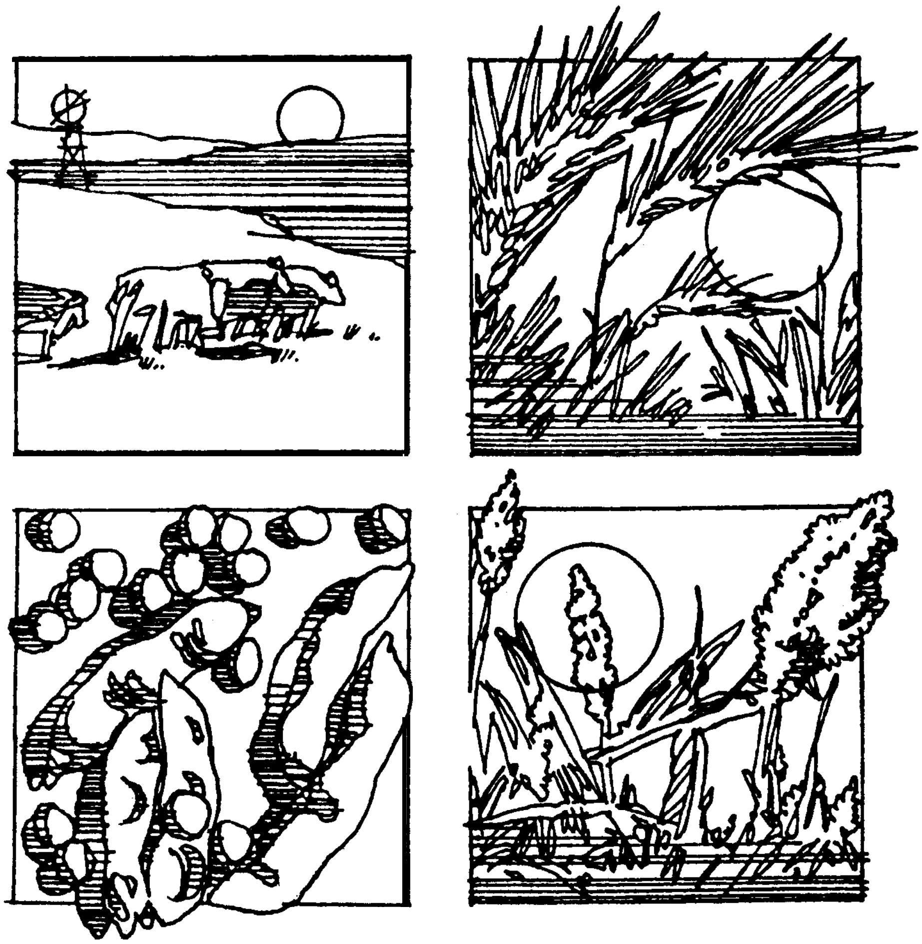
1998 AGRICULTURAL RESEARCH



Report of Progress 809

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

SOUTHEAST AGRICULTURAL RESEARCH CENTER

TABLE OF CONTENTS

BEEF CATTLE RESEARCH

FORAGE CROPS RESEARCH

SOIL AND WATER MANAGEMENT RESEARCH

CROPS AND SOILS RESEARCH

CROP VARIETY DEVELOPMENT RESEARCH

Contribution No. 98-377-S from the Kansas Agricultural Experiment Station.

EFFECT OF INTERSEEDING LEGUMES INTO ENDOPHYTE-INFECTED TALL FESCUE PASTURES ON FORAGE PRODUCTION AND STEER PERFORMANCE

Lyle W. Lomas, Joseph L. Moyer, and Gary L. Kilgore[1]

Summary

A total of 135 steers grazed high-endophyte tall fescue pasture interseeded with either lespedeza, white (ladino) clover, or red clover during 1995, 1996, and 1997. Legume cover, forage dry matter production, grazing steer performance, and subsequent feedlot performance were measured. Legume treatment caused no differences in forage availability. The greatest legume coverage was obtained from lespedeza in the first 2 years and white clover in the third. Although the difference was not significant (P > .10), steers grazing pastures interseeded with either lespedeza or ladino clover gained approximately 10% more than those grazing pastures interseeded with red clover in 1995 and 1996. Feedlot performance and overall performance of steers grazing in 1995 and 1996 were similar among legume treatments. In 1997, steers grazing pastures interseeded with ladino clover gained more (P < .05) than those grazing pastures interseeded with lespedeza or red clover. Gains were similar from pastures interseeded with lespedeza or red clover.

Introduction

Cattlemen with high-endophyte tall fescue pastures can either tolerate low gains from their cattle, seek to improve animal performance by destroying existing stands of fescue and replacing them with endophyte-free fescue or other forages, or interseed legumes into existing pastures to reduce the adverse effects on animal performance.

Previous research at the Southeast Agricultural Research Center has shown that performance of stocker steers grazing high-endophyte tall fescue improved significantly when 'Regal' ladino clover was broadcast on the pastures in late winter. Lespedeza and red clover are two other legumes widely grown in southeastern Kansas. Information comparing these legumes with ladino clover interseeded in high-endophyte tall fescue in grazing situations is limited. This study was conducted to compare legume establishment, forage production, grazing performance, and subsequent feedlot performance of stocker steers grazing high-endophyte tall fescue pastures interseeded with ladino clover, lespedeza, or red clover.

Experimental Procedures

Pastures

Nine 5-acre pastures located at the Parsons Unit of the Kansas State University - Southeast Agricultural Research Center on a Parsons silt loam soil (fine, mixed thermic Mollic Albaqualf) were used in an experiment with a randomized complete block design containing three replications. The pastures of established (> 5-yr)

[1] Southeast Area Extension Agronomist, Chanute, KS.

‘Kentucky 31' tall fescue had more than 65% infection rate with the endophyte (*Acremonium coenophialum* Morgan-Jones and Gams). Pastures were fertilized in September, 1994 with 40-40-40 and in September, 1995, 1996, and 1997 with 16-40-40 lb/a of N-P_2O_5-K_2O. Pastures were treated in early spring of 1994 with 3 tons/a of ag lime (62% ECC). Three legumes were seeded in late February, 1995 with a no-till drill. Three pastures each received 4 lb/a of Regal white (ladino) clover, 12 lb/a of ‘Kenland’ red clover, or 15 lb/a of 'Marion' striate lespedeza. Pastures were seeded again in mid-March of 1996 and early March of 1997 with the same respective legumes that were planted in 1995, except that ‘Korean’ rather than Marion lespedeza that was planted. Seeding rates in 1996 were 6 lb/a of Regal white (ladino) clover , 13 lb/a of Kenland red clover, or 17 lb/a of Korean lespedeza. Seeding rates in 1997 were 4 lb/a of Regal white (ladino) clover, 12 lb/a of Kenland red clover, or 14 lb/a of Korean lespedeza.

Available forage was determined at the initiation of grazing and during the season with a disk meter calibrated for tall fescue. Three exclosures (15-20 ft^2) were placed in each pasture; total production was estimated from three readings per exclosure, and available forage was determined from three readings near each cage. Legume canopy coverage was estimated from the percentage of the disk circumference that contacted a portion of the canopy.

Grazing Steers

In 1995, 1996, and 1997, 45 mixed-breed steers were weighed on consecutive days, stratified by weight, and allotted randomly to the nine pastures. Grazing was initiated on March 31, April 24, and April 1 in 1995, 1996, and 1997, respectively. Initial weights of steers utilized in 1995, 1996, and 1997 were 690, 524, and 516 lb, respectively. Cattle were treated for internal and external parasites prior to being turned out to pasture and later were vaccinated for protection from pinkye. Steers grazed for 200, 168, and 220 days in 1995, 1996, and 1997, respectively. Steers were fed 2 lb of ground grain sorghum per head daily and had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt. Grazing was terminated and steers were weighed on October 16 and 17, October 8 and 9, and November 6 and 7 in 1995, 1996, and 1997, respectively.

Following the grazing period, cattle were shipped to a finishing facility and fed a diet containing 80% ground milo, 15% corn silage, and 5% supplement on a dry matter basis. Steers were implanted with Synovex-S on days 0 and 84 of the finishing period. Cattle that had grazed during 1995 and 1996 were fed a finishing diet for 164 and 139 days, respectively, and slaughtered in a commercial slaughter facility. Carcass data were collected. Cattle that grazed these pastures during 1997 are currently in the finishing phase of this study.

Results and Discussion

Pastures

Available forage dry matter and legume coverage of the pastures for 1995 are shown in Figure 1. No interaction occurred between legume treatment and location of the readings (pasture vs. exclosure), so only pasture data are shown. Canopy coverage of legumes were generally less than 10%. Stands of legumes likely were diminished because of extremes of spring drought followed by wet soils in early summer and drought again in late summer. Coverage was higher ($P < .05$) in red clover-seeded pastures than in other legume pastures in March and

April, but coverage was best in the lespedeza pastures by the end of June. Lespedeza coverage in cages seemed high at the end of summer, but only one pasture was high, so the variation that occurred made the means nonsignificant ($P > .20$). Legume treatment caused no differences in forage availability.

Available forage dry matter and legume cover for 1996 are shown in Figure 2. Cover was higher for lespedeza than for red or white (ladino) clover. Cover was highest for lespedeza and lowest for red clover during July and August. Legume treatment caused no difference in forage availability. However, forage availability was less in 1996 than in 1995, perhaps because of a reduction in the density of the fescue stand that occurred as a result of the extremely cold and dry winter of 1995-96.

Available forage dry matter and legume cover for 1997 are shown in Figure 3. Both dry matter production and legume coverage were higher than in previous years because of the favorable rainfall pattern. Cover for most of the season was higher for white (ladino) clover than for red clover or lespedeza, particularly during July and August. Legume treatment caused no differences in forage availability.

Cattle Performance

Grazing and subsequent finishing performances of steers grazing fescue pastures interseeded with the various legumes in 1995 and 1996 are presented in Tables 1 and 2, respectively. Grazing performance for 1997 is listed in Table 3. No significant differences ($P < .05$) in grazing performance of steers were related to legume treatment in either 1995 or 1996. However, in both years, steers grazing pastures interseeded with lespedeza or ladino clover had nearly identical performance and approximately 10% higher gains than steers grazing red clover. In 1997, steers grazing pastures interseeded with ladino clover, gained significantly more ($P < .05$) than those grazing pastures interseeded with lespedeza or red clover. Gains of steers grazing pastures interseeded with red clover or lespedeza were not different ($P > .05$). Subsequent finishing performance and overall performance of steers that grazed these pastures during 1995 and 1996 were also similar among legume treatments. Cattle that grazed these pastures during 1997 are currently completing the finishing phase of this study. This project will be continued for at least three more grazing seasons, and the longevity of the various legumes will be evaluated.

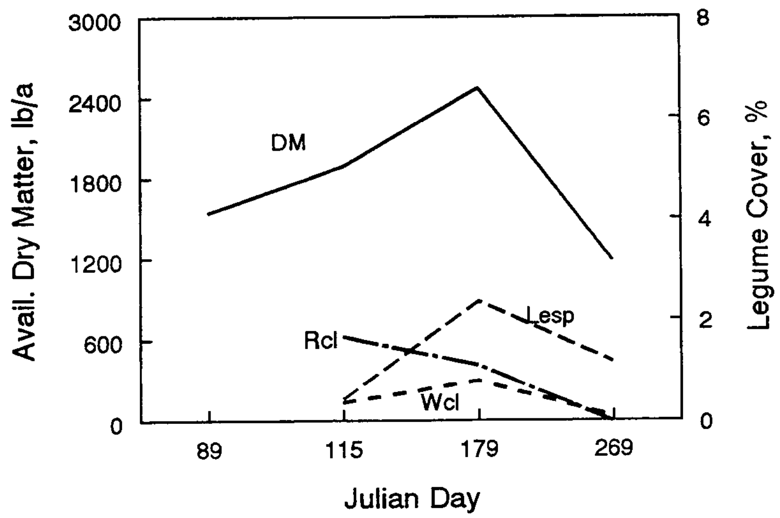


Figure 1. Available Forage and Legume Canopy Cover in Tall Fescue Pastures, 1995, Southeast Agricultural Research Center.

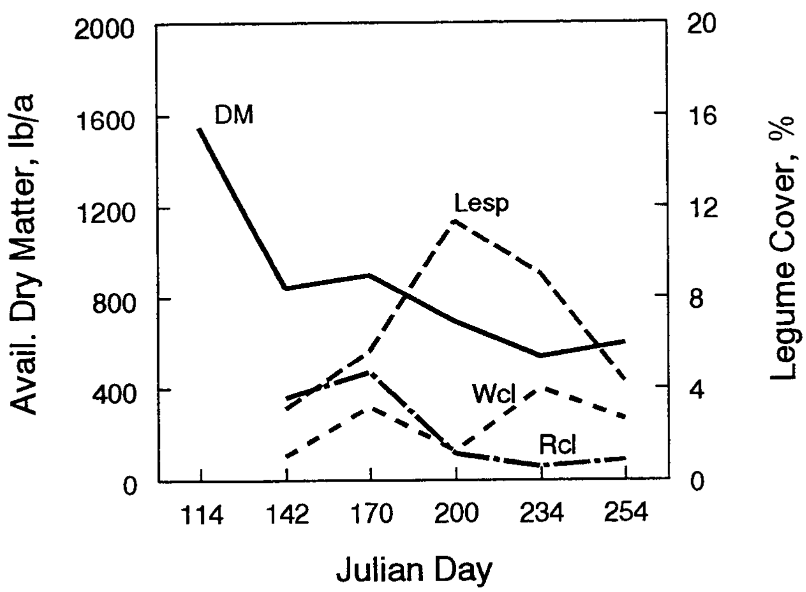


Figure 2. Available Forage and Legume Canopy Cover in Tall Fescue Pastures, 1996, Southeast Agricultural Research Center.

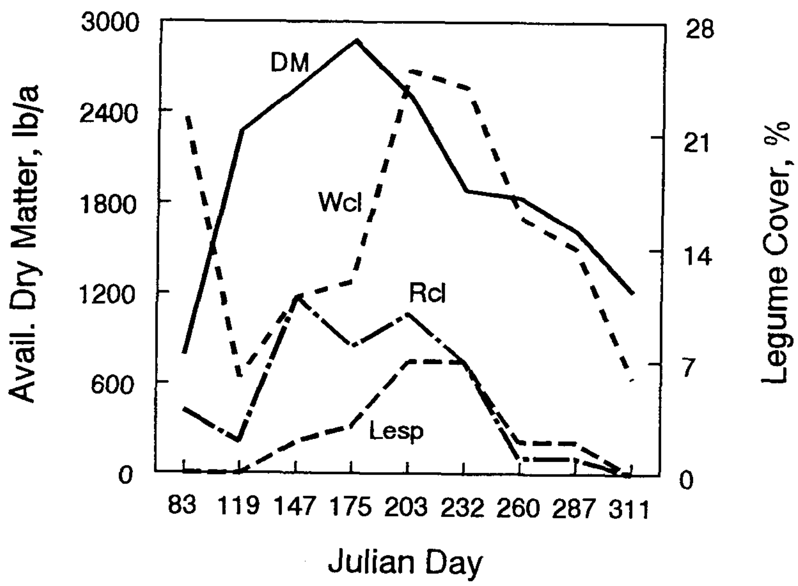


Figure 3. Available Forage and Legume Canopy Cover in Tall Fescue Pastures, 1997, Southeast Agricultural Research Center.

Table 1. Effects of Interseeding Legumes into Endophyte-Infected Fescue Pastures on Performance of Steers in 1995, Southeast Agricultural Research Center.

	Legume		
Item	Lespedeza	Red Clover	Ladino Clover
Grazing Phase (200 Days)			
No.of head	15	15	15
Initial wt., lb	690	694	691
Ending wt., lb	926	906	924
Gain, lb	236	212	233
Daily gain, lb	1.18	1.06	1.17
Finishing Phase (164 Days)			
No. of head	15	15	15
Starting wt., lb	926	906	924
Final wt., lb	1404	1386	1367
Gain, lb	478	480	443
Daily gain, lb	2.91	2.93	2.70
Daily DM intake, lb	25.7	25.0	25.2
Feed/gain	8.9	8.6	9.4
Hot carcass wt., lb	867	862	844
Dressing %	61.8	62.1	61.7
Backfat, in	.44	.46	.49
Ribeye area, in^2	14.5	14.1	14.0
Yield grade	2.3	2.1	2.5
Marbling score	SM^{63}	SM^{63}	SM^{89}
% Choice	87	80	87
Overall Daily Gain (364 Days)	1.96	1.90	1.86

[a,b]Means within a row with the same letter are not significantly different (P < .05).

Table 2. Effects of Interseeding Legumes into Endophyte-Infected Fescue Pastures on Performance of Steers in 1996, Southeast Agricultural Research Center.

Item	Legume		
	Lespedeza	Red Clover	Ladino Clover
Grazing Phase (168 Days)			
No.of head	15	15	15
Initial wt., lb	524	524	524
Ending wt., lb	757	733	758
Gain, lb	233	209	234
Daily gain, lb	1.39	1.24	1.39
Finishing Phase (139 Days)			
No. of head	14	15	14
Starting wt., lb	762	733	763
Final wt., lb	1223	1207	1227
Gain, lb	461	474	464
Daily gain, lb	3.31	3.41	3.34
Daily DM intake, lb	23.5	23.5	23.6
Feed/gain	7.1	6.9	7.1
Hot carcass wt., lb	756	735	761
Dressing %	61.8	60.9	62.1
Backfat, in	.29	.30	.24
Ribeye area, in^2	14.9	14.0	16.2
Yield grade	1.7	1.6	1.3
Marbling score	SM^{21}	SM^{03}	SL^{59}
% Choice	57	40	43
Overall Daily Gain (307 Days)	2.27	2.22	2.29

[a,b]Means within a row with the same letter are not significantly different (P < .05).

Table 3. Effects of Interseeding Legumes into Endophyte-Infected Fescue Pastures on Performance of Steers in 1997, Southeast Agricultural Research Center.

