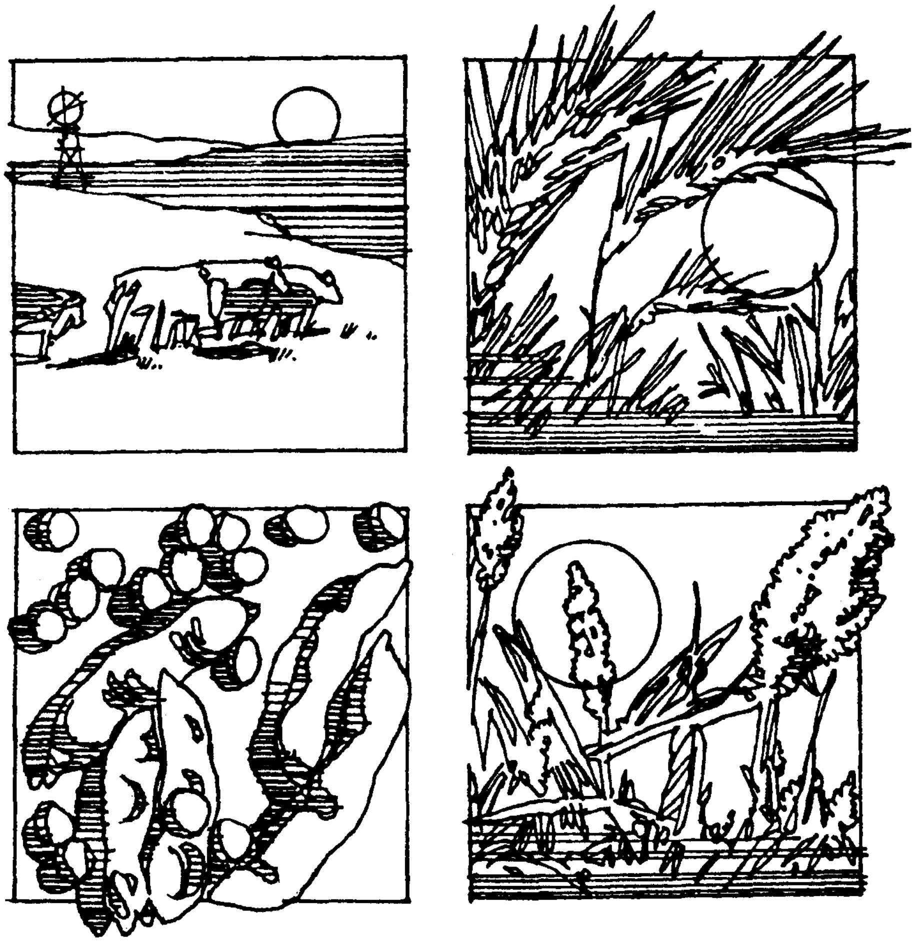
1996 Agricultural Research Southeast Agricultural Research Center

Kansas State University. Agricultural Experiment Station and Cooperative Extension Service

1996 AGRICULTURAL RESEARCH



Report of Progress 761

Agricultural Experiment Station

Kansas State University, Manhattan

Marc A. Johnson, Director

SOUTHEAST AGRICULTURAL RESEARCH CENTER

LYLE LOMAS, Research Center Head, received B.S. and M.S. degrees in Animal Husbandry from the University of Missouri and a Ph.D. degree in Animal Husbandry from Michigan State University. He provides leadership for research and is responsible for Research Center administration. Lyle joined the staff in 1979 as Animal Scientist. His research interests are beef cattle nutrition, production, and management.

KEN COFFEY, Animal Scientist, received a B.S. degree in Animal Science from the University of Tennessee, a M.S. degree in Animal Science from the University of Kentucky, and a Ph.D. degree in Animal Science from the University of Missouri. He joined the staff in 1986. His research focuses on ruminant nutrition and improving forage utilization by grazing beef cattle.

KEN KELLEY, Crops and Soils Agronomist, received a B.S. degree in Agricultural Education and a M.S. degree in Agronomy from Kansas State University. He has been a staff member since 1975. His research includes evaluation of herbicides, crop rotation systems, and intensive wheat management.

JIM LONG, Crop Variety Development Agronomist, received a B.S. degree from Missouri Southern State College and M.S. and Ph.D. degrees in Agronomy from the University of Arkansas. He joined the staff in 1990 and directs variety performance testing of grains, works with plant breeders in development and evaluation of new wheat and soybean cultivars, and conducts soybean production research.

JOE MOYER, Forage pgronomist, received B.S., M.S., and Ph.D. degrees in Agronomy from Kansas State University. He has been a staff member since 1978. His research evaluates cultivars and management practices with forage grasses and legumes and forage utilization by beef cattle.

DAN SWEENEY, Soil and Water Management Agronomist, received a B.S. degree in Chemistry from Kentucky Wesleyan College, a M.S. degree in Agronomy from Purdue University, and a Ph.D. degree in Soil Science from the University of Florida. He joined the staff in 1983. His research focuses on soil fertility, tillage and compaction, and irrigation.

TABLE OF CONTENTS

BEEF CATTLE RESEARCH

FORAGE CROPS RESEARCH

SOIL AND WATER MANAGEMENT RESEARCH

CROPS AND SOILS RESEARCH

CROP VARIETY DEVELOPMENT RESEARCH

NOTE

Trade names are used to identify products. No endorsement is intended, nor is any criticism implied of similar products not mentioned.

Contribution No. 96-422-S from the Kansas Agricultural Experiment Station.

EFFECT OF FEEDLOT IMPLANT PROGRAM ON PERFORMANCE BY STEERS PREVIOUSLY GRAZING INFECTED FESCUE PASTURES[1]

Kenneth P. Coffey, Frank K. Brazle[2], and Joseph L. Moyer

Summary

A total of 73 mixed breed steers grazed on a common *Acremonium coenophialum*-infected fescue pasture during either the spring or fall, then were allotted randomly to six pens to provide two replicates of three different implant procedures during both seasons. Implant programs consisted of zeranol (36 mg) initially and at reimplanting (Z-Z), progesterone-estradiol initially and at reimplanting (PE-PE), and zeranol initially and progesterone-estradiol at reimplanting (Z-PE). Forty steers grazed for 77 days beginning on April 1 and then were moved to the feedlot facility on June 17. Thirty-three steers grazed for 76 days beginning on September 16 and were moved to the feedlot facility on December 1. Steers implanted with PE-PE were heavier ($P < .10$) at the end of the feedlot period and had greater ($P < .05$) feedlot gain and daily gain and heavier hot carcass weights than those implanted with Z-Z. Steers implanted with Z-PE had lower ($P < .05$) DM intake and feed cost than those implanted with PE-PE and lower ($P < .05$) feed cost of gain and feed:gain than those implanted with Z-Z. Steers that grazed in the fall and were placed in the feedlot in December had better ($P < .05$) feedlot performance than those placed in the feedlot in June. Therefore, progesterone-estradiol or a combination of zeranol initially with progesterone-estradiol at reimplanting appeared to be a better feedlot-phase implant program than zeranol at both implant times for calves previously grazing infected fescue. When the totals of feed cost and carcass return were considered, little difference was observed whether zeranol or progesterone-estradiol was used as the initial implant in the feedlot program.

Introduction

Tall fescue is the predominant cool-season forage in Southeast Kansas and much of the southeastern United States. Much of this forage is infected with the endophytic fungus *A. coenophialum*, which produces alkaloids that provide many benefits for the plant but are toxic to cattle. The production of these alkaloids and their effects on cattle appear to be seasonal in nature. We and others at other locations have observed that "fescue cattle" tend to demonstrate symptoms of fescue toxicosis for a longer period following grazing of toxic pastures in the spring than in the fall. In earlier studies, cattle previously consuming infected fescue showed a greater response to zeranol implants than those consuming noninfected fescue. This implies that at least some of the toxic fescue effects were offset by the implant. This study was designed to compare the effects of feedlot implant programs on performance by steers previously grazing infected fescue in late spring or in the fall.

---

[1]Appreciation is expressed to SmithKline Beecham, West Chester, PA for providing Bovishield 4 + L5, Ultrabac/somnubac, and Boveye vaccinations; to Syntex Animal Health, West Des Moines, IA for providing oxfendazole and Synovex-S; to Mallinckrodt Veterinary, Mundelein, IL for Ralgro, De-Lice, and Saber Extra fly tags; and to Steve Clark for use of experimental animals.

[2]Southeast Kansas Area Extension Livestock Specialist, Chanute, KS.

Experimental Procedures

Forty mixed-breed steers were allowed to graze on a common 40 acre *A. coenophialum*-infected tall fescue pasture for 77 days beginning on April 1. Initially, a total of 80 steers grazed the common pasture until May 9. Then steers were divided into light- and heavy-weight groups and the light-weight group was moved to bermudagrass. All steers had been vaccinated previously against respiratory and clostridial organisms upon arrival and had been treated for internal and external parasites on April 1. Steers received a pair of insecticide ear tags and were vaccinated against pinkeye on May 9. On June 17, the heavy-weight group (G1) was transported to the Mound Valley Unit of SEARC. The light-weight (G2) group grazed on bermudagrass during the summer and was placed back on the 40-acre pasture for 76 days beginning on September 16. On December 1, steers were transported to the Mound Valley unit of SEARC.

Upon arrival at the feedlot facility, steers were vaccinated against respiratory and clostridial organisms and allotted randomly to six pens to provide two replicates of three different implant procedures. Implant programs consisted of zeranol (36 mg) initially and at reimplanting (Z-Z), progesterone-estradiol initially and at reimplanting (PE-PE), and zeranol initially and progesterone-estradiol at reimplanting (Z-PE). Steers placed on feed in June were reimplanted after 76 days, and those placed on feed in December were reimplanted after 63 days on feed.

