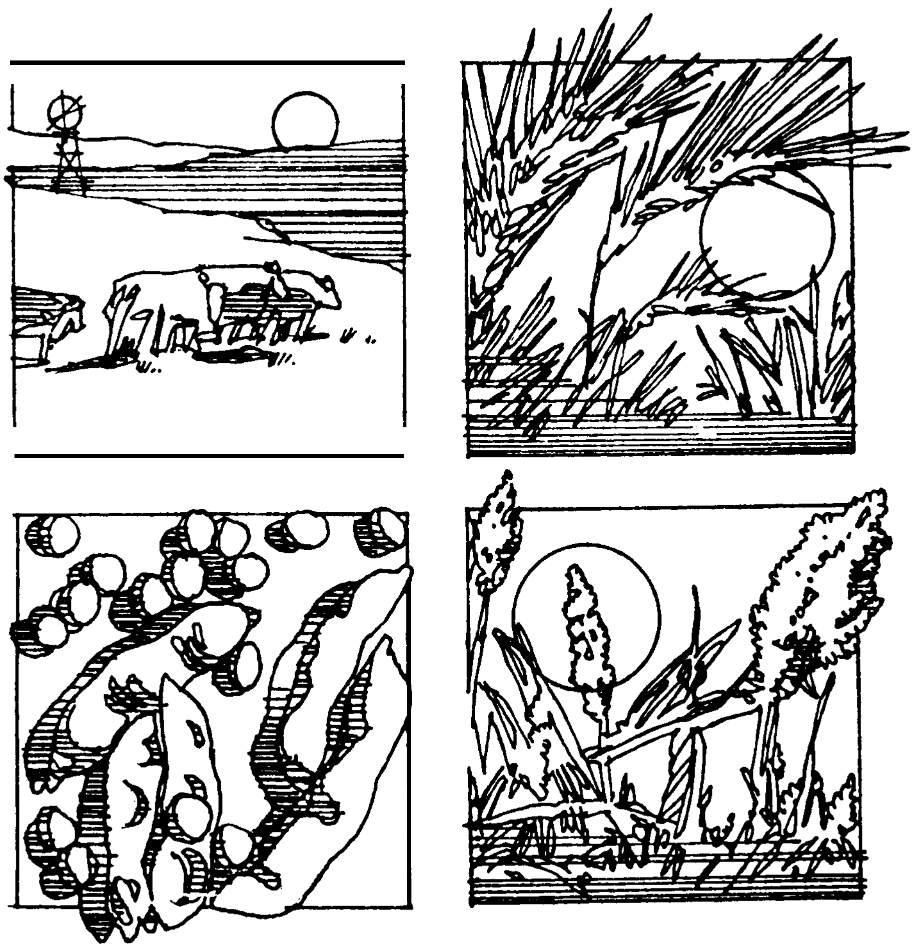
1992 AGRICULTURAL RESEARCH



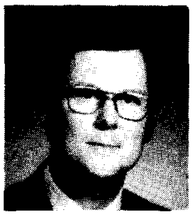
Report of Progress 654

Agricultural Experiment Station

Kansas State University, Manhattan

Walter R. Woods, Director

SOUTHEAST KANSAS BRANCH STATION



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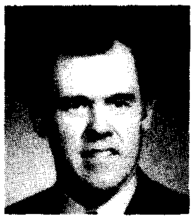

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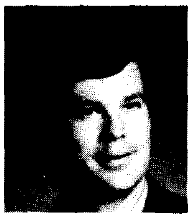

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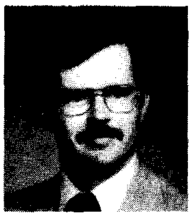

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EFFECT OF WEATHERING ON GRAIN SORGHUM STUBBLE QUALITY

Kenneth P. Coffey and Kenneth Kelley

Summary

Grain sorghum stubble was harvested from 35 plots representing 35 different hybrids before and after a 3.2 in. rain. Quality analyses were conducted on stubble leaves, stalks, and threshed heads. In vitro digestibilities were lower ($P < .01$) and crude protein and fiber contents higher ($P < .01$) in threshed heads collected after rain than in those collected before rain. Leaf concentrations of crude protein and digestible dry matter were higher ($P < .01$) and ash content was lower ($P <. 01$) before than after rain. In vitro digestibility of stalks was higher ($P < .01$) and lignin concentration lower ($P < .01$) before than after rain. Therefore, it is apparent that rainfall substantially reduces the quality of each component of grain sorghum stubble.

Introduction

Grain sorghum stubble is a plentiful but underutilized ruminant feed resource in Southeast Kansas. Previous work has demonstrated the benefits of ammoniation of grain sorghum stubble, but little is known about the effects of weathering on stubble quality. This study was conducted to determine the effects of 3.2 inches of rain on nutrient composition of grain sorghum stubble.

Experimental Procedure

Grain sorghum grain was harvested from SEKES grain sorghum performance test plots on September 29, 1989. On October 5, 10 stalks and 15 threshed heads were collected from each of 35 plots representing 35 different grain sorghum hybrids. Stalks were cut to an average height of 2 inches and the leaves were removed. That evening, 3.2 inches of rain fell on the field. On October 10, 10 stalks and 15 threshed heads were collected from the same 35 plots. All samples were oven dried at 130°F; ground to pass through a 1 mm screen; and analyzed for ash, crude protein (CP), in vitro digestibility (IVDMD), neutral (NDF) and acid detergent fiber (ADF), and acid detergent lignin (ADL).

Results and Discussion

Rain had a significant impact on the quality of each of the stubble constituents evaluated (Table 1). Crude protein content of leaves was higher ($P < .01$) before than after rain but that of heads was greater ($P < .01$) after than before the rain. Because most plant protein is water soluble, it is not certain why crude protein content of heads would be greater after a rain than before. Ash content of leaves was greater ($P < .01$) and that of heads tended ($P = .13$) to be greater after rain. However, protein and ash contents of stalks were not affected by rain. Both NDF and ADF of heads and ADF of stalks were greater ($P < .01$) after than before rain. Lignin content of stalks was also higher ($P < .01$) after than before rain. Digestibilities of all three stubble components were lower ($P < .01$) after than before rain. This would be expected, because many of the more digestible nutrients are water soluble. Removal of those more highly digestible nutrients by rainfall, therefore, would increase the relative concentrations of the nutrients that are either less or at least more slowly digested, such as fiber and ash. Therefore, rainfall leached valuable plant nutrients and substantially reduced the feed value of the stubble constituents.

Table 1. Effect of Rain on Quality of Grain Sorghum Stubble Constituents.

	Leaves		Stalks		Heads	
Variable	before rain	after rain	before rain	after rain	before rain	after rain
Crude protein, %	9.3[a]	7.9[b]	4.5	4.6	4.8[b]	5.2[a]
Ash, %	11.7[b]	15.9[a]	8.0	8.0	10.4	10.9
NDF, %	61.1	62.1	61.1	61.5	71.2[b]	74.2[a]
ADF, %	31.2	30.8	32.8[d]	33.9[c]	40.9[b]	42.6[a]
ADL, %	4.0	3.9	3.8[b]	4.4[a]	7.0	7.0
IVDMD, %	56.3[a]	49.2[b]	65.5[a]	61.5[b]	38.4[a]	34.3[b]

[a,b]Means within a stubble constituent differ ($P < .01$).
[c,d]Means within a stubble constituent differ ($P < .05$).

VARIATION IN DIGESTIBILITY OF GRAIN SORGHUM STUBBLE AMONG HYBRIDS

Kenneth P. Coffey and Kenneth Kelley

Summary

Twelve grain sorghum hybrids were selected based on consistent yield indexes in 1989 and 1990 grain sorghum performance tests, and stubble samples were collected. Hybrids were classified as either high, average, or low yield based on yearly indexes. Heads from high- and average-yield groups were more digestible ($P < .05$) than those from the low-yield group. Leaves from high- and low-yield groups were more ($P < .05$) digestible than those from the average-yield group. Stalks from the low-yield group were more ($P < .05$) digestible than stalks from the average-yield group, but digestibility of stalks from the high-yield group was not different ($P > .05$) from that of either the low- or the average-yield groups. Therefore, digestibility of grain sorghum residue may be directly related to relative grain yield, with average yielding hybrids generally being lower in digestibility.

Introduction

Grain sorghum stubble is a plentiful roughage source for cattle in southeastern Kansas. Currently, there is tremendous potential to utilize this resource to reduce hay expenditures. However, more information is needed concerning its feed value. This experiment was conducted to evaluate how quality of grain sorghum stubble constituents differs among hybrids and to determine if these differences are related to grain yield.

Experimental Procedure

Twelve grain sorghum hybrids were selected from over 80 different hybrids in the Southeast Kansas grain sorghum performance test. Selection criteria considered were 1) the hybrids must have been entered in the performance test in both 1989 and 1990; 2) yields during both growing seasons must have been consistent relative to the average of all other hybrids in the test; and 3) the hybrids must have been able to have been classified as having high, average, or low grain yield relative to all other hybrids in the performance test. Ten stalks and 15 threshed heads were selected at random from each of three replicates of each hybrid. The stalks were cut to an average height of 2" with corn knives, and leaves were removed. All samples were dried at 130°F, ground to pass through a 1mm screen, and analyzed for in vitro digestibility (IVDMD).

Grain was harvested from the plots on September 27, 1989 and October 11, 1990. Stubble samples were collected on October 10, 1989 after a 3.2 inch rain and on October 15, 1990 prior to any measurable precipitation. Hybrids selected, along with yields, yield indexes, and grouping by yield index, are shown in Table 1.

Results and Discussion

Although digestibility differences existed between years, no interactions between year and hybrid or yield grouping were detected. Also, no differences were detected in the digestibility of the stubble constituents of the hybrids within a yield group. Therefore, digestibilities of the different grain sorghum stubble constituents from the different hybrids were combined within yield group and shown in Table 2. Digestibilities of leaves from high- and low-yield groups were similar to each other and were both higher ($P<.05$) than the digestibility of the leaves from the average-yield group. Stalks from the low-yield group were more digestible ($P<.05$) than those from the average-yield group. Digestibility of stalks from the high-yield group were not different ($P>.05$) from that of either the low- or average-yield groups. Heads from the high- and average-yield groups were more ($P<.05$) digestible than heads from the low-yield group.

Therefore, relative yield of grain sorghum appears to have a significant effect on digestibility of the stubble constituents. Generally, hybrids yielding either high or low relative to other varieties were more digestible than average-yielding hybrids.

Table 1. Yields, Yield Indexes, and Yield Grouping of Selected Grain Sorghum Hybrids.

Brand	Hybrid	Yield, bu/ac 1989	Yield, bu/ac 1990	Yield Index 1989	Yield Index 1990	Average Index	Yield Grouping
Cargill	575	115	76	89	97	93	Low
Cargill	847	131	77	101	98	99.5	Average
Delange	DSA 922	142	84	109	108	108.5	High
Delange	DSA 141C	123	67	95	86	90.5	Low
Garrison	SG-932	144	89	110	114	112	High
Garst	5511	131	77	100	99	99.5	Average
Jacques	477-W	128	68	98	88	93	Low
Northrup-King	KS-737	132	78	101	100	100.5	Average
Ohlde	139A	129	79	99	101	100	Average
Ohlde	140W	124	73	96	94	95	Low
Pioneer	8379	141	89	108	114	111	High
Triumph	TW0 80-D	141	88	108	113	110.5	High
Test avg.	All entries	130	78	100	100	100	
Test avg.	Selected Hybrids	132	79	101	101	101	

Table 2. Effect of Relative Yield on Digestibility of Grain Sorghum Stubble Components.

Constituent	Yield Grouping High	Average	Low	$LSD_{.05}$
Leaf	51.0[a]	48.7[b]	52.2[a]	2.2
Stalks	56.8[ab]	54.0[b]	57.1[a]	2.8
Heads	42.0[a]	41.0[a]	39.4[b]	1.1

[a,b]Means within a row differ (P<.05).

HAY VS. DORMANT FESCUE FOR WINTERING STOCKER STEERS

Kenneth P. Coffey

Summary

Performance was measured from 82 stocker steers grazing dormant fescue or offered either hay during a 42-day winter study. All steers were offered 2 lb of a grain sorghum-based supplement daily. Steer gain was similar (P>.10) between treatments.

Introduction

Tall fescue is utilized to a large extent as a spring, fall and winter forage for beef cattle. Research from other states has shown the value of fall fertilization of fescue and grazing the vegetative regrowth during the fall. However, in dry years like 1991, fall regrowth was minimal until late in the fall. Many producers graze fescue not only during the fall but also during the winter. This experiment was conducted to compare performance by steers grazing dormant fescue with that by steers fed hay.

Experimental Procedure

Eighty-two crossbred steers were randomly allotted to four groups of 14 steers and 2 groups of 13 steers on January 21. Two of the groups of 14 and one group of 13 steers were randomly assigned to one of three 15-acre tall fescue pastures. The remaining groups of 13 or 14 steers were each assigned to one of three 5-acre bermudagrass pastures and offered hay ad libitum. Approximately 70% of the fescue plants were infected with the fungus *Acremonium coenophialum*. The bermudagrass pastures had been heavily grazed since late fall and had minimal available dormant bermudagrass. Hay consisted of a mixture of grasses with tall fescue predominating and was harvested at soft-dough maturity. All steers were offered 2 lb/day of a 20% crude protein grain sorghum-based supplement throughout the 42-day study.

Results and Discussion

Gain and daily gain were the same (P >. 10) for steers pastured on dormant fescue and those offered hay (Table 1). The reason for the similarity is not clear. Adequate forage was available on the fescue pastures. However, the particular pastures are highly infected with *A. coenophialum*. Gains from stocker cattle previously grazing these pastures has been low. Also, estimated hay consumption was 13.7 lbs./day, which was somewhat higher than expected. Therefore, from these data, one should expect similar performance from either grazing dormant *A. coenophialum*-infected fescue or feeding low quality fescue hay. However, production costs would differ considerably between these treatments.

Table 1. Performance of Stocker Steers Offered Hay or Dormant Fescue Pasture.[a]

Item	Pasture	Hay
Initial wt., lb.	568	554
Final wt., lb.	595	581
Total gain, lb.	27	27
Daily gain, lb.	.64	.64
Estimated hay consumption, lb.	0	575

[a]No significant (P<.10) differences were detected.

EFFICACY OF LAIDLOMYCIN PROPIONATE FOR IMPROVING WEIGHT GAIN OF GROWING CATTLE ON PASTURE[1]

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

Summary

A total of 160 mixed-breed steers was used in a 2-year grazing study on smooth bromegrass pastures to determine the effects of either 25, 50, or 75 mg/hd/d of laidlomycin propionate (LP) on steer performance. Steers were offered 1 lb/day of a ground grain sorghum carrier without LP or containing the different LP levels. Pastures were grazed for 119 days in 1990, beginning on April 24, and for 112 days in 1991, beginning on April 4. Laidlomycin propionate tended (P>.10) to improve animal gain by 1.9, 6.3, and 5.9 % for 25, 50 and 75 mg/hd/d, respectively. Amount of shrink incurred following a 16-h removal from feed and water was not affected by ionophore level. Apparently, LP has the potential to improve gains from grazing cattle. However, the magnitude of improvement appears to be somewhat low and related to LP level.

Introduction

Ionophores have been used in recent years to alter rumen fermentation such that feed efficiency is improved in feedlot cattle and rate of gain is improved in grazing cattle. Laidlomycin propionate (LP) is one of a group of second-generation ionophores used to alter rumen fermentation but at a much lower effective dose than was needed with first-generation ionophores. The efficacy of LP in improving feedlot performance has been proven. However, data concerning the effective dosage of LP for improving grazing performance are limited.

Experimental Procedure

One hundred sixty mixed-breed steers were used in a 2-year grazing experiment. Eighty steers each year were divided into light- and heavy-weight replicates, then allotted in a random stratified manner into four lots of 10 head each. The steers received vaccinations against IBR, PI_3, BVD, vibriosis, leptospirosis (5 strains), blackleg (8-way), pinkeye, and BRSV and were treated with levamisole (1990) or oxfendazole (1991) to control internal parasites. Each lot of steers was allotted randomly to receive either 25, 50, or 75 mg/hd/d of LP blended in a 1 lb. ground grain sorghum carrier, or grain sorghum only (control). The lots were then allotted randomly to one of four smooth bromegrass pastures blocked by replication. The lots of steers were rotated through the four pastures at 14-d intervals to minimize the effect of pasture variation. Beginning and ending weights were measured following a 16-h removal from pasture and water. The steers were also weighed unshrunk on the afternoon prior to the ending shrunk weight so that the effects of LP on

[1]Appreciation is expressed to Syntex Animal Health, Inc., Palo Alto, CA for financial assistance.

16-h shrinkage could be determined.

Water and mineral supplement were provided ad-libitum to all animals throughout the study.

Results and Discussion

None of the performance measurements was statistically different between steers offered the different levels of LP (Table 1). However, there was a tendency for increased weight gain with increasing levels. Weight gains were numerically increased by 1.9, 6.3, and 5.9 % with 25, 50 and 75 mg/hd/d LP, respectively. No apparent effect on live weight shrink was observed. Therefore, although no statistical improvements were observed, there appears to be a tendency for improved weight gain with supplements of LP. Studies at other locations in the U.S. have shown greater benefits than were observed in this study.

Table 1. Weight Gain and Shrink by Steers Offered Different Levels of Laidlomycin Propionate while Grazing Smooth Bromegrass Pastures[a].

		Laidlomycin Propionate, mg/hd/d		
Item	Control	25	50	75
No. steers	40	40	40	40
Initial wt., lb. (shrunk)	618.1	612.5	612.9	610.2
Final wt., lb. (unshrunk)	842.4	842.4	845.1	849.5
Final wt., lb. (shrunk)	794.0	791.4	799.3	796.3
Total gain	175.4	178.7	186.5	185.8
Daily gain	1.53	1.55	1.62	1.62
16-h shrinkage, %	5.72	6.00	5.37	6.23

[a]No significant (P<.10) differences were detected.

CONSUMPTION OF FREE-CHOICE GRAIN SUPPLEMENTS CONTAINING SALT OR MAGNESIUM-MICA[1]

Kenneth P. Coffey and Frank K. Brazle[2]

Summary

An experiment was conducted to determine the effects of the addition of magnesium-mica (MM) on free-choice grain consumption by steers grazing smooth bromegrass pastures. Steers were offered ground grain sorghum supplements containing either 12.5, 25, or 50 % of either salt or magnesium-mica. After 18 days (Phase 1), it was apparent that MM was not limiting supplement consumption. Therefore, the supplements were reformulated for the following 16 days (Phase 2) of the trial. New supplements consisted of grain sorghum containing 12.5 % salt alone or in combination with either 12.5, 25, or 37.5% MM, or grain sorghum containing 25% salt alone or with 25% MM. Higher levels of MM with either salt level appeared to reduce free-choice grain consumption. However, lower levels of MM apparently did not affect grain consumption. Therefore, using MM to limit consumption of free-choice grain supplements is not advisable. Furthermore, additions of MM of up to 25% did not affect grain consumption, indicating that its palatability is not adverse.

Introduction

Magnesium-mica (MM) is a naturally occurring magnesium, iron, and potassium layer silicate mined in Woodson County, Kansas. Magnesium-mica has been used in numerous mineral supplements and cattle feeds because of its mineral content and physical characteristics. In at least one instance, MM has been used to limit consumption of a cotton seed meal supplement for grazing cows. The purpose of this experiment was to determine if MM could be used to limit free-choice consumption of grain sorghum by grazing steers.

Experimental Procedure

Ninety crossbred steers (avg. wt. 814 lb.) were allotted in a random stratified manner into 18 groups of five head each. Each group was randomly assigned to one of 18 5-acre smooth bromegrass pastures on July 30. The pastures had previously been grazed since early March. The groups were randomly assigned to receive one of six free-choice grain supplements. The supplements for Phase 1 consisted of either 12.5, 25, or 50% salt or MM in a ground grain sorghum carrier (Table 1). Supplements containing 50% salt or MM were limited to a maximum of 5 lb/hd/day during the study. The remaining supplements were limited to 7 lb/hd/day during the first week and to 10 lb/hd/day thereafter. Supplement levels were monitored daily and additions

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[1]Appreciation is expressed to Micro-Lite, Inc., Chanute, KS, for financial assistance.

[2]Southeast Area Extension Office, Chanute.

made as necessary. Supplement remaining in feeders was weighed each Monday and Thursday to accurately determine consumption. Wet feed was rejected and dry matter content determined. All rejected amounts were calculated on an as-fed basis, and, thus, consumption was calculated on an as-fed basis.

After 18 days, it became apparent that MM had no effect on limiting grain consumption. Therefore, new supplements were formulated for Phase 2 to determine if MM would have grain consumption restrictive properties if fed in combination with salt. New supplements consisted of grain sorghum containing 12.5 % salt alone or in combination with either 12.5, 25, or 37.5% MM, or grain sorghum containing 25% salt alone or with 25% MM (Table 1). These supplements were offered for 16 days, and consumption was monitored. During Phase 2, total supplement consumption was limited to 8 lb/hd/d on all treatments. Feeders were checked on a daily basis, and additions were made as needed to ensure that up to 8 lb of supplement was available for each animal. Supplement remaining in feeders was weighed each Monday and Thursday and treated in a similar manner to that mentioned above.

Results and Discussion

Phase 1.

Salt at levels of 25 and 50% of the supplement restricted consumption in a linear manner ($P < .01$), but 12.5% salt did not restrict consumption (Table 2). Magnesium-mica at levels of 12.5 and 25% of the supplement did not restrict consumption. Consumption of the supplement with 50% MM was lower ($P < .01$) than consumption of the other supplements containing MM. However, as previously mentioned, amounts of this supplement offered were also lower, such that on the average, steers offered the supplement containing 50% MM consumed 98.5% of the amount offered.

The study was originally intended to run for 30 days. However, after viewing these data, we decided to discontinue the present treatments and try to determine if some combination of salt and MM would affect supplement consumption. Thus, the new supplements shown in Table 1 were offered.

Phase 2.

Addition of MM to a grain sorghum supplement containing 12.5% salt (Table 3) apparently did not affect consumption, except at a level of 37.5% MM ($P < .05$). At this level, supplement consumption was reduced by 4.08 lb/day or 51% ($P < .05$). Addition of MM to a supplement containing 25% salt further reduced consumption by 1.35 lb/day or 35.5%. Consumption of the supplement containing 12.5% salt and 37.5% MM was similar ($P = .85$) to that of the supplement containing 25% salt with no MM.

Using MM to limit grain consumption does not appear to be a viable option, because upper limits of grain consumption had to be manually imposed in this experiment. Magnesium-mica did not appear to be unpalatable. Furthermore, consumption in excess of 2 lb. of MM each day indicated that the tolerance for MM is quite high and that any feedback mechanism is somewhat limited in its ability to restrict MM consumption.

Table 1. Formulation of Free-Choice Grain Supplements Offered to Steers Grazing Smooth Bromegrass Pastures.

Ingredient	% Composition					
	Phase 1					
Grain sorghum	87.5	75	50	87.5	75	50
Salt	12.5	25	50	0	0	0
Magnesium-mica	0	0	0	12.5	25	50
	Phase 2					
Grain sorghum	87.5	75	62.5	50	75	50
Salt	12.5	12.5	12.5	12.5	25	25
Magnesium-mica	0	12.5	25	37.5	0	25

Table 2. Consumption of Free-Choice Grain Supplements Offered to Steers Grazing Smooth Bromegrass Pastures in Phase 1.

Item	% salt			% Magnesium-mica		
	12.5	25	50	12.5	25	50
Consumption, lb/day[a]	8.39[b]	2.13[d]	.80[e]	8.63[b]	8.63[b]	4.09[c]

[a]Linear and quadratic effects for consumption of both salt and MM supplements were significant (P < .01).
[bcde]Means within a row not bearing a common superscript differ (P < .01).

Table 3. Consumption of Free-Choice Grain Supplements Offered to Steers Grazing Smooth Bromegrass Pastures in Phase 2.

Item	12.5% salt				25% salt	
	0MM	12.5MM	25MM	37.5MM	0MM	25MM
Consumption, lb/day	8.00[a]	7.66[a]	7.30[a]	3.92[b]	3.80[b]	2.45[c]

[abc]Means within a row not bearing a common superscript differ (P < .05).

EFFECT OF STOCKING RATE ON PERFORMANCE OF STEERS GRAZING SMOOTH BROMEGRASS PASTURES

Kenneth P. Coffey and Joseph L. Moyer

Summary

Fifty-two Angus crossbred steers were stocked on smooth bromegrass pastures at rates of 1.0 or 1.5 head/acre to determine the effects of stocking rate on animal performance and gain per acre. Ending pasture weights and animal gains were similar between steers stocked at the two rates. Overall gain per acre was greater from pastures stocked at 1.5 steers per acre. Therefore, increasing the standard stocking rate from 1.0 to 1.5 may increase production per unit land area without substantially affecting individual animal performance.

Introduction

Altering stocking rates can have a substantial impact on animal production. Generally, gain per acre increases as stocking rate is increased, but often at the expense of reduced individual animal performance. Previous work at SEKES showed that increasing the stocking rate on smooth bromegrass pastures from 1.0 to 1.5 substantially increased gain per acre but tended to reduce individual animal performance. Length of grazing season was also decreased by increasing the stocking rate. However, data have been collected for only 1 year. The present study was conducted to provide additional information on how increasing the stocking rate from 1.0 to 1.5 steers per acre would affect grazing performance.

Experimental Procedure

Fifty-two Angus crossbred steers were grazed on smooth bromegrass pastures at either 1.0 or 1.5 steers per acre to determine effects on animal performance and gain per acre. Following vaccinations against IBR, BVD, PI_3, leptospirosis, blackleg (7-way), and pinkeye, and deworming with oxfendazole, steers were randomly allotted into two groups of 10 head and two groups of 16 head. One steer from one of the larger groups died but for simplicity, both groups will be discussed as having the same stocking rate. Each group was then placed on one of four 10-acre smooth bromegrass pastures, thus establishing stocking rates of 1.0 and 1.5 steers/acre.