	Legume		
Item	Lespedeza	Red Clover	Ladino Clover
<u>Grazing Phase (220 Days)</u>			
No.of head	15	15	15
Initial wt., lb	512	517	519
Ending wt., lb	814[a]	838[a]	930[b]
Gain, lb	302[a]	321[a]	411[b]
Daily gain, lb	1.37[a]	1.46[a]	1.87[b]

[a,b]Means within a row with the same letter are not significantly different ($P < .05$).

EFFECTS OF PREVIOUS MANAGEMENT AND ENDOPHYTE LEVEL ON LADINO CLOVER ESTABLISHMENT AND STEER PERFORMANCE IN TALL FESCUE PASTURES

Lyle W. Lomas and Joseph L. Moyer

Summary

Forty steers were used to evaluate the effect of nitrogen (N) fertilization in previous years on establishment of ladino clover in tall fescue pastures with and without the endophyte. Legume cover, grazing steer performance, and subsequent feedlot performance were measured. Legume canopy coverage after grazing showed no significant ($P > .10$) differences among treatments. Steers grazing low-endophyte pastures gained significantly more ($P < .05$) during the grazing phase, had more backfat ($P < .05$), and higher numerical yield grades ($P < .05$) than those grazing high-endophyte pastures. Steers grazing pastures that had been interseeded with ladino clover in previous years gained more ($P = .052$) during the grazing phase than those grazing pastures that had been fertilized with N and managed for fescue only in previous years.

Introduction

Previous research at the Southeast Agricultural Research Center has shown that performance of stocker steers grazing tall fescue improved significantly when 'Regal' ladino clover was broadcast on the pastures in late winter. However, legume establishment has sometimes been slow in pastures previously fertilized with nitrogen (N) and managed for fescue production only. This study was conducted to evaluate the effect of N fertilization in previous years on establishment of ladino clover in ‘Kentucky 31' tall fescue pastures with and without the endophyte.

Experimental Procedures

Sixteen 5-acre pastures of ‘Kentucky 31' tall fescue located at the Mound Valley Unit of the Kansas State University - Southeast Agricultural Research Center on a Parsons silt loam soil (fine, mixed, thermic, Mollic Albaqualf) were used in an experiment with a randomized complete block design. One-half of the pastures were endophyte-free and the other half had more than 65% infection rate with the endophyte (*Acremonium coenophialum* Morgan-Jones and Gams). Within each fescue type, one-half of the pastures had been interseeded with ladino clover in previous years and the other half had been managed for fescue production only and received N fertilization at the rate of 80 lb/a in the spring and 40 lb/a in the fall during each of the 3 previous years. All pastures had received 40 lb of P_2O_5 and 40 lb of K_2O/a annually for the past 3 years. Pastures were fertilized in September, 1996 and 1997 with 16-40-40 lb/a of N-P_2O_5-K_2O. Agricultural lime had been applied previously to all pastures according to soil test analysis. Regal ladino clover seed was broadcast on February 17, 1997 at the rate of 3 lb/a on the four high-endophyte and the four low-endophyte pastures that had been previously managed for fescue production only.

Forty mixed-breed steers were weighed on consecutive days, stratified by weight, and allotted randomly to eight groups. Each group was randomly assigned to a paired set of two pastures. Cattle within each group were rotated between the two pastures in their assigned pair. Grazing was initiated on April

1, 1997. Initial average weight of steers utilized was 589 lb. Cattle were treated for internal and external parasites prior to being turned out to pasture and later were vaccinated for protection from pinkye. Steers grazed for 161 days. Steers were fed 2 lb of ground grain sorghum per head daily and had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt. Grazing was terminated and the steers were weighed on November 6 and 7. Final legume stand was determined at the end of the grazing season with a disk meter calibrated for tall fescue. Legume canopy coverage was estimated from the percentage of the disk circumference that contacted a portion of the canopy.

Following the grazing period, cattle were placed in a finishing facility and fed a diet containing 80% ground milo, 15% corn silage, and 5% supplement on a dry matter basis. Steers were implanted with Synovex-S at the beginning of the finishing period. One steer was removed from the study for reasons unrelated to experimental treatment. Cattle were fed a finishing diet for 153 days and slaughtered in a commercial slaughter facility. Carcass data were collected.

Results and Discussion

Grazing performance, legume canopy coverage, and subsequent finishing performance of steers grazing fescue pastures are listed in Table 1. Because no significant interactions occurred between endophyte level and previous legume treatment, previous treatments were pooled within endophyte level and endophyte levels were pooled within previous legume treatment.

No significant ($P > .10$) differences for legume canopy coverage after the grazing season occurred among pasture treatments. However, legume coverage was numerically less where none had grown previously than where legume had been grown. High-endophyte pastures had more apparent legume cover than low-endophyte pastures. This may have been due to cattle grazing low-endophyte pastures closer than high-endophyte pastures, thereby removing more of the legume.

Steers grazing low-endophyte pastures gained .52 lb per day more ($P < .05$) than those grazing high-endophyte pastures. Steers that had previously grazed high-endophyte pastures had less backfat ($P < .05$) and lower numerical yield grades ($P < .05$) than those that had grazed low-endophyte pastures. Finishing and overall gains were not significantly different ($P < .05$) between the two groups of steers. However, steers that grazed low endophyte pastures were 56 lb heavier at slaughter than those that had previously grazed high-endophyte pastures.

Stocker steers grazing pastures that had been interseeded with ladino clover in previous years gained .51 lb per day more ($P = .052$) than cattle grazing pastures fertilized with N in previous years. No other differences in performance were observed.

Table 1. Effects of Endophyte Level and Previous Treatment on Establishment of Ladino Clover and Grazing Steer Performance in Tall Fescue Pastures, Mound Valley Unit, Southeast Agricultural Research Center, 1997.

	Endophyte Level		Previous Treatment	
Item	Low	High	No Legume	Legume
Grazing Phase (161 Days)				
No. of head	20	20	20	20
Initial wt., lb	588	590	592	586
Ending wt., lb	890	809	813	886
Gain, lb	302[a]	219[b]	221	300
Daily gain, lb	1.88[a]	1.36[b]	1.37	1.86
Final Legume Canopy Cover, %	2	13	2	14
Finishing Phase (153 Days)				
No. of head	19	20	20	19
Starting wt., lb	890	809	813	886
Final wt., lb	1308	1252	1271	1289
Gain, lb	418	443	458	403
Daily gain, lb	2.74	2.89	2.99	2.64
Daily DM intake, lb	24.6	23.7	24.3	23.9
Feed/gain	9.2	8.3	8.3	9.3
Hot carcass wt., lb	790	749	765	773
Dressing %	60.3	59.8	60.2	60
Backfat, in	.52[a]	.37[b]	.43	.46
Ribeye area, in^2	12.3	12.2	12.2	12.2
Yield grade	3.5[a]	3.0[b]	3.1	3.3
Marbling score	SM^{55}	SM^{56}	SM^{38}	SM^{74}
% Choice	85	85	80	90
Overall Daily Gain (314 Days)	2.30	2.11	2.16	2.24

[a,b]Means within a row with the same letter are not significantly different (P<.05).

USE OF LEGUMES IN SMALL GRAIN-BERMUDAGRASS PASTURES UNDER CONTINUOUS OR ROTATIONAL GRAZING

Joseph L. Moyer, Lyle W. Lomas, and Kenneth P. Coffey[2]

Summary

Rotational grazing of bermudagrass did not affect cow gains or forage availability. Red clover coverage was often greater in the rotational than in the continuous system.

Introduction

Bermudagrass [*Cynodon dactylon* (L.) Pers.] is a productive forage species when intensively managed. However, it has periods of dormancy and requires proper use to maintain forage quality and adequate nitrogen (N) fertilizer to optimize forage yield and quality. Interseeding wheat or other small grains can lengthen the grazing season but require additional N fertilization. Legumes in the bermudagrass sward could improve forage quality and reduce fertilizer usage but are difficult to establish and maintain with the competitive grass. Rotational grazing could improve the chances of successfully maintaining legumes in the sward. This study was designed to compare effects of continuous and rotational grazing on cow and calf performance, forage availability, legume cover, and botanical composition of small grain-bermudagrass pastures interseeded with red and ladino clovers and lespedeza.

Experimental Procedures

'Hardie' bermudagrass pastures located at the Mound Valley Unit of the KSU - Southeast Agricultural Research Center (Parsons silt loam soil) were arranged into four 10-acre units. Two units each were managed as continuous or rotationally grazed systems in a completely randomized design (two replications).

Ninety lb/a of wheat was interseeded (no-till) into bermudagrass sod in September each year and fertilized in February with 55 lb/a of N. In March of 1996 and 1997, red clover, white (ladino) clover, and lespedeza were interseeded into each pasture.

Eight randomly assigned cow-calf pairs were weighed twice on successive days and placed on each 10-acre unit in mid March (1997) or early April (1996). Rotationally grazed units, initially 5-acre paddocks, were subdivided with each successive rotation until each of eight paddocks was being grazed for 3.5-day (1996) or 2-day (1997) intervals. Continuously grazed pastures were maintained season-long in 10-acre units. In mid-May, cows and calves were weighed, calves were weaned, and pastures were fertilized with 60-50-50 lb/a of N-P_2O_5-K_2O. Cows resumed grazing as before.

Available forage and legume canopy coverage were monitored throughout the grazing season with a calibrated disk meter. Samples were clipped in midsummer, manually separated into botanical components, and weighed by component to determine botanical composition.

Pastures were hayed each July to remove excess, low-quality forage and fertilized with 50 lb N/a. Cows were weighed on consecutive days in August prior to calving to determine total cow

[2]Current address: Dept. of Animal Sci., Univ. of Arkansas, Fayetteville.

gain, and cows were removed from the pastures in early September.

Results and Discussion

The first grazing period of 1997 began on March 21 and ended on May 16 when wheat was grazed out and calves were weaned. Gain during the first grazing period (56 days) was 10% greater ($P < .05$) for calves and 20% greater for cows in the continuous than the rotational grazing system (Table 1). Average available forage was generally lower in the rotational than in the continuous grazing system during the first grazing period (data not shown).

Cow gains during the second period and season-long were similar for the two grazing systems (Table 2). Average available forage for the season was similar for the two systems, but at certain times significant ($P < .05$) differences occurred (data not shown). Excess forage that was removed as hay from the two systems was statistically similar ($P > .10$) but numerically higher on the rotational than the continuous grazing system.

Legumes constituted a similar amount of the dry matter in the pastures ($P > .10$) in the two systems, an average of 18% (Table 1). Red clover accounted for a similarly high proportion of legumes in the two systems, averaging about 79%. Canopy coverage of legumes was greater in the rotational than in the continuous system, particularly early in the season and after excess forage was hayed (data not shown).

Table 1. Effect of Continuous vs. Rotational Grazing Systems on Cow and Calf Performance, Hay Production, Average Available Forage and Legume Canopy Coverage, and Relative Forage Production of Legumes and Red Clover, Southeast Agricultural Research Center.

	Grazing System	
Item	Continuous	Rotational
Calf gain, lb/day	3.00[a]	2.70[b]
Cow gain, 1st period, lb/day	1.40[a]	1.16[b]
Cow gain, 2nd period, lb/day	1.83	2.08
Hay production, tons/a	1.41	2.16
Avail. forage, lb/a	3160[c]	3100[c]
Legume canopy coverage, %	5.7[c]	7.7[c]
Legume prod, % of total	14	21
Red clover prod., % of legume	70	88

[a,b]Means within a row with the same letter are not significantly different ($P < .05$).
[c]Significant ($P < .05$) interaction between pasture system and time of measurement.

ALFALFA VARIETY PERFORMANCE IN SOUTHEASTERN KANSAS

Joseph L. Moyer

Summary

An test of 18 alfalfa entries seeded in 1995 was cut five times in 1997. Yields were the highest recorded at this unit, ranging from 9.54 to 10.71 tons/a. For the year, 'Kanza' yielded significantly ($P < .05$) less than ABI 9141 and 'TMF Generation'.

Introduction

Alfalfa can be an important feed and/or cash crop on some soils in southeastern Kansas. The worth of a particular variety is determined by many factors, including its pest resistance, adaptability, longevity under specific conditions, and productivity.

Experimental Procedures

The 18-line test was seeded (15 lb/a) on April 6, 1995 at the Mound Valley Unit. Plots were fertilized preplant and on March 12, 1997 with 0-60-200 lb/a of N-P_2O_5-K_2O. Five harvests were obtained in 1997. All entries were about 25% bloom at the first cutting, 75% bloom at the second, and one-tenth bloom at the third and fourth cuttings. Alfalfa was vegetative at the fifth cutting.

Moisture was adequate during most of the season, but the soil became dry by the fourth cutting. Then no regrowth occurred until September rains provided adequate moisture (see weather summary). Pea aphid populations increased near the first cutting but were probably not at an economic threshold.

Results and Discussion

Favorable conditions resulted in the highest alfalfa yields recorded at this unit. Cut 1 yields were significantly ($P < .05$) higher from TMF Generation than from 'Innovator + Z' and Kanza (Table 1). Differences were less distinct in cuts 2, 3, and 4. In cut 5, yield of 'ABI 9141' and Magnum IV were higher than those of Kanza and '3T26 Exp'.

For the year, ABI 9141 and TMF Generation yielded significantly ($P < .05$) more than Kanza (Table 2). ABI 9141 also produced more than 'Perry', 3T26 Exp., and Innovator + Z. . Three-year total production was greater ($P < .05$) from ABI 9141, 'Total + Z', and 'Supercuts', than from Kanza, 'Riley', and Perry. ABI 9141 also produced more than 3T26 Exp. and three other entries.

Table 1. Forage Yields (tons/a @ 12% moisture) of Five Cuttings in the Alfalfa Variety Test in 1997, Mound Valley Unit, Southeast Agricultural Research Center.

Source	Entry	5/12	6/25	7/28	9/10	11/4
AgriPro Biosciences, Inc.	ABI 9141	2.88ab[1]	3.02a	1.77ab	1.64a	1.41ab
AgriPro Biosciences, Inc.	SUPERCUTS	2.95ab	2.85abc	1.75ab	1.46ab	1.32abcde
AgriPro Biosciences, Inc.	ABI 9231 EXP	3.02ab	2.91abc	1.73ab	1.36b	1.39abc
AgriPro Biosciences, Inc.	INNOVATOR + Z	2.71b	2.86abc	1.62b	1.33b	1.25abcde
AgriPro Biosciences, Inc.	TOTAL + Z	2.93ab	2.90ab	1.78ab	1.39ab	1.33abcde
AgriPro Biosciences, Inc.	ZC 9346	3.02ab	2.96ab	1.78ab	1.35b	1.25abcde
DEKALB Plant Genetics	DK 127	2.95ab	2.95ab	1.57b	1.35b	1.25abcde
DEKALB Plant Genetics	DK 133	2.91ab	2.93abc	1.56b	1.32b	1.34abcd
Forage Genetics	3T26 EXP	2.83ab	2.78abc	1.69ab	1.29b	1.17de
Great Plains Research	HAYGRAZER	3.04ab	2.94abc	1.60b	1.36ab	1.36abcd
Mycogen Plant Sciences	TMF GENERATION	3.10a	2.93abc	1.93a	1.33b	1.29abcde
Northrup King Co.	RUSHMORE	2.77ab	2.86abc	1.58b	1.30b	1.30abcde
Ohlde Seed Co.	MAGNUM IV	2.91ab	2.68c	1.69ab	1.48ab	1.45a
W-L Research, Inc.	WL 252 HQ	2.93ab	2.85abc	1.54b	1.49ab	1.32abcde
W-L Research, Inc.	WL 323	2.77ab	2.92abc	1.62b	1.30b	1.26abcde
Public-Nebraska AES	PERRY	2.84ab	2.71bc	1.69ab	1.25b	1.20bcde
Public-Kansas AES	KANZA	2.72b	2.83abc	1.58b	1.31b	1.11e
Public-Kansas AES	RILEY	2.83ab	2.84abc	1.70ab	1.36ab	1.18cde
Average		2.89	2.87	1.68	1.37	1.29

[1]Means within a column followed by the same letter are not significantly ($P < .05$) different, according to Duncan's test.

Table 2. Total Forage Yields (tons/a @ 12% moisture) of the Alfalfa Variety Test, Mound Valley Unit, Southeast Agricultural Research Center.

Source	Entry	1995	1996	1997	3-Year Total
AgriPro Biosciences, Inc.	ABI 9141	3.74	5.68	10.71	20.13
AgriPro Biosciences, Inc.	SUPERCUTS	3.94	5.66	10.33	19.93
AgriPro Biosciences, Inc.	ABI 9231 EXP	3.68	5.43	10.41	19.51
AgriPro Biosciences, Inc.	INNOVATOR + Z	3.88	5.24	9.76	18.88
AgriPro Biosciences, Inc.	TOTAL + Z	3.65	5.99	10.33	19.97
AgriPro Biosciences, Inc.	ZC 9346	3.59	5.49	10.36	19.44
DEKALB Plant Genetics	DK 127	3.50	5.14	10.08	18.73
DEKALB Plant Genetics	DK 133	3.72	5.79	10.06	19.58
Forage Genetics	3T26 EXP	3.65	5.22	9.75	18.63
Great Plains Research	HAYGRAZER	3.25	8.73	10.30	19.03
Mycogen Plant Sciences	TMF GENERATION	3.54	5.60	10.57	19.72
Northrup King Co.	RUSHMORE	3.48	5.46	9.80	18.74
Ohlde Seed Co.	MAGNUM IV	3.12	5.90	10.22	19.23
W-L Research, Inc.	WL 252 HQ	3.47	5.48	10.12	19.07
W-L Research, Inc.	WL 323	3.67	5.58	9.86	19.11
Public-Nebraska AES	PERRY	3.13	5.39	9.70	18.21
Public-Kansas AES	KANZA	2.89	5.55	9.54	17.98
Public-Kansas AES	RILEY	2.91	5.37	9.91	18.19
Average		3.49	5.52	10.10	19.11
LSD(.05)		0.49	NS	0.67	0.95

PERFORMANCE OF WARM-SEASON, PERENNIAL, FORAGE GRASSES

Joseph L. Moyer and Kenneth W. Kelley

Summary

A test of warm-season, perennial grasses seeded in spring, 1996 was harvested for forage production on July 23, 1997. Production averaged 3.54 tons/acre. 'WW Ironmaster' Old World bluestem and 'Kanlow' switchgrass produced more forage than PI-483446 big bluestem and 'Blackwell' switchgrass. Stands of 'Pete' and 2745 eastern gamagrasses were poor.