Steers were fed a diet of 80% ground grain sorghum, 15% corn silage, and 5% protein supplement on a dry matter basis. The protein supplement was formulated to provide 50% crude protein and to meet or exceed NRC requirements for minerals and vitamins. Following a 154- (G1) or 141-day (G2) feedlot period, steers were transported to Emporia, KS and slaughtered at a commercial slaughter facility. Carcass measurements were collected following a 24-h chill.

Results and Discussion

No significant ($P < .05$) implant program × group interactions were detected. Therefore, data on implant programs are presented as main effects averaged across seasons. Steers implanted with PE-PE had 26 lb greater ($P < .05$) feedlot gain and .17 lb greater ($P < .05$) daily gain than those implanted with Z-Z (Table 1). Steers implanted with Z-PE had lower ($P < .05$) DM intake and feed cost than those implanted with PE-PE and lower ($P < .05$) feed cost of gain and feed:gain than those implanted with Z-Z. Steers that grazed in the fall and were placed in the feedlot in December had greater ($P < .05$) feedlot gain and DM intake and lower ($P < .05$) feed:gain and feed cost/gain than those placed in the feedlot in June.

Steers implanted with PE-PE produced heavier ($P < .05$) carcasses than those implanted with Z-Z, but other carcass measurements did not differ ($P < .10$) among implant treatments (Table 2). Steers placed in the feedlot in December (G2) had heavier ($P < .05$) carcasses and higher ($P < .05$) dressing % and net carcass value and tended ($P < .10$) to have a higher percentage grading USDA Choice than G1 steers.

Based on previous trials, we postulated that zeranol reduced some of the impact of fescue toxicosis in feedlot cattle. If this was the case, and a progesterone-estradiol combination would not reduce this toxic impact, steers implanted with zeranol should have shown an advantage in earlier feedlot weights. Because no differential was detected from early weights, we postulate that the toxicosis-reducing effects of zeranol and progesterone-estradiol are similar. When all of the data are considered together, no difference is apparent between an implant program involving progesterone-estradiol initially and at reimplanting and one with zeranol initially and progesterone-estradiol at reimplanting.

We have observed a tremendous seasonality in the response of cattle to both fescue toxicosis and compounds that may reduce its impact. However, these seasonal differences were not observed with respect to the implant programs used in this study. Therefore, we conclude that these implant programs will have a similar impact, regardless of the season in which they are implemented.

Table 1. Effect of Feedlot Implant Program on Performance by Steers Previously Grazing Infected Fescue Forage, Southeast Agricultural Research Center, 1995.

	Implant Program[a]			Placement Time	
Item	Z-Z	Z-PE	PE-PE	June	December
Pasture gain, lb	86.5	87.6	84.0	107.5[b]	64.5[c]
Initial feedlot wt, lb	760.0	758.7	761.1	728.4[c]	791.5[b]
Final wt, lb	1291.3[e]	1307.5[de]	1318.5[d]	1253.7[c]	1357.8[b]
Gain, lb	534.4[e]	542.6[de]	557.4[d]	521.3[c]	566.3[b]
Daily gain, lb	3.62[e]	3.69[de]	3.79[d]	3.38[c]	4.02[b]
DM intake, lb/d	24.7[de]	23.9[e]	25.2[d]	23.1[c]	26.2[b]
Feed cost, $	191.30[de]	184.83[e]	195.08[d]	188.95	191.85
Cost/gain, $/cwt	36.10[d]	34.13[e]	35.00[de]	36.27[b]	33.88[c]
Feed:gain, lb/lb	6.86[d]	6.48[e]	6.66[de]	6.82[b]	6.52[c]

[a] Z-Z = implanted upon feedlot arrival and reimplanted with zeranol (36 mg).
Z-PE = implanted upon feedlot arrival with zeranol (36 mg) and reimplanted with progesterone-estradiol.
PE-PE = implanted upon feedlot arrival and reimplanted with progesterone-estradiol.
[b,c]Means within a main effect without a common superscript letter differ ($P < .05$).
[d,e]Means within a main effect without a common superscript letter differ ($P < .10$).

Table 2. Effect of Feedlot Implant Program on Carcass Characteristics of Steers Previously Grazing Infected Fescue Forage, Southeast Agricultural Research Center, 1995.

	Implant Program[a]			Placement Time	
Item	Z-Z	Z-PE	PE-PE	June	December
Dressing %	59.66	60.10	60.42	59.70[c]	60.42[b]
Hot carcass wt, lb	770.6[c]	785.6[bc]	797.1[b]	748.4[c]	820.5[b]
Backfat, in	.33	.35	.36	.34	.36
Ribeye area, in^2	14.05	14.62	14.55	14.8	14.0
Marbling score	532.4	524.7	555.9	495.7	579.6
Quality grade	9.17	9.03	9.46	8.87	9.57
% Choice	70.8	69.6	74.1	48.6[e]	94.4[d]
USDA yield grade	1.93	1.67	1.85	1.73	1.91
Net carcass value, $	825.78	837.66	847.66	814.13[c]	859.59[b]
Avg carcass price, $/lb	1.07	1.07	1.07	1.09[b]	1.05[c]

[a] Z-Z = implanted upon feedlot arrival and reimplanted with zeranol (36 mg).
Z-PE = implanted upon feedlot arrival with zeranol (36 mg) and reimplanted with progesterone-estradiol.
PE-PE = implanted upon feedlot arrival and reimplanted with progesterone-estradiol.
[b,c]Means within a main effect without a common superscript letter differ ($P < .05$).
[d,e]Means within a main effect without a common superscript letter differ ($P < .10$).

PERFORMANCE BY STEERS GRAZING INFECTED AND NONINFECTED FESCUE PASTURES WITH AND WITHOUT LADINO CLOVER OVERSEEDING[1]

Kenneth P. Coffey, Joseph L. Moyer, and Frank K. Brazle[2]

Summary

A total of 128 mixed-breed steers grazed infected (IF) and noninfected (FF) fescue pastures with (+L) and without (-L) ladino clover for an average of 212 days in a 3-year grazing study. In 1993, steers grazing +L gained 83% more (P < .05) weight than steers grazing -L pastures. In 1994, steers grazing FF gained 74 lb more (P < .15) than those grazing IF. In 1995, steer weights did not differ (P < .10) among pasture treatments. Environmental conditions had a substantial impact on steer performance. Periods of dry weather substantially hampered clover production and resultant animal gains.

Introduction

Tall fescue is the predominant cool season forage in Southeast Kansas and much of the southeastern United States. A large percentage of this fescue is infected with the endophytic fungus *Acremonium coenophialum*. This fungus produces alkaloids that benefit the plant but are toxic to livestock consuming the forage. Overseeding infected fescue pastures with ladino clover has resulted in a substantial performance benefit to livestock grazing those pastures. This study was conducted to compare performance by steers grazing infected or noninfected fescue with and without ladino clover overseeding.

Experimental Procedures

A total of 128 mixed-breed steers was used from 1993 to 1995 to determine the effects of forage type on grazing performance. In each year, steers were vaccinated against respiratory, clostridial, and pinkeye infections and treated for internal and external parasites. Steers were weighed on consecutive days, stratified by weight, and allotted randomly into groups of four head each. The groups were placed on 5-acre pastures of infected (IF) or noninfected (FF) fescue pastures with (+L) and without (-L) ladino clover. Grazing periods extended from April 27 - Nov. 11, 1993; Mar. 27 - Oct. 27, 1994; and from March 16 - October 20, 1995.

All pastures were fertilized in the fall of each year with 40 lb/a each of nitrogen (N), phosphate, and potash. Pastures having no ladino clover overseeding (-L) were fertilized with an additional 80 lb N/a in the winter.

Results and Discussion

Data were analyzed statistically across years, but a significant (P < .05) year × clover treatment interaction was detected. This indicates that the benefit of clover overseeding was not consistent across years. Therefore, the data were analyzed within years and are presented in Table 1. No fescue type × legume interaction was detected

---

[1]Appreciation is expressed to SmithKline Beecham, West Chester, PA for providing Bovishield 4+L5, Ultrabac/somnubac, and Boveye vaccinations; to Syntex Animal Health, West Des Moines, IA for providing oxfendazole; to Mallinckrodt Veterinary, Mundelein, IL for De-Lice, and Saber Extra fly tags; and to Steve Clark for use of experimental animals.

[2]Southeast Kansas Area Extension Livestock Specialist, Chanute, KS.

(P < .05) in any of the 3 years. Therefore, the effect of +L or -L was relatively the same whether on IF or FF. In 1993, steers grazing FF gained 63 lb more than those grazing IF, but the differences were not statistically significant. Steers grazing +L pastures gained 190 lb more (P < .05) than those grazing -L pastures.

In 1994, steers grazing FF pastures gained 74 lb more (P < .15) than those grazing IF. Gains did not differ between steers grazing +L and those grazing -L pastures in 1994. No statistical differences were detected in 1995 between steers grazing FF and IF or between those grazing +L and -L. However, steers grazing FF numerically (P > .10) gained 44 lb (.2 lb/day) more than those grazing IF pastures.

The substantial advantage from +L in 1993 and the failure of an advantage of +L in 1994 and 1995 are probably attributable to different weather conditions. 1993 was a wet year with generally cooler temperatures during the summer months. These types of weather conditions generally favor clover production. Weather conditions in 1994 and 1995 were much more arid for extended periods of the year, resulting in poor clover production. In previous studies, steer gains also have benefitted greatly during wet years and but not in dry years from ladino clover overseeding. Therefore, one should consider these factors when considering clovers for pastures in southeastern Kansas and should look at the long-term benefits of clover rather than the short-term failures.