Beginning weights of all groups were measured on April 4 following a 16-hour removal from feed and water. Steers grazed until forage availability became limiting. All steers were weighed full on July 11, and steers stocked at 1.5 steers per acre were removed from pasture at that time. Dry summer conditions contributed to reduced forage availability in the remaining pastures, such that steers stocked at 1.0 steers per acre were removed on July 25. Steers in that group were weighed before and after a 16-hour removal from feed and water. Percentage shrink was calculated from these values, and all weights measured on July 11 were adjusted to shrunk weights using this figure.

Results and Discussion

No statistically significant (P<.10) differences were detected for steer weight and gain measurements. However, steers stocked at the lower rate tended to gain 17 and 21 pounds more by July 11 and 25, respectively. Gains were very low (.25 lb/day) during the 14 days from July 11-25. This was probably due to rapidly deteriorating pasture conditions resulting from high ambient temperatures and insufficient rainfall. Gain per acre was 37% higher (P<.10) from pastures stocked at 1.5 steers per acre on July 11. Although steers stocked at the heavier rate were removed on July 11 and the other groups were allowed to graze for an additional 14 days, pastures stocked at the heavier rate still produced 34% more gain per acre than the pastures stocked at the lower rate. Again, this was probably due to the low July gains by steers stocked at the lower rate.

In the previous stocking rate study conducted in 1988, steers stocked at 1.0 steers per acre grazed 70 days longer than those stocked at 1.5 steers per acre and produced 22% more gain per animal but 19% less gain per acre. Therefore, increasing the stocking rate on smooth bromegrass from 1.0 to 1.5 steers per acre provides a means to increase pasture productivity. This system better utilizes spring forage growth and results in the cattle being removed prior to periods during the grazing season when gains are suboptimal.

Table 1. Performance of Steers Stocked at 1.0 or 1.5 Steers per Acre on Smooth Bromegrass Pastures.

Item	Stocking rate (steers/acre)	
	1.0	1.5
Steer weights, lb		
April 4	591	615
July 11	789	796
July 25	792	-
Steer gains, lb		
April 4 - July 11	198	181
April 4 - July 25	202	181
Steer daily gain, lb		
April 4 - July 11	2.02	1.84
April 4 - July 25	1.80	1.84
Gain per acre, lb		
April 4 - July 11	198[b]	271[a]
April 4 - July 25	202	271

[a,b]Means within a row differ (P<.10).

EFFECT OF TIME OF FEEDLOT PLACEMENT OR SUMMER ROTATION TO BERMUDAGRASS ON PERFORMANCE OF STEERS GRAZING ACREMONIUM COENOPHIALUM - INFECTED FESCUE PASTURES OVERSEEDED WITH LADINO CLOVER

Kenneth P. Coffey and Joseph L. Moyer

Summary

Sixty-five Simmental crossbred steers were used in a study to evaluate different grazing management regimens for cattle grazing pastures of *Acremonium coenophialum* - infected fescue overseeded with ladino clover. Steers were either continuously stocked on fescue - ladino clover pastures for 75 (EI) or 207 days (C) or were stocked on fescue - ladino clover pastures for a total of 120 days in the spring and fall and for 63 days on bermudagrass during the summer (R). All steers were placed in drylot and fed a concentrate ration following the grazing period. Steers grazed for 75 days (EI) had lower ($P<.01$) ending pasture weights and gains and higher total feedlot gain ($P<.10$), feed consumption ($P<.01$), and feed cost ($P<.01$) than C and R. Performance during both grazing and feedlot periods was similar for C and R. Therefore, grazing cattle for longer periods of time produced more gain on pasture rather than in a more expensive feedlot situation.

Introduction

The endophytic fungus *Acremonium coenophialum* produces one or more toxins that adversely affect cattle consuming fescue infected with it. Previous work at SEKES has shown that on the average, about 65% of the toxic effects of the endophyte may be offset by overseeding infected pastures with ladino clover. However, other management options may further reduce the impact of grazing infected fescue. In this experiment, we evaluated two options to continuously stocking fescue - ladino clover pastures for the entire grazing season. These options were to double stock the pastures early, then 1) remove the cattle and place them in drylot or 2) rotate them to bermudagrass in the summer and back to fescue in the fall.

Experimental Procedure

Sixty-five Simmental crossbred steers were weighed on April 27 following a 16-h removal from feed and water and randomly allotted by weight into five groups of 10 head and three groups of 5 head. The steers received an insecticide ear tag, were dewormed with fenbendazole, and were vaccinated against BRSV and pinkeye. The calves had previously been vaccinated against IBR, PI_3, BVD, and blackleg. Each group of steers was placed on one of eight 5-acre fescue pastures that were overseeded with ladino clover and in which approximately 70% of the fescue plants were infected with *A. coenophialum*. The three pastures with five head were continuously stocked at this rate until November 19 (C). Three pastures with 10 head were early-intensively stocked at this double stocking rate until July 11 (EI), then the steers were removed and placed directly in drylot pens. The remaining two pastures with 10 head were stocked at this double rate until June 22 and again from September 17 until November 19. Between these times, the steers were rotated to 5-acre bermudagrass pastures (R). All beginning and ending pasture and feedlot weights were measured following a 16-hour removal from feed and water. Dry weather conditions in late July forced removal of the steers assigned to bermudagrass pastures for 24 days.

Upon arrival at the feedlot, all steers were implanted with Synovex-S, vaccinated against blackleg, and dewormed with levamisole. Steers were offered a diet of corn silage with ground grain sorghum at a level of 1% of body weight and protein supplement[1] at a level 5% of the diet dry matter. Diet dry matter from silage was replaced by grain sorghum until a final diet of 80% grain sorghum, 15% corn silage, and 5% supplement was offered on a dry weight basis. The cattle were fed ad libitum until they were estimated as having similar carcass quality grades. Upon completion of the feedlot period, the steers were transported to Emporia, KS and slaughtered. Carcass constituents were measured following a 24-hour chill.

Results and Discussion

Ending pasture weights and pasture gains were 131 and 138 lb less (P<.01) from EI than C and R steers, respectively. Subsequent feedlot gains were 79 and 127 lb more (P<.10) for EI than C and R steers, respectively. Daily gains during the grazing period were statistically similar (P>.10) among treatments. Steers stocked EI remained in the feedlot for 56 days longer than C and R steers, and total dry matter consumption and feed cost were greater (P<.01) from EI. Feed cost per pound of gain for EI steers was greater (P<.05) than that for C but similar to that for R steers. Ribeye area from C steers was greater than that from EI or R steers. Other carcass measurements were similar between groups.

The similarity in performance between C and R steers is in agreement with previous SEKES grazing data involving similar treatments. However, the reason for the poor performance by EI steers is not clear. For early-intensive grazing of fescue to be feasible, both total and daily gains must be greater during the grazing period while gain costs are less. Otherwise, cheaper pasture gains are replaced by more expensive feedlot gains, thus reducing profitability.

[1]49% protein with 400 g/ton monensin.

Table 1. Grazing and Subsequent Feedlot Performance by Steers Early-intensively (EI) or Continuously (C) Stocked on Fescue-Ladino Clover Pastures Full Season or Stocked on Fescue-Ladino Pastures in the Spring and Fall and Bermudagrass in the Summer.

Item	Early-Intensive	Continuously Stocked Fescue-ladino	Fescue-Ladino Bermuda Rotation
Pasture phase			
No. head	30	15	20
Initial wt., lb.	650	643	643
Final wt., lb.	708	839	840
Total gain., lb.	59[b]	196[a]	197[a]
Daily gain., lb.	.78[b]	.95[a]	.95[a]
Feedlot phase			
Initial wt., lb.	708	839	840
Final wt., lb.	1322	1377	1329
Total gain, lb.	617[c]	537[d]	490[d]
Daily gain, lb.	3.08	3.68	3.35
Total DM consumption, lb.	5131[a]	4132[b]	3908[b]
Daily DM intake, lb.	25.2	27.2	26.2
Total feed cost, $	278[a]	215[b]	203[b]
Feed:gain	8.3	7.7	8.0
Gain cost, $/lb.	.45[e]	.40[f]	.41[ef]

[a,b]Means within a row differ (P<.01).
[c,d]Means within a row differ (P<.10).
[e,f]Means within a row differ (P<.05).

Table 2. Carcass Measurements of Steers Offered a Constant Finishing Diet after Being Previously Managed by Early-intensive (EI) or Continuous (C) Stocking on Fescue-Ladino Clover Pastures Full Season or Stocking on Fescue-Ladino Pastures in the Spring and Fall and Bermudagrass in the Summer.

Item	Early-Intensive	Continuously Stocked Fescue-ladino	Fescue-ladino Bermuda Rotation
Hot carcass wt., lb.	815	836	813
Dressing %	61.5	60.7	61.1
Backfat, in.	.35	.30	.29
Ribeye area, in^2	13.7[b]	14.9[a]	14.6[a]
USDA yield grade	2.1	1.9	1.7
USDA quality grade[c]	10.3	10.5	10.3

[a,b]Means within a row differ ($P<.05$).
[c]9 = $Select^{+}$; 10 = $Choice^{-}$.

EFFECT OF SUPPLEMENTAL GRAIN SORGHUM AND OVERSEEDING WITH LADINO CLOVER ON GRAZING AND SUBSEQUENT FEEDLOT PERFORMANCE OF STEERS GRAZING ACREMONIUM COENOPHIALUM - INFECTED TALL FESCUE PASTURES

Kenneth P. Coffey, Joseph L. Moyer, Lyle W. Lomas, and Frank K. Brazle[1]

Summary

One hundred sixty mixed breed steers (avg. wt. 560 lb.) early-intensively grazing Acremonium coenophialum-infected tall fescue (IF) pastures were used in a 2-year study to evaluate the effect on grazing and subsequent feedlot performance of different management options. Steers were allotted to pastures of IF or IF overseeded with ladino clover (FL) and received no supplement (C) or were offered grain sorghum at a level of .25% of body weight (GS). Half of the steers were removed from each pasture in late June of each year and placed directly in drylots (EI). The remaining half of the steers were stocked on their respective pastures as long as forage availability allowed (FS). Supplemental grain sorghum or overseeding with ladino clover did not affect grazing or subsequent feedlot gain by EI steers. Offering GS to EI steers grazing FL reduced ($P<.10$) subsequent feedlot feed efficiency but did not affect feed conversion of steers previously grazing IF. Dry weather conditions forced removal of numerous groups of FS steers each year. The management options evaluated in this study did not substantially affect grazing or subsequent feedlot performance by steers early-intensively stocked on infected fescue pastures. Also, double stocking fescue pastures early and removing half of the steers in late June does not appear to be an effective means of improving pasture productivity.

Introduction

The majority of tall fescue in southeast Kansas and the southeastern U.S. is infected with the endophytic fungus Acremonium coenophialum. Cattle grazing infected tall fescue typically demonstrate toxicity symptoms including poor performance and intolerance to heat. Although many management options have been tried in an attempt to reduce or alleviate the toxicity, few have proven successful. Previous work at the Southeast Kansas Experiment Station (SEKES) has shown that approximately 70% of this performance reduction may be offset by overseeding ladino clover in infected pastures. In another study, feeding grain sorghum (.25% of body weight) to steers grazing infected fescue improved pasture gain without adversely affecting subsequent feedlot performance. However, grain sorghum supplementation for steers grazing fescue-ladino clover pastures has not been evaluated.

Tall fescue produces greater than half of its annual forage by mid to late June. Much of this forage is not utilized. In an attempt to better utilize the spring forage production, we wanted to evaluate double stocking the fescue pastures early, then removing half of the steers and placing them in drylot while allowing the remainder to graze full-season. Therefore, the objectives of this experiment were to determine the effects of grain sorghum

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[1]Southeast Area Extension Office, Chanute.

supplementation, ladino clover overseeding, and time of feedlot placement on grazing and subsequent feedlot performance by steers grazing infected tall fescue pastures.

Experimental Procedures

A total of 160 mixed breed steers grazed eight 5-acre pastures at the Mound Valley Unit of the SEKES during 1990 and 1991. Steers were vaccinated against IBR, BVD, PI_3, BRSV, Leptospirosis (five strains), pinkeye, and 7-way blackleg and were dewormed. Each year, 80 steers were allotted to one of 16 groups of five head each. Two groups of five head were then assigned to the experimental pastures to establish a stocking rate of two head/acre. This was double the stocking rate typically used on these pastures when grazed full season. One group of the experimental animals grazed each pasture from 4/25 to 6/20, 1990 and from 3/29 to 6/18, 1991. The initial intention was to graze the second group of steers on each pasture until November. However, forage availability became limiting in two of the four FL pastures in 1990 and in all four FL pastures and two of the IF pastures in 1991. Therefore, this paper will emphasize only the grazing and feedlot performance by EI steers.

Four, 70% infected tall fescue pastures (IF) and four IF pastures that were overseeded with ladino clover (FL) were used. All pastures received fall application of 40 lb nitrogen (N), 40 lb P_2O_5, and 40 lb K_2O per acre, and IF received an additional 80 lb N/acre in January of each year.

At the end of the grazing period, steers were dewormed, implanted with Synovex S, and placed in feedlot pens with pasture replicates maintained. Steers were fed a diet of 80% ground grain sorghum, 15% corn silage, and 5% protein supplement[2] on a dry matter basis for 179 and 154 d in 1990 and 1991, respectively. Beginning and ending pasture and feedlot weights were measured following a 16-h shrink. At the end of the feedlot period, steers were slaughtered at a commercial slaughter facility and carcass data were collected following a 24-h chill.

Results and Discussion

As previously mentioned, dry summer conditions resulted in lower forage production and thus forced removal of some of the pastures of FS cattle in both years. Therefore, only data from EI steers will be discussed.

Differences were detected between years, but interactions between year and forage type or supplementation were significant (P<.10) only for carcass backfat and rib eye area. Therefore, data were pooled across years. Ending pasture and feedlot weight and gain and subsequent feedlot dry matter (DM) intake were not affected by either GS supplement or clover overseeding (Table 1). However, C steers previously grazing FL were more efficient than steers offered GS while grazing FL. Feed efficiency of steers previously grazing IF was not affected by supplementation. Rib eye areas and yield grades from C steers were intermediate between those from steers previously grazing FL and offered GS and those from steers previously grazing IF and offered GS, with those previously grazing FL having larger rib eye areas and lower yield grades. Other carcass components were similar among treatment combinations.

In previous work at SEKES, steers grazing FL gained more during the

[2]49% crude protein supplement containing 400 g/ton monensin.

grazing period than those grazing IF. After a feedlot period, their carcasses had greater backfat, and higher yield and quality grades than those from steers previously grazing IF. The previous trend was not repeated in this experiment. However, the grazing period of the previous study was over 200 days in each of 3 yr, thereby granting adequate time for ladino clover to afford its maximum benefit. In the present study, steers were removed from pasture and placed in the feedlot prior to the time when ladino clover would typically give its greatest advantage. The stocking rate differential between the studies may also have contributed to the divergence between responses in the two studies.

Limited amounts of supplemental grain sorghum have previously improved pasture gain of steers spring grazing tall fescue without impairing subsequent feedlot performance. No improvements in grazing gain were observed in this experiment, but the supplemental grain sorghum did negatively affect feed efficiency of steers previously grazing FL.

Therefore, neither of the management options evaluated in this experiment, appeared to substantially affect grazing or subsequent feedlot performance by steers spring grazing fescue pastures.

Table 1. Effect of Supplemental Grain Sorghum or Overseeding with Ladino Clover on Grazing and Subsequent Feedlot Performance and Carcass Characteristics of Steers Early-Intensively Grazed on *A. coenophialum*-Infected Tall Fescue Pastures.

	Fescue-Ladino Clover		Fescue	
Item	Control	.25% BW Milo	Control	.25% BW Milo
Pasture phase				
# head	20	20	20	20
Initial wt., lb.	560	560	560	560
Final wt., lb.	627	640	633	624
Total gain, lb.	67	80	73	64
Daily gain, lb.	1.03	1.19	1.11	1.00
Feedlot phase				
Initial wt., lb.	627	640	633	624
Final wt., lb.	1200	1170	1173	1160
Total gain, lb.	572	530	540	536
Daily gain, lb.	3.51	3.25	3.32	3.29
Daily DM intake, lb.	22.8	24.3	23.8	23.2
Feed/gain	6.60[b]	7.63[a]	7.30[ab]	7.18[ab]
Carcass data				
Hot carcass wt., lb.	735	729	726	716
Dressing %	61.3	62.2	61.9	61.5
Backfat, in.	.41	.36	.41	.46
Rib eye area, in^2	13.7[ab]	14.3[a]	13.5[ab]	12.8[c]
Quality grade[1]	9.7	10.0	10.2	10.0
Yield grade	2.5[ab]	2.2[b]	2.5[ab]	2.8[a]

[1]9=Select$^+$; 10=Choice$^-$.
[a,b,c]Row means differ (P<.10).

ALFALFA VARIETY PERFORMANCE IN SOUTHEASTERN KANSAS

Joseph L. Moyer

Summary

Alfalfa yields for 1991 reflect only three cuttings because of droughty conditions. Over the 2-year period, Garst 636 and Agripro Ultra have tended to produce more than 'Riley'.

Introduction

The importance of alfalfa as a feed crop and/or cash crop has increased in recent years. The worth of a particular variety is determined by many factors, including its pest resistance, adaptability, longevity under specific conditions, and productivity.

Experimental Procedure

The 15-line test was seeded (12 lb/acre) 23 April, 1990 at the Mound Valley Unit. Plots were fertilized with 20-50-200 lb/acre of N-P_2O_5-K_2O on 18 February, 1991. Only three harvests were obtained in 1991, because little rain was received after early June (see weather summary).

Results and Discussion

Forage yields for each of the three cuttings, total 1991 production, and 2-year totals are shown in Table 1. The most available soil moisture was present for cut 2, providing the most significant differences for 1991. 'Ultra' and 630 had significantly higher forage yield in cut 2 than 'Apollo Supreme' and WL 320. In cut 3, 5472 had higher production than 'Cimarron VR'. Over the 2-year period, Garst 636 and Agripro Ultra have tended to produce more than 'Riley'.

Table 1. Forage Yields of the 1991 Alfalfa Variety Test, Mound Valley Unit, SEK Station.

Source	Variety	Forage Yield 1991 4/24	6/7	7/1	Total	2-Yr Total
		- - - - - tons/acre @ 12% moisture - - - - -				
Garst	636	1.96a[1]	2.61a	1.39a	5.96a	9.50a
Agripro	Ultra	1.90a	2.62a	1.29a	5.81a	9.48a
Dairyland	Magnum III	1.93a	2.32ab	1.40a	5.65a	9.36a
Cargill	Trident II	1.79a	2.54ab	1.32a	5.65a	9.36a
Garst	630	1.94a	2.44ab	1.32a	5.69a	9.17a
Pioneer	5472	1.90a	2.38ab	1.49a	5.78a	9.16a
DeKalb	DK 135	1.79a	2.45ab	1.40a	5.64a	9.16a
Pioneer	5364	1.93a	2.47ab	1.33a	5.73a	9.14a
America's Alfalfa	Apollo Supr.	1.98a	2.27b	1.34a	5.58a	9.11a
W-L Research	WL 317	1.90a	2.47ab	1.38a	5.75a	9.04a
Agripro	Dart	1.86a	2.38ab	1.38a	5.62a	8.98a
W-L Research	WL 320	1.83a	2.23b	1.42a	5.48a	8.96a
Pioneer	5432	1.86a	2.33ab	1.42a	5.60a	8.93a
Great Plains Res.	Cimarron VR	1.83a	2.41ab	1.16a	5.40a	8.91a
USDA-KSU	Riley	1.76a	2.52ab	1.24a	5.52a	8.78a
	Average	1.87	2.43	1.35	5.66	9.14
	LSD(.05)	NS	0.27	0.32	NS	NS

[1]Means within a column followed by the same letter do not differ (P=.05) according to Duncan's test.

MANAGING FALL ALFALFA REGROWTH FOR WEEVIL CONTROL

Joseph L. Moyer and George Lippert[1]

Summary

Early-spring burning of alfalfa residue reduced numbers of early-April weevil larvae by 57% and increased first-cut forage yields by 16%, when compared to untreated plots. Early-June larval numbers were lower where fall regrowth was removed in early spring than in plots sprayed in April. No differences in spring larval numbers or spring forage yield or quality were found whether or not a late-fall cutting of 0.58 tons/acre was taken.

Introduction

First-generation larvae of alfalfa weevil (*Hypera postica* Gyllenhal) are responsible for most of the damage to the first cutting of alfalfa. These hatch from eggs laid in alfalfa stems the previous fall. The destruction of fall growth may reduce the larval population from the first hatch, delaying the economic threshold for spraying until the first cutting. We compared early-spring residue removal by flailing or burning with an LP gas burner with a chemical control treatment for effects on weevil larval numbers and forage parameters. We made the same comparisons with or without the removal of a late-fall (November) hay cutting.

Experimental Procedure

An established alfalfa field north of Oswego, KS on the Jacobs-Hoffman dairy farm was used in a 4 x 2 factorial experiment that had four randomized complete blocks. Plots were 8' x 20', with 20' alleys between blocks (replications). The four weevil management treatments included spring (6 Feb) removal of fall alfalfa growth by flailing (<1.5") or burning with an LP gas burner, spraying (12 Apr) with 1 lb a.i./acre chlorpyrifos, and no treatment (control). The two fall management regimes were to cut (4", 30 Nov, 1990) for hay production after fall dormancy or not.

Ten-stem counts of weevil larvae were taken on 9 Apr and 12 June, 1991. Samples (3'x 20') for yield determination were taken from the first two cuttings (7 May and 19 June), and subsamples were saved for moisture, crude protein, and neutral-detergent fiber (NDF) assays.

Results and Discussion

Burning reduced the number of weevil larvae in early April by 57% compared to the control, and the other treatments tended to have fewer larvae than the control (Table 1). By June 12, the sprayed plots had more larvae than flailed or burned treatments. Fall hay removal had no effect on spring

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weevil numbers.

First-cut yield was lower for the control than for any of the treated plots. Spring burning of fall growth increased yields by 13% compared to the control. Fall hay removal had no significant effect on first-cut yields. Spring treatments and fall hay removal had no effect on 2nd-cut yields.

Forage N of the first cutting was unaffected by spring treatment or fall cutting regime. In the second cutting, the controls and sprayed treatment had the highest forage N, and fall-hayed averaged greater in forage N than plots that were not hayed. However, there was a significant ($P<.05$) interaction between cutting regime and spring treatment in second-cut forage from the spring-flailed treatment, because fall-hayed plots had significantly higher N than those that were not hayed (means not shown).

In first-cut forage, the NDF content of the sprayed treatment was lower than that of the control but fall-hayed plots and those that were not hayed had the same NDF content. No significant ($P<.05$) differences were found in NDF content of second-cut forage.

Table 1. Effect of Spring Residue Treatments and Fall Cutting Regime on Subsequent Weevil Larval Counts and Forage Production and Quality of the First Two Alfalfa Cuttings.

Treatment/ Regime[2]	Weevil Larvae 4/9	Weevil Larvae 6/12	Forage Yield[1] 5/7	Forage Yield[1] 6/19	Forage N 5/7	Forage N 6/19	Forage NDF 5/7	Forage NDF 6/19
	- No./10 Stems -		- tons/acre -		- - - - - - - - - %		- - - - - - - - -	
Spring Treatment								
Control	6.4a[3]	12.6ab	2.06b	1.19a	3.47a	3.12a	44.8a	50.4a
Sprayed	4.1ab	18.0a	2.22a	1.23a	3.56a	3.05a	42.5b	51.8a
Burned	2.8b	7.4b	2.38a	1.22a	3.44a	2.88b	44.1ab	51.4a
Flailed	4.5ab	9.2b	2.27a	1.28a	3.46a	2.84b	43.8ab	52.1a
Fall Dormant Cut								
Yes	5.1a	13.1a	2.19a	1.22a	3.44a	3.03a	43.7a	50.7a
No	3.8a	10.5a	2.27a	1.24a	3.52a	2.92b	43.9a	52.1a

[1]Forage yields expressed on a 12% moisture basis.
[2]Interactions between fall cutting regime and spring treatments were nonsignificant (P<.05), except for forage N in the second cutting.
[3]Means within a treatment/regime followed by the same letter are not significantly (P<.05) different according to Duncan's test.

FORAGE YIELDS OF TALL FESCUE VARIETIES IN SOUTHEASTERN KANSAS

Joseph L. Moyer

Summary

In the fifth harvest year of the test, 'Festorina', 'Mo-96', 'Mozark', and 'Kenhy' yielded more first-cut forage than 'Triumph' and 'Stef'. For the year, Kenhy and Mozark produced more forage than Stef and Triumph under hay management. Under a 6-clipping system, however, Kenhy produced more than 'Forager', 'Fawn', and 'Martin'. Over the 5 years of the test, 'Phyter' yielded more than Stef and Triumph.

Introduction

Tall fescue is the most widely grown forage grass in southeastern Kansas. New and old cultivars were compared for agronomic adaptation and forage quality, because effects of a variety chosen for a new seeding will be apparent for as long as the stand exists.

Experimental Procedure

Plots were seeded on 4 September, 1986 at 20 lb/acre at the Mound Valley Unit, ostensibly with seed free of *Acremonium coenophialum* endophyte. Plots were 30 x 7.5 ft each, in four randomized complete blocks. Application of 160-50-57 lb/acre of N-P_2O_5-K_2O was made on 18 February, 1991, followed by fertilization with 60 N on 6 September, 1991. Plots 15'x 3' were cut on 28 May and 26 November, 1991. A subsample from each plot was collected for determinations of moisture, fiber, crude protein, and *in vitro* digestibility. A 10'x 7.5' subplot of each plot was measured with a disk meter for yield estimation before those harvests, plus an additional four clippings.

Results and Discussion

Mo-96, 'Festorina', 'Mozark' and 'Kenhy' yielded significantly more in cut 1 than 'Stef' and 'Triumph' (Table 1). Dry summer and early fall conditions did not enable a second cutting until November, and it averaged one-fifth of the yield of cut 1. In the second cutting, Kenhy yielded significantly more than 'Johnstone' and Mo-96. For the year, Kenhy and Mozark produced more than Stef and Triumph. Five-year average production was significantly higher from Phyter than from Stef and Triumph.

Intensive clipping altered the relative productivity of the cultivars. Kenhy produced more under intensive clipping than 'Forager', 'Fawn', and 'Martin' (Table 1).