Introduction

Warm-season, perennial grasses can be used to fill a production void in forage systems left by cool-season grasses. Reseeding improved varieties of certain native species, such as big bluestem, switchgrass, and Indiangrass, could help fill that summer production "gap". Certain introduced, warm-season grasses, such as the so-called Old World bluestems (*Bothriochloa* species), have as much forage potential as big bluestem and are easier to establish but may lack some quality characteristics.

Experimental Procedures

Warm-season grass plots (30 ft x 5 ft) were seeded with a cone planter in 10-inch rows on May 22, 1996 at the Parsons Unit, Southeast Agricultural Research Center. Fifty lb/a of diammonium phosphate (18-46-0) were applied with the seed material to facilitate movement through the planter. Big bluestem entries were seeded at 10 lb pure, live seed (PLS)/a. Indiangrass and switchgrasses were seeded at 8 lb and 5 lb PLS/a, respectively. 'Pete' eastern gamagrass was seeded with 10 lb material/a. The previous entries were obtained from the Manhattan USDA-NRCS Plant Materials Center. The two Woodward (WW) entries, 'WW Ironmaster' and 'WW 2745, were obtained from Dr. Chet Dewald, USDA Southern Plains Station, and seeded at 5 lb material/a. The plot area was clipped to control weeds in 1996 and burned on April 2, 1997. Plots were fertilized with 60 lb N/a on May 12. A 20 ft x 3 ft area was harvested July 23, 1997 with a Carter flail harvester at a height of 2-3 inches, and the remainder of the area was clipped.

Results and Discussion

Forage yields from the warm-season cultivar test are shown in Table 1. Stands were generally satisfactory except for eastern gamagrass entries. Much of the forage harvested from plots seeded with eastern gamagrass thus consisted of weedy grass species.

Forage production in 1997 averaged 3.54 tons/a and 3.80 tons/a without the eastern gamagrass entries. 'WW Ironmaster' Old World bluestem and 'Kanlow' switchgrass produced more forage than PI-483446 big bluestem and 'Blackwell' switchgrass.

Table 1. Forage Yield of Warm-season Grass Cultivars in 1997, Parsons Unit, Southeast Agricultural Research Center.

Cultivar	Species	Forage Yield
		tons/a@12% moisture
WW Ironmaster	Old World bluestem	4.36
Kanlow	Switchgrass	4.20
Blackwell	Switchgrass	3.22
Osage	Indiangrass	4.02
Kaw	Big bluestem	3.84
PI-483446	Big bluestem	3.18
Pete[1]	Eastern gamagrass	2.53
2745[1]	Eastern gamagrass	2.97
LSD(.05)		0.78

[1]Poor stand; much of the forage composed of weedy species.

EFFECTS OF RESIDUAL NITROGEN RATE AND PLACEMENT ON EASTERN GAMAGRASS UNDER 1-CUT OR 2-CUT HARVEST SYSTEMS

Joseph L. Moyer and Daniel W. Sweeney

Summary

Forage yields were increased for 3 years after 3 prior years of 90 lb/a of nitrogen (N) application. Three years of knifing N increased yield for the next 2 years compared to broadcast application. One-cut and 2-cut harvest systems responded similarly, but the 1-cut system yielded more in 2 of 3 years.

Introduction

Eastern gamagrass [*Tripsacum dactyloides* (L.)L.] is a warm-season, perennial grass native to the North American tallgrass prairie. It has relatively better forage yield potential and quality than most other warm-season native species. Eastern gamagrass thus may respond well to more intensive management practices, such as added nitrogen (N) and more harvests. This study was established to determine the response of eastern gamagrass to N fertilizer rates and placement under 1-cut or 2-cut harvest systems.

Experimental Procedures

Established (15-year-old) 'Pete' eastern gamagrass was fertilized with 54 lb P_2O_5/a and 61 lb K_2O/a each of the past 6 years and burned each spring except in 1996. In 1992-1994, nitrogen (urea-ammonium nitrate, 28% N) treatments of 45, or 90 lb/a were applied in late April to 8' x 20' plots by broadcast or knife (4-inch) placement. Control plots received no N but were knifed. Nitrogen was not applied in 1995-1997, so that residual responses could be tested.

Plots were cut with a flail-type harvester in mid-June and mid-August from the 2-cut system and on about 10 July from the 1-cut system. Yields were determined from a 3' x 20' strip of each plot, and a subsample was taken for moisture determination.

Results and Discussion

No significant ($P < .05$) interactions were found among previous treatment factors for yield in the years 1995-1997. However, interactions of treatment effects with year occurred often, so means of each treatment are shown by year in the following figures.

Yields in 1995 were increased ($P < .05$) by 23% with the first 45 lb/a increment of previous N and by an additional 12% with the next 45-lb increment (Fig. 1). Previous N application did not significantly ($P < .05$) increase 1996 yield. However, in 1997, previous applications of 90 lb N/a resulted in greater forage yield compared to the control. The lower response in 1996 probably resulted primarily from the below-average precipitation for late 1995 through the summer of 1996.

Knifing N for 3 years (1992-94) resulted in 15% additional yield in 1995 and 17% more yield in 1996 compared to previous broadcast applications (Fig. 2). In 1997, previous N placement had no significant effect.

The 1-cut harvest system resulted in a 17% greater ($P < .05$) total yield than the 2-cut system in 1995, a 94% yield advantage in 1996, but no difference in 1997 (Fig 3). The difference in

1996 was partly because the below-average precipitation for late 1995 through the summer of 1996 affected recovery of the 2-cut more than that of the 1-cut system.

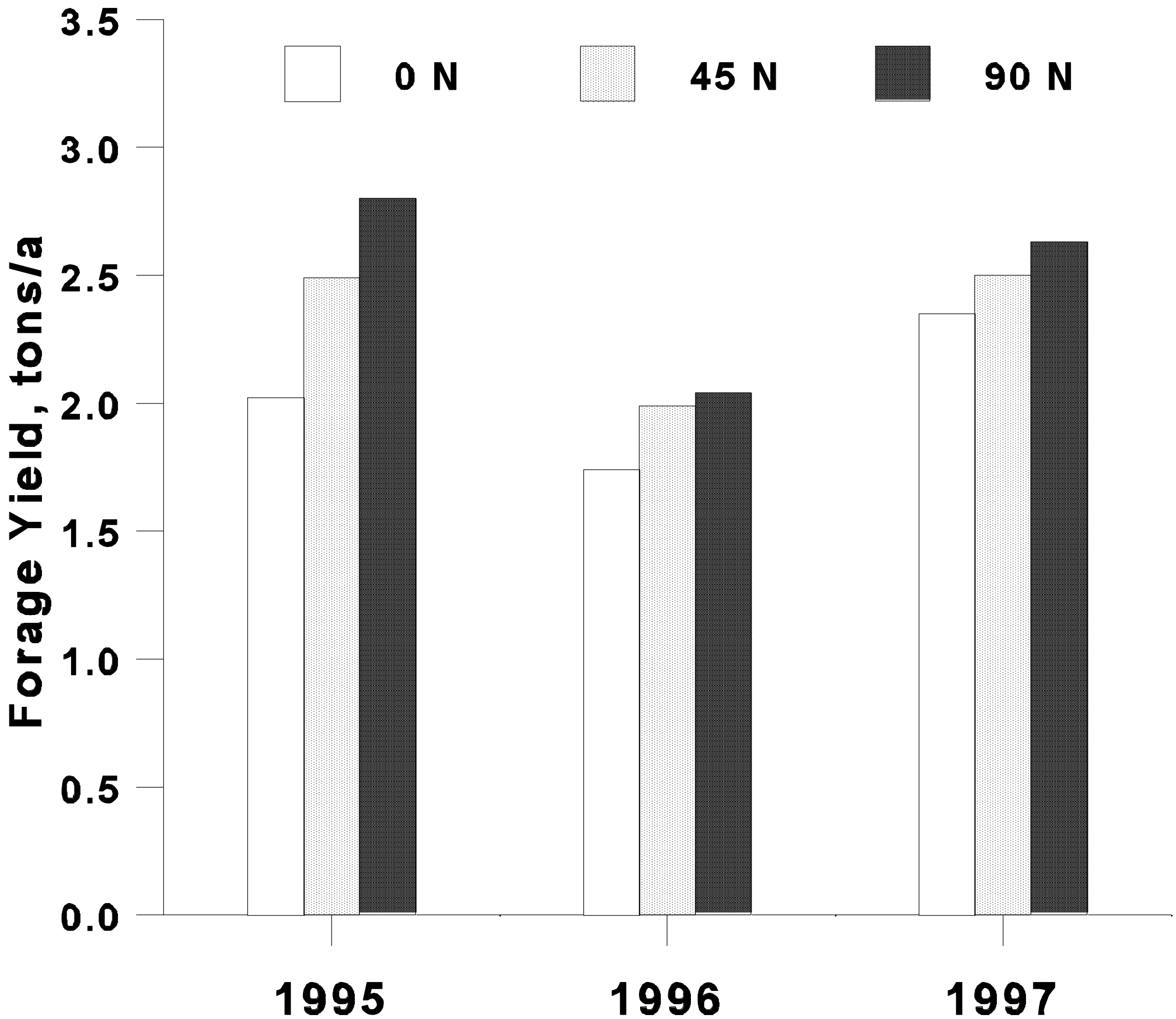


Figure 1. Eastern gamagrass forage yields (12% moisture) in 1995-1997 with residual nitrogen from different rates in 1992-1994, KSU-Southeast Agricultural Research Center.

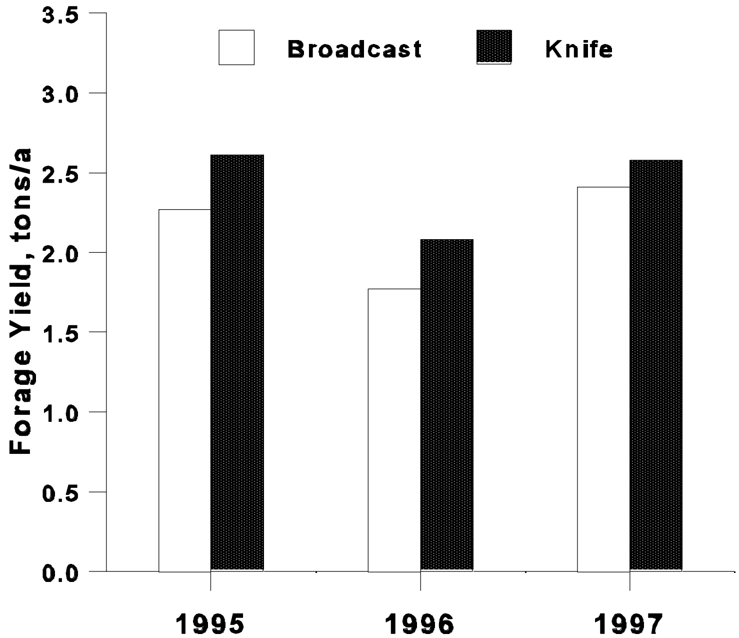


Figure 2. Eastern gamagrass forage yields (12% moisture) in 1995-1997 with residual nitrogen from different placements in 1992-1994, KSU-Southeast Agricultural Research Center.

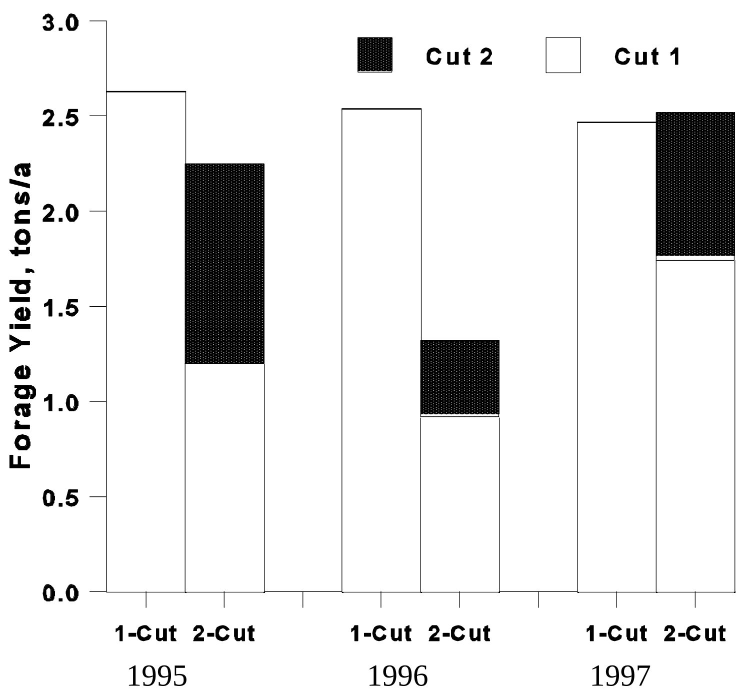


Figure 3. Eastern gamagrass forage yields (12% moisture) in 1995-1997 under two harvest systems, KSU-Southeast Agricultural Research Center.

SHORT-SEASON CORN AFTER A SMALL GRAIN - LEGUME DOUBLE-CROPPING SYSTEM

Joseph L. Moyer and Kenneth W. Kelley

Summary

Short season corn was grown after 4 years of small grain-legume systems to assess effects of the rotations. Lespedeza after small grains for forage or seed was compared with soybean after SG. Initial corn stands were poor after lespedeza for seed production. No difference in production of replanted corn resulted from different legume systems. Nitrogen (N) in 1997 increased corn yields. Corn test weight was increased by N in 1997 only after lespedeza grown for hay. Previous N used on small grains had no effect on corn.

Introduction

Wheat followed by double-cropped soybean is a common rotation in southeastern Kansas. Lespedezas are alternative warm-season legumes that can be grown after wheat for forage or seed. Cost of lespedeza production is lower than that of soybeans, reducing the risk, but potential returns may also be lower. We have grown three complete wheat-legume rotations and found no difference among them in wheat yield. Summer crops yielded an average of 2 tons/a of lespedeza hay, 325 lb/a of lespedeza seed, or 11 bu/a of soybean. Short-season corn was grown in 1997 to assess effects of the rotation on a subsequent, nitrogen-requiring crop.

Experimental Procedures

The plot area that had been double-cropped in a small grain-legume system for 4 years was disked three times in spring, 1997 and fertilized with 36 lb/a P_2O_5 and 40 lb/a K_2O. Eighty lb/a of N was applied to half of each of the six main plots in a split-plot arrangement of the randomized complete block design. The area was field cultivated and planted with 15,000 seeds/a of NK N4640 short season corn on April 2 and sprayed with 2 lb/a of atrazine. Stands were poor, particularly on certain main plots (Table 1), so the area was field cultivated and replanted on May 7. The corn was harvested on August 5, 1997.

Results and Discussion

Corn grain yield in 1997 was increased ($P < .05$) by 37% as a result of the application of 80 lb N/a to the corn (Table 1). Neither previous cropping system nor N application (60 lb/a) to small grains in the rotation significantly ($P > .10$) affected corn grain yield. Corn grain test weight was affected by N on the corn, but a significant interaction also occurred between cropping system and corn N rate. The interaction occurred because test weight was increased by N only where lespedeza had been grown for hay (interaction means not shown).

Corn plant dry matter production was not affected significantly ($P > .10$) by cropping system, previous N application to small grains, or N application to corn (Table 1).

Corn plant population at final harvest was not affected ($P > .10$) by cropping system or N application to the corn crop (Table 1). However, plant population was increased ($P < .05$) where previous small grains had received 60 lb N/a compared to where no N was applied. The initial corn plant population was low in all treatments, but was significantly (P < .05) reduced following lespedeza grown for seed. Grassy weeds, particularly crabgrass, were more dense (P < .05) at the end of the corn growing season following lespedeza for hay (92% coverage) compared to lespedeza for seed (48%) and soybean (10%, data not shown). Grass coverage in corn following lespedeza for seed was greater (P < .05) where 60 lb/a N had been applied to small grains in the rotation (57%) than where N was not applied to small grains (40%, data not shown).

Table 1. Corn Production and Populations in 1997 with or without N after Three Small Grain (SG)- Legume Cropping Systems with or without Nitrogen, 1993-1996, Southeast Agricultural Research Center.

Treatment			Short-Season Corn				
Cropping	SG	Corn	Grain	Grain	Plant	Population	
System	N Rate	N Rate	Yield	Test Wt.	Dry Wt.	Harvest	1st planting
(CS)	(SG-N)	(C-N)	bu/a[1]	lb/bu	lb/a	- - - plants/a (10^3) - - -	
SG-Lesp. hay	0	0	25	48	4020	14160	7990
		80	47	52	5830	13430	- -
	60	0	34	47	5320	15250	6170
		80	50	51	5800	14160	- -
SG-Lesp. seed	0	0	47	51	6500	13790	1450
		80	58	52	6280	11980	- -
	60	0	58	51	5740	17790	1090
		80	65	52	7230	14520	- -
SG-Soybean	0	0	27	46	5440	13790	5810
		80	35	44	5510	13790	- -
	60	0	56	51	7020	15610	9440
		80	69	52	8170	15250	- -
Significant (.05) treatment factors			C-N	C-N, CSxC-N	NS	SG-N	- -
Means, Cropping System							
SG-Lesp. hay			39	50	5240	14250	7080
SG-Lesp. seed			57	51	6690	14520	1270
SG-Soybean			47	48	6530	14610	7620
LSD(.05)			NS	NS	NS	NS	5010
Means, Small Grain N Rate							
	0		40	49	5600	13490	5080
	60		55	51	6710	15430	5570
	LSD(.05)		NS	NS	NS	1400	NS
Means, Corn N Rate							
		0	41	49	5840	15060	- -
		80	54	51	6470	13850	- -
		LSD(.05)	12	1.5[2]	NS	NS	

[1]Corn grain yield expressed on the basis of 56 lb/bu @15.5% moisture.
[2]Corn-N Rate x Cropping System interaction (P < .05).