Statistical interactions of treatments with year demonstrate that treatments respond differently relative to each other in different years. However, from a practical viewpoint, the average across years is the most important criterion to use in evaluating which forage to choose. Data from this study were averaged across the 3 years of grazing and presented in Table 2. Steers grazing IF -L gained less (P < .10) than those grazing IF +L or FF pastures both with and without ladino clover overseeding. Although gains did not differ (P < .10) between the other treatments, steers grazing FF+L numerically gained .11 lb/day more than those grazing FF -L and .18 lb/day more than those grazing IF -L.

It is also interesting to note that the difference in gain between IF -L and FF -L is .39 lb/day. We would have expected .7 lb/day differential based on a 70% infection level of these pastures and the popular rule of thumb of a .1 lb/day reduction in gain for each 10% increase in endophyte infection level. This again indicates that many of the rules of thumb in dealing with fescue toxicosis are highly seasonal and should be accepted with extreme caution.

Considering the data from this study and others conducted at SEARC, overseeding fescue pastures with ladino clover seems to have a long-term advantage over N fertilization. This advantage is strong in years of ample rainfall distribution, but may not be apparent in years having periods of extended hot arid conditions. Because we generally do not know the environmental conditions until it is too late, ladino clover overseeding of tall fescue pastures appears to be an economical management practice that should improve animal performance and reduce expenses over the long term.

Table 1. Performance by Steers Grazing Infected and Noninfected Fescue Pastures with and without Ladino Clover Overseeding, Southeast Agricultural Research Center.

	Fescue Type		Ladino Clover	
Item	Noninfected	Infected	Present	Absent
1993				
Initial wt., lb.	500	512	510	501
Final wt., lb.	854	803	928[a]	729[b]
Gain, lb	354	291	418[c]	228[d]
Daily gain, lb	1.74	1.43	2.05[c]	1.12[d]
1994				
Initial wt., lb.	457	455	457	456
Final wt., lb.	877[e]	801[f]	835	843
Gain, lb	420[e]	346[f]	379	388
Daily gain, lb	1.95[e]	1.60[f]	1.75	1.79
1995				
Initial wt., lb.	539	540	539	540
Final wt., lb.	878	841	850	869
Gain, lb	345	301	316	329
Daily gain, lb	1.59	1.39	1.46	1.52

[ab]Means within a row and main effect with unlike superscripts differ ($P < .10$).
[cd]Means within a row and main effect with unlike superscripts differ ($P < .05$).
[ef]Means within a row and main effect with unlike superscripts differ ($P < .15$).

Table 2. Performance by Steers Grazing Infected and Noninfected Fescue Pastures with and without Ladino Clover Overseeding (3-Year Average), SEARC.

	Non-infected		Infected	
Item	+ Ladino	+ Nitrogen	+ Ladino	+ Nitrogen
Initial wt, lb	499	498	502	499
Final wt, lb	875[a]	854[a]	844[a]	773[b]
Gain, lb	381[a]	356[a]	342[a]	274[b]
Gain, lb/day	1.78[a]	1.67[a]	1.60[a]	1.28[b]

[a,b]Means within a row without a common superscript letter differ ($P < .10$).

FEEDLOT PERFORMANCE BY STEERS PREVIOUSLY GRAZING INFECTED AND NONINFECTED FESCUE PASTURES WITH AND WITHOUT LADINO CLOVER OVERSEEDING[1]

Kenneth P. Coffey, Joseph L. Moyer, and Frank K. Brazle[2]

Summary

A total of 80 mixed-breed steers grazed infected (IF) and noninfected (FF) fescue pastures with (+L) and without (-L) ladino clover for an average of 209 days in a 2-year grazing study. Following the grazing period, steers were placed in the SEARC feedlot facility at Mound Valley and fed a finishing ration. Feedlot performance varied with year. In 1993, feedlot gain was lower ($P < .06$) from steers previously grazing +L, but feed efficiency was more desirable ($P < .05$) from steers previously grazing IF-L than the other forage combinations. Compensatory gain during the feedlot period was apparent to some degree but was variable by year and treatment.

Introduction

In the previous article, we reported the negative impact of grazing *Acremonium coenophialum*-infected fescue and the effects of ladino clover overseeding on grazing performance. In previous trials, cattle that grazed infected fescue have demonstrated compensatory gain in the feedlot when placed there in November. The objective of this study was to determine the effect of grazing infected and noninfected fescue pastures with and without ladino clover on subsequent feedlot performance by steers.

Experimental Procedures

A total of 80 mixed-breed steers was used in 1993 and 1994 to determine the effects of forage type on grazing and subsequent feedlot performance. In each year, steers were vaccinated against respiratory, clostridial, and pinkeye infections and treated for internal and external parasites. Steers were weighed on consecutive days, stratified by weight, and allotted randomly into groups of four head each. The groups were placed on 5-acre pastures of infected (IF) or noninfected (FF) fescue pastures with (+L) and without (-L) ladino clover. Grazing periods extended from April 27 - Nov. 11, 1993 and from Mar. 27 - Oct. 27, 1994.

All pastures were fertilized in the fall of each year with 40 lb/a each of nitrogen (N), phosphate, and potash. Pastures having no ladino clover overseeding (-L) were fertilized with an additional 80 lb N/a in the winter.

Following the grazing period, steers were moved to a feedlot facility and fed a finishing ration. At the end of the feedlot period, steers were slaughtered at a commercial slaughter facility, and carcass data were collected.

Results and Discussion

Data were analyzed statistically across years,

[1]Appreciation is expressed to SmithKline Beecham, West Chester, PA for providing Bovishield 4+L5, Ultrabac/somnubac, and Boveye vaccinations; to Syntex Animal Health, West Des Moines, IA for providing oxfendazole and Synovex-S; to Mallinckrodt Veterinary, Mundelein, IL for De-Lice, and Saber Extra fly tags; and to Steve Clark for use of experimental animals.

[2]Southeast Kansas Area Extension Livestock Specialist, Chanute, KS.

but a significant ($P < .05$) year × fescue or clover treatment interaction was detected for many of the variables. Therefore, the data were analyzed within years. In 1993, steers previously grazing -L pastures gained more ($P < .01$) than those previously grazing +L pastures when placed in the feedlot (Table 1). Steers previously grazing FF-L gained 81.5% of the weight differential compared with FF+L, whereas IF-L gained only 61.5% of the weight differential compared with IF+L, indicating differential compensatory gain between FF and IF forages. Steers previously grazing IF-L gained more efficiently ($P < .05$) and had a lower ($P < .05$) feed cost per unit of feedlot gain than from the other previous forage treatments. In 1994, feedlot gain was not affected ($P < .10$) by previous forage treatment, but steers previously grazing IF did appear to compensate completely for weight reductions during the grazing period. An endophyte × legume interaction was detected ($P < .05$) for feed efficiency and feed cost per unit gain. Steers previously grazing FF-L were less ($P < .05$) efficient and had a higher cost per unit gain than steers previously grazing IF-L.

Steers previously grazing FF-L in 1993 had higher ($P < .05$) marbling scores and % USDA Choice grade than those previously grazing FF+L (Table 2), but steers previously grazing +L pastures had a higher net carcass value than those previously grazing -L pastures. No carcass differences were detected in 1994.

The benefits of ladino clover overseeding can be substantial, provided rainfall amount and distribution is adequate. In those instances, performance differential between IF+L and FF-L are minimal. In the feedlot phase of this study, steers previously grazing pastures containing ladino clover tended to gain less than those previously grazing pastures without ladino clover, thereby exhibiting compensatory gain. In previous studies, steers previously grazing pastures with ladino clover had an advantage in carcass marbling scores. This did not occur in the first 2 years of this study. Although ladino clover exhibits significant advantages for cattle grazing fescue pastures, those advantages do not appear to positively influence subsequent feedlot performance.

Table 1. Feedlot Performance by Steers Previously Grazing Infected and Noninfected Fescue Pastures with and without Ladino Clover Overseeding, SEARC.

	Noninfected		Infected	
Item	Ladino	Nitrogen	Ladino	Nitrogen
1993				
Final wt., lb	1316	1289	1338	1237
Gain, lb[a]	380	517	419	550
Daily gain, lb	2.9	3.0	2.8	3.2
Days on feed[b]	131	173	152	173
DM intake, lb	25.4	25.6	24.4	22.6
Feed:gain	8.7[c]	8.6[c]	8.8[c]	7.1[d]
Feed cost, $[b]	198.90	265.75	221.75	234.35
$/cwt. gain	52.40[c]	51.60[c]	52.95[c]	42.65[d]
1994				
Final wt., lb	1356	1394	1351	1407
Gain, lb	495	500	542	613
Daily gain, lb	3.1	3.1	3.3	3.7
Days on feed	159	166	166	166
DM intake, lb	22.4	24.9	23.7	24.1
Feed:gain	7.1[cd]	8.1[c]	7.2[cd]	6.5[d]
Feed cost, $	176.88	204.55	195.35	201.60
$/cwt. gain	35.52[cd]	40.85[c]	36.25[cd]	32.70[d]

[a]Ladino clover differed from nitrogen ($P < .01$).
[b]Ladino clover differed from nitrogen ($P < .06$).
[cd]Means within a row without a common superscript letter differ ($P < .05$).

Table 2. Carcass Measurements of Steers Previously Grazing Infected and Noninfected Fescue Pastures with and without Ladino Clover Overseeding, SEARC.

