seed/acre and High=210,000 seed/acre
‡ Means followed by the same letter are not significantly different at the 5% probability level.

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