'Forager', 'Fawn', Triumph, and 'Martin' headed significantly earlier than seven other cultivars in 1991 (Table 2). Stef, Mo-96, Kenhy, and

Johnstone headed significantly later than seven other cultivars.

Forage quality parameters for cut 1 are also listed in Table 2. Crude protein content in the first cutting was significantly higher in Stef and Mo-96 than in five other cultivars.

Neutral-detergent fiber (NDF) in cut 1 was lower in Stef and Johnstone than in 10 other cultivars (Table 2). Forager had higher NDF content than five other cultivars. The ADF content of Johnstone was lower than that of Kenhy and Festorina.

Table 1. Forage Yield (@12% moisture) of Tall Fescue Varieties for 1991, Mound Valley Unit, Southeast Kansas Branch Experiment Station.

Variety	Cut 1 (5/28)	Cut 2 (11/26)	Total	Clip[1]	5-Year Average
	- - - - - - -	- - - - - - -	tons/acre	- - - - - - -	- - - - - - -
Kenhy	4.61a[2]	1.02a	5.64a	4.46a	6.69ab
Mo-96	4.74a	0.74b	5.48ab	3.90ab	6.67ab
Forager	4.50ab	0.78ab	5.28abc	3.60b	6.60ab
Cajun	4.24abc	0.80ab	5.03abc	3.98ab	6.42ab
Phyter	4.51ab	0.82ab	5.33abc	4.17ab	6.91a
Martin	4.35abc	0.83ab	5.18abc	3.73b	6.64ab
Festorina	4.66a	0.85ab	5.50ab	4.24ab	6.71ab
Triumph	3.96bc	0.87ab	4.83bc	3.93ab	6.25b
Fawn	4.27abc	0.79ab	5.06abc	3.72b	6.38ab
Ky-31	4.55ab	0.98ab	5.53ab	4.03ab	6.55ab
Johnstone	4.40ab	0.74b	5.14abc	4.28ab	6.08bc
Mozark	4.62a	0.94ab	5.56a	4.08ab	6.60ab
Stef	3.79c	0.85ab	4.64c	4.09ab	5.59c
Average	4.40	0.85	5.25	4.02	6.47
LSD(.05)	0.54	0.23	0.61	0.61	0.55

[1]Sum of disk meter yield estimates taken prior to each of six clippings.
[2]Means within a column followed by the same letter are not significantly ($P \leq .05$) different, according to Duncan's test.

Table 2. Crude Protein and Fiber Contents of Cut 1 for Tall Fescue Varieties in 1991, Mound Valley Unit, Southeast Kansas Branch Experiment Station.

Variety	Heading Date	Crude Protein	Fiber Content NDF	Fiber Content ADF
		- - - - - - - - - %	- - - - - - - - -	
Kenhy	123.8a	10.2bc	59.3bc[2]	34.3a
Mo-96	124.0a	11.4ab	59.8b	33.8ab
Forager	114.5cd	9.9c	62.5a	33.9ab
Cajun	116.8c	9.9c	60.5ab	33.7ab
Phyter	120.5b	10.3bc	59.7b	33.1ab
Martin	115.0cd	9.8c	60.3ab	33.6ab
Festorina	122.2ab	10.2bc	61.0ab	34.2a
Triumph	108.0e	10.1bc	60.7ab	33.6ab
Fawn	113.2d	9.7c	60.4ab	33.1ab
Ky-31	122.0ab	10.0bc	60.7ab	33.7ab
Johnstone	124.0a	10.0bc	58.2c	32.5b
Mozark	116.8c	9.5c	60.6ab	33.2ab
Stef	124.0a	12.2a	57.0c	33.4ab
Average	118.8	10.2	60.0	33.5
LSD(.05)	2.6	1.6	2.0	NS

[1]Julian day when heads first appeared. (Day 120=30 April).
[2]Means within a column followed by the same letter are not significantly ($P \leq .05$) different, according to Duncan's test.

MANAGEMENT OF TALL FESCUE WITH DIFFERENT RATES OF ENDOPHYTE INFECTION

Joseph L. Moyer, Kenneth P. Coffey, and Daniel W. Sweeney

Summary

Spring forage production was decreased under the intensive compared to the lax defoliation regime, except with mefluidide and spring burning. June tiller numbers were much higher under lax than intensive defoliation. High-endophyte plots had more tillers than low-endophyte plots in December, 1991, but not in June of 1990 or 1991.

Introduction

Tall fescue is an agronomically superior grass under a wide range of soil conditions, and is generally tolerant of intensive grazing. However, some of its adaptive advantage may be in its association with an endophytic fungus, Acremonium coenophialum Morgan-Jones and Gams, which is also responsible for production of toxins that cause poor performance and other symptoms in cattle and other classes of livestock. Effects of management practices including defoliation intensity, artificial growth regulators, residue management, and substitution of legumes for N are being tested for their effects on fescue vigor and infection rate, forage production, quality, and toxin level and long-term soil changes.

Experimental Procedure

Low- and high-endophyte (≈20% and ≈65% infected, respectively) fescue plots seeded in fall, 1984 were assigned to treatments beginning in spring, 1990. Two defoliation intensities were imposed on each of six other managment alternatives. The "lax" defoliation intensity consists of 2-3 cuts between mid-May and early December to a 3-inch stubble height, similar to hay meadow management. The "intensive" defoliation regime consists of 4-5 cuts between mid-April and early December to a 1.5-inch stubble height, approximating intensive rotational grazing. The six other management practices include a control, two plant growth regulators (mefluidide and dicamba), two spring residue managment treatments (clip or burn), and legume in lieu of spring N (-N+legume).

For 1991, plots were fall-clipped on 5 December, 1990, and burned or spring-clipped on 8 February, 1991. Fertilizer (90-44-57 lb/acre of actual N-P_2O_5-K_2O) was applied on 18 February, except that 4 lb PLS/acre of ladino clover seed and no N was applied to -N+legume plots. Treatments of mefluidide and dicamba (each @ 0.125 lb a.i./acre) were made on 10 April. Intensively defoliated plots were cut 2 May, and all plots were cut on 4 June and 26 November, 1991. Forage production and subsampling for moisture and forage quality were performed at each cutting, and subsamples from some "intensive" cuttings were freeze-dried for determination of ergovaline content. Tillers (>1/8" diameter) from two-2.7 ft^2 areas/plot were counted on 12 June and 5 December for determination of tiller density.

Results and Discussion

Forage Production

Early-spring clipping of fall regrowth at the time of burning (8 Feb) yielded 0.43 and 0.15 tons/acre @ 12% moisture for the intensive and the lax defoliation regimes, respectively. Yields of seasonal production for 1991 are shown in Table 1. Yield summed across cuttings averaged higher for the lax than the intensive defoliation regime, but there was a highly significant ($P<.01$) interaction between treatment and defoliation regime. The control, dicamba, and spring clip treatments had more ($P<.05$) total production in the lax than in the intensive defoliation regime, whereas the reverse was true for the -N +legume treatment (means not shown). The mefluidide and spring burn treatments were similar in total yield for the two defoliation regimes. Low- and high-endophyte plots were no different in seasonal forage production (Table 1). Yields in the June cutting accounted for much of the seasonal production, so responses in seasonal yield and yields of the June cutting were similar. The control, dicamba, and spring clip treatments in June had three-fold higher yield in the lax than in the intensive defoliation regime, the mefluidide and spring burn treatments had less than a twofold yield difference in favor of the low defoliation regime, and there was no yield difference between defoliation regimes in the -N +legume treatment (means not shown).

Tiller density was reduced in low- compared to high-endophyte plots in December but not in the June counts. Conversely, tiller density was reduced in the intensive compared to the lax defoliation regime in June but not December. The -N +legume treatment was lower in tiller density than most other treatments in 1991. The significant ($P<.05$) interaction in December, 1991 tiller density between treatment and defoliation regime was because there was a greater density in the intensive than the lax defoliation regime in the -N +legume treatment, but no difference from defoliation in the other treatments (means not shown).

Table 1. Average 1991 Forage Yields within and Summed across Cuttings for Different Endophyte Levels, Defoliation Regimes, and Treatments.

Item	Forage Yield 5/2[1]	6/4	11/26	Sum[2]
	- - - - - - - tons/acre @ 12% Moisture - - - - - - -			
	Endophyte Level (E)			
High	0.78	1.45	0.36	2.08
Low	0.72	1.42	0.43	2.07
$LSD_{.05}$	NS	NS	0.06	NS
	Defoliation Regime (D)			
Intensive	0.75	0.86	0.54	1.97
Lax	-	2.01	0.25	2.17
$LSD_{.05}$	-	0.11	0.03	0.12
	Treatment (T)			
Control	0.90	1.66	0.41	2.52
Spring Clip	0.98	1.64	-	2.14
Spring Burn	1.13	1.62	-	2.19
Mefluidide	0.49	1.36	0.42	2.02
Dicamba	0.92	1.65	0.39	2.50
-N +Legume	0.08	0.66	0.36	1.06
$LSD_{.05}$	0.14	0.18	0.05	0.21
	Interactions			
E x D	-	NS	*	NS
E x T	NS	NS	*	NS
D x T	-	**	NS	**
E x D x T	-	NS	*	NS

[1]Within-cut averages include only treatments that were cut at that time.
[2]Sum of all cuttings taken during the 1991 growing season.

Table 2. Spring (June) and Fall (December) Tiller Density for 2 Years at Different Endophyte Levels, Defoliation Regimes, and Treatments.

Item	1990 6/12	1990 12/5	1991 6/18	1991 12/6
	- - - - - - - - - - - tillers/m[2]	- - - - - - - - - - -		
Endophyte Level (E)				
High	364	446	170	170
Low	400	405	161	151
$LSD_{.05}$	NS	32	NS	13
Defoliation Regime (D)				
Intensive	366	436	147	160
Lax	398	415	184	161
$LSD_{.05}$	26	NS	13	NS
Treatment (T)				
Control	375	403	175	186
Spring Clip	411	418	163	150
Spring Burn	392	436	174	156
Mefluidide	426	469	195	177
Dicamba	359	386	160	159
-N +Legume	328	NS	127	135
$LSD_{.05}$	46	NS	23	22
Interactions				
E x D	NS	NS	NS	NS
E x T	NS	NS	NS	NS
D x T	NS	*	NS	NS
E x D x T	NS	NS	NS	NS

[1]Within-cut averages include only treatments that were cut at that time.
[2]Sum of all cuttings taken during the 1991 growing season.

USE OF A LEGUME-GRAIN SORGHUM ROTATION IN A CROP-LIVESTOCK SYSTEM

Joseph L. Moyer, Daniel W. Sweeney, and Kenneth P. Coffey

Summary

Grain sorghum was grown after no clover (winter fallow) or after red clover that was hayed (2.78 tons/acre) or mulched. Sorghum production was low, particularly following clover, likely because of drought. However, plant N concentration was increased after clover.

Introduction

Grain sorghum is a productive feedgrain crop, which is heat and drought tolerant, but requires the input of N and does not maintain soil physical condition. Legume crop rotations are under development that can reduce the reliance of grain sorghum production on added N and help maintain the physical condition of the soil, but the topgrowth could also 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 topgrowth can benefit the livestock component by supplementing low-quality roughage. The objectives of the research are to determine the effect of 1) fall-seeded red clover on grain sorghum yield and quality and on selected soil properties, 2) clover removal vs. incorporation of topgrowth on subsequent crop and soil properties, 3) 0 or 100 lb/acre of N, with or without haying on grain sorghum characteristics, and 4) the effect of the systems on nutrient content of grain sorghum stover.

Experimental Procedure

Red clover was seeded on designated plots in September, 1990. Hayed plots were cut 29 May, 1991, and all plots were offset-disked on 12 June. Urea was applied at the rate of 100 lb N/acre to appropriate plots, then all plots were tandem-disked three times just befor planting on 13 June. Phosphate and potash (21 and 33 lb/acre, respectively) were applied to all plots with the planter, and a preemergent application of 2 lb a.i./acre of alachlor was used for weed control.

Plant samples and soil data were collected at the 9-leaf stage (15 July), the boot stage (6 August), and the soft-dough stage (10 September). At harvest, whole plants, grain and stover samples were collected. At each sampling, dry matter production, multi-nutrient concentrations, and forage quality were or are being determined.

Results and Discussion

Hayed plots produced 2.78 tons/acre (12% moisture) of red clover forage that contained 2.7% N (16.9% crude protein), for a total of 132 lb N/acre. Subsequent grain sorghum dry matter production and N concentration are listed in Table 1. Sorghum plant dry matter production was significantly (P<.05) higher in the winter fallowed (no clover) treatment than after clover at the earlier samplings, and followed the same tendency at the soft dough stage. Adding N increased dry matter only at the boot stage, but the significant (P<.05) clover management x N rate interactions at the early stages resulted from a 40% increase in plant dry matter from the addition of N to the winter-fallowed plots, whereas no N response occurred after clover. Drought apparently affected productivity of sorghum plants, particularly following red clover.

Nitrogen concentration in the whole plant was significantly (P<.05) higher after clover, whether mulched or hayed, than after winter fallow (no clover). A significantly higher N concentration was also seen in plants from N-fertilized (100 lb/acre) than no-N plots, and no interaction occurred between clover management and N rate (Table 1).

Plant population was not affected by any of the treatments (Table 2). However, the number of heads/acre was reduced in treatments following clover compared to no clover (winter fallow), but no effect of added N was observed.

Kernels/head and kernel weight were reduced in treatments following clover compared to no clover, with no significant (P<.05) effect of added N (Table 2). However, a significant clover management x N rate interaction occurred in kernels/head because there was a 50% increase with added N in winter-fallowed plots, but no N response after clover (means not shown).

Grain yield and test weight were reduced in treatments following clover compared to no clover, with no significant (P<.05) effect of added N (Table 2). However, a significant clover management x N rate interaction occurred in grain yield, because there was a 69% increase with added N in winter-fallowed plots, but no N response after clover (means not shown). Again, drought had an apparent impact on heading, kernels/head, and the resulting grain yields.

Table 1. Grain Sorghum Dry Matter and Nitrogen Concentration at Three Growth Stages as Affected by Red Clover Management and N Application.

Treatment	Dry Weight 9-Leaf	Dry Weight Boot	Dry Weight Soft-dough	Nitrogen Concentration 9-Leaf	Nitrogen Concentration Boot	Nitrogen Concentration Soft-dough
	- - - - lb/acre - - - -			- - - - - - % - - - - -		
Clover Management						
None	523	2817	6018	3.18	1.78	0.98
Hayed	319	1485	5132	3.41	2.26	1.34
Mulched	334	1338	4293	3.44	2.27	1.42
$LSD_{.05}$	75	413	NS	0.21	0.10	0.17
Nitrogen Rate						
None	373	1706	5102	3.12	1.99	1.15
100 lb/acre	412	2054	5193	3.57	2.21	1.35
$LSD_{.05}$	NS	337	NS	0.17	0.08	0.14
Clover Treatment X Nitrogen Rate Interaction	**	*	NS	NS	NS	NS

Table 2. Grain sorghum plant and head populations, kernel number and weight, and grain yield and test weight as affected by red clover management and N application.

Treatment	Population Plants	Population Heads	Kernel Character No./Head	Kernel Character Wt.	Grain Yield	Grain Test Wt.
	No./acre (10^3)			mg	bu/ac	lb/bu
Clover Management						
None	38.4	34.6	18.6	19.3	29.4	58.3
Hayed	35.9	26.1	14.7	21.6	17.3	56.8
Mulched	36.6	24.0	10.6	21.1	11.2	56.0
$LSD_{.05}$	NS	3.9	3.3	1.6	5.5	0.8
Nitrogen Rate						
None	37.9	27.6	13.9	20.9	17.2	57.2
100 lb/acre	36.0	28.9	15.4	20.4	21.4	56.9
$LSD_{.05}$	NS	NS	NS	NS	NS	NS
Clover Treatment X Nitrogen Rate Interaction	NS	NS	**	NS	**	NS

EFFECTS OF SULFUR RATE, METHOD, AND SOURCE ON TALL FESCUE[1]

Daniel W. Sweeney and Joseph L. Moyer

Summary

Although differences were small, yield was increased by ammonium thiosulfate fertilization as compared to ammonium sulfate. Sulfur rate did not affect yield. Yield was increased by knife fertilizer applications as compared to broadcast in the final harvest.

Introduction

Because sulfur is a necessary element for both plants and animals, sulfur fertilization not only may benefit forage growth but may improve animal performance. Tall fescue is one of the major forages in southeastern Kansas, as well as in other parts of the country. Thus, this research was initiated to evaluate the effect of fluid S rate, method of application, and source on yield and quality of tall fescue.

Experimental Procedure

The study was established in spring 1989 at an off-station location (Calonder farm). Factors included 0 lb S/a compared with 15 and 30 lb S/a as ammonium sulfate (AS) and ammonium thiosulfate (ATS) as fluid sources. Methods of application were broadcast, dribble, and knife. Spacing for dribble and knife applications was 15 inches. Nitrogen was balanced to 150 lb N/a with UAN in all plots except the check which did not receive N or S fertilizer. Uniform broadcast applications of 77 lb P_2O_5/a and 84 lb K_2O/a were made to all plots each year. Midway between the spring fertilization and the final harvest, plant samples (termed intermediate harvests) were clipped from a 18 x 86" strip arranged lengthwise near the edge of each plot. In mid-May, final forage production was harvested near full bloom.

Results and Discussion

Ammonium thiosulfate tended to result in higher yield at both the intermediate ($p<0.10$) and final harvest than ammonium sulfate. However, S rate did not affect either harvest. Selected contrasts suggest that adding S did not result in an increase in the intermediate harvest yield above that with N fertilization with no S. In contrast, by the final harvest, ATS resulted in an average 8% yield increase. At the intermediate harvest, knifing resulted in lower yield than either surface application method. By the final harvest, yield was affected by fertilizer placement in the order: knife > dribble > broadcast.

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[1]Research was partially supported by grant funding from the Fluid Fertilizer Foundation; Kerley Ag, Inc.; The Sulphur Institute; and Allied-Signal, Inc.

In addition to yield data shown in Table 1, several measures of quality have been made. Several parameters such as N and S content, N:S ratios, and *in vitro* dry matter digestibilities have been found to be affected by S source, rate, and placement (data not shown).

Table 1. Effect of S Source, S Rate, and Method of Application on Intermediate and Final Tall Fescue Yield in 1991.

S Source	S Rate	Method	Yield Int.	Yield Final
	lb/a		--- ton/a ----	
Ammonium Sulfate	15	Broadcast	0.80	3.19
		Dribble	0.66	3.42
		Knife	0.51	3.87
	30	Broadcast	0.84	2.84
		Dribble	0.71	3.54
		Knife	0.62	3.69
Ammonium Thiosulfate	15	Broadcast	0.76	3.40
		Dribble	1.01	3.48
		Knife	0.65	3.95
	30	Broadcast	0.76	3.42
		Dribble	1.03	3.69
		Knife	0.45	4.04
None	0	Broadcast	0.92	3.54
		Dribble	0.66	3.09
		Knife	0.57	3.44
Check	-	-	0.25	0.70
LSD (0.05)			0.25	0.43
Treatment means:				
S Source (S)				
AS			0.69	3.42
ATS			0.78	3.66
LSD (0.05)			NS	0.14
S Rate (R)				
15			0.73	3.55
30			0.73	3.54
LSD (0.05)			NS	NS
Method (M)				
Broadcast			0.79	3.21
Dribble			0.85	3.53
Knife			0.56	3.89
LSD (0.05)			0.13	0.17
Interaction(s):			SxM	NS
Contrasts:				
No-N vs. N-only			**	**
N-only vs. AS @ 15			NS	NS
N-only vs. ATS @ 15			NS	*

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

Daniel W. Sweeney

Summary

In general, conventional and reduced tillage have resulted in higher grain sorghum yields than no tillage. Applying N resulted in large increases in grain sorghum yield, with anhydrous ammonia tending to result in highest yields except for 1991. In contrast, soybean yields have been affected little by tillage or residual N application method.

Introduction

Many kinds of rotational systems are employed in southeastern Kansas. This experiment was designed to determine the effect of selected tillage and nitrogen fertilization options on the yields of grain sorghum and soybeans in rotation.

Experimental Procedure

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, discing, and field cultivation. The reduced-tillage system consisted of discing and field cultivation. Glyphosate (Roundup) was applied each year at 1.5 qt/a to the no-till areas. The four nitrogen treatments for the 1983, 1985, 1987, 1989, and 1991 grain sorghum were a) zero N applied, b) anhydrous ammonia knifed to a depth of 6 inches, c) broadcast urea-ammonium nitrate (UAN - 28% N) solution, and d) broadcast solid urea. N rates were 125 lb/a.

Results and Discussion

Averaged across the 5-crop years of grain sorghum, conventional tillage has tended to result in higher yields than no tillage, even though the difference was not significant in 1983 or 1991 (Table 1). Small fluctuations occurred, but conventional and reduced tillage generally resulted in similar yields. As evidenced by the values obtained in the checks, N supplied by soybeans grown in alternate years was not sufficient to maintain yields. In general, any of the N fertilization systems resulted in large increases in yield as compared to the check. Except for 1983, which was dry, and 1991, where wet conditions resulted in poor soil closure behind the knives, anhydrous ammonia tended to result in highest yields. However, the use of either urea or UAN for surface N fertilization generally has not resulted in large decreases in grain sorghum yield as compared to anhydrous ammonia. Yield was affected by an interaction between tillage and N fertilization system in 1985. This was due to the large yield increase obtained with anhydrous ammonia in no-tillage plots as compared to smaller increases with anhydrous ammonia in conventional or reduced-tillage plots.

Although soybean yields in 1984, 1986, 1988, and 1990 generally tended to be less with no tillage, the differences were not significant (data not shown). Residual N affected soybean yield only in 1984. However, because yields were less than 7 bu/a, the yield differences between N treatments were less than 1.5 bu/a (data not shown).

Table 1. Effect of Tillage and N Fertilization on Yield of Grain Sorghum Grown in Rotation with Soybeans.

Treatment Means	Yield					
	1983	1985	1987	1989	1991	Avg.
	bu/a					
Tillage						
Conventional	46.8	95.4	69.8	52.3	80.2	68.9
Reduced	45.9	95.0	75.5	43.3	80.7	68.1
No tillage	42.8	58.8	52.0	30.1	76.8	52.1
LSD (0.05)	NS	7.3	11.6	15.8	NS	
N Fertilization						
Check	45.0	65.6	30.4	18.9	56.5	43.3
Anhy. NH_3 - knifed	45.2	92.3	92.0	55.0	73.2	71.5
UAN soln. - broadcast	43.9	85.6	60.4	47.1	87.7	64.9
Urea solid - broadcast	46.4	88.9	80.3	46.7	97.5	72.0
LSD (0.05)	NS	5.5	9.2	7.6	6.4	
T x N Interaction	NS	*	NS	NS	NS	

EFFECT OF PREVIOUS RESIDUE MANAGEMENT AND N RATE ON YIELDS IN A CONTINUOUS SMALL GRAIN - DOUBLE-CROP SOYBEAN ROTATION

Daniel W. Sweeney

Summary

In general, double-crop soybean yields were low from 1983 to 1991, with a poorly defined trend for disc-only residue management to result in higher soybean yields. However, wheat (or oat) yields often were lower where the previous double-crop soybeans were planted no-till as compared to burn and disc or discing only. Increased N rates for wheat had minimal effect on wheat or soybean yields.

Introduction

Double-cropping of soybeans after wheat or other small grains, such as oats, is practiced by many producers in southeastern Kansas. Several options exist for dealing with straw residue from the previous small grain crop. The method of managing the residue may affect not only the double-crop soybeans but also the following small grain crop. Wheat (or oat) residue that is not removed by burning or is not incorporated before planting soybeans may result in immobilization of N applied for the following small grain crop (usually wheat). Therefore, an additional objective of this study was to observe whether an increase in N rate, especially where double-crop soybeans were grown with no tillage, could increase small grain yields.

Experimental Procedure

Three wheat residue management systems for double-crop soybeans with three replications were established in spring 1983: no tillage, disc only, and burn then disc. After the 1983 soybean harvest, the entire area was disced, field cultivated, and planted to wheat. Before field cultivation, 6-24-24 was broadcast in all areas. In spring, urea was broadcast as a topdressing to all plots, so that the total N rate was 83 lb N/a. Wheat yield was determined in areas where the three residue management systems had been imposed previously. In spring 1985, residue management plots were split, and two topdress N rates were applied for wheat. These two rates were added to give total yearly N applications of 83 and 129 lb N/a. These residue management and total N rate treatments were continued through 1991, except in 1986 and 1987, when oats were planted in the spring because of wet conditions in the fall.

Results and Discussion

In general, yields of double-crop soybeans were low during the 8 years of this study (Table 1), rarely exceeding 15 bu/a. The disc only treatment tended to give higher yields in years where residue management resulted in significant differences. No tillage tended to result in lower yields, partly because of weed pressure. In 1987 and 1989, the residual N that was applied to the previous wheat crop resulted in higher soybean yield in the burn-then-disc treatment and in the disc-only treatment. However, yield was not increased by residual N in the no-tillage plots (interaction data not shown).

In general, the previous residue management used for double-crop soybeans affected the subsequent wheat or oat crops (Table 2). Small grain yields were up to 20 bu/a less where soybeans were double-cropped no-till in the previous year. Often, yield differences were small between the burn-then-disc treatment and the disc-only treatment. Averaged across residue management systems, increasing the N rate resulted in an increase in small grain yield only in 1990. However, oat yields in 1987 and wheat yields in 1991 were affected by an interaction between residue management system and N rate. In 1987, increasing N rate lowered oat yields in areas where double-crop soybeans had been planted no-till, whereas increasing N rate increased oat yields where the residue management had been either burn then disc or disc only. In 1991, increasing N rate increased wheat yields only in the disc-only system.

Table 1. Soybean Yield as Influenced by Small Grain Residue Management and Residual N Application Rates.