USE OF A LEGUME-GRAIN SORGHUM CROPPING SYSTEM

Joseph L. Moyer and Daniel W. Sweeney

Summary

Grain sorghum was grown for 3 years with 100 lb/a or no nitrogen (N) after no clover (continuous sorghum) or red clover that was hayed (2.8 tons/a) or mulched. In Yr 1, sorghum grain production was greater after clover than after sorghum. Nitrogen (100 lb/a) increased yields uniformly by about 40%. Sorghum heads/a were increased by N fertilization, but plants/a were not affected by treatments. In Yr 2, sorghum grain yield was greater after hayed clover when sorghum received no N than with 100 lb N/a or after continuous sorghum that received no N. Sorghum heads/a were greater after hayed clover when sorghum received no N than with 100 lb N/a and with no N after mulched clover. In Yr 3, sorghum grain yield was greater after mulched red clover than after continuous sorghum or hayed red clover. Nitrogen addition increased grain yield by 80% and number of heads by 17%.

Introduction

Grain sorghum is a productive feed-grain crop that is heat and drought tolerant but requires the input of nitrogen and does not maintain soil physical condition. Legume crop rotations can reduce the reliance on added N for grain sorghum production, help maintain the physical condition of the soil, or provide top growth that could be used as a livestock supplement. Red clover is suitable as a green manure crop because of its yield potential and substantial N content.

The optimum use of the legume-grain sorghum rotation in a crop-livestock system requires that several trade-offs be assessed. The legume top growth can benefit the livestock component by supplementing low-quality roughage. The objectives of this research are to determine the effects of 1) fall-seeded red clover on grain sorghum yield and quality and on selected soil properties; 2) clover removal vs. incorporation of top growth on subsequent crop and soil properties; 3) 0 or 100 lb/a of N, with or without haying, on grain sorghum characteristics; and 4) the systems on nutrient content of grain sorghum stover.

Experimental Procedures

Red clover was seeded on designated plots on March 31, 1994. Hayed plots were cut on June 16, 1995, and all plots were offset-disked on June 22. In 1995 to 1997, urea was applied at the rate of 100 lb N/a to appropriate plots, then all plots were tandem-disked two times and planted with Pioneer 8500 in June. Phosphate and potash (21 and 33 lb/a, respectively) were applied to all plots with the planter, and a preemergent application of 2 lb a.i./a of alachlor was used for weed control.

Plant samples and soil data were collected at the 9-leaf stage, the boot stage, and the soft-dough stage. At harvest, whole plants, grain, and stover samples were collected. At each sampling, dry matter production, nutrient concentrations, and forage quality are being determined. In 1997, birds damaged sorghum heads because of delayed harvest, so the relative amount of grain remaining in heads of each plot was estimated, and yields were adjusted accordingly.

Results and Discussion

Hayed plots produced 2.83 tons/a (12% moisture) of red clover forage in spring, 1995. Subsequent 1995 (Yr 1) grain sorghum plant stands were similar in all treatments (data not shown). Head counts were significantly ($P < .05$) higher after 100 lb/a of N had been applied than where no N was added but were similar for the previous cropping treatments. Sorghum grain yield was increased ($P < .05$) by 40% after the application of 100 lb/a of N. Yield was 5% higher after the production of red clover than after continuous grain sorghum. No interaction occurred between clover management and N rate treatments. Grain test weight and thousand kernel weight were similar for the treatments (data not shown).

In the second year of grain sorghum after red clover (Yr 2), plants/a and grain test weight were not affected by clover management or N rate (data not shown). Sorghum heads/a in Yr 2 were greater ($P < .05$) with no N after hayed clover than with no N after mulched clover. Heads/a were greater after mulched clover when sorghum received no N than when it received 100 lb N/a. Sorghum grain yield was greater ($P < .05$) with no N after hayed clover than with 100 lb N/a after hayed clover. Continuous sorghum with no N produced lower grain yield than sorghum with no N grown after hayed clover and sorghum with 100 lb N/a grown after mulched clover. Grain test weight was similar for the treatments (data not shown).

In the third year of grain sorghum after red clover (Yr 3), plants/a were fewer ($P < .05$) after mulched red clover than after no clover, but no stand difference occurred between hayed red clover and none (Table 1). Heads/a were no different in the different clover management treatments, but grain yield was about 30% higher ($P < .05$) after mulched red clover compared to the other treatments. Because kernel weights were similar among treatments (data not shown), kernels/head were increased after mulched red clover.

Nitrogen application in Yr 3 increased ($P < .05$) heads/a by 17% and grain yield by 80% compared to no N (Table 1). Kernel weight was increased with N application compared to no N but grain test weight was not affected by N application (data not shown).

Table 1. Grain Sorghum Plant and Head Populations and Grain Yield in Yr 3 following Red Clover (1997) as Affected by Clover Management and N Application, Southeast Agricultural Research Center.

Treatment	Population: Plants	Population: Heads	Grain Yield[1]
	- - - no./a (10^3) - - -		bu/a
Clover Management			
None	38.7	43.1	52.6
Hayed	34.3	43.5	52.2
Mulched	33.4	42.1	68.0
$LSD_{.05}$	4.7	NS	14.6
Nitrogen Rate			
None	38.4	39.5	41.0
100 lb/a	32.5	46.3	74.2
$LSD_{.05}$	3.8	3.0	11.9
Clover treatment X nitrogen rate interaction	NS	NS	NS

[1]Adjusted for bird damage to heads.

GRAIN SORGHUM RESPONSE TO FERTILITY MANAGEMENT*

Daniel W. Sweeney, Joseph L. Moyer, David A. Whitney, and Douglas J. Jardine*****

Summary

Damage to plots by midge and sorghum webworms resulted in unreliable yield measurements in 1997. Severity of *Fusarium* stalk rot was reduced by nitrogen and chloride fertilization.

Introduction

With the attention recently given to sustainable agriculture, interest has been renewed in the use of legumes in cropping systems. Because sustainability of our agricultural resources needs to coincide with profitability, achieving and maintaining adequate soil fertility levels are essential. The residual from legumes such as alfalfa and birdsfoot trefoil can benefit subsequent row crops by supplying nitrogen (N). However, little information is available on the importance of phosphorus (P), potassium (K), and chloride (Cl) fertility and the residual effects of alfalfa and birdsfoot trefoil on subsequent grain sorghum crops.

Experimental Procedures

The experiment was established on a Parsons silt loam in spring 1994. Since 1983, different soil test levels have been maintained in whole plots by fertilizer applications to develop a range of soil P and K levels. The experimental design was a split-split-plot. The whole plots comprised a factorial arrangement of P and K rates, in addition to selected Cl comparison treatments. Phosphorus rates were 0, 40, and 80 lb P_2O_5/a, and K rates were 0, 75, and 150 lb K_2O/a. Subplots were alfalfa and birdsfoot trefoil residuals. Chloride comparison treatments involved a 2x2 factorial combination of K and Cl by using KCl, K_2SO_4, $CaCl_2$, or no K or Cl. Sub-subplots were 0 and 125 lb N/a applied as urea. Three-year-old alfalfa and birdsfoot trefoil were killed by offset disking on March 22, 1994. Grain sorghum was planted at 62,000 seeds/a in June in 1994, 1995, 1996, and 1997. Stalk rot scores (bottom 10 nodes) were taken at harvest maturity in 1995, 1996, and 1997.

Results and Discussion

Yield measurements in 1997 were unavailable because of damage by midge and sorghum webworms.

Although lodging was minor (data not shown), the number of internodal spaces with visual evidence of *Fusarium* stalk rot symptoms was affected by an interaction of K with N (Fig.1). Without N, stalk rot severity exceed five nodes/plant at all K rates. With N, stalk rot severity was about four nodes/plant, but with N and K fertilization, stalk rot severity was reduced to about three nodes/plant.

[1] Research partially supported by the Kansas Fertilizer Research Fund.

[2] Department of Agronomy, KSU.

[3] Department of Plant Pathology, KSU.

Because the results mentioned in the previous paragraph refer to KC1, analyses of additional treatments provided data regarding separate Kand C1 effects on stalk rot. Stalk rot severity scores were affected by an interaction between N and C1 (Fig. 2) with no effect from K. With C1, adding N reduced the severity of stalk rot to less than three nodes/plant, whereas without C1, adding N only reduced the severity to an average of 3.7 nodes/plant. These data suggest that the K response reported in the previous paragraph was likely due to the C1 and not the K from the KC1 source.

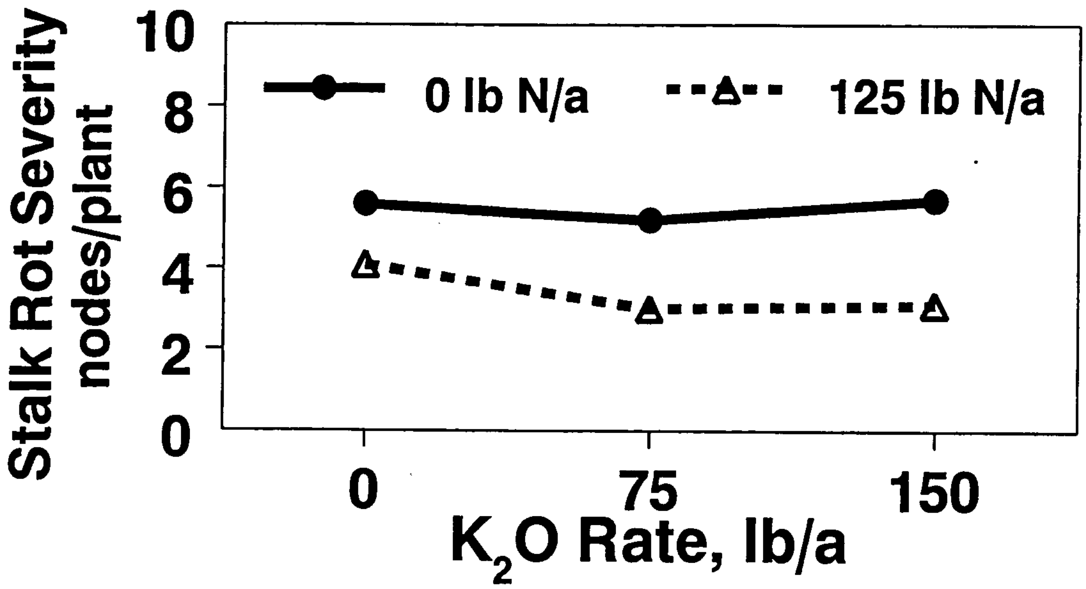


Figure 1. **Effects of N and K Fertilization Rates on Stalk Rot Severity in the Bottom 10 Nodes of Grain Sorghum Plants, Southeast Agricultural Research Center, 1997.**

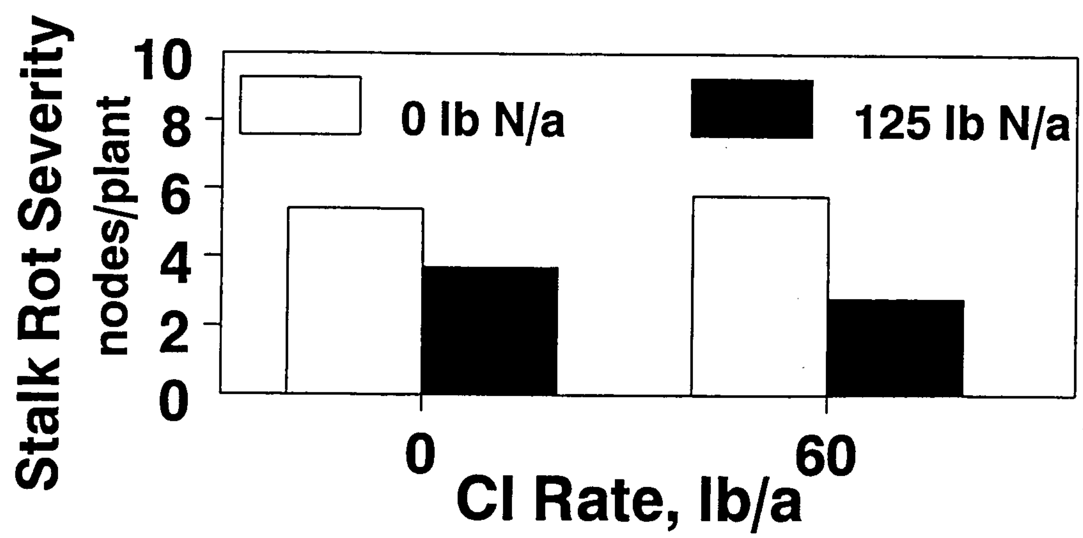


Figure 2. **Effects of N and C1 Fertilization on Stalk Rot Severity in the Bottom 10 Nodes of Grain Sorghum Plants, Southeast Agricultural Research Center, 1997.**

EFFECT OF TIMING OF LIMITED-AMOUNT IRRIGATION ON POPCORN GROWN AT DIFFERENT POPULATIONS

Daniel W. Sweeney and Charles W. Marr*

Summary

Irrigation of 1 in. at either R1 or R3 increased popcorn yields. Plant populations of 20,000 or 25,000 resulted in greater yields than 15,000 plants/a in 1997.

Introduction

Field corn responds to irrigation, and timing of water deficits can affect yield components. Popcorn is considered as a possible, value-added, alternative crop for producers and is being developed in western Kansas but less so in the southeastern part of the state. Even though large irrigation sources such as aquifers are lacking in southeastern Kansas, supplemental irrigation could be supplied from the substantial number of small lakes and ponds in the area. Literature is lacking on effects of both irrigation management and plant density on the performance of popcorn.

Experimental Procedures

The experiment was established on a Parsons silt loam in spring 1995 as a split-plot arrangement of a randomized complete block with three replications. The whole plots included six irrigation managements: 1) no irrigation, 2) 1 in. at R1 (silk), 3) 2 in. at R1, 4) 1 in. at R3 (milk), 5) 2 in. at R3, and 6) 1 in. at both R1 and R3. The subplots consisted of three plant densities; 15000, 20000, and 25000 plants/a. Plots were overplanted with P-410 popcorn on May 6, 1997 and thinned to the desired populations on June 3. Plots were harvested on October 1.

Results and Discussion

Overall popcorn yields averaged more than 2000 lb/a in 1997 (Table 1). Statistical contrasts showed that irrigation applied at either R1 or R3 increased yields. Yields were greater with 1 in. compared to 2 in. of irrigation. However, yields were also greater when 2 in. of irrigation were split-applied between R1 and R3 than when all 2 in. were applied at one time. Populations of 20,000 and 25,000 plants/a resulted in greater popcorn yield than a population of 15,000 plants/a.

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[1] Department of Horticulture, Forestry and Recreation Resources, KSU.

Table 1. Effects of Irrigation Timing and Plant Density on Popcorn Yield in 1997, Southeast Agricultural Research Center.

Treatment	Yield
	lb/a
Irrigation Timing	
None	2330
R1 — 1 in.	2930
R1 — 2 in.	2460
R3 — 1 in.	2680
R3 — 2 in.	2430
R1 & R3 — 1 in. at	3050
LSD $_{(0.05)}$	310
Plant Density (per acre)	
15,000	2450
20,000	2710
25,000	2780
LSD $_{(0.05)}$	140

TILLAGE AND NITROGEN FERTILIZATION EFFECTS ON YIELDS IN A GRAIN SORGHUM - SOYBEAN ROTATION

Daniel W. Sweeney

Summary

In 1997, the fifteenth cropping year of a grain sorghum-soybean rotation, tillage and N management systems affected grain sorghum yields. The greatest yields resulted from conventional tillage and anhydrous ammonia.

Introduction

Many kinds of rotational systems are employed in southeastern Kansas. This experiment was designed to determine the long-term effect of selected tillage and nitrogen (N) fertilization options on the yields of grain sorghum and soybean in rotation.

Experimental Procedures

A split-plot design with four replications was initiated in 1983, with tillage systems as whole plots and N treatments as subplots. The three tillage systems were conventional, reduced, and no tillage. The conventional system consisted of chiseling, disking, and field cultivation. The reduced-tillage system consisted of disking and field cultivation. Glyphosate (Roundup) was applied each year at 1.5 qt/a to the no-till areas. The four N treatments for the odd-year grain sorghum crops from 1983 to 1997 were a) no N (check), b) anhydrous ammonia knifed to a depth of 6 in., c) broadcast urea-ammonium nitrate (UAN - 28% N) solution, and d) broadcast solid urea. The N rate was 125 lb/a. Harvests were collected from each subplot for both grain sorghum (odd years) and soybean (even years) crops, even though N fertilization was applied only to grain sorghum.

Results and Discussion

In 1997, grain sorghum yields were affected by tillage in the order of conventional > reduced > no tillage (Table 1). Without N, yields averaged only about 5 bu/a, but all N sources resulted in grain sorghum yields exceeding 60 bu/a. Anhydrous ammonia resulted in greater yield than from urea application. UAN application resulted in yield that was intermediate between those with the other two N sources.

Table 1. Effects of Tillage and N Fertilization on Yield of Grain Sorghum Grown in Rotation with Soybean, Southeast Agricultural Research Center.

Treatment	Yield 1997	Yield Avg. 1983-1997
	-------------------- bu/a	--------------------
Tillage		
Conventional	75.3	70.1
Reduced	57.7	67.6
No tillage	38.7	52.7
LSD $_{(0.05)}$	9.1	
N Fertilization		
Check	4.8	38.4
Anhydrous NH_3	88.3	76.0
UAN broadcast	64.0	67.4
Urea broadcast	72.0	71.8
LSD $_{(0.05)}$	17.2	
T x N Interaction	NS	

YIELD RESPONSE OF SHORT-SEASON CORN TO NITROGEN FERTILIZATION AND TILLAGE*

Daniel W. Sweeney and Douglas J. Jardine**

Summary

In 1996, poor stands, poor growing conditions, and insect damage may have masked early-season corn response to tillage, nitrogen (N) placement, and N rate. Under these adverse conditions, early-season corn appeared to respond more to changes in N rate than tillage or N placement. However, in 1997 with more favorable growing conditions, tillage, N placement, and N rate all affected corn yield. Ridge tillage, broadcast N applications, and 120 lb N/a were management levels that resulted in the greatest yields.