Item	Noninfected Ladino	Noninfected Nitrogen	Infected Ladino	Infected Nitrogen
1993				
Dressing %[a]	62.6	59.8	61.3	59.8
Hot carcass wt., lb	824	770	797	739
Backfat, in	.33	.33	.29	.35
Ribeye area, in^2	16.3	14.0	14.9	14.3
Marbling score[b]	559[d]	670[c]	651[cd]	590[cd]
% choice	50[d]	88[c]	71[cd]	50[d]
USDA Yield Grade	1.4[d]	1.9[c]	1.6[cd]	1.5[d]
Net carcass value, $[e]	974.50	863.20	928.05	820.20
1994				
Dressing %[a]	62.0	62.4	62.0	62.1
Hot carcass wt., lb	839	869	838	873
Backfat, in	.51	.59	.47	.51
Ribeye area, in^2	15.0	14.4	13.9	14.3
Marbling score[b]	686	674	740	763
% choice	88	88	94	88
USDA Yield Grade	2.5	2.6	2.3	2.5
Net carcass value, $	869.17	865.44	886.96	909.94

[a]Based on actual nonshrunk weight.
[b]500-599 = $Select^+$; 600-699 = $Choice^-$.
[cd]Means within a row without a common superscript letter differ ($P < .05$).
[e]Ladino clover differed from nitrogen ($P < .10$).

PERFORMANCE AND SERUM COMPONENTS BY LAMBS FED INFECTED FESCUE HAY WITH LITHIUM OR YEAST

Kenneth P. Coffey, Joseph L. Moyer, Fredrick W. Oehme[1], Duane H. Keisler[2], and Frank K. Brazle[3]

Summary

Twenty crossbred lambs were fed basal diets of either *Acremonium*-free (FF) or infected (IF) fescue hay along with a protein supplement to provide essential vitamins and minerals. Infected hay diets were supplemented with a control supplement, supplements containing lithium carbonate to provide either 1 (IFL1) or 3 (IFL3) mg lithium/ kg body weight, or a supplement containing .25 g of *Saccharomyces cervisiae*. Rectal temperatures were higher ($P < .10$) from lambs fed IFL1, IFL3, and IFY than for those fed FF on 8/18. Serum prolactin levels on 9/1 were higher ($P < .10$) for lambs fed FF than for those fed the other treatments with IF, and alkaline phosphatase levels were lower for lambs fed IFL1 than for those fed the other diets on 9/28. Intake and weight gain were not different among treatments. Therefore, neither lithium nor yeast supplementation at the levels used in this study were effective in alleviating the symptoms of tall fescue toxicosis.

Introduction

Tall fescue toxicosis affects many physiological systems in the body. These toxins cause vasoconstriction, resulting in the animal having less ability to reduce body temperature. Psychoactive drugs such as lithium appear to act oppositely to fescue toxins on certain systems of the body. Yeast also has been shown to have heat-stress reducing properties. The purpose of this study was to evaluate lithium and yeast for their potential to offset the negative effects of tall fescue toxicosis in lambs.

Experimental Procedures

Twenty crossbred lambs were weighed on consecutive days and allotted randomly to one of five treatments. All lambs were housed in individual stalls with sawdust bedding in a ventilated barn. Lambs were fed basal diets of either *Acremonium*-free (FF) or infected (IF) fescue hay ad libitum along with .5 lb/day of a protein supplement to provide essential vitamins and minerals. Infected hay diets were supplemented with a control supplement, supplements containing lithium carbonate to provide either 1 (IFL1) or 3 (IFL3) mg lithium/ kg body weight, or a supplement containing .25 g of *S. cervisiae*. Supplements were fed at 7 AM daily, and hay was fed approximately 30 min later. Unconsumed hay was removed each Monday, Wednesday, and Friday. Lambs remained on the same diet throughout a 56-day feeding study.

Rectal temperatures were measured each week. Blood samples were collected initially and at 28 and 56 days of the study to measure serum prolactin and alkaline phosphatase.

[1]Department of Clinical Sciences, KSU College of Vet. Med., Manhattan, KS.

[2]Department of Animal Sciences, Univ. of Missouri, Columbia, MO.

[3]Southeast Kansas Area Extension Livestock Specialist, Chanute, KS.

Results and Discussion

Weight gain and dry matter intake did not differ ($P < .10$) among the five treatments (Table 1). Rectal temperatures were higher ($P < .10$) for lambs fed IFL1, IFL3, and IFY, than for those fed FF on 8/18. Serum prolactin levels on 9/1 were higher ($P < .10$) for lambs fed FF than for those fed the other treatments with IF. These latter two factors are consistent with being fed infected fescue hay. Alkaline phosphatase levels were lower for lambs fed IFL1 than for those fed the other diets on 9/28.

Alkaline phosphatase is an enzyme linked with liver function. Although alkaline phosphatase levels were lower for lambs fed IFL1, those levels were still within an acceptable range, indicating that lithium supplementation did not have a negative impact on liver function.

The decline in serum prolactin and the increase in rectal temperature for lambs fed IF diets indicate that the lambs were being affected by tall fescue toxicosis to some extent. Because intake was not reduced in these lambs, we conclude that the extent of toxicosis was not severe. Neither lithium nor yeast supplementation at the levels used in this study were effective in alleviating the symptoms of tall fescue toxicosis and, therefore, do not present a positive solution to the problem.

Table 1. Weight, Temperature, and Serum Components by Lambs Fed a Noninfected Fescue Hay Diet or an Infected-Fescue Hay Diet with Either Lithium or Yeast, SEARC.

Item	FF	IF	IFL1	IFL3	IFY[a]
Initial wt., lb	61	62	61	61	61
Final wt., lb	65	70	70	68	69
Gain, lb	4	8	9	7	8
Daily gain, lb	.06	.15	.16	.14	.15
DM intake, % BW	2.1	2.3	2.1	2.4	2.2
Temperatures, °F					
8/11	105.4	105.7	106.1	105.7	106.0
8/18	104.6[c]	105.1[bc]	105.3[b]	105.4[b]	105.8[b]
8/25	104.2	104.4	104.6	104.9	104.5
9/2	104.6	104.7	104.9	105.1	104.7
9/8	103.2	103.0	103.5	104.0	103.1
9/17	103.4	103.6	103.1	103.8	103.3
9/22	105.1	105.7	105.5	105.5	105.3
Average temperature	104.3	104.6	104.7	104.9	104.7
Serum prolactin					
8/4	85.9	64.2	98.2	43.3	26.9
9/1	7.7[b]	.2[c]	.2[c]	.2[c]	.6[c]
9/28	1.2	.6	.2	.2	3.6
Alkaline phosphatase					
8/4	51.3	63.8	40.8	59.8	70.0
9/1	82.0	69.5	48.3	67.0	70.8
9/28	111.5[b]	135.5[b]	72.3[c]	111.3[b]	119.3[b]

[a]FF = *Acremonium*-free; IF = *Acremonium*-infected; IFL1 = IF + 1mg/kg lithium; IFL3 = IF + 3mg/kg lithium; IFY = IF + .25 g *S. cervisiae*.
[a,b]Means within a row without a common superscript letter differ ($P < .10$).

PERFORMANCE BY STEERS GRAZING RYE/BERMUDAGRASS PASTURES WITH AND WITHOUT LADINO CLOVER OVERSEEDING[1]

Kenneth P. Coffey and Joseph L. Moyer

Summary

One hundred sixty mixed-breed steers grazed pastures of rye/bermudagrass (B) or rye/bermudagrass overseeded with ladino clover (BL) for 188 days beginning on March 15 in a 2-year study. Grazing gains were 37 lb greater ($P < .01$) but feedlot gains were 12 lb less ($P > .10$) for steers grazing B compared with those grazing BL. Steers previously grazing B had 15 lb heavier ($P < .10$) hot carcass weights and $22.83 higher net carcass value than BL steers. Ladino clover production was limited by arid weather conditions in late spring and early summer of 1994 and in summer and early fall of 1995. Under these conditions with continuous grazing, ladino clover overseeding did not positively benefit performance by steers grazing bermudagrass pastures.

Introduction

Bermudagrass is a highly productive warm-season forage capable of exceptional production, provided moisture and fertilizer are available. Bermudagrass quality declines dramatically as it reaches maturity. Ladino clover has proven extremely beneficial in tall fescue pastures, particularly during the summer and early fall. Successful interseeding of ladino clover into bermudagrass sod could provide an additional high-quality forage for cattle grazing lower-quality bermudagrass and thereby improve cattle gain and reduce nitrogen fertilizer usage.

Experimental Procedures

One hundred sixty mixed-breed steers grazed pastures of bermudagrass (B) or bermudagrass overseeded with ladino clover (4 lb/ac; BL) for 188 days beginning on March 15 in 1994 and 1995. Steers received vaccinations against respiratory, clostridial, and pinkeye organisms; were treated for internal and external parasites; and were implanted with zeranol (36 mg). Steers were weighed on consecutive days, stratified by weight, and allotted randomly to one of eight bermudagrass pastures that had been no-till drilled with 100 lb/a of cereal rye the previous fall. Pastures were allotted randomly such that four of the eight pastures were overseeded with 4 lb/a of ladino clover. All pastures were fertilized with 50 lb nitrogen (N)/a for the rye and fertilized to soil test for phosphate and potash for the bermudagrass. Pastures overseeded with clover were fertilized with 50 lb N/a and those without clover were fertilized with 100 lb N/a on May 19 and 20, 1994 and June 16, 1995. All pastures were clipped with a rotary mower on July 6 and 7, 1994 and received an additional 50 lb N/a on July 7 and Aug 5, 1994; and an additional 67 lb N/a on July 18, 1995; and an additional 50 lb N/a on Aug 14, 1995.