Treatment Means	Soybean Yield								
	1983	1984	1985	1986	1987	1988	1989	1990	1991
	bu/a								
Residue mgmt.									
Burn then disc	7	-	15	10	13	1	11	8	5
Disc only	4	-	21	12	17	3	10	12	14
No-tillage	6	-	0	9	13	6	0	3	5
LSD 0.05	NS	-	2	NS	3	2	6	4	5
N Rate (lb/a)									
83	-	-	12	10	13	3	5	7	9
129	-	-	13	12	15	4	10	9	8
LSD 0.05	-	-	NS	NS	1	NS	2	NS	NS
Interaction	-	-	NS	NS	*	NS	**	NS	NS

Table 2. Wheat Yield in 1984, 1985, 1988, 1989, 1990, and 1991 and Oat Yield in 1986 and 1987 as Influenced by Previous Small Grain Residue Management and N Application Rates.

Treatment Means	Small Grain Yield							
	1984	1985	1986	1987	1988	1989	1990	1991
	bu/a							
Previous residue mgmt.								
Burn, then disc	63	59	79	51	58	40	18	23
Disc only	59	55	85	49	53	45	12	17
No-tillage	43	48	64	42	50	33	7	15
LSD 0.05	13	8	6	NS	5	NS	6	3
N Rate (lb/a)								
83	-	53	77	47	56	38	10	19
129	-	55	75	47	51	40	14	18
LSD 0.05	-	NS	NS	NS	5	NS	3	NS
Interaction	-	NS	NS	*	NS	NS	NS	**

TIMING OF LIMITED-AMOUNT IRRIGATION TO IMPROVE EARLY-MATURING SOYBEAN YIELD AND QUALITY

Daniel W. Sweeney, James H. Long, and Mary Beth Kirkham[1]

Summary

Even though dry weather reduced overall yields, limited-amount irrigation resulted in increases in soybean yield and oil content. Response to irrigation was less at the R6 growth stage, likely because of accelerated senescence caused by moisture stress. Protein content was not affected by irrigation treatments.

Introduction

Production of early-maturing soybeans may spread economic risk by crop diversification. Previous research has shown that early-maturing soybeans can often have yields comparable to those of full-season soybeans. However, one potential disadvantage of early-maturing soybeans has been reduced quality. This potential for poor quality may be due to late reproductive growth that generally occurs in July when rainfall is typically low. Irrigation may not only improve early-maturing soybean yield, but may also improve quality. Even though large irrigation sources such as aquifers are lacking in southeastern Kansas, supplemental irrigation could be supplied from the substantial number of ponds in the area. Thus, the objective of this study is to determine the effect of timing and quantity of limited-amount irrigation for improving yield and quality of early-maturing soybeans.

Experimental Procedure

The experiment was established in 1991 on a Parsons silt loam soil. The experiment was a split plot arrangement of a randomized complete block design. The main plots were a 3x2 factorial arrangement of irrigation timing and amount. The three timings were irrigation at the R4, R5, and R6 soybean growth stages. The two amounts were 1 and 2 inches. Also included was a non-irrigated check plot. The subplots were two Maturity Group I soybean cultivars, Hodgson 78 and Weber 84. Both cultivars were drilled at 200,000 seeds/a on May 10, 1991. Plots were harvested on Aug. 7, 1991.

Results and Discussion

Dry weather from mid June to late July resulted in low overall soybean yields (Table 1). However, irrigation increased average soybean yield by approximately 5 bu/a (Table 1). Yield was higher with irrigations at the R4 and R5 growth stages than at the R6. The poor response to irrigation at the R6 growth stage likely was due to premature senescence caused by moisture stress (less than 1" of total rainfall) that occurred during the prior 5-week

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[1] Department of Agronomy, KSU

period. In general, irrigation amount had little effect on soybean yield. However, a growth stage x amount x cultivar interaction suggested that yield of Weber 84 increased with irrigation amount at the R5 growth stage; however, Hodgson 78 appeared to be responsive to irrigation amount at the R4 growth stage.

Protein content of seeds was higher for Hodgson 78 than Weber 84, but did not appear to be affected by irrigation treatment (Table 1). In contrast, irrigation significantly improved oil content as compared to no irrigation. Irrigating at the R5 growth stage resulted in the highest oil content, which was approximately 1 percentage unit higher than no irrigation. Oil content was higher for Hodgson 78 than Weber 84. Thus, quality measures such as protein and oil were not diluted by the increase in yield for Hodgson 78.

Table 1. Effect of Timing of Limited-Amount Irrigation on Early-Maturing Soybean Seed Yield and Quality.

Growth Stage	Amount	Cultivar	Yield	Protein	Oil
	inches		bu/a	------ %	-------
R4	1	Hodgson 78	17.5	33.9	16.9
		Weber 84	9.9	33.1	16.4
	2	Hodgson 78	22.2	34.2	17.4
		Weber 84	11.7	33.1	16.7
R5	1	Hodgson 78	21.6	34.0	18.1
		Weber 84	9.6	33.2	17.2
	2	Hodgson 78	20.1	34.8	18.2
		Weber 84	15.1	35.0	17.1
R6	1	Hodgson 78	15.0	34.7	17.3
		Weber 84	6.6	33.6	16.7
	2	Hodgson 78	16.2	34.5	17.2
		Weber 84	7.2	33.8	16.8
Check	None	Hodgson 78	12.9	34.6	16.6
		Weber 84	6.0	33.5	16.4
LSD (0.05)			2.9	0.7	0.8
Treatment Means:					
Growth Stage					
R4			15.3	33.6	16.8
R5			16.6	34.2	17.6
R6			11.3	34.1	17.0
LSD (0.05)			2.5	NS	0.5
Amount (inches)					
1			13.4	33.8	17.1
2			15.4	34.2	17.2
LSD (0.05)			NS	NS	NS
Cultivar					
Hodgson 78			18.8	34.3	17.5
Weber 84			10.0	33.6	16.8
LSD (0.05)			1.2	0.3	0.3
Interaction(s)			GxAxC	NS	NS
Contrasts:					
None vs. all irrigation			**	NS	**
None vs. 1"			**	NS	*
None vs. 2"			**	NS	**

NITROGEN AND PHOSPHORUS RATE AND PLACEMENT EFFECTS ON NO-TILL GRAIN SORGHUM[1]

Daniel W. Sweeney, John L. Havlin[2], Ray E. Lamond[2], and Gary Pierzynski[2]

Summary

Responses to placement, N rate, and P rate have been minimal for 1990 and 1991. Even though background soil P level was low, the apparent high potential for N mineralization may account for the minimal response to fertilization at this site.

Introduction

Economic concerns of producers as well as increased public awareness of environmental issues have emphasized the need for efficient management of N and P fertilizers for crop production. Among management options, proper N and P placement often can greatly influence crop uptake efficiency of the fertilizer. Recent development of a 'point-injection' (spoke wheel) fertilizer applicator has provided an additional fluid fertilizer placement option in reduced-tillage systems. Thus, this study was initiated to determine how grain sorghum is affected by N and P rates and method of fluid fertilizer application.

Experimental Procedure

The experiment was established in spring 1990 on a low P, Parsons silt loam (Mollic Albaqualf) soil at the Parsons field of the Southeast Kansas Branch Experiment Station of Kansas State University. The treatments were randomized as a 4x2x3 factorial in a complete block with three replications. Fertilizer placement methods were broadcast, dribble, knife, and spoke. Dribble, knife, and spoke spacings were 30" and knife and spoke depths were 4". The two N rates were 50 and 100 lb/a and the three P rates were 0, 20, and 40 lb P_2O_5/a. A check (no fertilizer) was included in each replication. Grain sorghum (Pioneer 8500c) was no-till planted at approximately 62,000 seeds/a in June of 1990 and 1991. Grain was harvested in October in both years.

Results and Discussion

In 1990, knife applications resulted in higher grain sorghum yield than obtained with either surface application; however, the difference was less than 7 bu/a (Table 1). In 1991, knife applications tended to result in lower yield than dribble applications, even though there were no significant differences among the four placement methods. The relatively lower yield

[1] Research was partially supported by grant funding from the Fluid Fertilizer Foundation.

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response from knifing in 1991 may have been due to the drying effect caused by the knives that likely affected emergence. N rate had no effect on yield or yield components in either 1990 or 1991. This may have been due to the high organic matter content (3.7% in the surface 6") and total N (1470 ppm in the 0-6" zone) in the soil, which may reflect a high potential for mineralizable N. This may also explain the minimal response to fertilization above that obtained with the check. In both years, applying P at the 40 lb P_2O_5/a rate resulted in higher yield than no P. The N x P interaction in 1990 appeared to be due to the low yield with the higher N rate and no P (data not shown).

Table 1. Effect of Fluid Fertilizer Placement, N Rate, and P Rate on Grain Sorghum in 1990 and 1991.

Treatment Means	1990	1991
	----- bu/a -----	
Method		
Broadcast	61.9	59.8
Dribble	64.7	64.8
Knife	68.3	62.1
Spoke	65.2	57.9
LSD (0.05)	3.7	NS
N Rate (lb/a):		
50	64.9	62.2
100	65.3	60.1
LSD (0.05)	NS	NS
P Rate (lb P_2O_5/a):		
0	62.5	56.5
20	65.5	62.4
40	67.1	64.3
LSD (0.05)	3.2	6.1
Interaction(s)	NxP	NS
Check[1]	64.7	64.1

[1] Not included in the 4x2x3 factorial analyses.

PHOSPHORUS, POTASSIUM, AND CHLORIDE EFFECTS ON ALFALFA AND BIRDSFOOT TREFOIL[1]

Daniel W. Sweeney, Joseph L. Moyer, and David A. Whitney[2]

Summary

Yield of both legumes increased with increasing P rate. Yield response to K additions was minimal. P concentration was increased 22% by P fertilization, whereas K content was increased 140% by K fertilization. Stand establishment was not affected by P and K rates.

Introduction

With the attention recently given to sustainable agriculture, interest has been renewed in the use of legumes in a cropping system. Because sustainability of our agricultural resources needs to coincide with profitability, achieving and maintaining adequate soil fertility levels are essential. The importance of initial soil test levels and maintaining those levels has not been clearly shown for alfalfa and birdsfoot trefoil production in southeastern Kansas. Thus, the objective of this study was to determine the effect of soil and fertilizer phosphorus, potassium, and chloride levels on the emergence, stand persistence, yield, and quality of alfalfa and birdsfoot trefoil.

Experimental Procedure

The experiment was established on a Parsons silt loam in spring 1991. The soil was in native grass until the fall of 1983 and soil test values were initially low in P and K. Since 1983, soil test levels have been established in the whole plots by P and K treatments, with current P levels ranging from below 10 to more than 60 lb/a and K levels from approximately 120 to more than 200 lb/a. The experimental design was a split-plot. The whole plots were a factorial arrangement of P and K rates, in addition to selected chloride comparison treatments. Phosphorus rates were 0, 40, and 80 lb P_2O_5/a and K rates were 0, 125, and 250 lb K_2O/a. Split plots were alfalfa and birdsfoot trefoil. Cuttings were taken from a 3x40' area of each plot.

Results and Discussion

Dry weather resulted in only two cutting for alfalfa and one cutting for birdsfoot trefoil in this establishment year. First cutting and total yield of both legumes increased with increasing P rate; however, the largest increase was with the first 40 lb P_2O_5/a (Table 1). The yield response of

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

[2] Department of Agronomy, KSU.

both legumes to K was minimal, with no difference between the two higher K rates. P fertilization increased P concentration of the first cut by 22%, whereas K fertilization increased K concentration by 140%. In addition, the highest K rate was required to raise K concentration above 2%, a value often cited as critical for alfalfa production. Stand establishment did not appear to be affected by P and K levels. Even though first cut yield was similar for both legumes, birdsfoot trefoil appeared to be less responsive to P fertilization than alfalfa.

Chloride application did not affect yield (data not shown). However, a KxCl interaction suggested that K concentration was less with KCl than K_2SO_4. Chloride concentrations were approximately 300% higher in both legumes when grown on soil that had received Cl applications as either KCl or $CaCl_2$.

Table 1. Effect of P and K Application on Yield, Nutrient Content, and Stand Establishment of Alfalfa and Birdsfoot Trefoil.

Treatment Means	Yield		Cut 1 Concentrations			Plant
	Total	Cut 1	N	P	K	Stand
	--- ton/a ---		--------- % --------			plt/ft^2
P_2O_5 Rate (lb/a)						
0	1.58	1.37	2.66	0.212	1.71	19.3
40	2.15	1.93	2.35	0.239	1.63	19.1
80	2.33	2.04	2.32	0.259	1.59	18.8
LSD (0.05)	0.09	0.08	0.09	0.009	NS	NS
K_2O Rate (lb/a)						
0	1.87	1.65	2.56	0.252	0.92	19.6
125	2.07	1.82	2.42	0.233	1.78	17.9
250	2.12	1.87	2.36	0.225	2.24	19.7
LSD (0.05)	0.09	0.08	0.09	0.009	0.12	NS
Legume						
Alfalfa	2.25	1.77	2.51	0.243	1.62	17.7
Birdsfoot Trefoil	1.79	1.79	2.28	0.231	1.67	20.4
LSD (0.05)	0.09	NS	0.08	0.012	NS	1.7
Interaction(s)	NS	NS	PxL	NS	NS	NS

WINTER ANNUAL LEGUMES AND GRASSES FOR GROUND COVER AND FORAGE IN SOUTHEASTERN KANSAS

James H. Long and Joseph L. Moyer

Summary

Six legumes planted for use as winter annuals and two winter grass crops were compared for their performance as cover crops and for forage production in the fall of 1990 and the early spring of 1991 at the Mound Valley field. Winter survival played a key role in both ground cover and forage production of the legumes in the following spring. Field peas, crimson clover, and hairy vetch accumulated more forage than other legumes by early May whereas hairy vetch, rye, and wheat had the greatest percent ground cover when sampled in early May. Winter wheat, rye, and hairy vetch have been consistent in their ground coverage and forage production during the 2 years of the study and would be considered the best cover crops. Winter wheat should be considered in those areas where rye and hairy vetch are competitive as weeds in fall sown crops.

Introduction

The use of crops, especially legumes, for ground cover and for their nitrogen contribution has been revived during the last 5 years. Although they are used similarly to the old "cover crops" and "green manures" of the early 20th century their use has taken on new meaning because of government programs and environmental concerns. The objective of this study was to compare selected available legumes and winter grasses for their potential use as winter/spring cover crops, forage, and green manure in Southeastern Kansas.

Experimental Procedure

Six legumes, including hairy vetch, black medic, crimson clover, winter peas, sweet clover (a biennial), and arrowleaf clover, and two small grains, winter wheat and rye, were planted on August 25, 1990 at Mound Valley. Plots were sampled on March 28, 1991; April 23, 1991; and May 6, 1991 for forage production. Percent ground cover measurements were collected at the May 6, 1991 sampling. Winter survival was recorded at the March 28, 1991 sampling.

Results and Discussion

The wheat and rye gave adequate ground cover and early spring growth for use as cover crops (Table 1). Both crops were killed with a postemergent herbicide in early April, 1991 because they were in the 'boot' stage and had reached the maximum growth allowable for a cover crop. Most legumes gave adequate early growth in March, though yields of all except hairy vetch were significantly less than yields of wheat and rye (Table 2). Hairy vetch was the only legume to provide as much ground cover as the rye or wheat by early May (Table 1). The field peas, crimson clover, and hairy vetch suffered moderate winter damage (Table 1) after good fall growth. However, by early May, they had accumulated the greatest amounts of forage (Table 2) and aboveground N (Table 1).

Table 1. Agronomic Characteristics of Winter Annual Cover Crops Grown at Mound Valley Kansas in 1990-91.

Crop	Winter Survival March 1991	Ground Cover May 1991	Nitrogen Production
	%	%	lb/a
Field peas	67	78	156
Hairy Vetch	73	100	142
Sweet Clover	59	91	92
Black Medic	88	91	73
Crimson Clover	80	89	135
Arrowleaf Clover	97	90	62
Winter Wheat	80	96	--
Rye	97	100	--
L.S.D. 0.05	20	5	35

Table 2. Dry Matter Accumulation of Winter Annual Cover Crops at Mound Valley Kansas in 1990-91.

Crop	Late March	Late April	Early May
	--------------tons dry matter/a---------------		
Field Peas	1.38	2.61	3.13
Hairy Vetch	0.65	2.17	3.44
Sweet Clover	0.46	0.90	2.02
Black Medic	0.25	0.83	1.61
Crimson Clover	0.87	1.29	2.98
Arrowleaf Clover	0.50	0.87	1.36
Winter Wheat	1.45	--[1]	--
Rye	1.52	--	--
L.S.D. 0.05			

1 Wheat and rye killed at the boot stage in early April.

SHORT-SEASON CORN COMPARED TO GRAIN SORGHUM

James H. Long

Summary

Short-season corn did as well as grain sorghum in two locations in Southeastern Kansas in 1991. Differences in grain yield between corn planting rates was inconsistent and more information is needed to clarify differences seen between hybrids and locations. The grain sorghum performed better at 35,000 plants/a than at 70,000 plants/a and yielded more grain when planted in June.

Introduction

Short-season corn, those hybrids of 105 or less days relative maturity, can be a viable alternative crop for use in rotations that are planted back to wheat in the fall or where it is needed for animal consumption. However, there is little information on how it compares agronomically to other summer-planted crops such as grain sorghum. This study was started to directly compare short-season corn to grain sorghum as a summer-planted crop. Comparisons were also made between corn and grain sorghum populations and grain sorghum planting dates.

Experimental Procedure

Two corn hybrids, DK 535 and Pioneer 3737, were planted in early April and thinned to 16,000 and 22,000 plants per acre. Grain sorghum, Oro G Xtra, was planted at two times to coincide as closely as possible to early May and early June target dates. Two planting rates were used to obtain final stands of 35,000 and 70,000 plants/a. Both crops received 100 lb/a of N and 50 lb/a of P_2O_5 and K_2O fertilizer applied before planting. Lasso and atrazine herbicides were applied for weed control after planting. Both crops were monitored for blooming dates and maturity. Crops were harvested with a plot combine when grain was determined to be field ready. Yields were adjusted to a dry weight and reported as such, as well as being reported on a bushel basis appropriate for each crop. Test weight and grain moisture were measured with a Dickey-John analyzer. Important dates are listed in Table 1.

Results and Discussion

Pioneer 3737 and DK 535 performed equally at Columbus, except that Pioneer 3737 at 22,000 plants per acre yielded 76.8 bu/a. In general, the short season corn outperformed the grain sorghum at Parsons and yielded nearly the same as grain sorghum at Columbus. The early-planted grain sorghum at Parsons yielded 51 bu/a or less at all planting dates and rates, whereas the short-season corn averaged between 50 and 60 bu/a. The Columbus yields were all in the range of 65 to 76 bu/a for both corn and grain sorghum. Late-planted grain sorghum outyielded the early-planted at both Parsons and Columbus.

Table 1. Production Information for Short-Season Corn and Grain Sorghum in 1991.

Crop	Parsons		Columbus	
	Plant	Harvest	Plant	Harvest
Corn	4/3	8/8	4/5	8/21
Grain Sorghum				
Early	5/9	8/20	5/14	9/9
Late	6/3	10/3	5/30	9/20

Table 2. Short-Season Corn Compared to Grain Sorghum Planted at Two Times and at Two Populations in Southeast Kansas - 1991 Crop Year.

Crop	Parsons		Columbus	
	-lb/a-[3]	-bu/a-[4]	-lb/a-	-bu/a-
Corn				
Pioneer 3737				
16000 p/a	2764	58.4	3156	66.7
22000 p/a	2564	54.2	3636	76.8
Dekalb 535				
16000 p/a	2556	54.0	3211	67.8
22000 p/a	2603	55.0	3187	67.4
Grain Sorghum [1]				
Early Planted[2]				
35000 p/a	976	19.9	3393	64.6
70000 p/a	853	17.4	3213	61.2
Late Planted				
35000 p/a	2499	51.0	3867	73.7
70000 p/a	1565	32.0	3754	71.5
L.S.D. (0.05)	881		381	

1 Oro G Xtra 100.6 bu/a 5 yr. avg.; 99.2 bu/a 5 yr avg. for all hybrids in Labette County.

2 Early-planted - mid May.
Late-planted - last week of May - first week of June.

3 Pounds per acre grain is reported on an oven dry-matter basis.

4 Bushels per acre grain is reported at standard grain moisture for each grain - 15.5 % for corn and 12.5 % for grain sorghum.

SOYBEAN CYST NEMATODE VARIETY TRIAL

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

Summary

Soybeans varieties with resistance to cyst nematodes, in some cases, doubled the grain yield of varieties without such resistance at Columbus, Kansas in 1991. Although yields were reduced by severe drought, resistant varieties averaged 16.8 bu/a, whereas susceptible varieties averaged 10.1 bu/a. This indicates the effectiveness of resistant varieties for use in conjunction with an acceptable cropping rotation on ground that is infested with the soybean cyst nematode.

Introduction

The appearance of soybean cyst nematode 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. This requires identifying those varieties that are resistant and are also adapted to this region of the state. To achieve this an ongoing cyst nematode variety trial was established in an area of the state known to have damaging populations of the soybean cyst nematode.

Experimental Procedure

Twenty varieties of soybeans, some rated as resistant to cyst nematode, were planted on June 17, 1991 at the Soybean Cyst Nematode Research Area located on the Martin Farms at Columbus, Kansas. This is a dedicated area for the study and control of the soybean cyst nematode in Kansas. Seed were planted at 10-12 seed/ft. Fertilizer application included 100 lb/a of 6-24-24 before planting and 200 lb/a of KCl sidedressed and cultivated in after planting. Maturities were rated in September and October, and plots were harvested with a plot combine on October 9, 1991. Test weight and seed moisture were measured with a Dickey-John analyzer and grain yields were adjusted to 13 % moisture.

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[2] Extension Agent, Cherokee County
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Results and Discussion

Varieties with resistance to soybean cyst nematode yielded 40% more grain than those that were not resistant (Table 1). Resistant varieties such as Forrest yielded as much as 20 bu/a whereas susceptible varieties such as Essex yielded only 7.5 bu/a. Soybean maturity grouping may have also played a role in grain yield with the mid maturity group V 'Bay' yielding 14 bu/a whereas the earlier maturing late group IV 'Stafford' yielded only 9.6 bu/a (Table 1).

Table 1. 1991 Southeast Kansas Soybean Cyst Nematode Variety Trial. Martin Farms / Soybean Cyst Nematode Research Area - Columbus.

Brand	Variety	Resist. --Race--		Yield	Height	Maturity after 8/31
		1	3	bu/a	in	days
----	Avery	S	R	19.8	29.3	35.5
----	Bay	S	S	14.0	20.0	39.0
----	Essex	S	S	7.5	15.0	32.5
----	Forrest	R	R	20.0	23.0	38.3
----	Hutcheson	S	S	11.6	17.8	39.3
----	KS 5292	R	R	14.3	19.5	30.8
----	Rhodes	S	R	19.9	20.8	39.8
----	Stafford	S	S	9.6	15.8	28.3
----	Manokin	R	R	19.9	21.3	31.8
----	Walters	-	R	17.5	19.0	36.8
----	Delsoy 4900	R	R	17.3	20.3	36.5
----	DS-510	R	R	9.7	19.3	33.0
Deltapine	415	R	R	14.9	18.3	38.0
Ohlde	5850	S	R	18.4	21.3	38.3
Pioneer	9521	-	R	15.7	18.5	32.5
Pioneer	9531	S	R	15.2	16.5	34.3
Pioneer	9501	S	S	9.4	21.8	35.5
Stine	5300	S	S	10.7	22.3	29.0
----	K1170S	S	S	7.5	13.8	31.3
----	K1192	S	S	10.7	21.0	28.5
L.S.D. 0.05				2.9	1.7	1.6

SHORT-SEASON CORN HYBRID PERFORMANCE TRIAL

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

Summary

Twenty two short-season corn hybrids were planted at 16,000 and 22,000 plants per acre in Parsons, Kansas and evaluated for yield and other agronomic characteristics throughout the summer of 1991. Grain yields were very low, but hybrid differences were seen under these severe drought stress conditions. Yields ranged from near 10 bushels per acre to 42 bushels per acre. The short-season hybrids had a distinct advantage over the long season, check hybrid Pioneer 3379. Many short-season hybrids silked 3.5 to 5.5 days sooner and outyielded it by as much as 30 bushels per acre.

Introduction

Short season corn hybrids with a 95-105 day relative maturity can flower and form seed much sooner in the summer than full season corn that has relative maturities of up to 120 days. This can be an advantage, especially on shallow upland soils, by allowing the corn crop to form during periods of high rainfall and before mid-summer drought can adversely affect yield. This study is conducted to identify short-maturity corn hybrids that are adapted to Southeast Kansas and compare them to full-season check hybrids. The trials are conducted at two plant populations to identify hybrids that can respond to high populations.

Experimental Procedure

Twenty two corn hybrids were planted on March 29, 1991 at high populations and then thinned back to 16,000 and 22,000 plants per acre. All hybrids and populations received 100 lbs/a of nitrogen and 50 lbs/a of P_2O_5 and K_2O fertilizer. Three quarts of Lariat were used for weed control. Mid-silk dates were recorded in June, and plant population and ear counts conducted prior to harvest on August 1, 1991. Grain was harvested with a Gleaner E plot combine with a two-row corn header and moisture and test weights were measured on a Dickey-John analyzer. The previous crop was soybeans.

[1] Southeast Area Extension Office

Results and Discussion

Many short season hybrids that had done well in previous 'good' years also did well in 1991, even though serious drought cut into yields. Pioneer 3737, Pioneer 3645, DS-1311, DK535, and H-2404 all yielded 40 bushels/a or better at either low or high populations (Table 1). Pioneer 3737 yield 44.1 bushels/a at 16,000 plants/a and 42.1 bushels/a at 22,000 plants/a. Also, the top-yielding short-season hybrids yielded as much as 30 bushels/a more than the full season hybrids. The full-season check-hybrid Pioneer 3379 yielded only 25.4 bushels/a with 16,000 plants/ acre and 10.6 bushels/a with 22,000 plants per acre. This indicates that the short season hybrids do utilize the early season moisture and develop a crop before the mid summer droughts.

Table 1. 1991 Labette County Short-Season Corn Performance Test
Southeast Kansas Branch Experiment Station, Parsons, KS.