Introduction

Corn grown on the upland soils in southeastern Kansas often is stressed by lack of moisture in July and August. However, short-season hybrids reach reproductive stages earlier than full-season hybrids and may partially avoid the periods with high probabilities of low rainfall during mid-summer. Because short-season hybrids were developed in northern climates, research is lacking concerning nitrogen (N) management in conservation tillage systems in southeastern Kansas.

Experimental Procedures

The experiment was established in 1996 at a remote site in Crawford County in southeastern Kansas. The experiment was a split plot arrangement of a randomized complete block with four replications, with tillage systems as whole plots and N fertilizer management as subplots. Tillage systems were ridge and no tillage. The N fertilizer management subplot treatments were arranged as a 3x5 factorial comprised of urea-ammonium nitrate (UAN) solution placement method (broadcast, dribble, and knife) and N rate (0, 30, 60, 90, and 120 lb/a). Tillage systems were established in 1995, and N fertilizer treatments were initiated in spring 1996 and continued in 1997. Short-season corn was planted on April 11, 1996 and on April 23, 1997.

Results and Discussion

Very dry conditions from fall 1995 to spring 1996 prevented previous grain sorghum stalks from decomposing, resulting in poor planting conditions and substandard corn plant stands. Average yield of short-season corn in 1996 was low (< 50 bu/a) and may have been partially due to poor stands, poor growing conditions, and insect damage. Grain yield was not affected by tillage or N placement (data not shown). Yield increased with increasing N rate to 60 lb/a but was not increased with higher N rates to 120 lb/a. In 1997, planting conditions were more favorable. Ridge tillage resulted in more than 20 bu/a greater yield than no tillage (Table 1). Broadcast N produced significantly greater yields than dribble applications, with yields from knife placement being intermediate. Each additional fertilizer N increment of 30 lb/a resulted in a 15-20 bu/a increase in corn yield.

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[1] Research partially supported by the Kansas Fertilizer Research Fund.

[2] Department of Plant Pathology, KSU.

Table 1. Effects of Tillage, N Placement, and N Rate on Yield of Short-Season Corn in 1997, Southeast Agricultural Research Center.

Treatment	Yield
	bu/a
Tillage	
Ridge	96.2
No tillage	75.4
$LSD_{(0.10)}$	20.5
Placement	
Broadcast	89.0
Dribble	82.2
Knife	86.2
$LSD_{(0.05)}$	5.3
N Rate (lb/a)	
0	47.7
30	67.1
60	87.9
90	105.7
120	120.6
$LSD_{(0.05)}$	6.8

EFFECT OF PREVIOUS RESIDUE MANAGEMENT SYSTEMS ON SUBSEQUENT GRAIN SORGHUM PRODUCTION

Daniel W. Sweeney

Summary

Across years, the residual effect from long-term burning of wheat straw reduced the yield of the following four grain sorghum crops by more than 6 bu/a, whereas previous nitrogen (N) management for wheat did not have a lasting effect on subsequent grain sorghum. Fertilizing the grain sorghum with 100 lb N/a resulted in 4-year average yields nearly 30 bu/a greater than those of sorghum without N. Within each year, this difference became more pronounced as the time increased since soybean, a legume, had been grown.

Introduction

Double-cropping of soybean after wheat or other small grains is practiced by many producers in southeastern Kansas. Options for dealing with the straw prior to planting the double-cropped soybean include tillage to incorporate it, burning, and no tillage. When these practices are continued long term and then the system is changed, it is uncertain if they will have residual effects on other row crops. Thus, the objective of this study is to determine whether long-term residue and N management systems used for a long-term, wheat — double-cropped soybean rotation will affect subsequent grain sorghum production.

Experimental Procedures

Three management systems for wheat straw residue with double-cropped soybean were established in 1983 and continued through 1993: no tillage, disk only, and burn then disk. Additionally, the residue management whole plots were split into two N fertility levels: low — 83 lb N/a and high — 129 lb N/a. Following this long-term, continuous wheat — double-cropped soybean rotation, grain sorghum was grown from 1994 through 1997. Whole and split plots were the residuals of the residue and N management systems used for the wheat — double-cropped soybean rotation. Additionally, these plots were split again to apply either no additional N or 100 lb N/a. Thus, the experiment was a split-split plot comprising 12 treatments with three replications.

Results and Discussion

Where double-cropped soybean had been grown after burning the residue in previous years, the average yield of the following four grain sorghum crops was more than 6 bu/a less than where the wheat straw either had been disked or left unincorporated with no tillage (Table 1). Although the previous residue management did not interact with year, the differences in grain sorghum yield appeared more pronounced in the latter years (data not shown). Nitrogen management for the wheat in the previous rotation had no significant effect on the following grain sorghum yield (Table 1). Fertilizing with 100 lb N/a increased average grain sorghum yield by nearly 30 bu/a. A year by N fertilization interaction showed a greater response to N application as the number of years increased since soybean had been grown (data not shown).

Table 1. Effects of Previous Residue and N Management of Wheat — Double-Cropped Soybean and N Fertility on Subsequent Grain Sorghum, Southeast Agricultural Research Center.

Treatment	Average Grain Sorghum Yield (1994-
	------------ bu/a ----------
Previous Residue Management	
Burn then disk	66.6
Disk only	74.0
No tillage	72.9
LSD $_{(0.10)}$	5.0
Previous N Management	
Low — 83 lb N/a	69.8
High — 129 lb N/a	72.6
LSD $_{(0.05)}$	NS
N Fertility (lb/a)	
0	57.4
100	85.0
LSD $_{(0.05)}$	3.4
Interactions	Year x N Fertility

MANAGEMENT OF PHOSPHORUS STRATIFIED SOIL FOR EARLY-SEASON CORN PRODUCTION*

Daniel W. Sweeney, Greg J. Schwab, and David A. Whitney[2]**

Summary

Favorable growing conditions likely minimized the potential for moisture stress, resulting in no significant differences in early-season corn yield from stratification, tillage, or phosphorus (P) placement in 1997.

Introduction

Phosphorus stratification in soils in reduced- or no-tillage cropping systems has been well documented. If dry conditions occur during the summer, P uptake from the surface few inches can be limited. This can be alleviated by redistribution of the stratified P or by subsurface placement of additional fertilizer P. The objective of this study was to determine the effectiveness of tillage and/or P placement to alleviate the effects of P stratification in soil on short-season corn grown with no tillage.

Experimental Procedures

Stratified or nonstratified areas were established prior to planting the 1996 background soybean crop. This was accomplished by applying P fertilizer and incorporating by chisel, disk (deep), and field cultivation for the unstratified profile or only incorporating to a depth of 2 in. with a field cultivator for the stratified profile. These main plots were subdivided in 1997 by tillage (chisel/disk and no tillage), and sub-subplots were P placement methods (no P, broadcast, and knife at 4 in.). Corn was planted on April 24, 1997.

Results and Discussion

Favorable growing conditions appeared to minimize any periods of moisture stress in 1997. Although nonstratified conditions tended to result in greater corn yield than stratified (150 vs. 141 bu/a), the difference was significant only at p = 0.11. Tillage or P placement resulted in no significant differences in yield (data not shown).

[1] Research partially supported by the Kansas Fertilizer Research Fund.

[2] Department of Agronomy, KSU.

EFFECTS OF PREVIOUS CROP, NITROGEN RATE, AND NITROGEN PLACEMENT ON NITROGEN REQUIREMENT FOR WHEAT

Kenneth W. Kelley and Daniel W. Sweeney

Summary

Wheat yields were influenced significantly by previous crop, tillage method, fertilizer nitrogen (N) placement, and N rate. In the first study, where both conventional- and no-tillage systems were evaluated, grain yields were highest for wheat following soybean with conventional tillage and lowest for wheat planted no-till following grain sorghum. Applying fertilizer N (28% UAN) below crop residues with a coulter-knife applicator also significantly increased grain yield compared with broadcast fertilizer N treatments, regardless of previous crop or tillage system. In the second study, where only conventional tillage was evaluated, wheat grain yields and leaf N concentration also were influenced by previous crop and N rate. Wheat yields averaged 83 bu/a following corn, 78 bu/a following soybean, and 70 bu/a following grain sorghum. Applying fertilizer N (28% UAN) below crop residues with a coulter-knife applicator again resulted in significantly higher grain yield compared to preplant broadcast or dribble applications of UAN solution or broadcast urea. Grain yields increased linearly with increasing fertilizer N rates, regardless of previous crop.

Introduction

This research seeks to evaluate how the previous crop (corn, grain sorghum, or soybean) affects the utilization of applied nitrogen (N) fertilizer by winter wheat. In southeastern Kansas, wheat often is planted after a summer crop as a means of crop rotation; however, previous crop and the quantity of stalk residue affect N efficiency. Placement of fertilizer as well as various N rates were evaluated in both conventional- and no-till previous cropping systems.

Experimental Procedures

Conventional- and No-Tillage

The experiment was a split-plot design with previous crop (soybean and grain sorghum) and tillage method (no-till and conventional) as main plots and a factorial arrangement of N rates (60 and 120 lbs/a) and N placement methods (broadcast and knifed) as subplots. All N treatments were fall-applied and, in conventional tillage, were incorporated shallowly with a field cultivator prior to wheat planting. In conventional-tillage plots, crop residues were incorporated partially with a tandem-disk prior to applying fertilizer N treatments. Urea ammonium nitrate 28% N solution (UAN) was the N source, except for one comparison treatment where urea was used as a split application (fall and late-winter). Knifed N treatments were banded on 17-in. centers at a depth of 4 to 6 in. Both conventional- and no-till plots were planted with a no-till drill at a seeding rate of 75 lbs/a.

Conventional Tillage

The experiment was a split-plot design, in which the main plots were previous crops (corn, grain sorghum, or soybean) and subplots included a factorial arrangement of three N rates (40, 80, and 120 lb N/a) with four placement methods - 1) broadcast urea, 2) broadcast liquid 28% N, 3) dribble liquid 28% N on 17-in. centers, and 4) knife liquid 28% N on 17-in.

28% N, 3) dribble liquid 28% N on 17-in. centers, and 4) knife liquid 28% N on 17-in. centers at a depth of 4 to 6 in. All N treatments were fall-applied and incorporated with a field cultivator prior to planting wheat. Crop residues were incorporated partially with disk tillage prior to fertilizer N applications. Soil type was a Parsons silt loam with 2.8% O.M. All plots also received 60 lbs/a of P_2O_5 and 75 lbs/a K_20.

Results and Discussion

Conventional- and No-Tillage (Table 1)

Wheat yield was influenced significantly by previous crop, tillage method, N rate, and N placement. Yield averaged 10 bu/a higher for wheat following soybean compared to wheat following grain sorghum. Conventional tillage also resulted in higher grain yield than no-till, regardless of previous crop. Yield component analyses (data not shown) indicated that number of wheat heads per unit area was significantly higher in conventional-tillage than no-till systems.

However, both fertilizer N placement and N rate also affected previous crop and tillage systems. Grain yields were significantly higher when liquid 28% N was placed below crop residues with a coulter-knife applicator compared with broadcast N applications. Plant N analyses and aboveground whole-plant, dry matter weights were significantly higher with knifed fertilizer N treatments, suggesting that wheat was able to utilize fertilizer N more efficiently. Urea used as a split application (60 lb N/a in fall and 60 lb N/a in late winter) gave results similar to those of the 120 lb N/a rate of UAN applied all in the fall.

Conventional Tillage (Table 2)

Wheat yields and leaf N concentration were influenced significantly by previous crop and N rate. Grain yields averaged 83 bu/a following corn, 78 bu/a following soybean, and 70 bu/a following grain sorghum. In 1997, cool weather and lack of severe leaf rust infection after heading were conducive to high grain yields.

Grain yields and leaf N concentrations were highest for knifed applications of 28% UAN, regardless of previous crop. Grain yields were not significantly different among broadcast UAN, dribble UAN, and broadcast urea fertilizer N treatments. Grain yields and leaf N concentration increased linearly with increasing N rates, regardless of previous crop. Differences in wheat yield within previous crops appeared to be related primarily to increased fertilizer N utilization following corn and soybeans and greater immobilization of fertilizer and soil N for wheat following grain sorghum. Soil analyses (0- 12 in. depth) also showed that residual soil nitrate-N levels prior to wheat fertilization were significantly higher following corn (36 lb N/a) than following soybean or grain sorghum (12 lb N/a). This difference likely influenced grain yields to some extent.

Table 1. Effects of Previous Crop, Tillage Method, Nitrogen Rate, and Nitrogen Placement on Nitrogen Requirements for Winter Wheat, Parsons Unit, Southeast Agricultural Research Center, 1997.

			Wheat Yield after			
N	N	N	Grain Sorghum		Soybean	
Rate	Method	Source	NT	CT	NT	CT
lb/a			bu/a			
0	---	---	26.9	34.5	38.0	43.2
60	B'Cast	UAN	38.0	51.7	48.8	62.0
60	Knife	UAN	53.2	61.5	66.7	73.6
120	B'Cast	UAN	56.3	64.7	69.6	75.5
120	Knife	UAN	68.6	73.6	77.8	81.6
120[1]	B'Cast	Urea	57.8	68.8	70.8	72.4
Avg[2]			50.1[c]	59.1[b]	61.9[b]	68.1[a]

Means: (No N and 120 N as urea omitted)	
Grain sorghum	58.4
Soybean	69.4
LSD (0.05)	2.4
Conventional tillage	68.0
No-tillage	59.9
LSD (0.05):	2.4
60 lb N/a	56.9
120 lb N/a	71.0
LSD (0.05):	2.0
B'Cast	58.3
Knife	69.6
LSD (0.05):	2.0

[1]60 lb N/a applied in the fall and 60 lb N/a top-dressed in Feb.
[2]Means followed by a different letter are significant at the 5% level of probability.
UAN = urea ammonium nitrate 28% N solution.
NT = no tillage, CT = conventional tillage (disk).
Planting date: Oct. 16, 1996; Variety = Karl 92

Table 2. Effects of Previous Crop, Nitrogen Rate, and Nitrogen Placement on N Requirement for Winter Wheat, Parsons Unit, Southeast Agricultural Research Center, 1997.

N Rate	N Method	Wheat Yield after Corn	Wheat Yield after Sorghum	Wheat Yield after Soybean	Wheat Leaf N Conc. after Corn	Wheat Leaf N Conc. after Sorghum	Wheat Leaf N Conc. after Soybean
lb/a		---- bu/a ----			---- % N ----		
0	---	57.7	42.8	50.6	3.00	2.49	2.73
40	BC-Urea	77.2	58.1	69.4	3.72	3.14	3.50
80	BC-Urea	83.9	67.9	81.4	3.90	3.57	3.68
120	BC-Urea	91.1	84.2	89.6	4.11	3.70	3.92
40	BC-UAN	75.6	54.6	68.0	3.48	3.22	3.38
80	BC-UAN	83.7	73.2	78.4	3.82	3.58	3.60
120	BC-UAN	93.4	82.0	85.9	4.00	3.93	3.95
40	DR-UAN	74.3	58.8	66.6	3.75	3.49	3.61
80	DR-UAN	84.6	74.2	82.5	3.92	3.76	3.82
120	DR-UAN	90.2	81.9	91.0	4.10	4.04	4.16
40	KN-UAN	81.9	67.5	77.3	3.76	3.56	3.64
80	KN-UAN	90.5	82.2	87.4	3.93	3.83	3.92
120	KN-UAN	95.6	89.0	92.3	4.14	4.06	4.02
Avg*		83.1[a]	70.5[c]	78.5[b]	3.88[a]	3.66[b]	3.76[b]
Means:							
40 lb/a N			69.1			3.52	
80 lb/a N			80.8			3.78	
120 lb/a N			88.8			4.00	
LSD (0.05):			2.0			0.04	
B'Cast-Urea			78.1			3.69	
B'Cast-UAN			77.2			3.66	
Dribble-UAN			78.2			3.85	
Knife-UAN			84.9			3.87	
LSD (0.05):			2.0			0.05	

*Means followed by a different letter are significant at the 5% level of probability.
All N treatments were fall-applied and incorporated with tillage prior to wheat planting.
UAN = urea ammonium nitrate solution (28%N).
Planting date: Oct. 16, 1996; Variety = Karl 92.

EFFECTS OF WHEAT DOUBLE-CROP AND WHEAT SUMMER-FALLOW SYSTEMS ON GRAIN YIELD OF SUBSEQUENT CROPS

Kenneth W. Kelley and Joseph L. Moyer

Summary

Where no fertilizer N was applied, both corn and grain sorghum yields were influenced significantly by previous wheat double-crop and summer-fallow treatments. Grain yields were highest following sweet clover and the summer-fallow (herbicide) treatment and lowest following double-cropped grain sorghum and double-cropped soybean. However, when fertilizer nitrogen (125 lb N/a) was applied, corn and grain sorghum yields were similar among previous cropping systems, except where corn followed double-cropped grain sorghum. Previous wheat cropping system did not have a significant effect on soybean grain yield. Fertilizer N increased soybean grain yield only slightly (3 bu/a).

Introduction

In southeastern Kansas, producers typically plant double-cropped soybean following wheat, although other crops, such as grain sorghum or sunflowers, some times are planted after wheat. However, other wheat cropping options can include planting a legume crop, such as sweet clover, in wheat in early spring to improve soil quality or summer-fallowing after wheat harvest, which likely will include mechanical tillage or the use of herbicides to control weeds during the summer. This research seeks to determine the influence of previous wheat double-crop and wheat summer-fallow systems on grain yield of subsequent spring crops (corn, grain sorghum, and soybean) in a 2-yr crop rotation.