Steers were weighed on 9/19 and 9/20, 1994 and on 9/17 and 9/18, 1995; transported to a

[1]Appreciation is expressed to SmithKline Beecham, West Chester, PA for providing Bovishield 4+L5, Ultrabac/somnubac, and Boveye vaccinations; to Syntex Animal Health, West Des Moines, IA for providing oxfendazole; to Mallinckrodt Veterinary, Mundelein, IL for Ralgro, De-Lice, and Saber Extra fly tags; to Cal-West Seeds, Woodland, CA for providing ladino clover seed; and to Richard Porter for use of experimental animals.

commercial feedlot facility, and fed a finishing ration for 140 or 146 days in 1994 or 1995, respectively. Following the finishing period, steers were transported to Emporia, KS and slaughtered at a commercial slaughter facility. Carcass measurements were collected following a 24-h chill.

Results and Discussion

Year differences were observed ($P < .05$) for both pasture and feedlot gain. However, a year × forage interaction was not observed ($P < .05$). Therefore, data were averaged across years. Steers grazing B gained 37 lb more ($P < .01$) than those grazing BL during the 2-year study (Table 1). Overall gains during the grazing period were low and averaged 1.12 lb/day. Erratic rainfall amounts at various times during the grazing periods appeared to have negative impacts on forage production in each year. Ladino clover production was particularly disappointing, presumably also because of the low and erratic rainfall. Considering the combination of poor clover production with lower N fertilization of BL, we conclude that the reduced animal performance on BL was due to less bermudagrass production and lower quality of the forage produced.

During the feedlot phase, steers previously grazing BL tended ($P > .10$) to gain more than those previously grazing B. All steers were fed in a common pen, so feed efficiency data could not be collected.

Steers previously grazing B had heavier ($P < .10$) hot carcass weights and higher ($P < .05$) net carcass value than BL steers (Table 2). Other carcass measurements did not differ ($P < .10$) between previous forage type. In previous studies at SEARC, steers grazing fescue pastures overseeded with ladino clover have had a higher % USDA Choice than those previously grazing fescue pastures without clover. The trend observed in this study probably was due to greater grazing gains by steers grazing pastures without clover as well as the relatively low amount of clover in the pastures.

Therefore, overseeding bermudagrass pastures with ladino clover may not be beneficial to animal performance. However, should rainfall amounts and distribution be adequate in future years, the results might reverse.

Table 1. Performance by Steers Grazing Rye/Bermudagrass Pastures with and without Ladino Clover Overseeding, Southeast Agricultural Research Center, 1995.

Item	Bermuda + N	Bermuda + Ladino
Pasture phase		
Initial wt, lb	580.3	580.5
Final wt, lb	800.0[a]	769.1[b]
Gain, lb	228.9[c]	192.1[d]
Daily gain, lb	1.22[c]	1.02[d]
Feedlot phase		
End wt, lb	1228.3[e]	1204.9[f]
Gain, lb	420.3	432.5
Daily gain, lb	2.93	3.02
Total gain, lb	649.2[e]	624.6[f]

[a,b]Means within a row without a common superscript letter differ (P < .05).
[c,d]Means within a row without a common superscript letter differ (P < .01).
[e,f]Means within a row without a common superscript letter differ (P < .10).

Table 2. Carcass Measurements of Steers Previously Grazing Rye/Bermudagrass Pastures with and without Ladino Clover Overseeding, SEARC, 1995.

Item	Bermuda + N	Bermuda + Ladino
Hot carcass wt, lb	772.8[a]	758.2[b]
Backfat, in	.54	.56
Marbling score	632	608
USDA yield Grade	2.58	2.58
Net carcass value, $	838.06[c]	815.23[d]
% USDA Choice	66.6	59.0
% USDA Choice, transformed	73.3	63.9

[a,b]Means within a row without a common superscript letter differ (P < .10).
[c,d]Means within a row without a common superscript letter differ (P < .05).

LIFETIME PERFORMANCE OF STOCKER CALVES SUBJECTED TO DIFFERENT RECEIVING TREATMENTS[1]

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

Summary

One hundred forty mixed-breed steer calves were purchased from northwestern Texas and transported to the Mound Valley unit of the Kansas State University - Southeast Agricultural Research Center (SEARC). Upon arrival, steers were placed in pens with free-choice access to prairie hay and water. Steers were processed the following morning according to routine procedures and allocated at random to one of 12 drylot pens or one of two 15-acre tall fescue pastures. The drylot pens were allotted such that half of the pens received a control soybean meal supplement (C) and half received a soybean meal -based supplement containing Fastrack® probiotic (PB) to provide 1 oz/head daily of the probiotic product. No differences were detected ($P > .10$) for animal weight, gain, or feed intake between drylot treatments. Calves grazed on the fescue pastures (F) gained less ($P < .01$) weight but had lower cost of gain than drylot calves. Only two animals required treatment; one for a respiratory problem and one for a shoulder injury. Both animals were in C pens. Following the 28-day receiving trial, steers were moved to smooth bromegrass pastures for 58 days and then used for a 112-day grazing trial on smooth bromegrass. Steer weights at the end of the 112-day grazing study did not differ ($P < .10$) among the different receiving programs. The supplemental probiotic pack was not effective in improving performance. Considering the levels of feed consumption and minimal health problems, the levels of stress on the calves probably were not sufficient to illicit a treatment response. Receiving cattle onto winter fescue may provide a lower-cost alternative to drylot receiving programs.

Introduction

Receiving cattle are typically under considerable stress from the adverse conditions imposed by transportation, weather, disease exposure, and other factors. These stressful factors may affect the animal in a number of ways and ultimately affect animal health and performance. The rumen of calves often is affected by stress and feed deprivation. Revitalizing the rumen of receiving calves should improve intake and reduce stress, resulting in faster growing, healthier calves. The purpose of this study was to compare performance by calves received on fescue pastures or fed diets in drylot that did or did not contain Fastrack® probiotic.

Experimental Procedures

One hundred forty mixed-breed calves were purchased from northwestern Texas and transported to the Mound Valley unit of the Kansas State University - Southeast Agricultural

[1]Appreciation is expressed to Conklin Company, Inc., Shakopee, MN for providing financial assistance; to SmithKline Beecham, West Chester, PA for providing Bovishield 4 + L5, Ultrabac/somnubac, and Boveye vaccinations; to Syntex Animal Health, West Des Moines, IA for providing oxfendazole; to Mallinckrodt Veterinary, Mundelein, IL for Ralgro, De-Lice, and Saber Extra fly tags.

[2]Southeast Kansas Area Extension Livestock Specialist, Chanute, KS.

Research Center on January 3, 1995. Steers were placed in pens with free-choice access to prairie hay and water. On the following morning, steers were comingled and individually identified by eartag and tattoo; dewormed (Synanthic®); and vaccinated against IBR, BVD, PI_3, Leptospirosis (5 strains), BRSV (Bovishield 4 + L5®), and Clostridial infections (Fortress 7®). Steers were then weighed and allotted to one of 12 drylot pens or one of two fescue pastures (F) directly off of the scale. The pens were allotted such that even-numbered pens received a control soybean meal supplement (C) offered at a rate of 1 lb/head daily. Odd-numbered pens received a soybean meal - based supplement fed at a rate of 1 lb/head daily containing Fastrack® probiotic (PB) to provide 1 oz/head daily of the probiotic product. Supplements were fed daily at approximately 7:30 followed by feeding of prairie hay ad libitum and a receiving ration (Table 1) at a rate of 1% of body weight. Steers on F were fed 2 lb/day of the receiving ration only. Steers were weighed again on the morning of January 5, 1995, and the two weights were averaged to arrive at an initial study weight. Concentrate level was increased and prairie hay level decreased daily, until steers were consuming the concentrate mixture ad libitum and consumption of prairie hay was limited to 2 lb/head daily. Steers that did not readily come to the feedbunk when fed their supplement were pulled, diagnosed, and treated for sickness. Steers were weighed on the mornings of January 31 and February 1 to determine ending weights for the study.

On February 1, steers were transported to Parsons and allotted to smooth bromegrass pastures at a stocking rate of 1.4 head/a. No supplemental feed was offered during that period. On March 30 and 31, 86 of the steers were weighed and utilized on a 112-day study on the smooth bromegrass pastures. In that study, steers grazed at a stocking rate of 1 head/acre and were fed 2 lb/day of ground grain sorghum. At the end of the grazing study, steers were moved to the SEARC feedlot facility at the Mound Valley Unit. Steers were fed a finishing diet until December 11, and then slaughtered at a commercial packing plant.

Results and Discussion

Weight gain, feed consumption, and feed conversion ratios did not differ ($P < .10$) between steers fed C or PB in drylot (Table 2). However, gain by steers fed in drylot was higher ($P < .01$) than gain by F steers. Steers on F had lower feed cost/gain than steers fed C or PB because of lower supplementation with purchased feed. Two animals necessitated treatment during the study. One steer was treated for respiratory infection, and the other was examined and treated for a shoulder injury. Both steers were in C groups.

During the winter period in which all steers were maintained on dormant smooth bromegrass pastures, steers previously on F numerically ($P > .10$) gained 9 lb more than steers previously on C or PB (Table 3). During the ensuing 112 days when steer gains were generally good, steers previously on F gained more ($P < .05$) than those previously on C and PB, such that steer weights were similar among all previous receiving programs. The similarity in weight was maintained throughout the feedlot period.

Although gain differential was observed between steers placed on fescue pastures upon arrival compared with those placed in drylot and fed a more expensive receiving ration, that gain differential was recovered easily once the steers were placed in a situation in which rapid gains were supported. Furthermore, the costs involved in receiving steers on pasture were considerably lower than the drylot alternatives. The supplemental probiotic pack used in this study was not effective in improving performance by receiving calves compared with those fed the control diet in drylot. However, the overall performance and feed consumption by the drylot steers was good.

Table 1. Formulation of Receiving Ration for Steers, SEARC, 1995.