Corn Hybrid	Plant Popul.	Yield	Harvest Moisture	Test Wt.	Date 50 % Silk	Plants	Ear Count
		bu/a	%	lb/bu	June	no/a	no/plant
Cargill 1627	high	27.0	20.7	51.2	15.8	22149	0.76
	low	32.0	18.7	52.0	16.8	16665	0.91
Cargill 7877*	high	27.1	29.2	48.1	17.0	21612	0.81
	low	33.6	27.5	48.5	17.5	16830	0.90
Delange DS-1311	high	11.7	23.9	50.5	17.0	21801	0.47
	low	19.9	24.4	50.8	18.5	16830	0.74
Delange DS-4001	high	40.0	12.6	48.3	14.3	21887	0.99
	low	37.2	12.2	48.1	13.5	16307	1.16
Dekalb DK 535	high	35.8	13.8	51.5	14.8	22236	0.99
	low	42.5	12.3	51.4	14.8	16307	1.16
Dekalb DK 584	high	33.7	21.1	49.3	16.0	22062	0.94
	low	37.0	18.9	49.7	15.3	16307	1.05
Golden Harv. H-2404	high	42.3	16.9	52.6	13.3	22759	1.03
	low	39.6	16.0	52.6	13.5	16743	1.02
Golden Harv. H-2390	high	34.3	14.6	51.0	14.0	22323	0.88
	low	38.6	13.4	51.5	14.0	16394	1.00
Hoegemeyer 2588	high	12.9	20.8	50.4	16.5	22062	0.43
	low	25.0	16.9	52.4	15.3	15696	0.89
Hoegemeyer 2594	high	22.0	18.8	54.5	16.0	21887	0.78
	low	31.0	16.8	55.4	15.3	16220	0.98
Jacques 5700	high	37.4	14.5	52.3	14.5	22323	0.95
	low	33.0	14.7	52.1	15.0	15958	1.00
Jacques 6770	high	30.2	17.0	50.8	15.3	22236	0.81
	low	28.1	14.7	51.8	15.0	16481	0.96
NC+ 3088	high	23.7	17.7	52.5	15.3	21713	0.79
	low	30.8	16.5	52.6	15.0	16481	0.96
NC+ 4616	high	11.2	24.4	51.0	17.8	21713	0.79
	low	24.5	23.9	51.0	16.5	16568	0.99
Ohlde 1101	high	35.8	17.1	51.5	14.3	22149	0.75
	low	32.8	15.6	51.7	14.0	15958	0.99
Ohlde EXP 200	high	30.9	18.5	49.8	16.5	22149	0.75
	low	33.9	16.4	50.8	16.0	16497	0.97
Oro 002	high	30.8	17.0	52.1	16.5	20666	0.87
	low	33.6	14.6	52.5	15.3	15640	1.06
Oro 003	high	26.7	16.3	51.1	15.5	22236	0.83
	low	33.5	14.2	51.7	15.0	16219	0.97
Pioneer 3379*	high	10.6	20.6	51.6	20.0	22149	0.30
	low	25.4	20.2	52.2	20.0	16481	0.67
Pioneer 3645	high	34.2	15.6	49.5	16.0	23195	0.97
	low	40.6	13.9	51.2	16.3	16132	1.08
Pioneer 3737	high	42.1	13.6	52.8	15.3	23544	1.00
	low	44.1	13.1	52.8	14.8	16132	1.11
L.S.D. 0.05		5.7	NS	0.8	NS	721	0.09
Population means	high	28.6	18.3	51.1	15.8	22177	0.80
	low	33.2	16.9	51.6	15.6	16305	0.97
L.S.D. 0.05		NS	1.2	0.5	NS	---	0.07

*Full-season hybrids

FULL-SEASON CORN PERFORMANCE TRIAL

James H. Long, Kraig Roozeboom[1], and Mark Davied[2]

Summary

Fifty nine full-season corn hybrids were evaluated on a deep Lanton silt loam soil located in the Neosho river bottoms at Erie, Kansas. Although there was severe drought stress, the test averaged 82 bu/a, with a high yield of 97 bu/a and low of 56 bu/a. This wide range of 41 bu/a indicated differences among hybrids and their ability to adapt to the growing conditions of 1991.

Introduction

Full season corn is a major crop of the deep river bottom soils and under irrigation in Southeastern Kansas. Although grown on the better soils of the region, corn hybrids must still be able to withstand periodic summer drought, insects, and diseases typical of this area. This was the first year for this test to be located in Neosho County.

Experimental Procedure

Fifty nine corn hybrids were thickly seeded on March 25, 1991 and thinned back to 18,000 plants per acre at the four-leaf stage. The plots received 120 pounds of N before planting. Lasso and atrazine were applied before planting, and Buctril was applied postemergence to control weeds. Mid-silk dates were observed in June, and stand counts were taken prior to harvest on August 22, 1991. Plots were harvested with a Gleaner E modified plot combine with a two- row corn header. Grain moisture and test weight were measured on a Dickey-John analyzer. Yields were adjusted to 15.5 % moisture. The previous crop was soybeans.

Results and Discussion

Good early season conditions in April and May led to excellent growth of the crop; however, by July a promising corn crop was under severe drought stress. The dry and warm conditions accelerated maturity and dry-down and allowed an early harvest. The top hybrids ranged from 83 to 97 bu/a with many yielding more than 90 bu/a (Table 1). The test provided a good separation of hybrids and their ability to withstand the summer drought in 1991. There was a wide difference of 41 bu/a between the top yielders, Cargill 8027 and Pioneer 3162 both at 97 bu/a , and the low yielder, Nebraska 715 at 56 bu/a.

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[1] Assistant Agronomist, KSU Dept. of Agronomy.
[2] Neosho County Extension Agent.

Table 1. 1991 Labette County Corn Performance Test Results sorted by yield (bu/acre).

Brand	Hybrid	Acre Yield	Yield As % Of Test Av.	Mois- ture	Lodg- ing 1/	Dropped Ears 1/	Stand	Days to Silking	Test Weight
		Bu.	%	%	%	%	%		lbs.
CARGILL	8027	97*	117*	11	0	0	104	81	57
PIONEER	3162	97*	118*	12	0	0	100	81	58
PIONEER	3379	96*	117*	11	0	0	100	80	58
DELTAPINE	G-4673B	93*	112*	11	0	0	101	81	57
NORTHRUP-KING	N6330	93*	113*	12	0	0	100	80	57
ORO	188	93*	112*	13	1	0	98	82	56
PIONEER	3159	93*	113*	12	1	0	99	81	58
CARGILL	7997	92*	112*	12	1	0	100	81	58
NC+	7304	91*	110*	12	0	0	100	84	56
ORO	120	91*	110*	12	1	0	98	80	57
TRIUMPH	1270	91*	110*	11	0	0	98	81	57
JACQUES	8210	90*	109*	12	0	0	100	81	57
NORTHRUP-KING	N7816	90*	109*	11	0	0	101	81	56
TERRA	TR 1020	90*	109*	11	0	0	101	79	56
TERRA	TR 1120	90*	109*	12	0	0	102	80	57
CARGILL	7697	89*	107*	12	3	0	100	80	59
STINE	1180	89*	108*	12	1	0	100	81	57
NORTHRUP-KING	S7751	88*	107*	11	0	0	100	80	57
DEKALB	DK671	87*	105*	11	0	0	101	80	55
TERRA	TR 3400	87*	106*	11	1	0	97	80	55
BO-JAC	612	86*	104*	11	0	0	101	81	57
GARST	TP4445	86*	105*	11	0	0	98	80	57
OHLDE	501A	86*	104*	11	0	0	99	80	56
ORO	150	86*	104*	12	0	0	100	81	55
PIONEER	3417	86*	104*	11	0	0	99	80	58
GOLDEN ACRES	T-E 6951	84*	102*	11	0	0	99	81	57
ASGROW	RX899	83*	101*	12	0	0	98	84	57
NC+	5963	83*	101*	12	0	0	100	80	56
TRIUMPH TRX	TRX 1630 EXP	83*	100*	12	0	0	100	83	58
DELTAPINE	G-4513	82*	99*	12	1	0	99	81	57
DELANGE	DS-1951	81	99	11	0	0	96	80	57
NC+	6414	81	98	12	1	0	100	81	56
ORO	180	81	99	12	3	0	99	81	56

(Continued on next page)

Table 1. 1991 Labette County Corn Performance Test Results sorted on yield (continued).

Brand	Hybrid	Acre Yield	Yield As % Of Test Av.	Mois-ture	Lodg-ing 1/	Dropped Ears 1/	Stand	Days To Silking	Test Wt
		bu.	%	%	%	%	%		lbs.
GARRISON	SG-8545	80	97	12	0	0	93	81	58
GOLDEN ACRES	T-E 7055	80	98	12	1	0	100	81	57
TERRA	TR 1040	80	98	11	0	0	95	80	58
TERRA	TR 1170	80	97	12	0	0	96	80	58
BO-JAC	6272	79	95	12	1	0	100	80	57
NC+	7507	79	96	12	9	0	100	84	57
SSI	USN 318 EXP	79	96	12	0	0	100	83	56
TERRA	TR 1010	79	96	11	0	0	99	78	57
CARGILL	8427	78	94	12	0	0	100	80	58
TERRA	TR 1125	78	95	11	0	0	94	80	57
TERRA	TR 1190	78	94	12	2	0	100	82	56
TRIUMPH	1595	78	94	11	0	0	99	81	57
----B73 X MO17		78	95	11	0	0	102	84	54
ASGROW	RX908	77	94	12	2	0	100	83	58
DEKALB	DK711	77	94	12	0	0	99	81	58
GARST	8398	77	93	11	0	0	99	81	56
JACQUES	7970	76	93	12	0	0	100	81	57
GOLDEN ACRES	T-E 6988	75	91	11	1	0	100	82	56
NEBRASKA	611	74	90	11	4	0	100	82	56
ORO	190	73	89	12	0	0	100	82	57
STINE	1161	72	87	11	0	0	101	84	56
GARRISON	SG-6909	71	86	11	1	0	100	80	57
SSI	USN 314 EXP	68	83	12	0	0	92	83	55
GOLDEN HARVEST	H-2592	67	81	12	0	0	102	82	57
SSI	USN 316 EXP	61	74	12	2	0	100	84	57
NEBRASKA	715	56	68	12	0	0	101	84	54
Test Averages		82	100	12	1	0	99	81	57
L.S.D. (.05)	**	15	18	1	2	-	NS	2	1
C.V. %		13.0	3.2	190	-	3.9	1.3	1.2	

Upper yield group; differences among those values marked with an asterisk are not statistically significant.

** Unless two varieties differ by more than the L.S.D. (Least Significant Difference), little confidence can be placed in one being superior to the other.

SHORT-SEASON SOYBEAN TEST

James H. Long

Summary

Sixteen short season soybean varieties, planted in early May, were hit hard by mid summer drought and averaged only 4.7 bu/a grain yields. The low yield, coupled with very poor seed quality indicated how this crop can be hurt by the seasonal summer drought in Southeastern Kansas. Five years of testing have shown average yields ranging from the low of 4.7 bu/a in 1991 to 36.3 bu/a in 1989.

Introduction

Early-planted short-season soybeans, those in maturity groupings of 00 to early III, can yield well if adequate rainfall is received. Their early maturity also allows for crop rotation back to fall-planted winter wheat, if desired. Several problems continue to plague this type of soybeans including variable yields, short height, low pod set, and poor seed quality. These tests have been run since 1987 to provide a long-term yield average for comparing variety adaptation to Southeast Kansas. The 1991 study ended the testing of early maturity soybeans.

Experimental Procedure

Sixteen varieties of Group I to III maturity soybeans were planted on May 7, 1991 in drill row plots. Varieties were seeded at 240,000 seed/a in 8 inch rows. Two hundred and twenty pounds of 6-24-24 fertilizer were added before planting. Prowl and Scepter was used preplant incorporated for weed control. Maturity was evaluated during July and early August and plots were harvested on August 2 (for Group I and II) and August 8 (for Group III) with an Almaco plot combine. Test weight and moisture were measured on a Dickey-John analyzer, and seed quality was visually rated on representative samples of each plot. Yields were adjusted to 13 % moisture.

Results and Discussion

Yields in 1991 were very low, ranging from only 1.8 to 8.6 bu/a (Table 1). Average yields across years give a better indication of yield potential. The varieties had good early growth and were taller than in 1991 (Table 2), but the mid summer drought caused very slow growth and then early plant death. Maturity evaluations show nearly identical ratings because of the premature deaths (Table 3). The drought also caused very poor seed quality across all varieties (Table 4).

Table 1. Yield of Short-Season Soybeans, Parsons, Kansas 1991 and Summaries.

			Year					Average		
Brand	Cultivar	MG[1]	1991	1990	1989	1988	1987	4-yr	3-yr	2-yr
			bu/a							
------	Corsoy 79	II	7.4	--	--	--	--	--	--	--
------	Hack	II	3.4	--	--	--	--	--	--	--
------	Hardin	I	8.6	18.0	--	--	--	--	--	13.3
------	Hobbit 87	III	5.2	--	--	--	--	--	--	--
------	Hodgson 78	I	7.4	20.2	33.2	27.6	22.8	22.1	20.3	13.8
Northrup King	S19-90	I	6.3	21.4	--	--	--	--	--	13.9
Northrup King	S30-41	III	2.7	--	--	--	--	--	--	--
Pioneer	9161	I	4.8	17.6	43.1	35.4	--	25.2	21.8	11.2
Pioneer	9191	I	4.0	13.0	--	--	--	--	--	8.5
Pioneer	9202	II	5.3	18.3	44.8	28.5	29.3	24.2	22.8	11.8
------	Sibley	I	3.8	16.8	31.9	22.7	29.4	18.8	17.5	10.3
Terra	Flag	I	4.4	17.3	--	--	--	--	--	10.9
Terra	Runner III	I	3.6	--	--	--	--	--	--	--
Terra	225 Exp.	II	4.0	--	--	--	--	--	--	--
------	Weber 84	I	3.2	19.7	42.5	27.8	38.0	23.3	21.8	11.5
------	Zane	III	1.8	--	--	--	--	--	--	--
	$LSD_{0.05}$		1.8	2.9	8.5	5.1	8.0	--	--	--
	Test Mean		4.7	17.6	36.3	22.3	23.5	--	--	--
	Plant		5/08	6/05	4/19	4/22	NA			
	Harvest		8/19	9/04	8/18	8/15	NA			

[1]MG -- Maturity group.

Table 2. Height of Short-Season Soybeans, Parsons, Kansas 1991 and Summaries.

Brand	Cultivar	MG[1]	Year					Average		
			1991	1990	1989	1988	1987	4-yr	3-yr	2-yr
			--in--							
------	Corsoy 79	II	20.8	--	--	--	--	--	--	--
------	Hack	II	14.5	--	--	--	--	--	--	--
------	Hardin	I	18.3	12.6	--	--	--	--	--	15.5
------	Hobbit 87	III	12.3	--	--	--	--	--	--	--
------	Hodgson 78	I	18.5	13.4	27.0	18.0	--	19.2	19.6	15.9
Northrup King	S19-90	I	15.5	12.6	--	--	--	--	--	14.0
Northrup King	S30-41	III	13.3	--	--	--	--	--	--	--
Pioneer	9161	I	16.0	13.0	25.0	19.1	--	18.3	18.0	14.5
Pioneer	9191	I	14.0	11.8	--	--	--	--	--	12.9
Pioneer	9202	II	16.0	13.0	24.0	17.5	--	17.6	17.7	14.5
------	Sibley	I	17.8	12.6	28.0	16.6	--	18.8	19.5	15.2
Terra	Flag	I	15.8	13.4	--	--	--	--	--	14.6
Terra	Runner III	I	16.8	--	--	--	--	--	--	--
Terra	225 Exp.	II	13.8	--	--	--	--	--	--	--
------	Weber 84	I	17.4	13.0	33.0	19.1	--	20.7	21.1	15.2
------	Zane	III	16.5	--	--	--	--	--	--	--
	$LSD_{0.05}$		1.8	--	4.0	1.8	--	--	--	--
	Test Mean		16.1	12.6	26.0	16.5	--	--	--	--
	Plant		5/08	6/05	4/19	4/22	NA			
	Harvest		8/19	9/04	8/18	8/15	NA			

[1]MG -- Maturity group.

Table 3. Seed Quality[1] of Short Season Soybeans, Parsons, Kansas 1991 and Summaries.

Brand	Cultivar	MG[2]	Year 1991	1990	1989	1988	1987	Average 4-yr	3-yr	2-yr
------	Corsoy 79	II	4.0	--	--	--	--	--	--	--
------	Hack	II	4.3	--	--	--	--	--	--	--
------	Hardin	I	4.3	--	--	--	--	--	--	--
------	Hobbit 87	III	4.3	--	--	--	--	--	--	--
------	Hodgson 78	I	4.0	--	3.0	--	--	--	--	--
Northrup King	S19-90	I	4.5	--	--	--	--	--	--	--
Northrup King	S30-41	III	4.3	--	--	--	--	--	--	--
Pioneer	9161	I	4.0	--	2.0	--	--	--	--	--
Pioneer	9191	I	4.3	--	--	--	--	--	--	--
Pioneer	9202	II	4.5	--	2.0	--	--	--	--	--
------	Sibley	I	4.5	--	3.0	--	--	--	--	--
Terra	Flag	I	4.5	--	--	--	--	--	--	--
Terra	Runner III	I	4.3	--	--	--	--	--	--	--
Terra	225 Exp.	II	4.5	--	--	--	--	--	--	--
------	Weber 84	I	4.0	--	2.0	--	--	--	--	--
------	Zane	III	4.3	--	--	--	--	--	--	--
	$LSD_{0.05}$		0.5	--	1.0	--	--	--	--	--
	Test Mean		4.3	--	3.0	--	--	--	--	--
	Plant		5/08	6/05	4/19	4/22	NA			
	Harvest		8/19	9/04	8/18	8/15	NA			

[1]Graded on a scale of 1 - 5 with 1 best.
[2]MG -- Maturity group.

Table 4. Maturity of Short Season Soybeans, Parsons, Kansas 1991 and Summaries.

Brand	Cultivar	MG[1]	Year 1991	1990	1989	1988	1987	Average 4-yr	3-yr	2-yr
			----------	----------	----------	----------	date	----------	----------	----------
------	Corsoy 79	II	7/31	--	--	--	--	--	--	--
------	Hack	II	7/31	--	--	--	--	--	--	--
------	Hardin	I	7/31	8/30	--	--	--	--	--	8/15
------	Hobbit 87	III	8/03	--	--	--	--	--	--	--
------	Hodgson 78	I	7/31	8/28	7/31	8/05	--	8/08	8/09	8/14
Northrup King	S19-90	I	7/31	8/31	--	--	--	--	--	8/16
Northrup King	S30-41	III	8/04	--	--	--	--	--	--	--
Pioneer	9161	I	7/31	8/31	8/07	8/06	--	8/11	8/13	8/16
Pioneer	9191	I	7/31	9/02	--	--	--	--	--	8/17
Pioneer	9202	II	7/31	8/31	8/09	8/07	--	8/12	8/13	8/16
------	Sibley	I	7/30	8/27	8/05	8/05	--	8/09	8/10	8/13
Terra	Flag	I	7/31	8/31	--	--	--	--	--	8/16
Terra	Runner III	I	7/31	--	--	--	--	--	--	--
Terra	225 Exp.	II	7/31	--	--	--	--	--	--	--
------	Weber 84	I	7/31	9/01	8/07	8/09	--	8/12	8/13	8/16
------	Zane	III	8/04	--	--	--	--	--	--	--
	$LSD_{0.05}$		1	--	2	2	--	--	--	--
	Test Mean		8/01	--	8/03	8/02	--	--	--	--
	Plant		5/08	6/05	4/19	4/22	NA			
	Harvest		8/19	9/04	8/18	8/15	NA			

[1]MG -- Maturity group.

EFFECTS OF PLANTING DATE AND FOLIAR FUNGICIDE ON WINTER WHEAT YIELD

Kenneth Kelley and Bob Bowden[1]

Summary

Grain yield was significantly affected by planting date, foliar fungicide application, and cultivar selection. A mid-October planting produced the highest grain yield. Grain yield of disease-susceptible cultivars was significantly increased with a foliar fungicide application. Plant maturity was only slightly affected by planting date.

Introduction

Wheat is often planted over a wide range of dates in southeastern Kansas because of the varied cropping rotations. Wheat following early corn, early grain sorghum, or wheat is planted in late September and early October, whereas wheat following soybeans is typically planted from early October through early November. This research seeks to determine how planting date affects grain yield and yield components of selected hard and soft winter wheat cultivars with varying disease resistance.

Experimental Procedure

In 1990, six winter wheat cultivars were planted on four different dates at both the Columbus and Parsons Units. Cultivars were selected for various foliar disease resistances: 1) resistant soft wheat cultivars (Caldwell and Pioneer 2551), 2) susceptible hard wheat cultivars (Chisholm and TAM 107), and resistant hard wheat cultivars (Karl and 2163). Cultivars were seeded at the recommended rate for each planting date (850,000 seeds/A for late Sept., 1,050,000 seeds/A for October plantings, and 1,250,000 seeds/A for early Nov.) Tilt, a systemic foliar fungicide, was applied at 4 oz/A to half of the plot area for each planting date when the wheat was at Feeke's growth stage 8 (flag leaf just visible from the boot). Grain yield and yield components were measured.

Results and Discussion

Yield and test weight (Tables 1 and 3) were significantly affected by planting date, fungicide treatment, and cultivar selection. At both locations, the mid-October planting produced the highest grain yield. Without a foliar fungicide application, grain yields were similar for the late September and late October planting, but yield was significantly higher when Tilt was applied at the late October planting. Lowest grain yield occurred with the mid-November planting at both locations. Even though seeding rate was increased for the later planting date, the number of heads per unit area was still significantly lower compared to October planting dates.

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[1] Extension plant pathologist, KSU.

Yield response among cultivars varied with foliar fungicide application and planting date. Karl, with high resistance to foliar diseases, was the least responsive to Tilt application. 2163 also has good disease resistance, but Tilt significantly increased grain yield at both Parsons and Columbus. For the October planting dates, grain yields increased over 25% for both TAM 107 and Chisholm with a Tilt application. Even though soft wheat cultivars typically show good disease resistance, the foliar fungicide treatment still significantly increased grain yield and test weight of Pioneer 2551.

Grain protein was not significantly affected by planting date or fungicide treatment (Tables 2 and 4). Karl had the highest grain protein, whereas Caldwell had the lowest for all planting dates.

Analyses of yield components showed various levels of compensation among planting dates, fungicide treatment, and cultivars (Tables 2 and 4). The mid-October planting produced the highest number of heads per unit area. Tilt did not influence the number of heads per unit area or kernels per head but did significantly increase individual kernel weight for nearly all cultivars and planting dates.

Plant maturity (Table 5) was only slightly affected by planting date. A 6-wk delay in planting delayed maturity approximately 5 days, regardless of cultivar maturity. Plant height (Table 5) was not significantly affected by planting date, except for the mid-November planting, where plants were shorter. Plant lodging was not a problem for any planting date or cultivar.

Table 1. Effects of Planting Dates and Foliar Fungicide on Wheat Yield and Test Weight of Selected Varieties, Columbus Field, 1991.

Planting Date / Variety	Grain Yield: Fungicide No	Grain Yield: Fungicide Yes	Grain Yield: Avg.	Test Weight: Fungicide No	Test Weight: Fungicide Yes	Test Weight: Avg.
	-------- bu/A --------			------- lb/Bu --------		
Late September (Sept. 27)						
Caldwell (S)	68.7	73.1	70.9	56.6	58.7	57.7
Chisholm	60.6	68.1	64.4	59.6	61.1	60.4
Karl	64.7	64.8	64.8	59.4	58.9	59.2
2163	69.9	81.0	75.5	56.1	58.1	57.1
Pioneer 2551 (S)	71.7	74.6	73.1	55.7	56.7	56.2
TAM 107	70.3	74.5	72.4	58.0	59.1	58.6
Mid-October (Oct. 15)						
Caldwell (S)	74.1	81.8	78.0	57.8	59.4	58.6
Chisholm	65.7	74.1	69.9	61.3	62.1	61.7
Karl	74.1	75.3	74.7	60.3	60.6	60.5
2163	74.0	85.3	79.7	57.0	59.2	58.1
Pioneer 2551 (S)	74.5	82.5	78.5	56.7	59.0	57.9
TAM 107	76.1	94.5	85.3	58.0	59.9	58.9
Late October (Oct. 26)						
Caldwell (S)	67.3	82.4	74.8	56.1	58.5	57.3
Chisholm	60.8	76.8	68.8	61.0	62.3	61.7
Karl	71.8	77.3	74.5	60.8	60.6	60.7
2163	72.0	86.3	79.2	56.4	58.5	57.5
Pioneer 2551 (S)	68.0	85.0	76.5	55.6	57.9	56.8
TAM 107	66.9	89.6	78.2	56.3	60.3	58.3
Mid-November (Nov. 14)						
Caldwell (S)	46.1	60.8	53.4	52.3	54.8	53.5
Chisholm	42.1	58.0	50.1	59.2	61.5	60.4
Karl	60.0	64.9	62.4	60.9	61.0	61.0
2163	53.2	66.6	59.9	53.6	56.9	55.3
Pioneer 2551 (S)	47.5	62.0	54.7	53.4	56.1	54.8
TAM 107	61.1	76.6	68.9	57.5	59.9	58.7
LSD (0.05):						
Cultivar within same (F) & (DOP)			4.5			1.0
Cultivar for different (F) & same (DOP)			2.6			0.6

S = soft wheat cultivar.
Foliar fungicide = Tilt, applied at 4 oz/A at Feekes' GS 8 (early boot stage).

Table 2. Grain Yield, Test Weight, Grain Protein, and Yield Components Summarized over Planting Dates and Cultivars, Columbus Field, 1991.