Experimental Procedures

In 1996, six cropping systems were established at the Parsons Unit, which included three crops (soybean, grain sorghum, and sunflower) planted no-till after wheat harvest, two wheat summer-fallow treatments (disk tillage versus herbicide only); and one legume crop (yellow sweet clover) interseeded in wheat in early spring. Roundup herbicide was used to control weeds in the summer-fallow treatment. Double-cropped grain sorghum and sunflowers each received 75 lb/a of fertilizer nitrogen (N). In 1997, corn, grain sorghum, and soybeans were planted with conventional tillage in each of the six previous wheat cropping systems. A fertilizer N variable (no nitrogen versus 125 lb N/a) also was included for each spring crop.

Results and Discussion

Where no fertilizer N was applied, both corn and grain sorghum yields were influenced significantly by previous wheat double-crop and summer-fallow treatments (Table 1). Grain yields were highest following sweet clover and the summer-fallow (herbicide) treatment and lowest following double-cropped grain sorghum and double-cropped soybean. However, when fertilizer N (125 lb N/a) was applied, corn and grain sorghum yields were similar among previous cropping systems, except where corn followed double-cropped grain sorghum. Plant N analyses (data not shown) indicated that grain yields were influenced largely by differences in plant and soil N availability following the previous wheat cropping systems. Soil samples taken in early spring prior to corn planting showed that residual soil nitrate-N levels were relatively low (less than 20 lbs/a) for all previous wheat cropping systems. However, because grain yield and plant N were highest following sweet clover and for the chemical fallow treatment, results suggest that significant amounts of residual soil N or mineralized plant N were present in the organic fraction of the soil, which became available for plant uptake later in the growing season. Results also indicate that when corn or grain sorghum followed wheat and double-cropped grain sorghum, the fertilizer N requirement was higher than for the other wheat cropping systems because significant amounts of both fertilizer N and soil N likely were immobilized in the decomposing plant residues and unavailable for plant uptake.

Previous wheat cropping system did not have a significant effect on soybean grain yield. Fertilizer N increased soybean grain yield only slightly (3 bu/a).

In the fall, wheat was planted following corn, grain sorghum, and soybean harvest to further evaluate effects of wheat cropping sytems on grain yield and N availability. Plans are to continue the study for three complete crop rotations.

Table 1. Effects of Wheat Double-Crop and Wheat Summer-Fallow Cropping Systems on Grain Yield of Corn, Sorghum, and Soybean Crops, Parsons Unit, Southeast Agricultural Research Center, 1997.

Previous Wheat	Corn Yield		Sorghum Yield		Soybean Yield	
Cropping System	No N	125 N	No N	125 N	No N	125 N
	------ bu/a ------		------ bu/a ------		------ bu/a ------	
Wh-Chemical fallow	118.8	168.3	120.4	134.2	50.6	52.8
Wh-Tillage fallow	95.5	157.9	104.4	132.3	48.3	50.7
Wh-Sweet clover	147.2	166.2	116.7	138.0	50.2	53.3
Wh-Grain sorghum	72.8	147.8	75.5	132.3	46.7	50.2
Wh-Soybean	86.8	165.6	87.3	141.1	47.4	50.1
Wh-Sunflower	97.0	160.5	101.9	137.5	48.7	51.6
Avg*	101.9[b]	161.1[a]	101.0[b]	135.9[a]	48.7[b]	51.4[a]

LSD (0.05):
Comparing subplot N treatments within same previous crop:
corn = 13.0 bu/a; sorghum = 10.3 bu/a; soybean = NS.
Comparing subplot N treatments for different previous crop:
corn = 14.2 bu/a; sorghum = 10.9 bu/a; soybean = NS.

*Means followed by a different letter are significant at the 5% level of probabililty;
NS = not significant at the 5% level of probability.
Fertilizer N (28% UAN) applied at a depth of 4 to 6 in. with a coulter-knife applicator.

EFFECTS OF PREVIOUS CROP AND TILLAGE ON SOYBEAN YIELD*

Kenneth W. Kelley and Daniel W. Sweeney

Summary

In 1996 and 1997, rainfall distribution was ideal for optimum soybean production, but tillage did not have a significant effect on either full-season (1996) or double-cropped (1997) soybean yields. However, more research is needed under varying climatic conditions to determine the long-term effects of tillage and crop rotation on crop yield.

Introduction

In southeastern Kansas, soybean is grown typically in rotations with wheat, grain sorghum, or corn. The acreage of double-cropped soybean planted no-till has increased significantly in recent years; however, only a limited acreage of spring crops is planted no-till. In the fall, some wheat is planted no-till into previous summer crop residues, although wheat typically is planted with reduced disk tillage. This research seeks to evaluate the combined effects of crop rotation and tillage on both full-season and double-cropped soybean.

Experimental Procedures

Beginning in 1995, two 3-yr crop rotations were started at the Columbus and Parsons Units. Rotations are: 1) corn - soybean - [wheat - double-cropped soybean] and 2) grain sorghum - soybean - [wheat - double-cropped soybean]. Tillage treatments include: 1) grow all crops with conventional tillage (CT), 2) plant all crops no-till (NT), or 3) alternate CT and NT systems. In 1996, full-season soybean followed corn and grain sorghum, whereas in 1997, wheat and double-cropped soybean were compared. All soybean crops were planted at 30-inch row spacing.

Results and Discussion

Yield of full-season and double-cropped soybeans are shown in Table 1. In 1996, soybean following grain sorghum yielded significantly higher than soybean following corn at the Columbus Unit, but soybean yields were similar following the two crops at the Parsons Unit. No significant differences in grain yield occurred among tillage treatments in 1996 or 1997 for full-season or double-cropped soybeans. However, rainfall distribution was ideal for optimum soybean yields both in 1996 and 1997. Additional evaluations are needed under varying climatic conditions to determine the long-term effects of tillage and crop rotation on soybean yield for the shallow, claypan soil conditions of southeastern Kansas.

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[1] Research partially supported by Kansas Soybean Check-Off funding.

Table 1. Effects of Previous Crop and Tillage on Full-Season and Double-Cropped Soybean Yield, Southeast Agricultural Research Center, 1996-97.

Crop Rotation and Tillage System[1]				Soybean Yield			
				1996 Full-Season		1997 Double-Cropped	
YR-1	YR-2	YR-3	YR-3	Par Unit	Col Unit	Par Unit	Col Unit
				------------------- bu/a -------------------			
Corn NT	FS Soy NT	Wheat NT	DC Soy NT	45.6	44.8	24.5	37.8
Corn CT	FS Soy CT	Wheat CT	DC Soy CT	46.7	46.4	26.0	38.3
Corn NT	FS Soy CT	Wheat NT	DC Soy CT	45.6	52.0	26.2	38.0
Corn CT	FS Soy NT	Wheat CT	DC Soy NT	42.7	42.0	23.2	32.3
Milo NT	FS Soy NT	Wheat NT	DC Soy NT	45.1	48.3	25.3	38.8
Milo CT	FS Soy CT	Wheat CT	DC Soy CT	43.7	52.9	27.6	39.3
Milo NT	FS Soy CT	Wheat NT	DC Soy CT	45.9	55.2	26.4	38.8
Milo CT	FS Soy NT	Wheat CT	DC Soy NT	44.6	54.8	24.8	34.5
LSD (0.05):				3.8	5.2	3.1	3.6

[1]CT = conventional tillage; NT = no-tillage.

COMPARISON OF SOYBEAN AND GRAIN SORGHUM CROPPING SEQUENCES

Kenneth W. Kelley

Summary

In 1997, cropping sequence had a significant effect on grain sorghum yields, whereas soybean was unaffected. Grain yields were significantly higher for first-year grain sorghum following 5 years of soybean and for grain sorghum following soybean in a 2-yr rotation. In 1996, soybean yields showed a similar response when rotated out of grain sorghum. However, preliminary results indicate that environmental conditions influence the yield benefit associated with crop rotation, and this effect also can vary with the particular crop being grown.

Introduction

Crop rotation is an important management tool. Research has shown that crops grown in rotation often yield 10 to 15% higher than continuous cropping systems (monoculture). However, it has been observed that the "rotation effect" may be affected by environmental growing conditions. This research seeks to determine how soybean and grain sorghum yields are affected by various cropping sequences and yearly climatic conditions.

Experimental Procedures

Beginning in 1992, various cropping sequences of soybean and grain sorghum have been compared at the Parsons Unit. Treatments include: 1) continuous soybeans and grain sorghum; 2) 2-yr rotation of grain sorghum and soybean; and 3) 1,2,3,4, and 5 years of one crop following 5 years of the other. Grain sorghum plots also are split to include two fertilizer nitrogen variables (60 and 120 lb N/a). Phosphorus and potassium fertilizers have been applied yearly to both crops. The site had been in native grass prior to establishing the various cropping sequences.

Results and Discussion

Soybean yield responses for the various soybean and grain sorghum cropping sequences are shown in Table 1. In 1997, rain distribution was ideal for grain production, but soybean yields were not affected significantly by cropping sequence. In 1996, soybean yields also were high because of favorable growing conditions; however, grain yields were affected significantly by cropping sequence. It is unclear why the soybean yield response varied, even though high grain yields were produced in both years.

Grain sorghum yield response to cropping sequence (Table 2) was different than that of soybeans. Grain sorghum yields were affected significantly by cropping sequence in 1997, but not in 1996. In 1997, grain yields were significantly higher for first-year grain sorghum following 5 years of soybeans and for grain sorghum following soybean in the 2-yr rotation. Grain yields increased with increasing fertilizer N; however, the response to fertilizer N was small for first-year grain sorghum and for grain sorghum following soybean in the 2-yr rotation, indicating significant levels of residual soil-N.

Table 1. Comparison of Soybean Yields in Various Cropping Sequences, Parsons Unit, Southeast Agricultural Research Center.

Soybean Sequence[1]	1996 Yield	1997 Yield
	bu/a	bu/a
Fifth-year soybean	41.0	42.3
Fourth-year soybean	39.1	40.1
Third-year soybean	37.0	43.6
Second-year soybean	37.9	42.8
First-year soybean	49.4	40.9
Soybean - grain sorghum (2-yr rotation)	46.1	42.5
LSD (0.05)	4.0	NS

[1]Rotations started in 1992; previous crop was native prairie grass.

Table 2. Comparison of Grain Sorghum Yields in Various Cropping Sequences, Parsons Unit, Southeast Agricultural Research Center.

	1996 Yield		1997 Yield	
Grain Sorghum Sequence[1]	60 N	120 N	60 N	120 N
	bu/a	bu/a	bu/a	bu/a
Fifth-year grain sorghum	104.1	106.3	112.5	133.2
Fourth-year grain sorghum	104.7	98.8	109.4	130.1
Third-year grain sorghum	101.1	104.9	125.4	139.7
Second-year grain sorghum	103.3	97.2	119.6	132.2
First-year grain sorghum	104.0	98.9	142.5	147.9
Grain sorghum - soybean (2-yr rotation)	97.7	99.1	144.3	148.3
LSD (0.05):	NS	NS	5.0	5.0

[1]Rotations started in 1992; previous crop was native prairie grass.
NS = not significant.

EFFECT OF SOIL pH ON CROP YIELDS*

Kenneth W. Kelley

Summary

Grain yields of wheat, soybean, and grain sorghum have increased as soil acidity decreased, except for a slight yield reduction in some years at the highest pH range. Results confirm the importance of maintaing soil pH in the 6.5 to 7.0 range, regardless of the crop being grown.

Introduction

In southeast Kansas, nearly all topsoils are naturally acidic (pH less than 7.0). Agricultural limestone is applied to correct soil acidity and to improve nutrient availability. However, applying too much lime results in alkaline soil conditions (pH greater than 7.0), which also reduces nutrient availability and increases persistence of some herbicides.

Experimental Procedures

Beginning in 1989, five soil pH levels ranging from 5.5 to 7.5 were established on a native grass site at the Parsons Unit. The crop rotation consists of wheat - double-cropped soybean, grain sorghum, and soybean using conventional tillage practices. Soil samples have been taken yearly to evaluate changes in soil pH levels. In addition, plant and grain samples have been taken to determine pH effects on nutrient uptake, although only grain yields are reported here.

Results and Discussion

Grain yield responses for the various soil pH treatments over several years are shown in Table 1. All grain yields have increased as soil acidity decreased, except for a slight yield reduction in some years at the highest pH range. Results confirm the importance of maintaing soil pH in the 6.5 to 7.0 range, regardless of the crop being grown.

Plant and grain samples (data not shown) indicate that soil pH has the greatest effect of phosphorus (P) uptake. When soil pH is acidic or alkaline, soil P becomes less available for plant uptake. Plans are to summarize nutrient uptake data after several more cropping cycles have been completed.

[1] Research partially supported by Midwest Minerals, Inc.

Table 1. Effects of Soil pH on Grain Sorghum, Soybean, and Wheat Yields, Parsons Unit, Southeast Agricultural Research Center.

	Grain Yield				
Soil pH (0-6")	1993 Gr Sorghum	1994 Soybean	1996 Wheat	1996 DC Soybean	1997 Gr Sorghum
	bu/a	bu/a	bu/a	bu/a	bu/a
5.5	59.4	25.0	27.4	19.0	112.4
6.4	65.6	25.9	32.5	21.5	123.8
6.8	70.3	35.6	33.5	22.5	134.8
7.2	82.6	36.2	37.2	24.2	134.1
7.6	84.2	38.3	38.7	22.6	129.7
LSD (0.05):	4.5	3.7	3.3	1.2	3.7

LONG-TERM EFFECTS OF CROPPING SYSTEMS ON SOYBEAN YIELDS[1]

Kenneth W. Kelley and James H. Long

Summary

Soybean yields have been highest following wheat - fallow or grain sorghum and lowest following wheat - double-cropped and continuous soybean rotations, regardless of soybean cyst nematode (SCN) infection. In this study, soybean yield losses associated with SCN have been highest during the initial stages of infection (1989).

Introduction

Soybean is a major crop for producers in southeastern Kansas. Typically, soybean is grown in several cropping sequences with wheat, grain sorghum, and corn or in a double-cropping rotation with wheat. With the recent arrival of soybean cyst nematode (SCN) into extreme southeastern Kansas, producers use crop rotation and resistant varieties to reduce yield losses associated with SCN infection. This long-term study seeks to determine how crop rotations and cultivar resistance affect soybean yields in the presence of SCN.

Experimental Procedures

In 1979, four cropping rotations were started at the Columbus Unit: 1) [wheat - double-cropped soybean] - soybean, 2) [wheat - summer fallow], 3) grain sorghum - soybean, and 4) contiunous soybean. Full-season soybean was compared across all rotations in even-numbered years. Beginning in 1984, an identical study was started adjacent to the initial site, so that full-season soybean also could be compared in odd-numbered years. In 1989, SCN was detected in the continuous soybean plots, and since then, has spread into all crop rotation treatments. Beginning in 1994, cultivars with different maturity and SCN resistance were compared across all four rotations. All rotations received the same amount of phosphorus and potassium fertilizers (80 lb/a each), which were applied to the crop preceeding full-season soybean.

Results and Discussion

Soybean yield responses for 1997 across all rotations in the presence of SCN are shown in Table 1, and year summary results for odd-numbered years since 1985 are shown in Table 2. Soybean yields have been highest following wheat - fallow or grain sorghum and lowest in wheat - double-cropped and continuous soybean rotations, regardless of SCN infection. In 1997, highest yields occurred with maturity group (MG) III cultivars; although in other years, MG IV and V cultivars typically have yielded higher. Yield differences within the same rotation were small between resistant and susceptible SCN cultivars of similar maturity in 1997. In this study, soybean yield losses associated with SCN infection have been highest during the initial stages of infection (1989).

Soil data for 1997 have not been analyzed yet for SCN populations; however, SCN egg counts were high (18,000 to 74,000 eggs/100 cm^3 of soil) in the continuous soybean rotation after the 1996 fall harvest and moderately high in the wheat - double-cropped soybean rotation. Egg counts have been lowest in the wheat - fallow and grain sorghum rotation. This long-term study will be completed after the 1998 soybean harvest and results then will be summarized.

[1] Research partially supported by the Kansas Soybean Check-Off funding.

Table 1. Comparison of Soybean Cultivars with Different Maturity and SCN Resistance in Four Crop Rotations in the Presence of SCN, Columbus Unit, Southeast Agricultural Research Center.

			Full-Season Soybean following				
Cultivar	MG	SCN[1]	Wheat - DC Soy	Grain Sorghum	Wheat - Fallow	Soybean	Avg.
			bu/a	bu/a	bu/a	bu/a	bu/a
Jack	II	R	39.4	37.8	38.0	36.6	37.9
Sherman	III	S	52.3	49.8	49.3	48.2	49.9
Flyer	III	S	51.5	48.5	43.7	43.8	46.9
Delsoy 4210	IV	R	50.4	47.8	47.7	41.9	47.0
Stafford	V	S	43.5	42.9	43.5	40.3	42.6
Manokin	V	R	48.3	43.2	42.4	41.6	43.9
Hutcheson	V	S	48.0	46.2	41.6	38.9	43.7
Forrest	V	R	43.3	40.4	36.3	35.2	38.8
Avg.			47.1	44.6	42.8	40.8	
LSD (0.05):							
Comparing cultivars within same rotation:							3.5
Comparing means of different crop rotations:							2.9
Comparing means of soybean cultivars:							2.9

[1]R = SCN resistant; S = SCN susceptible.

Table 2. Effect of Long-Term Cropping Rotations on Soybean Yield in the Presence of SCN, Columbus Unit, Southeast Agricultural Research Center.

	Full-Season Soybean following				
Year	Wheat - DC Soybean	Grain Sorghum	Wheat - Fallow	Soybean	LSD (0.05)
	bu/a	bu/a	bu/a	bu/a	
1985	31.9	30.9	29.5	27.9	3.2
1987	30.7	31.5	33.2	28.2	3.8
1989	27.0	27.5	33.4	20.7	4.5
1991	33.4	39.1	39.4	30.6	5.1
1993	32.5	36.9	37.1	25.3	3.8
1995	21.1	23.6	26.8	24.0	3.1

SOYBEAN HERBICIDE RESEARCH

Kenneth W. Kelley

Summary

Several newer soybean herbicides as well as Roundup Ready and STS soybean seed and herbicide systems were evaluated for effects on grain yield and weed control using conventional tillage methods. In 1997, control of annual broadleaf and grass weeds was good to excellent for nearly all herbicide treatments.