Ingredient	lb/ton
Whole oats	684.75
Alfalfa pellets	500.00
Wheat middlings	500.00
Cottonseed hulls	200.00
Liquid molasses	100.00
Calcium carbonate	10.00
Vitamin A	2.00
Decox 6%	1.25
Zinc oxide	1.00
Copper sulfate	1.00

Table 2. Performance by Steers Fed a Receiving Ration with or without Fastrack® Probiotic Pack in Drylot or Grazing Fescue Pasture, SEARC, 1995.

Item	Control	Probiotic	Pasture
Initial wt., lb.	493.2	494.7	482.6
Final wt., lb.	570.0[a]	570.9[a]	531.8[b]
Gain, lb.	76.1[a]	77.0[a]	49.2[b]
Daily gain, lb.	2.72[a]	2.75[a]	1.76[b]
Feed intake, lb/day	15.9[a]	15.9[a]	2.0[b]
Feed:gain	5.91[a]	5.78[a]	-
Feed cost/gain, $/cwt	41.02[a]	40.28[a]	9.53[b]

[ab]Means within a row without a common superscript letter differ ($P < .01$).

Table 3. Effect on Subsequent Performance of Receiving Steers on Fescue Pasture or in Drylot and Feeding a Ration with or without Fastrack® Probiotic Pack[a], SEARC, 1995.

Item	Control	Probiotic	Pasture
Steer wt, lb			
3/31	597.6[b]	599.8[b]	557.5[c]
7/21	874.5	875.7	873.6
12/11	1278.0	1289.1	1277.0
Steer gain, lb			
2/1-3/31	50.5	50.5	59.3
3/31-7/21	276.9[c]	275.9[c]	316.2[b]
7/21-12/11	403.4	413.2	403.1

[a]Data on 86 head grazed on smooth bromegrass from 2/1 - 7/21.
[b,c]Means within a row without a common superscript letter differ ($P < .05$).

ALFALFA VARIETY PERFORMANCE IN SOUTHEASTERN KANSAS

Joseph L. Moyer

Summary

An alfalfa test of 18 entries was seeded in 1995. Yields from three cuttings ranged from 3.31 to 4.46 tons/a. For the year, 'Riley' yielded significantly ($P < .05$) less than 14 other entries. The top three entries yielded more than the seven lowest-producing entries.

Introduction

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

Experimental Procedures

The 18-line test was seeded (15 lb/a) on April 6, 1995 at the Mound Valley Unit. Plots were fertilized preplant with 0-60-200 lb/a of N-P_2O_5-K_2O. Three harvests were obtained in 1995. All entries were about half-bloom at the first cutting and one-tenth bloom at the others. Growing conditions were extremely wet early in May and June, then dry beginning in August (see weather summary). Annual grasses, particularly green foxtail, were a problem in the second cutting, so plots were sprayed with 0.2 lb/a of sethoxydim on July 31. Leafhoppers attacked the plants in July, so notes on visible damage were taken prior to the second cutting.

Results and Discussion

Leafhopper damage ratings, forage yields of each of the three cuttings, and total 1995 production are shown in Table 1. Leafhopper damage at the second cutting was significantly ($P < .05$) less for ZC 9346 than for 13 other entries. Five of the entries from Agripro had significantly less leafhopper damage than seven entries that received the most damage.

Cut 1 yield was significantly ($P < .05$) higher from 'Rushmore' than from 'Riley', 'Magnum IV', or ABI 9231. In cut 3, yields of 'Innovator + Z' and 'Supercuts' were higher than those of eight other entries. Total 1995 yields of ABI 9141, Rushmore, and Innovator + Z were higher than yields of Riley, 'Kanza', and three commercial entries.

Table 1. Forage Yields of the Alfalfa Variety Test in 1995, Mound Valley Unit, Southeast Agricultural Research Center.

Source	Entry	Leafhopper Damage[a]	1995 6/23	7/21	8/21	Total
			- - - - - - - - - - tons/a @ 12%	- - - - - - - - - -		
AgriPro Biosciences, Inc.	ABI 9141	3.0	1.82	1.00	1.12	3.93
AgriPro Biosciences, Inc.	Supercuts	3.5	1.45	0.93	1.15	3.53
AgriPro Biosciences, Inc.	ABI 9231 Exp	3.5	1.38	0.98	0.96	3.31
AgriPro Biosciences, Inc.	Innovator + Z	4.3	1.75	0.89	1.20	3.84
AgriPro Biosciences, Inc.	Total + Z	3.8	1.57	0.96	0.94	3.47
AgriPro Biosciences, Inc.	ZC 9346	2.3	1.75	0.94	1.03	3.72
DEKALB Plant Genetics	DK 127	5.8	1.55	0.82	0.91	3.28
DEKALB Plant Genetics	DK 133	5.5	1.55	0.89	1.08	3.47
Forage Genetics	3T26 Exp	5.0	1.69	0.93	0.98	3.61
Great Plains Research	Haygrazer	5.5	1.60	0.81	0.95	3.36
Mycogen Plant Sciences	TMF Generation	5.3	1.68	0.85	0.97	3.47
Northrup King Co.	Rushmore	5.3	1.91	0.92	1.02	3.85
Ohlde Seed Co.	Magnum IV	6.3	1.27	0.97	0.81	3.05
W-L Research, Inc.	WL 252 HQ	6.0	1.84	0.89	1.05	3.78
W-L Research, Inc.	WL 323	6.0	1.83	0.94	1.05	3.81
Public - Nebraska AES	Perry	5.0	1.54	0.97	0.84	3.35
Public - Kansas AES	Kanza	6.3	1.63	0.81	0.78	3.22
Public - Kansas AES	Riley	5.3	1.24	0.99	0.68	2.91
Average		4.8	1.61	0.92	0.97	3.50
LSD(.05)		1.4	0.34	NS	0.16	0.44

[a]Leafhopper damage rated 0-10, where 0 = no visible damage and 10 = all leaflets totally chlorotic.

FORAGE PRODUCTION OF BERMUDAGRASS CULTIVARS IN SOUTHEASTERN KANSAS

Joseph L. Moyer and Charles M. Taliaferro[3]

Summary

Total 1995 production was higher from experimental lines 74 X 11-2 and 74 X 12-6 than the other 18 entries. 'Hardie', 'Tifton 44', and seven experimentals yielded more than 11 other entries. Average 3-year production was highest from 74 X 11-2.

Introduction

Bermudagrass can be a high-producing, warm-season, perennial forage for southeastern Kansas. Producers have profited from the use of the variety 'Midland' compared to the common bermudas. Further developments in bermudagrass breeding should be monitored closely to speed adoption of improved types.

Experimental Procedures

Plots were sprigged with plants in peat pots on June 28, 1991 at the Mound Valley Unit. Plots were 15 x 20 ft each, in four randomized complete blocks. Plots were sprayed on March 22, 1995 with 1 lb/a of 2,4-D and 0.25 lb of dicamba. Application of 160-53-60 lb/a of N-P_2O_5-K_2O was made on May 16, followed by fertilization with 64 lb/a of N on July 31. Strips 20 x 3 ft were cut on June 15, July 28, and October 9, 1995. Subsamples were collected for determination of moisture. Sward verdure (greenness) was assessed on October 9 because the early frosts of September 22 and 23 produced apparent color differences.

Results and Discussion

In the first cutting, experimental lines 74 X 11-2 and LCB84 X 15-26 yielded significantly ($P < .05$) more forage than 11 other entries (Table 1). The top three lines and 'Hardie' produced more first-cut forage than eight other entries. In the second cutting, lines 74 X 12-6, 74 X 11-2, and 74 X 12-12 yielded significantly ($P < .05$) more than nine other entries. In the third cut, 74 X 11-2, 74 X 12-12, and 74 X 12-6 yielded more than 14 other entries, including four named cultivars.

Total 1995 production was significantly ($P < .05$) higher from lines 74 X 11-2 and 74 X 12-6 than the other 18 entries (Table 2). Hardie, Tifton 44, and seven lines yielded more than eight other entries.

Tifton 44 had significantly ($P < .05$) greater sward verdure remaining on 9 October than 13 other entries, including World Feeder, Greenfield, and Hardie (Table 2). Experimental lines 74 X 12-12 and 74 X 11-2 were also more verdant than those three varieties and five other experimentals.

Average yields for the last 3 years are also shown in Table 2. Relative yields of entries varied by year, as indicated by the significant ($P < .01$) year x entry interaction. However, 74 X 11-2 averaged 53% higher in yield than Midland and 71% higher than Greenfield.

[3]Department of Agronomy, Oklahoma State University, Stillwater.

Table 1. Forage Yield and Verdure of Bermudagrass in 1995, Mound Valley Unit, Southeast Agricultural Research Center.

Entry	Verdure[a]	Cut 1	Cut 2	Cut 3
		- - - - - - tons/a @ 12% moisture - - - - - -		
LCB84 X 9-45	2.8bcde[b]	2.24cdef	1.84cdefg	1.62bc
LCB84 X 16-66	2.5cde	2.66abc	2.01cdef	1.61bc
74 X 12-12	3.8ab	2.25cdef	2.23bc	2.01ab
LCB84 X 19-16	2.0e	2.51abcd	2.14cd	1.40cde
LCB84 X 15-49	3.3abcd	2.43bcde	2.10cde	1.40cde
Hardie	2.5cde	2.62abc	1.98cdef	1.44cd
LCB84 X 12-28	2.3de	1.94ef	1.15h	1.14cdef
74 X 11-2	3.8ab	3.00a	2.62b	2.19a
LCB84 X 14-31	2.5cde	1.73f	1.51fgh	1.33cde
LCB84 X 19-31	2.8bcde	2.57abcd	2.08cde	1.32cde
LCB84 X 19-23	2.8bcde	2.03def	1.38gh	1.34cde
LCB84 X 21-57	3.3abcd	2.44bcde	1.38gh	0.92ef
Tifton 44	4.0a	2.40bcde	1.79cdefg	1.61bc
LCB84 X 15-26	1.8e	2.88ab	1.50fgh	0.80f
LCB84 X 18-62	2.8bcde	1.83f	1.59efgh	1.00def
74 X 12-6	3.5bac	2.13cdef	3.28a	1.96ab
Greenfield	2.3de	1.85f	1.72cdefg	1.24cdef
Midland	3.5abc	1.73f	1.68defg	1.46cd
LCB84 X 16-55	2.8bcde	1.76f	1.34gh	0.79f
World Feeder	2.1de	1.92ef	1.58efgh	0.83f
Average	2.8	2.24	1.85	1.37
LSD(.05)	1.0	0.48	0.45	0.43

[a]Visual rating (0-5) on 9 Oct., where 0 is no green tissue remaining and 5 is 100% green.
[b]Means within a column followed by the same letter are not significantly ($P < .05$) different, according to Duncan's test.