Variable	Yield Fungicide No	Yield Fungicide Yes	Test Wt. Fungicide No	Test Wt. Fungicide Yes	Protein Fungicide No	Protein Fungicide Yes	1000 Ker. Wt. Fungicide No	1000 Ker. Wt. Fungicide Yes	Kernels/Hd Fungicide No	Kernels/Hd Fungicide Yes	# Heads Fungicide No	# Heads Fungicide Yes
	bu/A		lbs/bu		%		gr				hds/m2	
Cultivar:												
Caldwell (S)	64.0	74.5	55.7	57.9	10.7	10.6	26.2	28.8	37.0	36.0	450	493
Chisholm	57.3	69.2	60.3	61.8	11.4	11.7	33.8	38.5	24.9	24.4	469	510
Karl	67.7	70.6	60.4	60.3	13.9	14.1	34.0	34.8	22.4	22.1	608	625
2163	67.3	79.8	55.8	58.2	11.3	11.3	27.8	32.2	33.2	33.2	500	518
Pioneer 2551 (S)	65.4	76.0	55.4	57.4	11.7	11.7	29.4	33.2	37.7	37.2	401	422
TAM 107	68.6	83.8	57.5	59.8	12.2	11.6	32.0	38.1	29.1	28.3	505	532
Planting Date:												
Late September	67.7	72.7	57.6	58.8	12.1	12.1	30.4	33.3	30.7	30.7	506	497
Mid-October	73.1	82.2	58.5	60.1	11.8	11.6	32.0	36.1	29.9	28.5	537	561
Late October	67.8	82.9	57.7	59.7	11.8	12.0	31.0	35.2	29.7	29.7	524	567
Mid-November	51.7	64.8	56.2	58.4	11.7	11.6	28.7	32.4	32.6	32.0	389	441
(AVG).	65.0	75.7	57.5	59.2	11.8	11.8	28.7	32.4	32.6	32.0	389	441
LSD (0.05):												
Cultivar mean for same (F):		2.3		0.5		0.3		0.9		0.4		29
Fung. mean for same (DOP):		3.8		0.9		NS		0.9		NS		36

Table 3. Effects of Planting Dates and Foliar Fungicide on Wheat Yield and Test Weight of Selected Varieties, Parsons Field, 1991.

Planting Date Variety	Grain Yield Fungicide No	 Yes	 Avg.	Test Weight Fungicide No	 Yes	 Avg.
	--------	bu/A	--------	--------	lb/Bu	-------
Late September (Sept. 25)						
Caldwell (S)	53.4	53.2	53.3	54.7	55.2	55.0
Chisholm	49.0	53.5	51.3	57.3	57.4	57.3
Karl	55.6	54.3	54.9	56.6	56.7	56.7
2163	52.8	56.5	54.7	55.0	55.9	55.4
Pioneer 2551 (S)	55.3	57.5	56.4	53.4	53.6	53.5
TAM 107	56.8	61.7	59.2	56.3	56.6	56.5
Mid-October (Oct. 12)						
Caldwell (S)	61.3	62.5	61.9	53.8	54.1	54.0
Chisholm	67.1	72.5	69.8	58.0	58.4	58.2
Karl	67.9	70.4	69.2	57.7	57.3	57.5
2163	62.6	70.7	66.7	53.5	54.7	54.1
Pioneer 2551 (S)	66.3	70.5	68.4	52.8	53.7	53.3
TAM 107	63.6	79.1	71.4	54.2	55.7	55.0
Late October (Oct. 25)						
Caldwell (S)	47.2	53.5	50.4	52.3	53.5	52.9
Chisholm	58.0	67.4	62.7	57.8	59.0	58.4
Karl	58.1	62.8	60.5	57.5	58.1	57.8
2163	51.9	58.2	55.1	53.2	53.3	53.2
Pioneer 2551 (S)	52.2	59.3	55.7	51.9	53.4	52.7
TAM 107	48.1	66.6	57.3	52.3	56.2	54.3
Mid-November (Nov. 14)						
Caldwell (S)	39.0	41.5	40.3	50.2	50.7	50.4
Chisholm	42.6	53.6	48.1	57.5	58.8	58.2
Karl	51.6	54.2	52.9	57.8	57.7	57.8
2163	42.1	47.6	44.9	51.8	52.2	52.0
Pioneer 2551 (S)	40.5	46.4	43.5	50.5	51.2	50.9
TAM 107	44.0	59.8	51.9	52.4	56.3	54.3
LSD (0.05):						
Cultivar for same (F) & (DOP):			5.1			0.9
Cultivar for different (F) & same (DOP):			5.4			1.1

S = soft wheat cultivar.
Foliar fungicide = Tilt, applied at 4 oz/a at Feekes' GS 8 (early boot stage).

Table 4. Grain Yield, Test Weight, Grain Protein, and Yield Components of Winter Wheat Summarized over Planting Dates and Cultivars, Parsons Field, 1991.

Variable	Yield Fungicide No	Yield Fungicide Yes	Test Wt. Fungicide No	Test Wt. Fungicide Yes	Protein Fungicide No	Protein Fungicide Yes	1000 Ker. Wt. Fungicide No	1000 Ker. Wt. Fungicide Yes	Kernels/Hd Fungicide No	Kernels/Hd Fungicide Yes	# Heads Fungicide No	# Heads Fungicide Yes
	bu/A		lbs/bu		%		gr.				hds/m2	
Cultivar:												
Caldwell (S)	50.3	52.7	52.8	53.4	10.8	10.7	24.0	24.5	31.2	31.3	462	473
Chisholm	54.2	61.8	57.7	58.4	10.9	11.1	31.7	34.2	22.1	22.7	527	546
Karl	58.3	60.4	57.4	57.5	12.3	12.7	31.0	30.4	21.5	21.5	606	629
2163	52.3	58.3	53.4	54.0	11.3	11.4	26.1	28.0	27.2	26.9	513	538
Pioneer 2551 (S)	53.6	58.4	52.2	53.0	11.2	11.2	26.1	28.1	31.9	31.2	436	455
TAM 107	53.1	66.8	53.8	56.2	11.8	11.3	28.9	32.4	23.7	23.9	525	593
Planting Date:												
Late September	53.8	56.1	55.5	55.9	11.0	10.9	29.2	29.9	22.9	22.9	556	572
Mid-October	64.8	71.0	55.0	55.7	11.0	10.8	28.9	30.2	25.6	24.8	603	655
Late October	52.6	61.3	54.2	55.6	11.8	11.8	28.4	31.0	26.8	28.2	483	484
Mid-November	43.3	50.5	53.4	54.5	11.7	12.0	25.4	27.3	29.4	29.1	404	443
(AVG.)	53.6	59.7	54.5	55.4	11.4	11.4	28.0	29.6	26.2	26.3	512	539
LSD (0.05):												
Cultivar mean for same (F):		2.6		0.5		0.2		0.9		1.2		35
Fung. mean for same (DOP):		2.8		0.6		NS		1.0		NS		30

Table 5. Effects of Planting Date and Varieties on Wheat Heading Date and Plant Height, 1991, Southeast Kansas Branch Expt. Station.

Planting Date Variety	Heading Date Parsons	 Columbus	Plant Height Parsons	 Columbus
			---- in. ----	
Late September				
Caldwell	April 23	April 22	36	39
Chisholm	April 20	April 19	36	37
Karl	April 20	April 20	34	36
2163	April 22	April 23	33	36
Pioneer 2551	April 24	April 24	36	39
TAM 107	April 19	April 19	35	38
Mid-October				
Caldwell	April 24	April 24	39	38
Chisholm	April 21	April 21	37	37
Karl	April 21	April 22	36	36
2163	April 24	April 24	36	37
Pioneer 2551	April 26	April 26	38	37
TAM 107	April 20	April 20	37	37
Late October				
Caldwell	April 24	April 24	36	37
Chisholm	April 22	April 21	35	35
Karl	April 22	April 22	35	35
2163	April 24	April 24	35	35
Pioneer 2551	April 27	April 26	36	37
TAM 107	April 21	April 20	35	36
Mid-November				
Caldwell	April 28	April 27	31	33
Chisholm	April 25	April 23	32	32
Karl	April 26	April 23	32	32
2163	April 27	April 26	31	32
Pioneer 2551	April 29	April 27	32	33
TAM 107	April 24	April 22	33	33

EFFECT OF PREVIOUS CROP ON RATE AND TIME OF NITROGEN APPLICATION FOR WINTER WHEAT PRODUCTION

Kenneth Kelley

Summary

In 1991, the previous crop (wheat, soybeans, or grain sorghum) had a significant effect on wheat yield. Grain yield was 57 bu/A following wheat, 40 bu/A after soybeans, and 29 bu/A following grain sorghum. Nitrogen fertilizer was evidently temporarily immobilized in the milo stalk residue near the soil surface and, thus, unavailable for the growing wheat plants.

Introduction

This research seeks to evaluate how the previous crop (wheat, soybean, or grain sorghum) affects the utilization of applied nitrogen fertilizer by wheat and also to determine the optimum rate and time of nitrogen application for wheat after these crops.

Experimental Procedure

The experiment was a split-plot design, in which the main plots were the previous crops (wheat, soybean, or grain sorghum) and subplots included a factorial arrangement of three nitrogen rates (40, 80, and 120 lb N/A) with four application times - 1) all in the fall; 2) all in late winter; 3) l/2 in fall and l/2 in late winter; and 4) l/4 in fall, l/2 in late winter, and l/4 in early spring. Urea was the N source for all rates and application times, except for the foliar N treatment in early spring, which consisted of liquid 28% N diluted with water to reduce foliar leaf burn. The fall N application was preplant incorporated, and late winter N treatments were broadcast on the soil surface in late February. Soil type was a Parsons silt loam with 3% organic matter and had been plowed out of native grass nearly 20 years before. Leaf tissue samples were collected when wheat was fully tillered (Feekes' Growth Stage 30) and analyzed for N concentration. Grain protein and wheat yield components also were determined.

Results and Discussion

The previous crop had a significant effect on wheat yield in 1991 (Table 1). Wheat yield was highest when wheat followed wheat and lowest when wheat followed grain sorghum. Soil samples taken prior to wheat planting showed that summer-fallowed wheat plots had nearly 40 lbs/A of available N in both the 0 to 6" and 6 to 12" soil depths, whereas grain sorghum plots were nearly depleted of available nitrate-N. Because of the high soil mineralization rate follows a late-maturing soybean cultivar (maturity group 5) in the rotation, not enough time is available in late fall or early spring for the soil microorganisms to break down the fixed N from the soybean roots and make it available to the growing wheat plants.

Rate of N application had a more significant effect on wheat yield, leaf N concentration, and grain protein (Table 3) than time of applicatiion in each of the rotations. When wheat followed grain sorghum, 120 lb N/A was necessary to produce optimum wheat yield. However, when wheat followed soybeans, only 40 lb/A of N was necessary to produce optimum yield. Fertilizer N was not immobilized in soybean residue to the degree that it was in the grain sorghum residue. Grain protein was not significantly different when wheat followed wheat or soybeans, but was nearly 2% lower in wheat following grain sorghum. When wheat followed wheat, grain protein increased with increasing N rates, even though wheat yield declined somewhat. Previous research in 1989 suggested that when N was foliar applied at a low rate in late spring near flowering time, grain protein was significantly increased; however, that did not occur in 1991.

Analyses of wheat yield components are shown in Table 3. The number of heads per unit area was the major factor in explaining the yield differences relating to crop rotation and N effects. Wheat following wheat had 500 to 600 heads per square meter, whereas wheat following grain sorghum produced only 200 to 400 heads. Wheat following soybeans produced intermediate levels of 400 to 500 heads per square meter. Kernels per head were also higher when wheat followed wheat. Higher N rates tended to increase wheat head numbers when wheat followed soybeans or grain sorghum but decreased tiller number for wheat following wheat. N rate did not have a major effect on number of kernels per head, although a late winter N application seemed to produce more kernels per head when wheat followed grain sorghum.

Results of this study confirm that crop rotation can have a significant affect on wheat yield in southeastern Kansas. When wheat follows grain sorghum, data suggest that deeper placement of N is necessary to prevent immobilization in the surface residue. When wheat is rotated after later maturing soybean cultivars, producers should apply N fertilizer for the desired yield goal.

Table 1. Effect of Previous Crop Rotation on Time and Rate of Nitrogen for Winter Wheat, Southeast Ks. Branch Expt. Station, Parsons - 1991.

Time and Rate of Nitrogen			Grain Yield Previous Crop				Test Weight Previous Crop			
F	LW	SPR	Wh	Soy	GS	Avg.	Wh	Soy	GS	Avg.
--- lb N/A ---			---------- bu/A ---------				---------- lb/Bu --------			
0	0	0	57.5	34.1	11.9	34.5	58.4	58.1	58.1	58.2
40	0	0	58.8	39.0	21.7	39.8	58.2	57.9	58.2	58.1
80	0	0	56.0	39.9	30.8	42.2	57.6	57.9	58.4	58.0
120	0	0	53.3	38.9	34.8	42.3	57.2	57.7	58.2	57.7
0	40	0	59.0	39.6	22.9	40.5	58.2	58.0	58.2	58.1
0	80	0	57.8	40.7	31.6	43.3	57.9	58.0	58.4	58.1
0	120	0	56.4	41.1	35.5	44.3	57.8	57.9	58.1	58.0
20	20	0	54.4	39.9	21.0	38.4	58.1	58.0	58.1	58.1
40	40	0	57.1	39.4	30.4	42.3	57.9	57.8	58.3	58.0
60	60	0	54.1	39.4	35.8	43.1	57.6	57.8	58.2	57.9
10	20	10	60.2	38.5	22.2	40.3	58.3	58.2	57.9	58.1
20	40	20	59.2	40.5	26.4	42.0	57.9	58.1	58.1	58.0
30	60	30	55.9	38.6	31.7	42.0	57.5	57.8	58.2	57.8
Means:										
Crop Rotation:										
Wheat						56.8				57.8
Soybean						39.6				57.9
Grain sorghum						28.7				58.2
LSD: (0.05)						3.9				NS
N Rate:										
40						39.8				58.1
80						42.5				58.0
120						42.9				57.8
LSD: (0.05)						0.8				0.1
N Time:										
Fall						41.5				57.9
Late winter						42.7				58.1
Fall + late winter						41.3				58.0
Fall + late winter + spring						41.5				58.0
LSD: (0.05)						0.9				NS

Variety: Karl. Planted Oct.5, 1990.
Time of N application: F= fall, preplant (Oct. 4);
LW = late winter (Feb. 12); SPR = early spring (April 23).

Table 2. Effect of Previous Crop Rotation on Time and Rate of Nitrogen for Winter Wheat, Southeast Ks. Branch Expt. Station, Parsons - 1991.

Time and Rate of Nitrogen			Leaf - N (GS 30)				Grain Protein			
			Previous Crop				Previous Crop			
F	LW	SPR	Wh	Soy	GS	Avg.	Wh	Soy	GS	Avg.
--- lb N/A ---			------------ % N --------				----------- % -----------			
0	0	0	3.07	2.66	2.09	2.61	12.2	11.5	12.0	11.9
40	0	0	3.20	3.32	2.18	2.90	12.5	12.5	11.0	12.0
80	0	0	3.46	3.64	2.54	3.21	13.8	14.0	10.9	12.9
120	0	0	3.83	3.59	3.01	3.47	14.1	14.4	11.8	13.4
0	40	0	3.32	3.19	2.83	3.11	13.0	12.7	10.4	12.0
0	80	0	3.54	3.47	3.54	3.52	13.8	13.3	11.0	12.7
0	120	0	3.43	3.63	3.39	3.48	14.1	14.0	11.5	13.2
20	20	0	3.43	3.12	2.56	3.03	12.7	12.4	10.9	12.0
40	40	0	3.76	3.50	2.94	3.40	13.9	13.8	10.9	12.9
60	60	0	3.80	3.64	3.06	3.50	14.4	14.1	11.7	13.4
10	20	10	3.24	3.11	2.46	2.93	13.4	12.3	10.6	12.1
20	40	20	3.49	3.46	2.59	3.18	13.8	13.2	10.6	12.5
30	60	30	3.81	3.57	3.07	3.48	14.0	14.2	11.5	13.3
Means:										
Crop Rotation:										
Wheat						3.52				13.6
Soybean						3.44				13.4
Grain sorghum						2.85				11.1
LSD: (0.05)						0.10				0.6
N Rate:										
40						3.00				12.0
80						3.33				12.7
120						3.48				13.3
LSD: (0.05)						0.06				0.2
N Time:										
Fall						3.20				12.8
Late winter						3.37				12.6
Fall + late winter						3.31				12.7
Fall + late winter + spring						3.20				12.6
LSD: (0.05)						0.07				0.2

Table 3. Effect of Previous Crop and Time and Rate of Nitrogen on Winter Wheat Yield Components, Southeast Ks. Branch Expt. Station, Parsons.

Time and Rate of Nitrogen			Kernel Number Previous Crop				Plant Population Previous Crop			
F	LW	SPR	Wh	Soy	GS	Avg.	Wh	Soy	GS	Avg.
--- lb N/A ---			------ kernels/head -----				---- heads/sq meter ----			
0	0	0	22.1	17.8	17.4	19.1	573	403	153	376
40	0	0	22.2	18.3	17.6	19.4	575	475	267	439
80	0	0	22.6	18.0	17.2	19.3	572	503	380	485
120	0	0	21.8	17.1	18.7	19.2	578	503	403	494
0	40	0	22.8	19.0	20.2	20.7	559	463	244	422
0	80	0	22.4	19.1	22.2	21.2	584	466	294	448
0	120	0	24.0	18.0	20.9	21.0	520	524	364	469
20	20	0	21.0	19.5	18.8	19.7	578	458	230	422
40	40	0	23.3	18.3	18.4	20.0	558	475	338	457
60	60	0	22.9	19.4	20.6	21.0	547	469	361	459
10	20	10	21.2	17.6	18.4	19.0	656	473	264	465
20	40	20	21.5	18.1	19.0	19.5	626	507	298	477
30	60	30	23.3	17.9	18.6	19.9	587	502	378	489
Means:										
Crop Rotation:										
Wheat						22.4				578
Soybean						18.3				485
Grain sorghum						19.2				318
LSD: (0.05)						0.8				38
N Rate:										
40						19.7				437
80						20.0				467
120						20.3				478
LSD: (0.05)						0.4				12
N Time:										
Fall						19.3				473
Late winter						20.9				446
Fall + late winter						20.2				446
Fall + late winter + spring						19.5				477
LSD: (0.05)						0.5				14

Table 4. Summary of Previous Crop and Time and Rate of Nitrogen Effects.

Previous Crop	Nitrogen Rate Time	Yield	TW	Lf-N	Prot.	K/hd	#Hds
		bu/A	lb/bu	%	%		hd/m2
Wheat	0	57.5	58.4	3.07	12.2	22.1	573
	40	58.1	58.2	3.30	12.9	21.8	592
	80	57.5	57.8	3.56	13.8	22.4	585
	120	54.9	57.5	3.71	14.1	23.0	558
Soy	0	34.1	58.1	2.66	11.5	17.8	403
	40	39.3	58.0	3.18	12.5	18.6	467
	80	40.1	57.9	3.52	13.6	18.4	488
	120	39.5	57.8	3.61	14.2	18.1	499
Milo	0	11.9	58.1	2.09	12.0	17.4	153
	40	21.9	58.1	2.51	10.7	18.7	251
	80	29.8	58.3	2.90	10.8	19.2	328
	120	34.4	58.2	3.13	11.6	19.7	377
Wheat	F	56.0	57.6	3.50	13.5	22.2	575
	LW	57.7	58.0	3.43	13.6	23.1	554
	F+LW	55.2	57.8	3.66	13.6	22.4	561
	F+LW+SPR	58.4	57.9	3.51	13.7	22.0	623
Soy	F	39.3	57.8	3.52	13.6	17.8	494
	LW	40.5	58.0	3.43	13.3	18.7	484
	F+LW	39.6	57.9	3.42	13.4	19.0	468
	F+LW+SPR	39.2	58.0	3.38	13.2	17.9	494
Milo	F	29.1	58.3	2.57	11.2	17.8	351
	LW	30.0	58.3	3.25	10.9	21.1	301
	F+LW	29.0	58.2	2.85	11.2	19.3	310
	F+LW+SPR	26.8	58.0	2.70	10.9	18.6	313
<u>F-test Significance</u>:							
Crop rotation		***	10%	***	***	***	***
Rate of N		***	***	***	***	*	***
Time of N		**	10%	***	NS	***	***
Rate x Time of N		NS	NS	**	NS	NS	NS
CR x N rate		***	***	*	***	*	***
CR x N time		***	10%	***	NS	***	***
CR x NR x NT		NS	NS	***	NS	**	*
C.V. (%)		4.8	0.5	4.3	3.2	5.4	6.7

*, **, *** = Significance at the 0.05, 0.01, and 0.001 probability levels

EFFECT OF SOIL PH ON WINTER WHEAT PRODUCTION

Kenneth Kelley

Summary

Soil pH, ranging from 5.5 to nearly 7.0, had no significant effect on wheat grain yield, test weight, or protein. However, soil pH did signficantly affect plant nutrient uptake of nitrogen and phosphorus.

Introduction

Legume crops, such as soybeans and alfalfa, can fix atmospheric N via bacteria in root nodules. These bacteria function best in soils of near neutral pH (7.0). Cereal crops, such as wheat, are not as sensitive to soil pH and can grow adequately at somewhat lower soil ph levels. This research seeks to determine how soil pH affects wheat yield, nutrient uptake, and possible infection by soil disease.

Experimental Procedure

Beginning in 1989, lime was applied to a site at the Parsons Unit that had previously been in native grass sod. The initial soil pH was near 5.5, with a lime requirement of 6,000 lbs/A of ECC (effective calcium carbonate). Lime was applied with the objective of keeping soil pH at 0.5 unit increments ranging from 5.5 to 7.5. Additional lime was applied to some plots in 1991 to obtain the desired pH in the 7.0 to 7.5 range.

Results and Discussion

In 1991, soil pH did not have a significant effect on wheat yield, test weight, or grain protein (Table 1). However, lime did significantly affect nutrient uptake. Leaf samples taken at Feekes' growth stage 30 (just prior to jointing) showed that nitrogen and phosphorus concentrations were affected by soil pH. Acid soil conditions decreased nitrogen and phosphorus uptake. Potassium leaf concentration tended to decrease with increasing lime application, but this was not statistically significant.

When desired soil pH ranges are finally established at this site, future research plans are to investigate how phosphorus placement affects nutrient uptake within the various pH ranges.

Table 1. Effect of Soil pH on Winter Wheat Yield, Grain Protein, Test Weight, and Leaf Nutrient Concentration, Parsons Field, 1991.

Soil pH	Lime Applied	Grain Yield	Grain Protein	Test Weight	Kernel Weight	Leaf Concentration N	P	K
	T/A	bu/A	%	lb/Bu	gr/1000	----------	%	----------
5.5	0	37.6	12.5	57.8	31.5	3.30	0.326	2.40
5.9	1.0	37.1	12.5	57.7	30.1	3.30	0.325	2.36
6.4	2.5	36.8	12.5	57.7	30.2	3.46	0.349	2.35
6.5	4.0	34.7	12.8	57.5	30.4	3.50	0.363	2.33
6.8	6.0	37.3	12.5	57.6	30.5	3.64	0.375	2.29
LSD 0.05		NS	NS	NS	NS	0.21	0.028	NS
C.V. (%)		9.0	3.0	0.4	3.1	4.5	6.1	5.0

Initial lime was applied in the spring of 1989. Additional lime was applied in 1991.
Variety: Karl

WHEAT AND SOYBEAN CROPPING SEQUENCES COMPARED[1]

Kenneth Kelley

Summary

Three different wheat and soybean crop rotations have been compared over an 11-yr period. Full-season soybeans yielded significantly higher than double-crop in 6 of 11 yrs, no yield difference occurred in 4 yrs, and double-crop soybeans yielded higher in 1 yr. Full-season soybean yield was highest for crop rotations with no double-cropping the previous year. Wheat following two soybean crops (double-crop and full-season) or one full-season soybean crop was equal in yield. Wheat yield was highest following wheat and lowest following continuous double-crop soybeans.

Introduction

In southeastern Kansas, producers often rotate wheat after soybeans or plant double-crop soybeans following wheat harvest. Management practices of one crop, therefore, may affect the production of the subsequent crop. This research seeks to determine the long-term effects of wheat and soybean cropping rotations on yield and soil properties.

Experimental Procedure

Beginning in 1981, three different wheat and soybean cropping rotations were established at the Parsons Unit: 1) [wheat - double-crop soybean], 2) [wheat - double-crop soybean] - soybean, and 3) full-season soybean following wheat. Prior to 1988, soybean varieties were selected from maturity groups IV and V for double-crop and full-season soybeans, respectively. Beginning in 1988, maturity groups I, III, IV, and V were compared in rotation No. 2. Group I maturity was planted in 7-inch row spacing, whereas the other maturity groups were planted in 30-inch row spacing. In 1986 and 1987, spring oats were included rather than wheat because wet fall conditions prevented planting wheat. Fertilizer has been applied only to the wheat crop. For double-crop soybeans, wheat straw has been burned and disced prior to planting.

Since 1988, group I soybeans have been planted in early May (except for 1990), whereas groups III, IV, and V normally have been planted in mid-June. Double-crop soybeans have been plantd in late June or early July. Prior to 1988, wheat was not planted until all soybeans had been harvested, regardless of rotation. However, since 1988, wheat has been planted after a particular soybean maturity group has been harvested. Wheat following wheat or maturity group I soybean has been planted in early October.

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[1] This research was funded by the Kansas Soybean Commission.

Results and Discussion

Table 1 shows the yearly soybean yields for the three different wheat and soybean rotations for the past 11 years. Double-crop soybean yields have averaged nearly 5 bu/A less than those of full-season soybeans, but the variation from year to year has been significant. Full-season soybeans following double-crop soybeans have yielded nearly 3 bu/A less than full-season soybeans following summer-fallowed wheat.

Since 1988, soybean maturity has had a significant effect on both double-crop and full-season yields (Tables 2 and 3). For full-season soybeans, no one maturity group has been best for all years. However, in double-cropping systems, maturity group IV has produced the highest yield.

Wheat yield as affected by the different crop rotations is shown in Table 4. Yield differences have been more pronounced since wheat has been planted at different dates according to the particular rotation scheme (Table 5). More data are needed on the effects of soybean maturity and crop rotation on wheat yield; however, in the continuous double-crop rotation, wheat yield often has been significantly lower.

Table 1. Effects of Wheat and Soybean Cropping Systems on Soybean Yield, Southeast Kansas Branch Experiment Station, Parsons, Ks.