Experimental Procedures

In 1997, conventional soybean herbicide treatments were compared with Roundup Ready and sulfonylurea-tolerant (STS) seed and herbicide systems at the Columbus Unit using conventional tillage methods. Soybeans were planted in early June in 30-inch row spacing. All treatments were applied with a tractor-mounted, compressed-air sprayer with a spray volume of 20 GPA. Plots were four rows wide by 30 ft. long and replicated three times. The center two rows of each plot were harvested for yield. Weed ratings were visual estimates of percent weed control for a naturally occurring weed population.

Results and Discussion

Soybean yield and weed control results comparing conventional herbicide treatments with Roundup Ready and STS systems are shown in Tables 1, 2, and 3. Because individual studies were evaluated in three adjacent areas, yield comparisons between studies are not statistically valid. However, compared to untreated control plots, nearly all herbicide treatments gave good to excellent control of large crabgrass, common waterhemp, and common cocklebur.

Several newer herbicides (Raptor, First Rate, Canopy XL, Expert, and Axiom) were compared in the conventional herbicide and soybean seed system (Table 1). Raptor, applied postemergent as a tank mix with Status, effectively controlled common waterhemp and cocklebur. When soil-applied, First Rate gave excellent broadleaf weed control; however, when applied postemergent, First Rate should be tank mixed with other herbicides to effectively control pigweed and common waterhemp species. Canopy XL or Authority Broadleaf, applied preemeregent, gave excellent control of common waterhemp and good control of common cocklebur. Expert, applied postemergent, also gave excellent broadleaf weed control. Axiom, applied preemergent, gave excellent control of large crabgrass and common waterhemp; however, Axiom should be tank mixed with other herbicides to control large-seeded broadleaf weeds, such as cocklebur.

In the Roundup Ready trial (Table 2), Roundup, applied 3 weeks after planting, gave excellent control of annual grass and broadleaf weeds and was as effective as the residual soil treatments plus Roundup. However, in 1997, climatic conditions were ideal for postemergent spraying. In fields with heavy weed pressure, a residual soil-applied herbicide followed by a postemergent application of Roundup would be recommended, especially if weather conditions prevent a timely postemergent application of Roundup.

In the STS system (Table 3), Synchrony, applied postemergent in various tank-mix combinations, gave excellent control of broadleaf weeds with no crop injury. However, some pigweed species, such as waterhemp and Palmer pigweed, have developed resistance to Synchrony STS and other herbicides having the same mode of action. Management strategies such as alternative control methods, crop rotation, and use of herbicides with a different mode of action to replace or supplement Synchrony STS in a tank mix need to be considered in areas that may have resistant weed biotypes.

Table 1. Effects of Herbicides and Time of Application on Yield and Weed Control for Soybeans, Columbus Unit, Southeast Agricultural Research Center, 1997.

Trt	Time	Herbicide	Rate	Yield	Weed Control Lacg	Weed Control Cowh	Weed Control Cocb
			product/a	bu/a	---------- % ----------		
1	PPI	Steel	3 pt	42.0	94	90	98
2	SPPI	Freedom	3 qt	48.1	90	94	95
	POST	Storm	1.5 pt				
	POST	Crop Oil	1 %				
	POST	28% N	1 qt				
3	PPI	Prowl	2.4 pt	44.8	90	95	92
	POST	Raptor	5 oz				
	POST	Status	8 oz				
	POST	Crop Oil	1 %				
	POST	28% N	1 qt				
4	PPI	Treflan HFP	1 qt	48.6	88	92	91
	PPI	First Rate	0.6 oz				
5	PRE	Frontier (6EC)	25 oz	42.5	88	92	87
	PRE	Canopy XL	6.4 oz				
6	PRE	Dual	1 qt	45.4	98	90	94
	POST	Expert	1.5 oz				
	POST	Crop Oil	1 %				
	POST	28% N	1 qt				
7	PRE	Axiom	15 oz	49.1	98	96	97
	PRE	Sencor	5.3 oz				
	POST	Scepter	1.4 oz				
	POST	Crop Oil	1 %				
8	---	No herbicide	---	25.5	0	0	0
LSD (0.05):				3	3	3	3

Planted June 9, 1997; Variety = 5292. Weed rating: 8/5/97.
Date of herbicide applications: PPI (preplant incorporated) = 6/9; SPPI (shallow preplant incorporated = 6/9; PRE (preemergent) = 6/9; POST (postemergent) = 7/7.
Lacg = large crabgrass; Cowh = common waterhemp; Cocb = common cocklebur.

Table 2. Effects of Herbicides and Time of Application on Yield and Weed Control for Soybeans, Columbus Unit, Southeast Agricultural Research Center, 1997.

Trt	Time	Herbicide	Rate	Yield	Weed Control Lacg	Weed Control Cowh	Weed Control Cocb
			product/a	bu/a	---------- % ----------		
1	PPI POST	Prowl Roundup	2.4 pt 1.5 pt	51.6	97	94	96
2	PPI POST	Squadron Roundup	3 pt 1 pt	47.8	96	95	96
3	SPPI POST	Freedom Roundup	3 qt 1.5 pt	52.8	98	98	98
4	POST	Roundup + Cultivation	1.5 pt	55.5	94	96	97
5	POST POST	Roundup Am. Sulfate	1.5 pt 3 lb	53.9	96	94	98
6	EP POST	Roundup Roundup	1 pt 1 pt	52.8	96	96	98
7	POST	Roundup	2 pt	54.4	94	93	98
8	---	No Herbicide	---	26.8	0	0	0
LSD (0.05):				4	3	3	4

Planted June 9, 1997; Variety = Asgrow 4601 (Roundup Ready)
Date of herbicide applications: PPI (preplant incorporated) = 6/9; SPPI (shallow preplant incorporated = 6/9; PRE (preemergent) = 6/9; EP (early postemergent) = 7/1; POST (postemergent) = 7/7; Lacg = large crabgrass; Cowh = common waterhemp; Cocb = common cocklebur.
Weed rating 8/5/97.

Table 3. Effects of Herbicides and Time of Application on Yield and Weed Control for Soybeans, Columbus Unit, Southeast Agricultural Research Center, 1997.

Trt	Time	Herbicide	Rate	Yield	Weed Control		
					Lacg	Cowh	Cocb
			product/a	bu/a	---------- % ----------		
1	PPI	Prowl	2.4 pt	48.9	93	98	100
	POST	Synchrony STS	0.85 oz				
	POST	Crop Oil	1 %				
	POST	28% N	1 qt				
2	SPPI	Freedom	3 qt	49.8	97	98	100
	POST	Synchrony STS	0.85 oz				
	POST	Crop Oil	1 %				
	POST	28% N	1 qt				
3	PRE	Dual	1.5 pt	47.1	98	98	89
	PRE	Canopy	5 oz				
4	POST	Synchrony STS	0.85 oz	47.3	97	98	100
	POST	Cobra	6 oz				
	POST	NIS	0.25%				
	POST	28% N	1 qt				
	L-POST	Assure II	8 oz				
	L-POST	Crop Oil	1 %				
5	PRE	Frontier	25 oz	49.9	98	98	91
	PRE	Canopy XL	6.4 oz				
6	POST	Synchrony STS	0.85 oz	49.4	98	91	100
	POST	Assure II	8 oz				
	POST	Crop Oil	1 %				
	POST	28% N	1 qt				
7	POST	Assure II	8 oz	51.1	98	95	100
	POST	Crop Oil	1 %				
	L-POST	Synchrony STS	0.85 oz				
	L-POST	Crop Oil	1 %				
	L-POST	28% N	1 qt				
8	---	No Herbicide		24.8	0	0	0
LSD (0.05):				5	3	3	4

Planted June 9, 1997; Variety = Asgrow 5545 (STS). Weed rating 8/5/97.
Date of herbicide applications: PPI (preplant incorporated) = 6/9; SPPI (shallow preplant incorporated = 6/9; PRE (preemergent) = 6/9; EP (early postemergent) = 7/1; POST (postemergent) = 7/7; L-POST (late postemergent) = 7/11.
Lacg = large crabgrass; Cowh = common waterhemp; Cocb = common cocklebur.

SOYBEAN VARIETY TRIAL FOR CYST NEMATODE RESISTANCE

James H. Long, William T. Schapaugh[1], Ted Wary[2], and Timothy C. Todd [3]

Summary

Soybeans varieties with resistance to soybean cyst nematode (SCN) have prevented as much as 50 % of the grain yield loss seen for varieties without such resistance in Cherokee County, Kansas since 1991. During this 4-year study, severe drought occurred in 1995, whereas 1994, 1996, and 1997 were normal to wet years. Several varieties in both Maturity Groups IV and V had very good yield potential and adequate SCN resistance. These could be used in suitable rotations to combat the pest.

Introduction

The appearance of SCN in Southeastern Kansas has complicated the production of soybeans by requiring a definite plan to combat the pest. Part of this planning is to use varieties that are resistant to the nematode. Ongoing trials to identify adapted resistant varieties were established in an area of the southeast region, Cherokee County, known to have damaging populations of the pest.

Experimental Procedures

Fifty four varieties of soybeans, some rated as resistant to SCN, were planted on June 21, 1997, in cooperation with Roger Draeger on the Wilkinson farm in Pittsburg, Kansas. Seed were planted at eight per row foot in 30-inch rows. Maturities were rated in September and October, and plots were harvested with a plot combine in October. Test weight and seed moisture were measured with a Dickey-John analyzer, and grain yields were adjusted to 13 % moisture.

Results and Discussion

Varieties with resistance to SCN prevented yield losses of 30 % to 40% during the years 1994 - 1997 (Table 1). Resistant Maturity Group (MG) V varieties such as 'Manokin', and 'Pioneer 9521' averaged yields of 38 bu/a for the 4-year period. Susceptible varieties of similar maturity, such as 'Essex', had average yields of only 26 bu/a during the same period. Several resistant MG IV varieties yielded 33-36 bu/a during the 1994-97 period and were superior to ‘Flyer’, a susceptible MG IV variety that yielded approximately 23 bu/a during that same period. These varieties include ‘NC+ 4A27', ‘Midland 8475', ‘Novartis S4644', and ‘Terra TS4792'. Several new MG IV and MG V varieties have just been put into the performance test and look very promising. More variety test information can be found in Report of Progress 798, 1997 Kansas Performance Tests with Soybean Varieties.

[1] Department of Agronomy, KSU.

[2] Formerly Cherokee County Extension Agent.

[3] Department of Plant Pathology, KSU.

Table 1. Grain Yield of SCN Soybean Variety Trial in Southeastern Kansas, 1994 - 1997 and Summaries.

Brand	Variety	MG	1994	1995	1996	1997	2-yr	3-yr	4-yr
			------bu/a------						
Dekalb	CX450C	IV	--	--	--	31.7	--	--	--
Dekalb	CX510C	V	--	--	32.0	41.7	36.9	--	--
Delange	DS466	IV	--	--	38.0	31.2	34.6	--	--
Dynagro	3444N	IV	--	--	32.7	40.9	36.8	--	--
Dynagro	3395	III	--	--	--	32.2	--	--	--
Hoegemeyer	471 SCN IV	--	--	--	37.5	--	--	--	
Hornbeck	HBK 4600	IV	--	--	--	38.9	--	--	--
Golden Harvest	H1454	IV	--	25.6	29.9	34.8	32.4	30.1	--
Golden Harvest	X 487	IV	--	--	--	40.3	--	--	--
Golden Harvest	H1500	V	--	30.4	31.3	38.6	34.9	33.4	--
Garst	EX 7470N	IV	--	--	--	41.3	--	--	--
Garst	D473	IV	--	--	32.6	39.8	36.2	--	--
Merschman	Richmond IV	IV	--	--	--	38.2	--	--	--
MSIA	Magellan IV	--	--	--	34.4	--	--	--	
MSIA	Mustang	IV	--	--	--	40.3	--	--	--
Midland	8401	IV	--	--	28.2	30.3	29.2	--	--
Midland	8475	IV	39.3	28.4	33.9	40.1	37.0	34.1	35.4
Midland	XP530N	V	--	--	--	41.4	--	--	--
Midland	XP521N	V	--	--	--	42.7	--	--	--
Mycogen 429	IV	--	25.6	31.7	25.9	28.8	27.7	--	
NC +	4A27	IV	41.3	30.3	32.8	39.5	36.2	34.2	36.0
NC +	5A44	V	--	--	35.3	41.9	38.6	--	--
Novartis	S46-44	IV	33.6	27.3	34.1	39.8	37.0	33.8	33.7
Novartis	3505	V	--	--	--	40.3	--	--	--
Novartis	S57-11	V	--	--	28.4	33.4	30.9	--	--
Patriot	412N	IV	--	--	--	40.1	--	--	--
Patriot	452N	IV	--	--	--	37.2	--	--	--
Patriot	457N	IV	--	--	--	45.0	--	--	--
Patriot	482N	IV	--	--	--	37.9	--	--	--
Pioneer	94B41	IV	--	--	--	41.7	--	--	--
Pioneer	9492	IV	--	--	--	40.7	--	--	--
Pioneer	9521	V	42.5	31.2	38.7	40.0	39.3	36.6	38.1
Stine	4292	IV	--	--	--	37.7	--	--	--
Terra	TS4792	IV	33.8	27.5	31.5	38.9	35.2	32.7	32.9
Terra	TS5504	V	--	--	31.0	41.3	36.1	--	--
Willcross	9539N +	III	--	--	--	36.7	--	--	--
Willcross	AP-40N	IV	--	--	--	35.6	--	--	--
Willcross	9541N	IV	--	--	32.9	40.6	36.8	--	--
Willcross	467	IV	--	--	--	35.4	--	--	
Willcross	9644N	IV	--	--	34.6	40.1	37.3	--	--
Willcross	9650N	V	--	--	32.6	40.3	36.5	--	--
Willcross	517	V	--	--	--	39.9	--	--	--
Public	Flyer	IV	20.2	18.1	25.3	27.9	26.6	23.7	22.9
Public	Stafford	IV	29.3	20.9	25.7	32.2	29.0	26.3	27.0
Public	Essex	V	28.8	19.3	37.4	34.2	28.2	25.2	26.1
Public	Holladay	V	34.9	22.1	26.4	36.4	31.4	28.3	29.9
Public	Hutcheson	V	25.4	31.5	23.2	26.0	24.6	26.9	26.5
Public	Delsoy 4710	IV	39.2	26.9	31.4	34.9	33.2	31.1	33.1
Public	Manokin	IV/V	42.2	32.3	37.4	40.7	39.1	36.8	38.2
Public	Hartwig	V	36.1	30.5	28.2	38.3	33.3	32.4	33.3
Public	KS 5292	V	--	28.7	27.7	39.1	33.4	31.9	--
Public	Stressland	IV	--	19.3	26.7	32.9	29.8	26.3	--
Public	K1307	V	--	--	30.5	37.8	34.1	--	--
Average			35.6	26.9	30.2	37.9	--	--	--
LSD (.1)			3.6	2.7	3.8	4.1	--	--	--

PERFORMANCE TRIAL OF DOUBLE-CROPPED SOYBEAN VARIETIES

James H. Long and Gary L. Kilgore[1]

Summary

Eighteen double-cropped soybean varieties were planted following winter wheat in Columbus, Kansas and evaluated for yield and other agronomic characteristics throughout the summer of 1997. Grain yields were excellent, and variety differences were seen under the very good growing conditions. Yields ranged from 30 bu/a to near 46 bu/a. The short-season Maturity Group (MG) IV varieties matured during the first week of October, whereas long-season varieties in MG V matured as much as 3 weeks later. Generally, varieties were more than 2 feet tall.

Introduction

Double-cropped soybean is an opportunistic crop grown after winter wheat over a wide area of southeast Kansas. Because this crop is vulnerable to weather-related stress, such as drought and early frosts, it is important that the varieties have not only high yield potential under these conditions but also the plant structure to allow them to set pods high enough to be harvested. They also should mature before a threat of frost.

Experimental Procedures

Soybean varieties were planted to moisture following winter wheat harvest at the Southeast Agricultural Research Center at Columbus. The soil is a Parsons silt loam. The wheat stubble was burned, then Squadron herbicide was applied before the area was field cultivated prior to planting. Soybean then was planted on July 2, 1997 at 10 seed per foot of row. A shower 24 hours after planting assured a nearly perfect stand. Excellent growing conditions persisted even during harvest, which occurred on October 23, 1997.

Results and Discussion

Yields ranged from 30 bu/a to near 46 bu/a (Table 1). Several varieties yielded over 40 bu/a, which is excellent for this area. Consideration should be given to plant height and maturity during years such as 1997. Overall plant heights ranged from only 18.9 in to 30.3 in. Most varieties matured before October 15; however, some MG V varieties matured 1 week later.

[1] Southeast Area Extension Agronomist, Chanute, KS.

Table 1. Yield of Double-Cropped Variety Trial for Soybeans at Columbus, Parsons, and Altamont, Kansas, 1994-1997. Grouping based on maturity.