Table 2. Forage Yield of Bermudagrass, 1993-1995, Mound Valley Unit, Southeast Agricultural Research Center.

Entry	1993	1994	1995	Average[a]
	- - - - - - - - - - -	tons/a @ 12% moisture	- - - - - - - - - - -	
LCB84 X 9-45	6.38	7.52	5.70	6.53
LCB84 X 16-66	6.31	8.18	6.28	6.92
74 X 12-12	6.12	7.22	6.52	6.62
LCB84 X 19-16	6.05	8.36	6.04	6.82
LCB84 X 15-49	6.04	8.01	5.92	6.65
Hardie	5.97	7.85	6.04	6.62
LCB84 X 12-28	5.94	6.04	4.22	5.40
74 X 11-2	5.91	9.54	7.81	7.75
LCB84 X 14-31	5.88	6.99	4.58	5.82
LCB84 X 19-31	5.74	7.41	5.96	6.37
LCB84 X 19-23	5.54	6.52	4.75	5.60
LCB84 X 21-57	5.24	4.25	4.74	4.74
Tifton 44	5.23	7.05	5.79	6.02
LCB84 X 15-26	5.10	5.16	5.18	5.14
LCB84 X 18-62	4.62	4.88	4.43	4.64
74 X 12-6	4.60	8.10	7.37	6.69
Greenfield	4.54	4.28	4.81	4.54
Midland	4.40	5.88	4.86	5.05
LCB84 X 16-55	4.28	3.86	3.88	4.00
World Feeder	4.11	4.30	4.44	4.28
Average	5.40	6.57	5.45	5.81
LSD(.05)	0.59	0.79	0.82	- -[a]

[a]Entry x year interaction was significant ($P < .01$), so entry mean comparisons across years are not shown.

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

Joseph L. Moyer and Daniel W. Sweeney

Summary

Eastern gamagrass was fertilized for 3 previous years with three nitrogen (N) rates applied by broadcast or knife placement. Hay crops were taken in 1995 to measure residual effects under 1-cut or 2-cut harvest systems. Forage yield was increased 17% under the 1-cut system as compared to the 2-cut. Residual N increased total yield by 23% with the first 45 lb/a increment and by an additional 12% with the next 45-lb increment. Knifing N in the previous 3 years resulted in 15% additional yield compared to previous broadcast applications.

Introduction

Eastern gamagrass [*Tripsacum dactyloides* (L.) L.] is a warm-season perennial grass native to the North American tallgrass prairie. It has relatively better forage-yield potential and quality than most other warm-season native species. Eastern gamagrass thus may respond well to more intensive management practices such as added N and more harvests. This study was established to determine the response of eastern gamagrass to N fertilizer rates and placement under a 1-cut or 2-cut harvest system. Plots were harvested in 1995 to determine residual effects of N treatments.

Experimental Procedures

Established (15-year-old) 'Pete' eastern gamagrass was burned for the 4th year on March 22, 1995 and fertilized with 54 lb P_2O_5/a and 61 lb K_2O/a on May 15. Nitrogen was not applied in 1995 because of wet May conditions. In 1992-94, nitrogen (urea-ammonium nitrate, 28% N) treatments of 0, 45, or 90 lb/a were applied in late April to 8 x 20 ft plots by broadcast or knife(4-inch) placement. Water was used on plots that received no N.

Plots were cut with a flail-type harvester on June 15 and August 14 from the 2-cut system and on July 10 from the 1-cut system. Yields were determined from a 3 x 20 ft strip of each plot, with a subsample taken for moisture determination.

Results and Discussion

No significant ($P < .05$) interactions were found among the three treatment factors for 1995 total yield, so treatment means are listed in Table 1. Total forage yield was increased by 17% under the 1-cut system as compared to 2 cuts in 1995. Residual N effects increased total forage yield in the different years by 23% with the first 45 lb/a increment and by an additional 12% with the next 45-lb increment. Knifing N in the previous 3 years resulted in 15% additional yield compared to previous broadcast applications.

Yields from the 1-cut system and from the first harvest and total yield of the 2-cut system also showed residual responses to N application (Table 1). Forage yields from the 1-cut system were increased 36% with the first 45-lb/a increment of N, but not with the next 45-lb increment. No yield difference for cut 2 of the 2-cut system resulted from previous N application rate. However, total yield of the 2-cut system was 27% greater where 90 lb/a had been applied compared to no N, largely because of the effect of N carryover on first-cut yield. Previous knife compared to broadcast applications of N resulted in a 17% yield in-crease in the 1-cut system (Table 1). However, no significant ($P < .05$) yield difference resulted from placement in the 2-cut harvest system.

Table 1. Eastern Gamagrass Forage Yields in 1995 under Two Harvest Systems with Residual Nitrogen from Different Nitrogen Rates and Placements in 1992-1994, Southeast Agricultural Research Center.

Harvest System	Nitrogen Rate	Nitrogen Placement	Forage Yield Cut 1	Cut 2	Total
	lb/a		- - - - tons/a (12% moisture) - - - -		
Means, Nitrogen Placement					
1-Cut		Broadcast	2.42	-	2.42
		Knife	2.84	-	2.84
		LSD(.05)	0.39	-	0.39
2-Cut		Broadcast	1.10	1.01	2.11
		Knife	1.29	1.09	2.38
		LSD(.05)	NS	NS	NS
Overall		Broadcast			2.27
		Knife			2.61
		LSD(.05)			0.23
Means, Nitrogen Rate					
1-Cut	0		2.04	-	2.04
	45		2.78	-	2.78
	90		3.07	-	3.07
	LSD(.05)		0.48	-	0.48
2-Cut	0		1.01	0.99	2.00
	45		1.15	1.06	2.21
	90		1.44	1.10	2.54
	LSD(.05)		0.27	NS	0.39
Overall	0				2.02
	45				2.49
	90				2.80
	LSD(.05)				0.28
Means, Harvest System					
1-Cut					2.63
2-Cut					2.25
LSD(.05)					0.23

SMALL GRAIN - LEGUME DOUBLE-CROPPING SYSTEMS

Joseph L. Moyer and Kenneth W. Kelley

Summary

Wheat followed by double-crop soybeans is a common rotation, but the soybeans have inconsistent yields and a high cost of production. Lespedezas can be grown after small grains (SG) for forage or seed and have a lower cost of production than soybean, but potential returns may be lower. Three SG - legume rotations were tested for 3 years. Yields averaged just over 12 bu/a for double-crop soybean, 2 tons/a for lespedeza hay, and 330 lb/a for lespedeza seed. Differences in SG production that resulted from different legume systems were small. Nitrogen produced a positive response only in 1994 wheat production and 1995 lespedeza seed production.

Introduction

Wheat followed by double-crop soybeans is a common rotation in southeastern Kansas. Inconsistent soybean yield can be a problem, particularly considering the cost of production. Lespedezas are alternative warm-season legumes that can be grown after wheat for forage or seed. Cost of production is lower for lespedeza than soybeans, reducing the risk, but potential returns also may be lower. We have grown three SG crops and three summer legume crops to determine (1) relative performance of crops within each system and (2) the effect of adding nitrogen to the SG on performance of each component of the rotation.

Experimental Procedures

Spring oats were seeded (100 lb/a) at the Mound Valley unit on March 16, 1993. 'Marion' striate lespedeza was broadcast (22 lb/a) to designated plots on April 12. Hay was cut from the area on June 23, and samples were separated by species. 'Flyer' soybeans were seeded (60 lb/a) in appropriate plots on June 28, after three or four tandem diskings. Metribuzin (0.3 lb a.i./a) and 1 lb/a of alachlor were applied preemergent to the soybeans. Lespedeza hay was cut on August 30, and lespedeza and soybean seed were harvested on November 1.

The area was disked three times (after burning lespedeza seed residue), and 'Karl 92' wheat was seeded at 75 lb/a on November 2, 1993. The area was fertilized with 30 lb/a of P_2O_5 and 40 lb/a of K_2O on February 16, 1994, and designated plots received 60 lb/a of N as urea. Lespedeza was seeded as in the previous year on March 15. Wheat was combined on June 20, soybean plots were disked twice, and soybeans were seeded as before on June 22 (with 0.375 lb metribuzin and 1.5 lb alachlor preemergent). All plots were sprayed on July 25 with 0.28 lb a.i./a of sethoxydim. Lespedeza for hay was cut on August 23, lespedeza seed was harvested on November 2, and soybean was harvested on December 2, 1994.