	Soybean Yield											
Crop Rotation	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	11-yr Avg.
	bu/A											
Wh - DC Soy	18.7	23.6	17.9	2.1	33.2	19.9	19.5	9.1	27.6	22.1	18.6	19.3
Wh - DC Soy FS Soy	18.0	23.0	16.9	2.0	31.6	17.5	19.3	8.4	28.0	23.9	15.2	18.5
Wh - DC Soy FS Soy	25.8	24.3	15.5	11.1	32.6	21.2	35.4	22.7	28.3	19.6	14.9	22.9
Wh - Wh - FS Soy	25.7	24.9	14.5	12.8	32.1	23.9	42.6	25.1	29.8	22.0	27.3	25.5
LSD: (0.05)	3.7	NS	NS	2.9	NS	3.8	2.5	1.5	1.7	1.2	0.8	----

DC = Double-crop soybeans; FS = Full-season soybeans.
Full-season and double-crop soybeans were planted on the same date in 1982, 1985, and 1989.

Table 2. Comparison of Soybean Maturity Groups in a Full-Season Soybean Crop Rotation, Southeast Ks. Branch Expt. Station, Parsons.

Mat. Group	Cultivar	Full-season Soybean Yield 1988	1989	1990	1991	4-yr Avg.
I	Weber 84	31.8	31.5	22.0	3.9	22.3
III	Flyer	24.0	30.8	14.5	23.8	23.3
IV	Staffford	26.9	28.8	16.0	24.0	23.9
V	Hutcheson	22.7	28.3	19.6	14.9	21.4
LSD: (0.05)		1.5	1.7	----	----	----

Rotation is [Wheat - double-crop soybean] - full-season soybean.

Table 3. Comparison of Soybean Maturity Groups in a Double-crop Soybean Crop Rotation, Southeast Ks. Branch Expt. Station, Parsons.

Mat. Group	Cultivar	Double-crop Soybean Yield 1988	1989	1990	1991	4-yr Avg.
		bu/A				
I	Weber 84	2.0	28.7	10.9	4.2	11.5
III	Flyer	2.2	28.9	16.6	14.7	15.6
IV	Stafford	8.4	28.0	23.9	15.1	18.9
V	Essex	6.5	22.8	20.7	12.1	15.5
LSD: (0.05)		1.5	1.7	----	----	----

Rotation: [Wheat - double-crop soybean] - full-season soybean

Table 4. Effect of Wheat and Soybean Cropping Rotations on Wheat Yield, Parsons Field.

	Crop Rotation			
Year	(Rot.-1) [Wh - DC Soy]	(Rot.-2) [Wh - DC Soy] FS Soy	(Rot.-3) Wheat Wheat FS Soy	(Rot.-4) Wheat Wheat FS Soy
	bu/A			
1982	58.9	55.4	52.1	51.6
1983	48.4	53.4	51.6	51.9
1984	51.4	55.1	55.0	54.6
(1982-84 Avg).	52.9	54.6	52.9	52.7
1988	49.5	52.6	60.5	61.6
1989	50.3	64.8	64.3	68.6
1990	30.4	29.5	33.4	23.7
1991	39.4	46.1	39.5	60.0
(1988-91 Avg.)	42.4	48.3	49.4	53.5

Wheat was not harvested from 1985 through 1987 because of wet soil conditions.
Spring oats were planted in 1986 and 1987 as a substitute crop for wheat.
Soybean maturity group:
Rotation - 1: Group III or early Group IV
Rotation - 2,3,& 4: Group V

Table 5. Effects of Soybean Maturity Group on Wheat Yield, Parsons Field.

Soybean Maturity	Wheat Yield 1989	1990	1991	3-yr Avg.
	bu/A			
Group I	71.4	25.1	58.2	51.6
Group III	68.1	27.5	54.9	50.2
Group IV	71.9	36.0	48.3	52.1
Group V	64.8	29.5	46.1	46.8
LSD 0.05:	5.8	5.1	5.8	----

Crop rotation: [Wheat - double-crop soy] - full-season soybeans
Planting dates:
<u>1989</u>: Oct. 14, 1988 (MG I, III, & IV)
Oct. 25, 1988 (MG V)
<u>1990</u>: Oct. 16, 1989 (MG I, III)
Oct. 27, 1989 (MG IV, V)
<u>1991</u>: Oct. 5, 1990 (MG I, III)
Oct. 16, 1990 (MG IV)
Oct. 24, 1990 (MG V)

ECONOMIC COMPARISONS OF WHEAT AND SOYBEAN CROPPING SEQUENCES[1]

William P. Casey[2], Robert O. Burton, Jr.[2], and Kenneth W. Kelley

Summary

Economic comparisons of three crop rotations were based on budgeting and on experimental data shown in the previous article of this report. Income above variable costs based on 1991 yields and prices or average yields and prices favored a 1-year sequence of wheat followed by double-crop soybeans. Four soybean maturity groups were considered in the two-year rotation containing wheat, doublecrop soybeans, and full-season soybeans. A comparison of income above variable costs based on 1991 yields and prices or average yields and prices favored Group IV soybeans for both full-season and double-crop use.

Introduction

Farmers producing wheat and soybeans in southeastern Kansas select a cropping sequence that enables them to manage soil fertility, control weeds, and maximize income. An ongoing experiment at the Parsons Unit of the Southeast Kansas Branch Experiment Station provides biological data about alternative cropping sequences. The purpose of this study is to provide information about economic returns associated with these alternative sequences.

Experimental Procedure

Budgeting was used to calculate income above variable costs for each crop in three crop sequences (Table 1). Crop sequences included a 1-year sequence of wheat and double-crop soybeans; a 2-year sequence of wheat, double-crop soybeans, and full-season soybeans; and a 3-year sequence of 2 years of wheat followed by full-season soybeans. Output prices were for the month of harvest, July for wheat; October for soybean maturity groups III, IV, V, and group I when double-cropped; and August for full-season soybean maturity group I. Seed costs for maturity group I were actual costs plus a shipping charge. Other soybean seed costs were from a seed distributor in southeastern Kansas. Fertilizer prices were the same for all wheat, and interest rate was the same for all crops. No fertilizer was applied on soybeans. Yields and machinery operations differed according to the crop sequence (Table 2). For purposes of this study, labor was included as a variable cost. Incomes above variable cost for each crop were added to provide total income for each sequence; these totals were then divided by the number of years required to complete a sequence to provide average annual incomes for each sequence. Incomes above variable costs were calculated based

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[1]This research was partially funded by the Kansas Soybean Commission.

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on 1991 yields and prices for both wheat and soybeans and also based on average yields and prices over several years--1988-91 yields for wheat, 1981-91 yields for soybeans, and 1987-91 prices. The 1987-90 prices were converted to a 1991 price level before averaging.

Results and Discussion

Results of a comparison of income above variable costs based on 1991 yields and prices or average yields and prices favor a 1-year sequence of wheat followed by double-crop soybeans (Table 3). Although both 1991 and average data favor double-cropping, this result will not hold every year. For example, in a previous progress report, budgeting based on 1988 yields and projected prices showed double-cropping every year to be least profitable and no double-cropping to be most profitable. Moreover, some producers will not have adequate labor and machinery to double-crop every year, especially when weather limits the number of days machinery operations may be performed during harvesting and planting periods.

One strategy for managing labor and machinery constraints during critical seasons is to use early maturing soybeans. From 1988 to 1991, four maturity groups were considered in the 2-year rotation containing wheat, double-crop soybeans, and full-season soybeans (see previous article). In this experiment, group I soybeans were drilled in 7-inch rows at 90 pounds of seed per acre. Budgeted costs of Group I soybean seeds were 18 cents per pound plus a 2 cents per pound shipping charge. Group III, IV, and V soybeans were planted in 30-inch rows with per acre seeding rates of 50 pounds for groups III and IV and 35 pounds for group V. Costs of group III, IV, and V soybean seeds were 16 cents per pound, based on a $9.75 price per bushel obtained from a seed distributor in Southeastern Kansas. Thus, budgeted seed costs were $8.00 per acre for group III and IV soybeans and $18.00 per acre for group I. Early harvest favors full-season group I soybeans because soybeans harvested prior to the traditional harvest season typically have a price advantage.

Early maturing soybeans have shown promise in the past few years by taking advantage of southeast Kansas's normally abundant spring rainfall. This failed to materialize in 1991 because of an extremely dry spring and summer, which drastically reduced yields and caused negative returns above variable costs. For both full-season soybeans (Table 4) and double-crop soybeans (Table 5), group IV had the highest returns above variable costs.

Table 1. Sample Budgets for Two-year Crop Sequence of Wheat, Double-crop Soybeans, and Full-season Soybeans.

		Wheat			Double-crop Soybeans Group IV			Full-season Soybeans Group IV		
Item	Unit	Price[a]	Quantity per Acre[b]	Value or Cost	Price[a]	Quantity per Acre[b]	Value or Cost	Price[a]	Quantity Per Acre[b]	Value or Cost
1. Gross Receipts from Production	Bu.	$2.52	46.10	$116.17	$5.42	15.10	$ 81.84	$5.42	24.00	$130.08
2. Variable Costs										
Seed	Lbs.	0.10	75.00	7.50	0.16	50.00	8.00	0.16	50.00	7.92
Nitrogen	Lbs.	0.23	70.00	16.10	-	-	0.00	-	-	0.00
Phosphate	Lbs.	0.24	50.00	12.00	-	-	0.00	-	-	0.00
Potash	Lbs.	0.13	50.00	6.50	-	-	0.00	-	-	0.00
Herbicide		-	-	0.00	-	-	14.65	-	-	14.65
Labor	Hrs.	8.00	1.21	9.68	8.00	1.29	10.32	8.00	1.61	12.88
Machinery				14.27			15.04			19.17
Interest on ½ of variable cost	Dol.	0.12	33.03	3.96	0.12	24.01	2.88	0.12	27.60	3.28
Total Variable Cost				70.01			50.89			52.89
3. Income above variable costs				46.16			30.95			72.19

[a]Wheat and soybean prices are for the 1991 month of harvest from Kansas Agricultural Statistics, Topeka, Kansas. Input costs other than machinery and soybean seed costs are projections from Fausett, Marvin and John R. Schlender, Soybean Production in Southeast Kansas and Continuous Cropped Winter Wheat in Southeast Kansas, KSU Farm Management Guides MF-570 and MF-572, revised August 1991. Machinery variable costs (fuel, lubrication, and repairs) and labor requirements are based on information from Fuller, Earl I and Mark F. McGuire, Minnesota Farm Machinery Economic Cost Estimates for 1991, Minnesota Extension Service, University of Minnesota, AG-FO-2308-C, revised 1991, with adjustments for Southeastern Kansas. Soybean seed costs are from a seed distributor in Southeastern Kansas.

[b]Yields, seed, and fertilizer are 1991 data from Kenneth Kelley at the Southeast Kansas Branch Experiment Station.

Table 2. Typical Average Machinery Operations per Acre Used in Budgets for Crops in Alternative Crop Sequences.

Machinery Operations	Wheat Following Wheat	Wheat Following Double-crop or Full-season Soybeans	Double-crop Soybeans Following Wheat	Full-season Soybeans Following Wheat	Full-season Soybeans Following Double-crop Soybeans
	-Number of Times over the Field-				
Burn Wheat Straw			1.00		
Moldboard Plow	0.50				
Chisel Plow				1.00	1.00
Disk	2.50	1.00	1.00	3.00	2.00
Fertilizer Buggy	1.00	1.00			
Field Cultivate	1.25	1.00			
Field Cultivate with Herbicide			1.00	1.00	1.00
Plant[a]	1.00	1.00	1.00	1.00	1.00
Herbicide Application			0.50	0.50	0.50
Row Cultivate				0.50	0.50
Combine	1.00	1.00	1.00	1.00	1.00
	-Acre/Truck Load-				
Medium Truck[b]	6.67	10.13	26.32	14.65	26.85
	-Acres/hour-				
Light Truck	3.50	3.50	3.50	3.50	3.50
	-Dollars/Acre-				
Machinery Variable Costs[c]	20.05	14.04	15.04	21.02	18.13

[a]Group I soybeans are planted with a grain drill and, therefore, have machinery variable costs about $1.00 less than soybeans planted with a planter.
[b]Acres per truck load for a 400 bushel truck are based on yields of each crop in each rotation. Lower yields would increase acres per truckload and decrease costs per acre and vice versa. Thus, truck costs for the same crop in a different sequence will differ because of different yields.
[c]Variable costs include fuel, lubrication, and repairs and $2.50 per acre rental charge for the fertilizer buggy.

Table 3. Incomes above Variable Costs for Alternative Cropping Sequences Containing Wheat, Double-crop Soybeans, and/or Full-season Soybeans at Parsons, Kansas[a]

Crops and Crop Sequences[b]	Incomes above Variable Costs[d] Based on: 1991 Yields and Output Prices[e]	Incomes above Variable Costs[d] Based on: 1988-1991 Average Wheat and 1981-1991 Average Soybean Yields, 1987-1991 Average Output Prices[f]
	-Dollars/Acre-	
[W-DCSB]		
W	29.70	67.96
DCSB	49.79	71.43
Annual Average[c]	79.49	139.39
[W-DCSB]-FSSB		
W	46.16	86.46
DCSB	31.58	66.67
FSSB	25.39	86.93
Annual Average[c]	51.57	120.03
W-W-FSSB		
W Year 1	29.94	90.40
W Year 2	72.92	93.28
FSSB	89.36	99.87
Annual Average[c]	64.07	94.52

[a] Incomes are based on agronomic data shown in the previous article of this report.

[b] Abbreviations are as follow W = wheat; DCSB = double-crop soybeans, FSSB = full-season soybeans. Brackets indicate wheat and double-crop soybeans harvested the same year.

[c] Annual average income is the total income for the crop sequence divided by the number of years required to complete the sequence.

[d] Input costs are based on the same price level for all budgets. See Table 1 for sources.

[e] Source of 1991 wheat and soybean prices for the month of harvest is Kansas Agricultural Statistics, Topaka, KS.

[f] Source of average 1987-91 prices for the month of harvest is Kansas Agricultural Statistics. Prices were updated to a 1991 price level using the personal consumption expenditure (PCE) portion of the implicit GNP price deflator before averaging.

Table 4. Incomes above Variable Costs for Soybean Maturity Groups: Full-Season Soybeans in a 3-Year Rotation, Parsons, Kansas[a].

Variety	Maturity Group	1991 Soybean Price[b]		5-yr. Avg. Soybean Price[b]	
		Based on 1991 Yield[c]	Based on 4-yr. Avg. Yield[c]	Based on 1991 Yield[c]	Based on 4-yr. Avg. Yield[c]
Weber 84	I	(44.26)	60.06	(39.87)	85.20
Flyer	III	71.01	68.30	89.99	86.88
Stafford	IV	72.19	71.64	91.32	90.70
Hutcheson	V	25.38	60.61	37.26	77.67

[a]Rotation is [wheat-double-crop soybeans] - full-season soybeans

[b]Prices are for the 1991 month of harvest: August for group I and October for groups III, IV, and V. Prices for 1987-90 were updated to a 1991 price level to calculate a 5-year average. The personal consumption expenditure portion of the implicit GNP price deflator was used to update prices.

[c]Yields are shown in the previous article of this report.

Table 5. Incomes above Variable Costs for Soybean Maturity Groups: Double-crop Soybeans in a 3-Year Rotation, Parsons, Kansas[a].

Variety	Maturity Group	1991 Soybean Price[b]		5-yr. Avg. Soybean Price[b]	
		Based on 1991 Yield[c]	Based on 4-yr. Avg. Yield[c]	Based on 1991 Yield[c]	Based on 4-yr. Avg. Yield[c]
Weber 84	I	(34.66)	4.91	(31.31)	14.08
Flyer	III	28.78	33.66	40.50	46.10
Stafford	IV	30.95	51.55	42.99	66.62
Hutcheson	V	17.24	35.66	26.88	48.02

[a]Rotation is [wheat-double-crop soybeans] - full-season soybeans

[b]Prices are for the 1991 month of harvest: October for groups I, III, IV, and V. Prices for 1987-90 were updated to a 1991 price level to calculate a 5-year average. The personal consumption expenditure portion of the implicit GNP price deflator was used to update prices.

[c]Yields are shown in the previous article of this report.

EFFECTS OF CROPPING SYSTEM ON SOYBEAN YIELDS[1]

Kenneth Kelley

Summary

Comparisons of full-season soybeans grown continuously or in three different 2-year crop rotations with wheat and grain sorghum have shown that cyst nematode reduced yield by 25% in the continuous soybeans. However, soybean yield was reduced only 10% when a nematode-resistant cultivar was grown continuously.

Introduction

Soybean is a major crop for farmers in southeastern Kansas. Typically, soybeans are grown in several cropping sequences with wheat, grain sorghum, and corn or in a double-cropping rotation with wheat. With the recent infection of soybean cyst nematodes (SCN) into the area, more information is needed to determine how crop rotations can be used to manage around the nematode problem.

Experimental Procedure

In 1979, four cropping systems were initiated at the Columbus Unit: 1) [wheat - double-crop soybean] - soybeans, 2) [wheat - summer fallow] - soybeans, 3) grain sorghum - soybeans, and 4) continuous soybeans. Full-season soybeans were 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 soybeans could also be compared in odd-numbered years. All rotations received the same amount of phosphorus and potassium fertilizer (80 lb/A), which was applied to the crop preceeding full-season soybeans.

Some modifications have been added to the original plot design. Starting in 1988, lespedeza has been seeded in the wheat as a summer legume crop in rotation No. 2. Also, in 1991, a susceptible and a resistant cyst nematode cultivar were planted in each of the four full-season cropping systems.

Results and Discussion

Soybean yields from the initial study that was started in 1979 are shown in Table 1. Soybean cyst nematodes have not been detected at this site. For the 6-yr average, yield has been highest for the wheat - (fallow-lespedeza) rotation and lowest in the continuous soybeans. However, in the continuous

[1] This research was funded by the Kansas Soybean Commission.

soybeans, yield has not been depressed as much as anticipated considering that soybeans have been grown continuously on that site for the past 13 years.

shown in Table 2. At this site, SCN were detected in 1989, and yield was reduced nearly 25% where nematodes had infected the continuous soybeans. In

a nematode-susceptible cultivar was grown. However, when a resistant cultivar was grown, yield was reduced slightly less than 10%.

season soybeans following the wheat - lespedeza rotation have yielded higher than soybeans following grain sorghum for the past 3 crop years. More data

SCN.

Table 1. Effects of Long-Term Cropping Systems on Soybean Yield in the

Crop Rotation	1980	1982	1984	1986	1988	1990	6-yr avg.
	---------------------- bu/A						----------------------
Soybeans following Wheat - double-crop soy	12.6	28.0	11.8	21.9	31.3	22.4	21.3
Soybeans following Grain sorghum	13.3	30.4	10.8	23.6	30.1	23.4	21.9
Soybeans following Wheat - lespedeza (*)	12.8	31.9	12.0	23.9	32.8	24.9	23.1
Soybeans following Soybeans	10.3	27.2	12.1	21.8	25.2	22.4	19.8
LSD: (0.05)	1.0	3.0	NS	1.8	3.0	NS	----

(*) Lespedeza was included in the rotation beginning in 1988.

Table 2. Effects of Long-term Cropping Systems on Soybean Yield in the Presence of Soybean Cyst Nematode, Columbus Unit.

Crop Rotation	1985	1987	1989	1991 N:Sus	1991 N:Res	4-yr avg. (N:Sus)
	----	----	----	bu/A	----	----
Soybeans following <u>Wheat - double-crop soy</u>	31.9	30.7	27.0	33.4	32.3	30.8
Soybeans following <u>Grain Sorghum</u>	30.9	31.5	27.5	39.1	35.8	32.3
Soybeans following <u>Wheat - lespedeza</u> (*)	29.5	33.2	33.4	39.4	38.3	33.9
Soybeans following <u>Soybeans</u>	27.9	28.2	20.7	30.6	33.2	26.9
LSD: (0.05)	3.2	3.8	4.5	7.1	3.2	----

(*) Lespedeza was included in the rotation starting in 1988.
Nematodes were found in the continuous soybean rotation beginning in 1989.
(N:Sus) = nematode susceptible and (N:Res) = nematode resistant.

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

COMPARISONS OF TILLAGE METHODS FOR DOUBLE-CROP SOYBEANS AND SUBSEQUENT CROP EFFECTS

Kenneth Kelley

Summary

Comparisons among four tillage methods for double-crop soybeans have shown that no specific tillage method is superior for all years. Plowing the wheat stubble under has been better when summer rainfall was adequate for crop growth, but leaving the stubble residue on the soil surface was better when rainfall was below normal. Crops that follow double-crop soybeans (full-season soybeans and wheat) have not been significantly affected by any of the double-crop tillage methods after five complete crop rotation cycles.

Introduction

Producers in southeastern Kansas typically grow double-crop soybeans after wheat, when soil moisture and time permit. Various tillage methods are used, depending partly on the type of equipment that is available. The primary goals of double-cropping are to plant soybeans as quickly as possible after wheat harvest and produce acceptable grain yields as economically as possible. However, the long-term effects from double-crop tillage methods have not been thoroughly evaluated for shallow, claypan soils.

Experimental Procedure

Since 1982, four tillage methods have been compared for double-crop soybeans after wheat at the Columbus Unit. Tillage methods are: 1) plow under stubble, 2) burn stubble and then disc, 3) disc stubble, and 4) chisel - disc stubble. The tillage study is alternated each year between two different sites, so that the double-crop tillage methods can be compared yearly when the crop rotation is [wheat - double-crop soybeans] - followed by full-season soybeans. All plots are chiseled in the spring following double-crop soybeans. Fertilizer is applied only to the wheat crop.

Results and Discussion

Double-crop soybean yields for the 9-yr period are shown in Table 1. When averaged over years, highest yield has occurred where the wheat stubble was plowed under and lowest yield where the wheat stubble was burned. However, double-crop yields have fluctated considerably over the period, with only 3 bu/A separating the high and low tillage method when averaged over years. With normal or above rainfall during the summer growing period, plowing the residue under has been more beneficial to double-crop soybean growth; however, when droughty conditions prevailed, higher yield was produced with the disc tillage method, which leaves more residue on the soil surface.

The subsequent effect of double-crop tillage methods on full-season soybean and wheat yields are shown in Table 2. The previous double-crop tillage method has not significantly affected soybean or wheat yield after a 9-yr period.

Table 1. Long-term Effects of Double-crop Tillage Methods on Soybean Yield, Columbus Unit.

Double-crop Tillage	1982	1983	1985	1986	1987	1988	1989	1990	1991	9-yr avg.
	-------	-------	-------	-------	bu/A	-------	-------	-------	-------	-------
Plow	26.1	25.2	32.9	20.2	18.7	14.6	27.9	20.8	15.5	22.4
Burn - disc	25.8	24.2	32.1	14.7	9.8	10.5	23.3	18.3	14.9	19.3
Disc	26.6	23.2	30.3	15.2	12.8	19.2	22.6	15.8	19.4	20.6
No-till	26.3	20.5	24.7	----	----	----	----	----	----	----
Chisel-disc	----	----	----	15.3	14.4	14.3	22.1	16.3	14.1	----
LSD: (0.05)	NS	3.6	4.9	1.3	2.8	3.0	1.2	2.0	1.9	

No yield data in 1984 because of poor stands and summer drought.

Table 2. Long-term Effects of Double-crop Tillage Methods on Subsequent Full-season Soybean and Wheat Yield, Columbus Unit.

Double-crop	Full-Season Soy		Wheat	
Tillage (*)	1991	9-yr avg.	1991	9-yr avg.
	--------	bu/A	--------	--------
Plow	27.9	25.4	48.6	50.1
Burn - Disc	28.5	24.9	46.8	48.4
Disc	31.2	24.8	53.7	50.0
Chisel - Disc	31.0	25.4	54.2	49.7
LSD: (0.05)	NS	NS	3.2	NS

(*) All double-crop tillage treatments were chiseled in the spring prior to planting full-season soybeans, so the tillage method represents only the double-crop tillage effect from the previous year. After full-season soybean harvest, all plots were disced prior to planting wheat.

SOYBEAN HERBICIDE RESEARCH

Kenneth Kelley

Summary

Various soybean herbicide treatments and application methods were compared for weed control. In 1991, preplant and postemergent applications gave better weed control than preemergent treatments because of insufficient rainfall after planting for herbicide activation. Comparisons with reduced rates of postemergent herbicides applied 10 to 14 days after planting showed that good to excellent cocklebur control occurred, if a timely cultivation followed to control later emerging weeds.

Introduction

Soybeans occupy 40% of the crop acreage in southeastern Kansas. Herbicide research studies are conducted to compare herbicide performance and application methods for the control of annual broadleaf and grassy weeds in soybeans.

Experimental Procedure

Soybean herbicide trials were conducted at the Columbus and Parsons Units in 1991. Soybeans were grown in 30-inch row spacing. All treatments were applied with a tractor-mounted, compressed air sprayer, with a spray volume of 20 GPA. Herbicides were applied early preplant incorporated, shallow preplant incorporated, preemergent, early and late postemergent. Amount of crop injury and weed infestations were determined by visual ratings.

Results and Discussion

Soybean herbicides, application methods, and timing of herbicides were compared at the Parsons Unit (Table 1). The objective was to compare weed control in the following systems: 1) apply both broadleaf and grass herbicides together, 2) apply grass herbicide first - then broadleaf herbicide, and 3) apply broadleaf herbicide first - then grass herbicide. Also, mechanical cultivation versus no cultivation was compared across all treatments.

Weed species consisted primarily of annual grasses (crabgrass and fall panicum) and smooth pigweed. Best overall weed control was obtained with early preplant and shalllow preplant incorporated treatments. Postemergent treatments were less effective because of dry conditions at the time of spraying, which prevented herbicide uptake by the emerged weeds. Cultivation improved soybean yield where grass and broadleaf weeds were not controlled, but cultivation did not affect soybean yield where herbicides adequately controlled weeds.

Soybean herbicides and application methods were compared for velvetleaf control at the Columbus Unit (Table 2). Excellent weed control was obtained with both preplant incorporated and postemergent treatments. In 1991, preemergent treatments resulted in poor velvetleaf control because rainfall was insufficient for soil herbicide activation.