Brand	Variety	Yield 1997	1996	1995	1994	1997 Characteristics Ht	Mat In Oct.	Mat 2 yr Avg.
		--------------bu/a------------				-in-		
Mycogen	5404	35.0	--	--	--	18.9	1.5	--
Hoegemeyer	371 SCN	30.6	--	--	--	19.5	2.3	--
Check Early MG IV	Flyer	40.1	10.1	14.9	17.0	25.5	5.3	5.2
Hoegemeyer	471 SCN	30.6	--	--	--	23.5	5.5	--
Mycogen	5430	34.5	--	--	--	21.0	5.5	--
Delange	DS410	32.6	--	--	--	23.0	6.0	--
Delange	DS454	45.8	--	--	--	27.3	7.0	--
Check Mid MG IV	KS4694	40.2	6.5	--	--	24.3	7.5	10.2
Dekalb	CX450C	41.9	--	--	--	27.5	8.0	--
Midland	8496	42.9	--	--	--	29.0	8.0	--
Mycogen	470	40.8	--	--	--	27.0	9.0	--
Pioneer	9481	36.0	--	--	--	28.3	9.0	--
Pioneer	9452	33.1	--	--	--	20.3	9.0	--
Check Late MGIV	KS4997	42.0	--	--	--	24.3	15.0	--
Pioneer	9521	41.9	21.9	--	--	26.3	20.8	18.9
Public Early MG V	Manokin	43.5	17.4	19.8	26.5	26.8	22.0	17.0
Check Early MG V	KS5292	39.5	13.3	13.8	25.4	23.8	22.8	17.8
Check Mid MG V	Forrest	37.1	--	--	--	30.3	25.0	--
LSD (0.05)		5.2	5.6	--	--	3.9	2.5	--
Averages		38.2	11.4	15.6	23.6	15.5	--	--

PERFORMANCE TRIAL OF RIVER-BOTTOM SOYBEAN VARIETIES

James H. Long and Gary L. Kilgore[1]

Summary

Thirteen soybean varieties, typically grown on deep river bottom soils, were planted at Erie, Kansas and evaluated for yield and other agronomic characteristics throughout the summer of 1997. Grain yields were excellent, and variety differences were seen with the very productive soils. Yields ranged from 53 bu/a to over 63 bu/a. The shorter-season Maturity Group (MG) IV varieties yielded as well or better than the MG V varieties. The soybeans were tall, and some lodging did occur.

Introduction

Full-season soybeans are grown on the highly productive river-bottom soils of southeast Kansas. Because this crop is not as vulnerable to weather-related stress, such as drought, it is important that the varieties have high yield potential and low levels of lodging. In addition, it is important that the crop be harvested before fall rains make clayey soils impassable or heavier precipitation causes flooding.

Experimental Procedures

Thirteen soybean varieties were grown following soybeans in 1996. The farmer/cooperator was Joe Harris. The soil is a Lanton deep silt loam that sits on the Neosho flood plain approximately 1750 feet from the river channel. The soil was disked, Squadron herbicide was applied, and the soil field cultivated prior to planting. Soybean then was planted on May 29, 1997 at 10 seed per foot of row. Plants emerged to form an excellent stand. Basagran was applied postemergent to help control cocklebur. Warm and moist conditions persisted until late summer, and soybean grew throughout the season. The soybeans were harvested on October 21, 1997.

Results and Discussion

Yields ranged from 52.9 bu/a to 63.5 bu/a (Table 1). Several varieties yielded more than 60 bu/a for the 1997 growing season, and several also have averaged more than a 60 bu/a for the 2 years of the study. The varieties 'Pioneer 9412', 'Midland 8413', and 'Flyer' have the highest 2 year averages. Consideration should be given to plant height and its effect on lodging as well as plant maturity. Overall plant height ranged from 34.3 to 44 in. Notice that some of the highest grain yields were obtained from the shortest varieties. With respect to plant maturity, the indeterminate, early to mid MG IV varieties yielded as well or better than the determinate growth habit, MG V varieties in the test.

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[1] Southeast Area Extension Agronomist, Chanute, KS.

Table 1. Yield of River-Bottom Soybean Variety Trial at Erie, Kansas, 1996-97.

Brand	Variety	Yield 1997	Yield 1996	Yield 2 yr Avg.	1997 Characteristics Lodging[1]	1997 Characteristics Height of Plant	1997 Characteristics Mat from Sep 1
		--------bu/a-----------				-in-	
Pioneer	9412	63.5	70.8	67.2	2.8	36.5	24.5
Midland	8410	57.7	59.9	58.8	4.3	38.3	26.3
Early Check	Flyer	54.7	66.2	60.5	3.0	37.5	27.3
Pioneer	9452	61.9	--	--	1.8	35.8	28.0
DynaGro	237	52.9	--	--	3.3	40.3	28.3
Midland	8413	57.1	66.8	62.0	2.3	37.5	28.5
Pioneer	9421	60.5	--	--	4.0	41.5	28.5
Delange	DS454	59.0	--	--	3.3	44.0	30.3
DynaGro	236	60.8	--	--	3.5	42.5	31.0
Dekalb	CX510	58.6	--	--	2.3	34.5	33.0
Mid Check	KS4694	53.1	65.7	59.4	1.8	35.0	33.0
Late Check	KS5292	56.9	58.1	57.5	1.3	35.8	41.5
DynaGro	238	60.1	--	--	2.3	34.3	42.5
Averages		58.2	62.8	--	6.8	40.4	--
(L.S.D. 0.05)		5.8	6.9	--	1.1	4.5	2.8

[1] Lodging based on a scale of 1 to 5 with 1 standing upright and 5 flat on the ground.

PERFORMANCE TRIAL OF SUNFLOWER HYBRIDS WITH TWO PLANTING DATES

James H. Long and Gary L. Kilgore[1]

Summary

Twelve sunflower hybrids were grown on upland soils and evaluated for yield and other agronomic characteristics throughout the summer of 1997. The weather was cool and other summer crops did well, yet sunflower seed yields were low. However, seed yield differences were seen. Yields ranged from 600 to near 1400 lb/a. The second (late) planting yielded as well as the early full-season planting averaging approximately 1000 lb/a of seed.

Introduction

Sunflowers are grown in southeast Kansas to provide a high oil, high energy supplement for the birdseed market. They also can be grown after winter wheat in a doublecrop system. It is important that the varieties have high yield potential under the dry and hot conditions of southeast Kansas in summer and low levels of lodging, because sunflower is a tall crop.

Experimental Procedures

Twelve sunflower hybrids were grown in 1997 following a previous crop of soybeans on the Mark Piper farm in Altamont, KS. The soil is a Parsons silt loam that typically is cropped on the upland.. Treflan herbicide was applied, the soil was disked and field cultivated, and 90 lb/a of N were added prior to planting. The first planting occurred on June 7, 1997 and the second planting occurred following a field cultivation on July 3, 1997. Stands were thinned back to 20,000 plants/a. The plots then were cultivated before canopy closure. Excellent growing conditions lasted all summer so the plants were rarely under stress. Sunflowers were harvested on September 16 for the early planting and on October 20, 1997 for the late planting.

Results and Discussion

Yields ranged from 600 lb/a to 1400 lb/a (Tables 1 and 2), which were lower than expected. Average yields from both planting dates were near 1000 lb/a of seed. The hybrids Dekalb 3790, Pioneer 6338, and Novartis 231 were in the top yield group for the early planting and Cargill SF270, Pioneer 6451, and Novartis 231 were top yielders for the late planting. Over the 2 years of the study Novartis 231 and Dekalb 3790 have done best when planted early while Novartis 231 and Pioneer 6451 have done best when planted late. Consideration should be given to the height and lodging characteristics of each hybrid. Sunflowers can be tall, and average height for the first planting date was over 5 ft. However, hybrids in the late planting had the most lodging problems when harvest was delayed. Cargill SF270 had the least (10%) lodging among hybrids planted in July.

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[1] Southeast Area Extension Agronomist, Chanute, KS.

Table 1. Seed Yield of Sunflower Hybrids Planted Early (May 28, 1996 and June 7, 1997) in Southeastern Kansas.

Brand	Variety	Yield 1997	Yield 1996	Lodging (1997 Characteristics)	Height of Plant (1997 Characteristics)	Bloom Date After 7/1 (1997 Characteristics)
		-----lb/a-----		-%-	-in-	
Asgrow	545	748	--	0.5	63.5	30.5
Asgrow	3211	652	--	0.5	69.0	28.0
Cargill	SF187	974	1884	0.3	57.3	32.3
Cargill	SF270	988	--	0.5	63.8	31.5
Dekalb	3790	1217	1575	0.8	64.8	30.3
Dekalb	3785	912	--	1.0	66.3	31.3
Interstate	IS6767	951	--	1.8	64.5	31.0
Interstate	IS6077	576	1754	11.3	69.3	32.0
Novartis	231	1240	1759	0.8	63.0	32.0
Pioneer	6338	1013	--	1.0	67.0	32.3
Pioneer	6340	992	--	0.3	61.5	30.5
Pioneer	6451	943	1694	0.3	64.3	30.8
Averages		934	1567	1.6	64.5	31.0 (Jul 31)
LSD (0.05 in 1996, 0.1 in 1997)		224	655	2.4	3.9	1.3

Table 2. Seed Yield of Sunflower Hybrids Planted Late (June 24, 1996, and July 3, 1997) in Southeastern Kansas.

Brand	Variety	Yield 1997	Yield 1996	1997 Characteristics: Lodging	Height of Plant	Bloom Aug. after 8/1
		-----lb/a------			-%-	-in-
Asgrow	545	1010	--	20.5	51.8	21.5
Asgrow	3211	801	--	20.5	54.8	23.0
Cargill	SF187	1070	1840	23.8	48.8	25.5
Cargill	SF270	1304	--	10.0	53.0	21.5
Dekalb	3790	871	1369	15.0	58.0	19.5
Dekalb	3785	956	--	31.3	54.5	20.5
Interstate	6767	1037	--	23.8	49.8	21.0
Interstate	6077	614	1415	21.3	53.8	22.0
Novartis	231	1382	2199	17.5	54.3	21.0
Pioneer	6338	1020	--	23.8	55.0	20.5
Pioneer	6340	1082	--	13.8	61.3	22.5
Pioneer	6451	1230	1888	23.8	55.0	21.5
Averages		1031	1496	20.4	54.2	21.7
(LSD (0.05 in 1996, .1 in 1997)		235	569	12.9	8.8	2.7

ANNUAL WEATHER SUMMARY FOR PARSONS — 1997

Mary Knapp[1]

1997 Data

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg. Max	39.7	47.0	59.2	62.5	74.8	83.2	88.5	85.8	81.1	69.4	52.1	42.4	65.5
Avg. Min	17.6	30.1	35.0	40.5	50.8	62.7	68.1	65.5	59.7	48.4	34.6	27.8	45.1
Avg. Mean	28.7	38.6	47.1	51.5	62.8	73.0	78.3	75.6	70.4	58.9	43.4	35.1	55.3
Precip	0.58	4.38	2.11	2.6	5.30	7.32	5.31	4.39	5.49	3.17	1.94	3.93	46.51
Snow	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Heat DD*	1126	806	556	405	122	4	2	2	26	264	650	928	4890
Cool DD*	0	0	0	0	53	243	414	332	187	75	0	0	1304
Rain Days	3	7	9	7	9	9	7	8	10	7	7	11	94
Min < 10	10	1	0	0	0	0	0	0	0	0	0	0	11
Min < 32	25	22	11	6	0	0	0	0	0	2	15	24	105
Max > 90	0	0	0	0	0	3	14	11	6	0	0	0	34

NORMAL VALUES (1961-1990)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg. Max	40.5	46.6	57.1	68.2	76.8	85.2	91.7	90.1	81.5	71.3	56.8	44.5	67.5
Avg. Min	19.3	24.8	34.2	45.8	55.5	64.1	69.0	66.4	59.1	47.3	35.7	24.8	45.5
Avg. Mean	29.9	35.7	45.7	57.0	66.2	74.7	80.3	78.3	70.3	59.4	46.3	37.0	56.5
Precip	1.32	1.46	3.40	3.80	5.26	4.61	3.15	3.63	4.80	3.92	2.91	1.76	40.02
Snow	2.0	3.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	8.5
Heat DD	1088	820	598	261	88	0	0	0	31	220	561	939	4606
Cool DD	0	0	0	21	125	294	474	412	190	46	0	0	1562

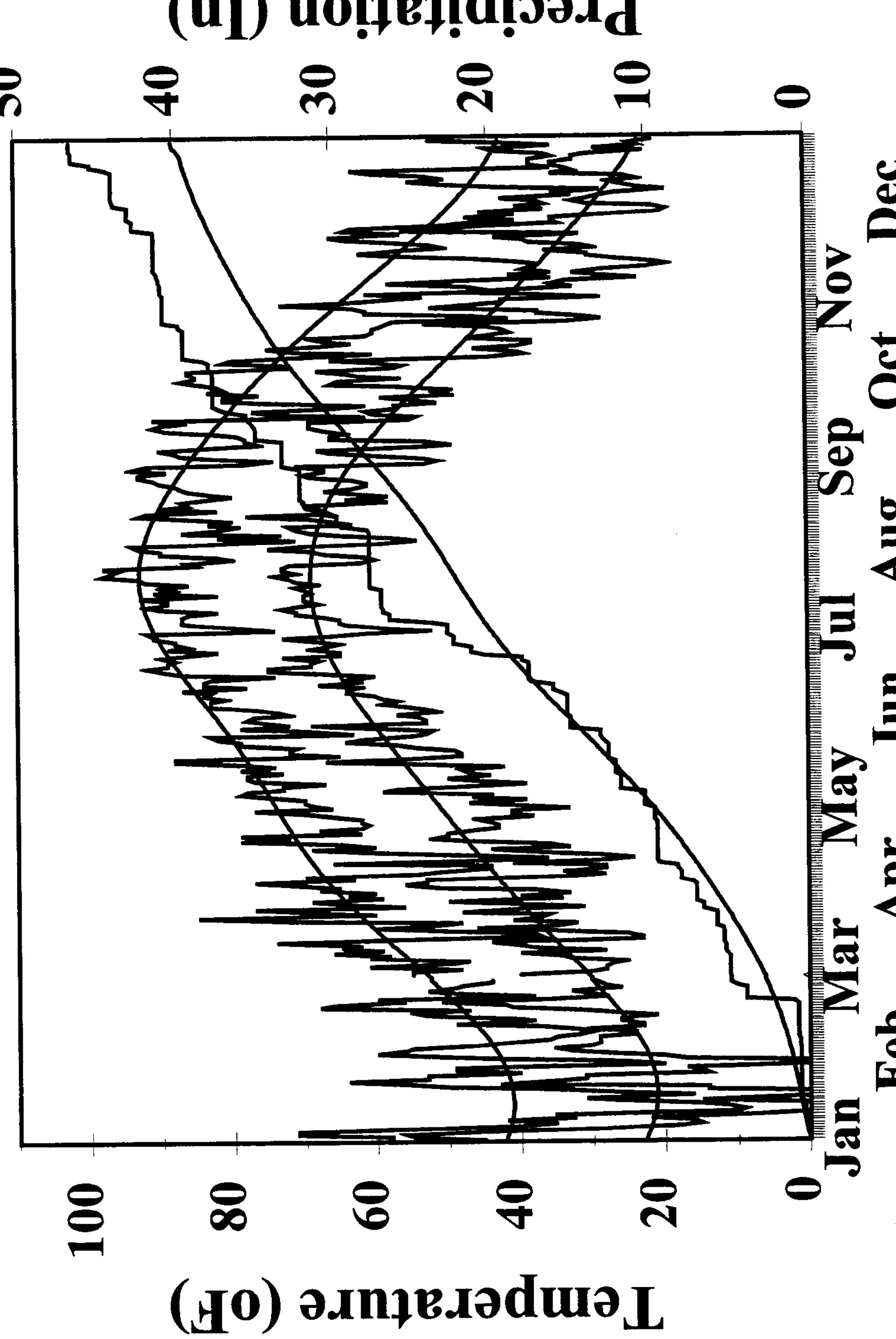
DEPARTURE FROM NORMAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg. Max	-0.8	0.4	2.1	-5.7	-2.0	-2.0	-3.2	-4.3	-0.4	-1.9	-4.7	-2.1	-2.1
Avg. Min	-1.7	5.3	0.8	-5.3	-4.7	-1.4	-0.9	-0.9	0.6	1.1	-1.1	3.0	-0.4
Avg. Mean	-1.2	2.9	1.4	-5.5	-3.4	-1.7	-2.0	-2.7	0.1	-0.5	-3.0	-1.9	-1.5
Prcip	-0.74	2.92	-1.29	-1.21	0.04	2.71	2.16	0.76	0.69	-0.75	-0.97	2.17	6.49
Snow	0.0	-3.0	-1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	0.0	-6.5
Heat DD	39	-15	-43	144	34	4	2	3	-6	44	89	-12	284
Cool DD	0	0	0	-21	-72	-51	-60	-80	-3	29	0	0	-258

* Daily values were computed from mean temperatures. Each degree that a day's mean is below (or above) 65 F is counted for one heating (or cooling) degree day.

[1] Assistant Specialist, Weather Data Library, KSU.

1997



Temperature (oF)
0
20
40
60
80
100
Precipitation (In)
0
10
20
30
40
50
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

ACKNOWLEDGMENTS

Listed below are individuals, organizations, and firms that have contributed to this year's research programs through financial support, product donations, or services.

ABI Alfalfa, Ames, IA
AgriPro Biosciences, Inc., Shawnee Mission, KS
AGSECO, Girard, KS
American Cyanamid Co., Wayne, NJ
Bartlett Coop Association
BASF Wyandotte Corp., Parsippany, NJ
Bayer Corp., Kansas City, MO
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DuPont Agrichemical Co., Wilmington, DE
Elanco Products Co., Greenfield, IN
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Calvin Flaharty, McCune, KS
FMC Corp., Philadelphia, PA
Forage Genetics, Minneapolis, MN
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Ft. Dodge Animal Health, Overland Park, KS
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Johnson Seed Co., Mound Valley, KS
Jones Farm Services, Willard, MO
Kansas Corn Commission, Topeka, KS
Kansas Fertilizer Research Fund, Topeka, KS
Kansas Soybean Commission, Topeka, KS
Mallinckrodt Veterinary, Terre Haute, IN
Markley Seed Farms, Dennis, KS
Martin Farms, Columbus, KS
Merck & Co, Inc., Rahway, NJ
Midwest Minerals, Pittsburg, KS
Monsanto Agricultural Products, St. Louis, MO
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Mycogen Plant Sciences, Tulia, TX
Northrup King Co., Victoria, TX
Novartis Crop Protection, Greensboro, NC
Ohlde Seed Co., Palmer, KS
Parsons Livestock Market, Parsons, KS
Pfizer, Inc., Lee's Summit, MO
Mark Piper, Parsons, KS
Pioneer Hi-Bred International, Johnston, IA
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Terra International, Inc., Champaign, IL.
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Kansas State University Agricultural Experiment Station and Cooperative Extension Service, Manhattan 66506

SRP 809 May 1998