Herbicides and application methods were compared for cocklebur control at the Columbus Unit (Table 3). In 1991, best cocklebur control occurred with postemergent treatments. Among postemergent comparisons, full herbicide rates applied 21 days after planting were slightly more effective in controlling cockleburs than reduced rates (1/2 x) applied 10 days after planting; however, soybean yields were similar for the two application timings with cultivation 28 days after planting.

Scepter gave better cocklebur control than Canopy in early preplant applications, but Canopy was better when applied just ahead of planting. Both herbicides gave poor control when applied preemergent because of insufficient rainfall for herbicide activation.

Various postemergent soybean herbicides were compared at full and reduced (1/2 X) rates for cocklebur control at the Columbus Unit (Table 4). Herbicides were applied at 14 (reduced) and 21 (full) days after planting. All treatments were cultivated 28 days after planting. Excellent cocklebur control was obtained with nearly all herbicides and combinations that were evaluated.

Results indicate that early postemergent soybean herbicides, applied 10 to 14 days after planting at the 1/2 X and followed by mechancial cultivation, are options for the producer wanting to lower herbicide cost. However, if weather conditions prevent early postemergent applications or weeds are under drought stress at the time of spraying, then producers should be prepared to use full herbicide rates 2 to 3 weeks after planting.

Four postemergent soybean herbicides or combinations were compared for morningglory control at the Columbus Unit (Tables 5 and 6). Three different times and applications were compared: 1) full rate applied 21 days after planting, 2) reduced rate (1/2 X) applied 10 days after planting, and 3) reduced rate (1/2 X) applied both at 10 and 21 days after planting. Mechanical cultivation effects were also evaluated for all treatments.

A preplant grass herbicide applied across all treatments gave effective control of annual grasses and small-seeded broadleaf weeds. Ivyleaf morningglory was the only weed species to emerge following soybean emergence. There was no significant difference in soybean yield for the three application times. Pursuit and Pinnacle combinations gave better morningglory control than Basagran + Blazer tankmixes, but no significant difference occurred in soybean yield. Cultivation increased soybean yield an average of 5 bu/A across all treatments, even when weeds were not competitive. Soybeans injury was more severe with Pinnacle combinations, but yield was not affected.

Table 1. Comparison of Soybean Herbicides, Method and Time of Application, and Cultivation on Soybean Yield and Weed Control, Southeast Ks. Branch Expt. Station - Parsons, 1991.

Herbicide Treatment	Cultivation	Product Rate	When Applied	Yield	Weed Control B-lf	Weed Control Gr
				bu/A	%	%
1) Tri-Scept + Command	No	2.33 pt + 4 oz	EPPI	32.0	100	97
2) Tri-Scept + Command	Yes	2.33 pt + 4 oz	EPPI	32.0	100	98
3) Treflan + Command + (Scepter)	No	1.5 pt + 4 oz + .33 pt	EPPI + POST	31.2	87	84
4) Treflan + Command + (Scepter)	Yes	1.5 pt + 4 oz + .33 pt	EPPI + POST	31.6	95	93
5) Scepter + Command + (Select)	No	.66 pt + 4 oz + .8 pt	EPPI + POST	32.6	100	97
6) Scepter + Command + (Select)	Yes	.66 pt + 4 oz + .8 pt	EPPI + POST	30.0	98	97
7) Lasso + Canopy	No	1.5 qt + 6 oz	SPPI	31.2	95	87
8) Lasso + Canopy	Yes	1.5 qt + 6 oz	SPPI	33.3	91	95
9) Lasso + (Classic/Pinnacle)	No	2 qt + .25 oz + .25 oz	SPPI + POST	32.7	97	83
10) Lasso + (Classic/Pinnacle)	Yes	2 qt + .25 oz + .25 oz	SPPI + POST	33.1	94	91
11) Canopy + (Assure)	No	6 oz + 1 pt	SPPI + POST	34.4	94	89
12) Canopy + (Assure)	Yes	6 oz + 1 pt	SPPI + POST	31.2	94	93
13) Turbo + Scepter	No	1 qt + .33 pt	PRE	30.3	95	86
14) Turbo + Scepter	Yes	1 qt + .33 pt	PRE	32.1	100	94
15) Dual + (Cobra)	No	1 qt + .8 pt	PRE + POST	32.3	88	79
16) Dual + (Cobra)	Yes	1 qt + .8 pt	PRE + POST	30.3	87	87
17) Sencor + Scepter + (Fusilade)	No	.33 lb + .25 pt + 1 pt	PRE + POST	33.6	81	82
18) Sencor + Scepter + (Fusilade)	Yes	.33 lb + .25 pt + 1 pt	PRE + POST	33.2	88	88
19) Poast+ + Basagran + Blazer	No	1.5 pt + 1 pt + 1 pt	POST	25.0	77	33
20) Poast+ + Basagran + Blazer	Yes	1.5 pt + 1 pt + 1 pt	POST	31.1	91	83
21) Poast+ + (Basagran/Blazer)	No	1 pt + 1 pt + 1 pt	POST + POST	29.5	60	48
22) Poast+ + (Basagran/Blazer)	Yes	1 pt + 1 pt + 1 pt	POST + POST	28.4	65	88
23) Basagran/Blazer + (Poast+)	No	1 pt + 1 pt + 1 pt	POST + POST	24.2	40	43
24) Basagran/Blazer + (Poast+)	Yes	1 pt + 1 pt + 1 pt	POST + POST	31.8	73	83
25) Control (No Herbicide)	---	---	---	22.6	0	0
26) Weed Free	---	---	---	33.5	96	88
LSD: (0.05)				4.9	17	16
C.V. (%)				9.7	12	12

BL = Broadleaf species, predominantly smooth pigweed.
GR = Grassy species, predominantly large crabgrass.

Table 2. Comparison of Soybean Herbicides and Time and Method of Application on Yield and Velvetleaf Control, Southeast Ks. Branch Expt. Station - Columbus Field, 1991.

Herbicide Treatment		Product Rate	Application	Yield	Vele	CI
				bu/A	%	
1)	Treflan + Canopy	1.5 pt + 6 oz	PPI	27.2	97	1.4
2)	Pursuit (+)	2.5 pt	PPI	25.5	100	1.4
3)	Squadron + Command	3 pt + 4 oz	PPI	28.8	95	1.5
4)	Salute + Command	3 pt + 4 oz	PPI	27.0	92	1.3
5)	Freedom + Scepter + Command	2.5 qt + 0.33 pt + 4 oz	Shal. PPI	27.8	93	1.3
6)	Lasso + Canopy	1.5 qt + 6 oz	Shal. PPI	27.6	95	1.3
7)	Lasso + Pursuit	1.5 qt + 4 oz	Shal. PPI	26.1	91	1.3
8)	Turbo + Scepter	1 qt + 0.33 pt	PRE	23.3	37	1.2
9)	Lasso + Canopy	1.5 qt + 6 oz	PRE	20.7	35	1.2
10)	Dual + Pursuit	1.5 pt + 4 oz	PRE	24.4	33	1.2
11)	Commence + Basagran	1 qt + 1 pt	PPI + Post	26.0	100	2.5
12)	Prowl + Pursuit	1.5 pt + 4 oz	PPI + Post	27.9	99	1.3
13)	Treflan + Basagran + Cobra	1.5 pt + 1 pt + 0.5 pt	PPI + Post	28.5	99	2.8
14)	Treflan + Classic + Pinnacle	1.5 pt + 0.25 oz + 0.25 oz	PPI + Post	26.9	92	4.0
15)	Cultivation only	----	----	25.9	62	1.0
16)	Control (No herbicide)	----	----	16.4	0	1.0
	LSD: (0.05)			3.2	12	0.2
	C.V. (%)			7.6	9	9

CI = Crop injury rating (1 = no injury, 5 = all plants dead).

Table 3. Comparison of Soybean Herbicides and Time and Method of Application on Soybean Yield and Cocklebur Control, Southeast Ks. Branch Expt. Station - Columbus, 1991.

Herbicide Treatment		Product Rate	When Applied	Yield	Coc	CI
				bu/A	%	
1)	Prowl + Canopy	1.5 pt + 6 oz	Early PPI	23.5	43	1.2
2)	Prowl + Scepter	1.5 pt + 0.66 pt	Early PPI	30.9	77	1.4
3)	Lasso + Canopy	1.5 qt + 6 oz	Shal. PPI	29.3	68	1.3
4)	Lasso + Scepter	1.5 qt + 0.66 pt	Shal. PPI	25.4	47	1.4
5)	Dual + Canopy	1.5 pt + 6 oz	PRE	25.5	50	1.2
6)	Dual + Scepter	1.5 pt + 0.66 pt	PRE	24.0	27	1.2
7)	Treflan + Basagran	1.5 pt + 0.5 pt	PPI + E.Post	30.7	77	1.2
8)	Treflan + Basagran	1.5 pt + 1.0 pt	PPI + Post	31.9	87	1.5
9)	Treflan + Basagran + Cobra	1.5 pt + 0.5 pt + 0.33 pt	PPI + E.Post	31.3	85	1.4
10)	Treflan + Basagran + Cobra	1.5 pt + 1.0 pt + 0.66 pt	PPI + Post	31.3	98	2.5
11)	Treflan + Classic	1.5 pt + 0.25 oz	PPI + E.Post	31.2	82	1.3
12)	Treflan + Classic	1.5 pt + 0.5 oz	PPI + Post	36.5	98	1.5
13)	Prowl + Pursuit	1.5 pt + 2 oz	PPI + E.Post	33.7	83	1.4
14)	Prowl + Pursuit	1.5 pt + 4 oz	PPI + Post	31.3	99	1.4
15)	Prowl + Scepter	1.5 pt + 0.166 pt	PPI + E.Post	33.0	80	1.2
16)	Prowl + Scepter	1.5 pt + 0.33 pt	PPI + Post	32.2	95	1.4
17)	Control	----	----	16.0	0	1.0
18)	Cultivation only	----	----	19.5	37	1.0
19)	Hand weeded	----	----	29.9	100	1.0
	LSD: (0.05)	----	----	5.8	12	0.2
	C.V. (%)	----	----	12.2	10	1.0

All treatments cultivated 28 days after planting, except for control treatment.
Crop injury rating: 1 = no injury, 5 = all plants dead.

Table 4. Comparison of Postemergent Soybean Herbicides Applied at Full and Reduced Rates, Southeast Ks. Branch Experiment Station, Columbus Field - 1991.

Herbicide Treatment		DAP	Product Rate	Yield	Weed Control Coc	Weed Control Mg	Crop Injury
				bu/A	%	%	
1)	Classic	14	0.25 oz	37.8	90	68	1.2
2)	Classic	21	0.50 oz	36.6	97	73	1.6
3)	Scepter + Blazer	14	0.166 pt + 0.5 pt	38.5	93	78	1.3
4)	Scepter + Blazer	21	0.33 pt + 1.0 pt	37.3	90	33	2.0
5)	Basagran + Scepter	14	0.5 pt + 0.166 pt	36.7	92	50	1.3
6)	Basagran + Scepter	21	1.0 pt + 0.33 pt	35.5	94	27	2.3
7)	Pursuit	14	2 oz	36.6	91	88	1.4
8)	Pursuit	21	4 oz	38.6	96	87	1.6
9)	Classic + Cobra	14	0.125 oz + 6 oz	38.1	87	58	1.3
10)	Classic + Cobra	21	0.25 oz + 12 oz	38.0	78	65	2.2
11)	Classic + Blazer	14	0.125 oz + 0.5 pt	34.2	65	50	1.2
12)	Classic + Blazer	21	0.25 oz + 1.0 pt	34.7	57	35	2.0
13)	Classic + Pinnacle	14	0.125 oz + 0.125 oz	37.1	88	67	1.3
14)	Classic + Pinnacle	21	0.25 oz + 0.25 oz	35.1	95	73	3.0
15)	Scepter + Cobra	14	0.166 pt + 3 oz	35.2	95	58	1.2
16)	Scepter + Cobra	21	0.33 pt + 6 oz	37.1	93	48	2.3
17)	Basagran + Blazer	14	0.5 pt + 0.5 pt	32.6	73	43	1.3
18)	Basagran + Blazer	21	1.0 pt + 1.0 pt	35.5	88	23	2.1
19)	Pursuit + Cobra	14	2 oz + 3 oz	36.0	95	65	1.5
20)	Pursuit + Cobra	21	4 oz + 6 oz	36.5	95	53	2.5
21)	Classic + Cobra	14	0.25 oz + 3 oz	35.7	90	48	1.2
22)	Classic + Cobra	21	0.5 oz + 6 oz	37.2	90	48	2.5
23)	Basagran + Cobra	14	0.5 pt + 3 oz	36.9	88	23	1.3
24)	Basagran + Cobra	21	1.0 pt + 6 oz	38.0	95	63	2.5
25)	Control	--	------	20.7	0	0	1.0
	LSD: (0.05)			4.7	12	29	0.2

All treatments were cultivated 28 days after planting.
Prowl applied preplant incorporated to all treatments.
Crop injury rating: 1 = no injury, 5 = all plants dead.
DAP = days after planting.
Weed species: COC = common cocklebur, MG = ivyleaf morningglory.

Table 5. Comparison of Postemergent Soybean Herbicides and Time and Rate of Application on Yield and Morningglory Control, Southeast Ks. Branch Expt. Station, Columbus Field, 1991.

Herbicide Treatment		Product	Rate	Time	Cult.	Yield	MG	CI
				day		bu/A	%	
1)	Basagran + Blazer	1 pt + 1 pt	Full	21	No	32.8	47	1.8
2)	Basagran + Blazer	1 pt + 1 pt	Full	21	Yes	34.8	50	1.8
3)	Basagran + Blazer	0.5 pt + 0.5 pt	Reduced	10	No	31.4	30	1.3
4)	Basagran + Blazer	0.5 pt + 0.5 pt	Reduced	10	Yes	37.3	17	1.2
5)	Basagran + Blazer	0.5 pt + 0.5 pt	Split	10 + 21	No	30.0	42	1.8
6)	Basagran + Blazer	0.5 pt + 0.5 pt	Split	10 + 21	Yes	39.0	40	1.8
7)	Classic + Pinnacle	0.25 oz + 0.25 oz	Full	21	No	36.5	57	3.3
8)	Classic + Pinnacle	0.25 oz + 0.25 oz	Full	21	Yes	37.7	65	3.5
9)	Classic + Pinnacle	0.125 oz + 0.125 oz	Reduced	10	No	29.7	47	1.4
10)	Classic + Pinnacle	0.125 oz + 0.125 oz	Reduced	10	Yes	34.0	35	1.4
11)	Classic + Pinnacle	0.125 oz + 0.125 oz	Split	10 + 21	No	33.2	63	2.7
12)	Classic + Pinnacle	0.125 oz + 0.125 oz	Split	10 + 21	Yes	35.5	68	3.0
13)	Scepter + Pinnacle	0.33 pt + 0.25 oz	Full	21	No	32.4	57	3.0
14)	Scepter + Pinnacle	0.33 pt + 0.25 oz	Full	21	Yes	36.9	50	3.3
15)	Scepter + Pinnacle	0.166 pt + 0.125 oz	Reduced	10	No	30.9	20	1.4
16)	Scepter + Pinnacle	0.166 pt + 0.125 oz	Reduced	10	Yes	37.7	27	1.3
17)	Scepter + Pinnacle	0.166 pt + 0.125 oz	Split	10 + 21	No	33.2	60	2.7
18)	Scepter + Pinnacle	0.166 pt + 0.125 oz	Split	10 + 21	Yes	35.9	58	3.0
19)	Pursuit	4 oz	Full	21	No	33.5	53	1.4
20)	Pursuit	4 oz	Full	21	Yes	38.8	55	1.5
21)	Pursuit	2 oz	Reduced	10	No	34.3	55	1.3
22)	Pursuit	2 oz	Reduced	10	Yes	40.1	52	1.3
23)	Pursuit	2 oz	Split	10 + 21	No	33.7	57	1.4
24)	Pursuit	2 oz	Split	10 + 21	Yes	36.9	75	1.5
25)	Control	---	---	---	---	27.7	0	1.0
26)	Weed Free	---	---	---	---	37.4	100	1.0
	LSD: (0.05)					6.3	18	0.3

Prowl applied preplant incorporated to all treatments.
Major weed pressure was ivyleaf morningglory.

Table 6. Summary of Effects of Soybeans Herbicides, Applications, and Cultivation on Yield, Crop Injury, and Morningglory Control.

Factor	Yield	MG	Crop Inury
	bu/A	%	
Mean Values:			
Herbicide Treatment			
Basagran + Blazer	34.2	38	1.6
Classic + Pinnacle	34.4	56	2.6
Scepter + Pinnacle	34.5	45	2.4
Pursuit	36.2	58	1.4
LSD: (0.05)	NS	7	0.1
Herbicide Application			
Full rate at 21 days	35.4	54	2.5
Reduced rate at 10 days	34.4	35	1.3
Split rate at 10 & 21 days	34.7	60	2.2
LSD: (0.05)	NS	6	0.1
Cultivation			
No	32.6	49	2.0
Yes	37.0	49	2.1
LSD: (0.05)	1.9	NS	NS
F-test significance			
Herbicide	NS	***	***
Application	NS	***	***
Cultivation	***	NS	NS
Herb. x Applic.	NS	*	***
Herb. x Cultiv.	NS	NS	NS
Applic. x Cultiv.	NS	NS	NS
Herb. x Applic. x Cultiv.	NS	NS	NS
C.V. (%)	11	22	10

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

ANNUAL WEATHER SUMMARY FOR PARSONS - 1991

Mary Knapp[1]

1991 DATA

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
AVG. MAX	36.5	56.1	61.8	69.3	79.7	86.3	92.9	92.4	79.8	72.6	50.0	48.7	68.8
AVG. MIN	19.7	26.6	36.1	46.6	59.0	67.0	68.4	65.8	57.0	44.8	31.7	31.2	46.2
MEAN	28.1	41.4	49.0	57.9	69.9	76.7	80.6	79.1	68.4	58.7	40.9	39.9	57.5
PRECIP	1.49	.07	1.08	5.77	3.72	2.14	3.92	2.2	3.74	1.99	4.51	3.48	34.11
SNOW	3	0	0	0	0	0	0	0	0	0	0	0	3
HEAT DD	145	661	503	224	43	0	0	0	0	233	725	778	3310
COOL DD	0	0	6	12	194	351	486	437	214	37	0	0	1735
RAIN DAYS	8	2	4	12	15	6	6	7	9	8	7	7	91
MIN <= 10	5	0	0	0	0	0	0	0	0	0	0	0	5
MAX >= 90	0	0	0	0	1	10	24	21	5	0	0	0	61
MIN <= 32	30	21	11	0	0	0	0	0	0	3	16	18	99

NORMAL VALUES (1951 - 1980 Average)

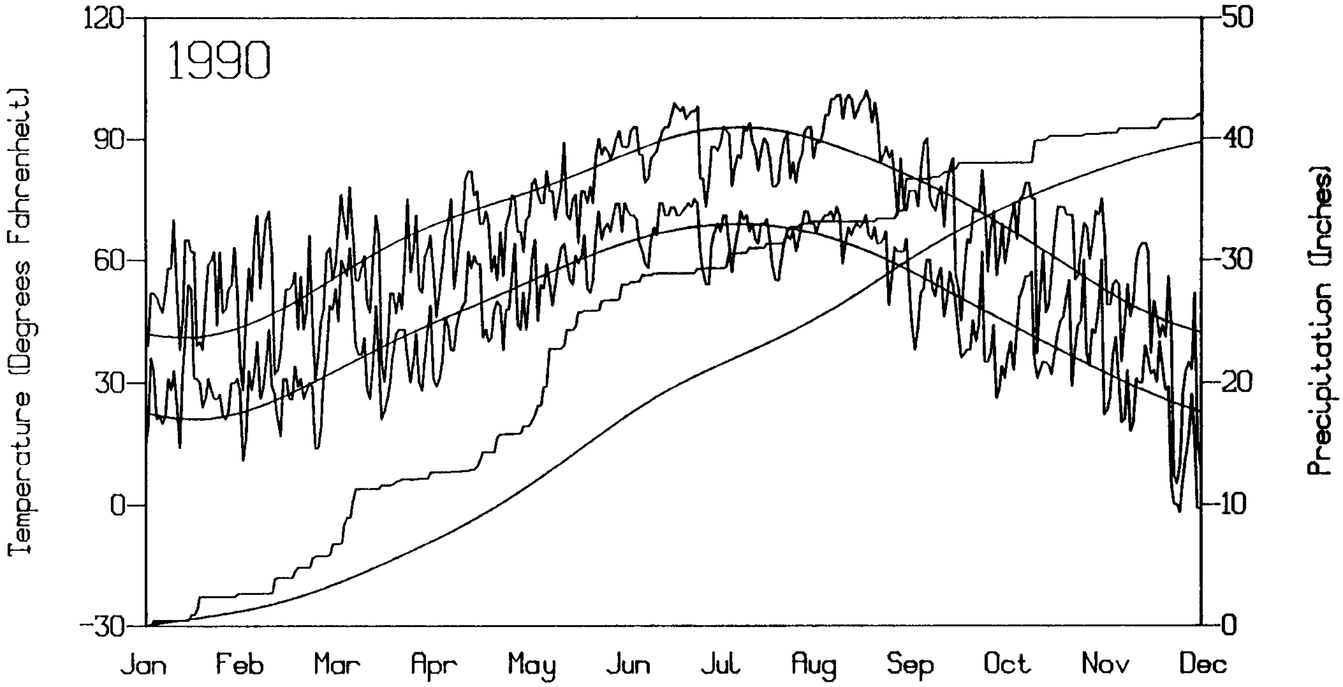
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
AVG. MAX	42.8	49.3	58.6	70.8	78.8	87.2	93.1	92.2	84.0	73.6	57.9	47.3	69.6
AVG. MIN	22.6	27.6	35.5	47.2	56.5	64.9	69.5	67.6	60.3	49.0	36.8	27.8	47.1
MEAN	32.7	38.5	47.1	59.0	67.7	76.1	81.3	79.9	72.1	61.3	47.4	37.6	58.4
PRECIP	1.22	1.34	2.98	3.72	5.18	4.80	3.65	3.43	4.53	3.47	2.54	1.65	38.51
SNOW	2	3	1.5	0	0	0	0	0	0	0	2	0	8.5
HEAT DD	1001	742	565	209	59	6	0	0	24	173	528	849	4156
COOL DD	0	0	10	29	143	339	505	462	237	58	0	0	1783

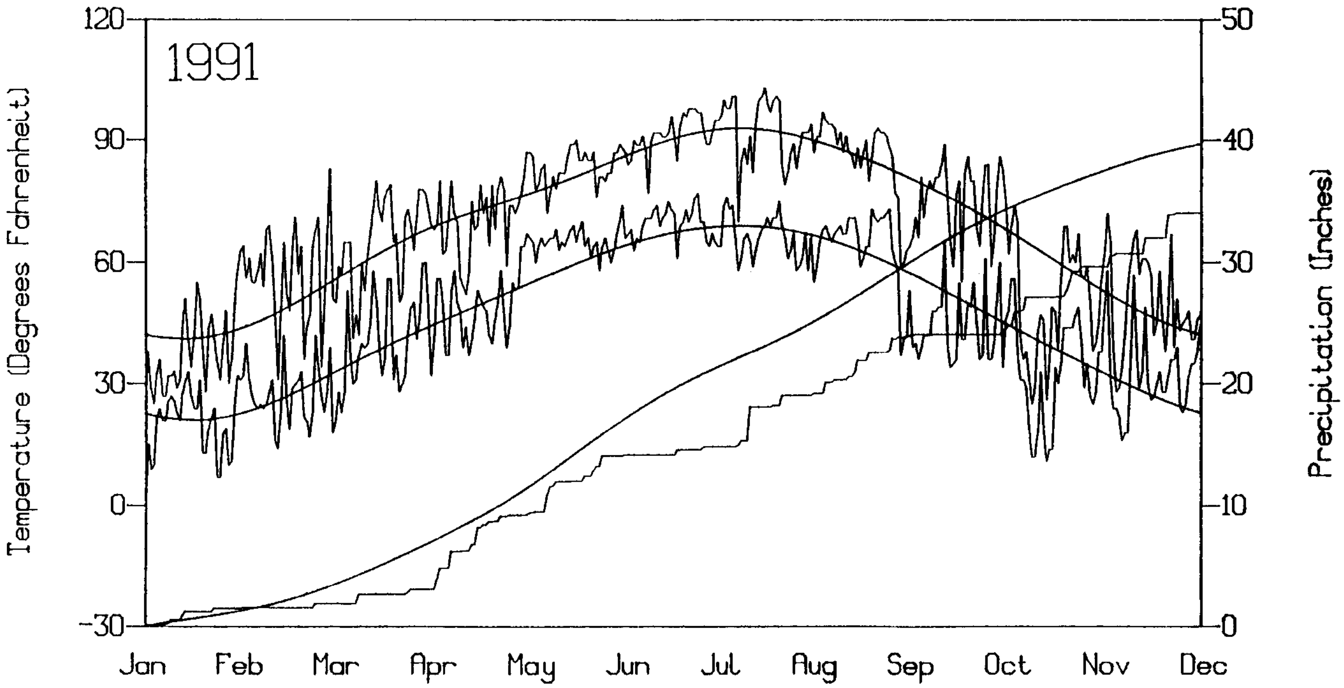
1991 DEPARTURE FROM NORMALS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
AVG. MAX	-6.3	6.8	3.2	-1.5	.9	-.9	-.2	.2	-4.2	-1.0	-7.9	1.4	-.8
AVG. MIN	-3.0	-1.0	.6	-.6	2.5	2.1	-1.2	-1.8	-3.3	-4.2	-5.1	3.4	-1.0
MEAN	-4.6	2.9	1.9	-1.1	2.2	.6	-.7	-.8	-3.7	-2.6	-6.6	2.3	-.9
PRECIP	.27	-1.3	-1.9	2.05	-1.5	-2.7	.27	-1.2	-.79	-1.5	1.97	1.83	-4.4
SNOW	1	-3	-1.5	0	0	0	0	0	0	0	-2	0	-5.5
HEAT DD*	-857	-81	-63.	15	-16	-6	0	0	-24	59.5	197.	-71	-846
COOL DD*	0	0	-4.5	-17	50.5	11.5	-20.	-25	-24.	-21	0	0	-48.5

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

1 Assistant Specialist, Weather Data Library, KSU.





Weather Summary for Parsons

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