The area was disked two times and seeded with Karl 92 at 90 lb/a on December 2, 1994. Plots were fertilized as in previous years on February 13, 1995; lespedeza was seeded on March 13. Wheat was harvested on June 19, plots for soybean production were field cultivated twice, and soybeans were planted as in previous years on June 21 without premergence herbicide. The entire area was sprayed with 1 lb a.i./a of 2,4-DB on July 18, and soybeans were cultivated once. Lespedeza hay was harvested on August 21, soybeans on October 10, and lespedeza seed on October 27, 1995. The ground was disked and planted to Karl 92 wheat on the same day.

Results and Discussion

Yields of the first summer crop, 1993 oat hay, are shown in Table 1. Overseeded lespedeza treatments produced more hay than staight oats ahead of soybeans. This was because the oat component of all treatments produced just over a ton of forage, whereas lespedeza produced about 0.8 tons in treatments where it was seeded (data not shown). The lespedeza-overseeded treatments contained 42% lespedeza forage in the oat hay, making that hay more valuable.

Wheat grain production in 1994 was not significantly ($P < .05$) affected by the legume system (Table 1). However, wheat production tended ($P < .10$) to be more after lespedeza grown for hay than after soybean. Adding 60 lb/a of N increased 1994 wheat production by 17 bu (47%). No cropping system by N rate interaction occurred. Wheat yields were poor in 1995. Significantly more wheat was produced after lespedeza grown for seed than after a lespedeza hay crop, but the difference amounted to only 4bu. Wheat yield after soybeans was no different than after either lespedeza crop. No effect of N, and no interaction between cropping system and N rate occurred in the 1995 wheat crop.

Yields of fall crops from the different cropping systems are also in Table 1. Yields of lespedeza hay after small grains increased from 1.02 ton to 2.2 to 2.75 ton/a during the 3-year period. Lespedeza hay yields were never affected by N applied to preceding wheat.

Lespedeza seed yields were 400 lb in 1993, more than 500 lb in 1994, but less than 100 lb/a in 1995. No effect of N occurred in 1994, but 60 lb/a of N on the 1995 wheat increased lespedeza seed yield by 75 lb, more than a twofold increase.

Soybean seed yields were 10.4 bu in 1993, almost 20 bu in 1994, but just over 6 bu/a in 1995. Soybean yields followed a similar trend across years as lespedeza seed, except that soybeans had a more dramatic increase between 1993 and 1994. Nitrogen application to wheat in 1994 or 1995 had no significant effect on soybean yield.

Table 1. Yields from Three Small Grain (SG)- Legume Cropping Systems with or without N, 1993-1995, Southeast Agricultural Research Center.

Cropping System	Harvest Phase	N Rate	Year 1993	1994	1995
		lb/a	oat hay	wheat	
			ton/a	- - - - - bu/a - - - - -	
SG - lespedeza hay	Summer	0	1.73[1]	44.1ab	10.6a
		60	- [2]	54.9c	1.23ab
SG - lespedeza seed		0	2.16[1]	37.7ab	15.5ab
		60	- [2]	56.0c	16.1b
SG - double-crop soybean		0	0.94	30.8a	12.0ab
		60	- [2]	54.8c	14.6ab
<u>Means, Cropping Systems</u>					
SG - lespedeza hay			1.73a[1]	49.5	11.5a
SG - lespedeza seed			2.16a[1]	46.9a	15.8b
SG - double-crop soybean			0.94b	42.8a	13.3ab
<u>Means, Nitrogen Rate</u>					
		0	- [2]	37.5a	12.7a
		60	-	55.2b	14.3a
			- - - - tons lespedeza hay/a - - - -		
SG - lespedeza hay	Fall	0	1.02[1]	2.38a	2.77a
		60	- [2]	2.01a	2.74a
		Avg.	-	2.20	2.75
			- - - - - lb clean seed/a - - - - -		
SG - lespedeza seed		0	400[1]	584a	50a
		60	- [2]	423a	125b
		Avg.	-	504	88
			- - - - - - bu soybean/a - - - - - -		
SG - double-crop soybean		0	10.4	20.6a	4.1a
		60	- [2]	18.9a	8.4a
		Avg.	-	19.8	6.3

[1]Includes 42% lespedeza in oats hay.
[2]No N applied to oats.
[3]Means of a crop yield within a harvest followed by the same letter are not significantly (P < .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

Total and spring yields averaged higher for the lenient than the intensive defoliation system, but interactions of management treatment x defoliation system occurred in each year. Intensive defoliation plots usually yielded more spring and total seasonal forage than the lenient for the legume management and in 3 of 5 years for the mefluidide (Embark) treatment. Spring yield usually was reduced in the legume and mefluidide (Embark) treatments. However, total yield was higher for the legume treatment under intensive defoliation than for the other treatments in 1992-1995. High- vs. low-endophyte plots showed no difference in yield. Tiller density in June was reduced in the intensive compared to the lenient defoliation system in all except the last year. December tiller density was also lower in intensive compared to lenient defoliation in the last 3 years. The legume treatment generally was lower in tiller density than other treatments, particularly mefluidide. Tiller density was not affected by endophyte level.

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 were 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 ≈60% infected, respectively) fescue plots seeded in fall, 1984 were assigned to treatments beginning in spring, 1990. Two defoliation intensities were imposed with each of six other management alternatives. The "lenient" defoliation intensity consists of two to three cuts between mid-May and early December to a 4-inch stubble height, similar to hay meadow management. The "intensive" defoliation system consists of four to five cuts between mid-April and early December to a 2-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 management treatments (clip or burn), and legume in lieu of spring N (legume minus N).

Spring residue management treatments of burning or spring clipping were performed in late February to early March in each year. The area was fertilized with 90-44-57 lb/a of actual N-P_2O_5-K_2O, except that no N was applied to legume plots. However, ladino clover was overseeded at 4 lb pure, live seed (PLS)/a of by broadcasting on legume plots in 1990 and 1991 and interseeded with a no-till planter at 5 lb PLS/a in 1992. Treatments of mefluidide (Embark®) and dicamba (each @ 0.25 lb a.i./a) were made in early April. Legume plots also were treated with mefluidide. Forage yield determination and subsampling for moisture and forage quality were performed at each cutting, and subsamples from some treatments were collected in spring and freeze-dried for determination of ergovaline content. Tillers (> 1/8" diameter) from two-2.7 ft^2 areas/plot were counted in each June and December for determination of tiller density.

Endophyte infection frequency was determined prior to the test (January, 1990) by collecting 20 tillers from each of the eight blocks, staining the sheaths with 1% aniline blue in 85% lactic acid solution, and examining each tiller under a microscope at 100-400X. In June, 1994, 12 or more tillers from each plot were examined in the same way to compare endophyte frequencies at the end of the study.

Results and Discussion

Forage Production

Early-spring clipping of fall regrowth typically yielded low-quality forage amounting to about 0.4 (@12% moisture) for the intensive and 0.15 tons/a for the lenient defoliation systems (data not shown). Total seasonal and spring (April-June) yields for 1990-94 are shown in Fig. 1. Total and spring yields averaged higher for the lenient than the intensive defoliation system, but highly significant ($P < .01$) interactions occurred among years and for management treatment x defoliation system in each year. The intensive defoliation system yielded more spring and total seasonal forage than the lenient in each year (except in spring, 1991) for the legume management and in 3 of 5 years for the mefluidide (Embark) treatment. The other treatments varied by year as to whether the intensive or the lenient defoliation system was higher yielding (Fig. 1).

Spring forage production was reduced in the legume and mefluidide (Embark) treatments compared to the control in each year except 1994 (Fig. 1). However, total yield was higher for the legume treatment under intensive defoliation than for the other treatments in 1992-1995. No difference in yield occurred in high- vs. low-endophyte plots (data not shown).

Tiller Density

Tiller density in June was reduced in the intensive compared to the lenient defoliation system in all except the last year (Fig. 2). December tiller density was also lower in intensive compared to lenient defoliation in the last 3 but not the first 2 years. The legume treatment was lower in tiller density than most other treatments, particularly mefluidide, at all samplings except the first two December counts (data not shown). Tiller density was not affected by endophyte level (data not shown).

Figure 1. **Total and Spring Forage Yields under Four Management Options with Intensive or Lenient Defoliation Harvest Systems, Southeast Agricultural Research Center.**

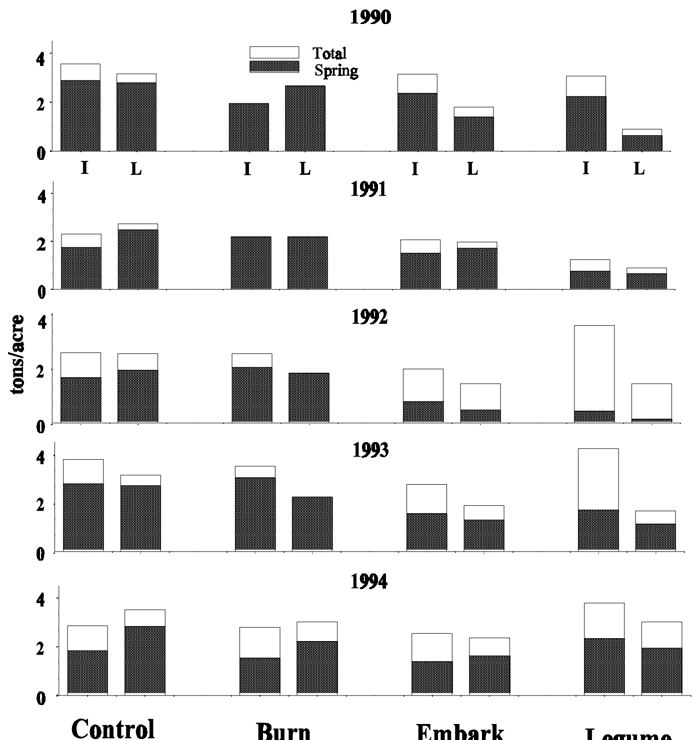
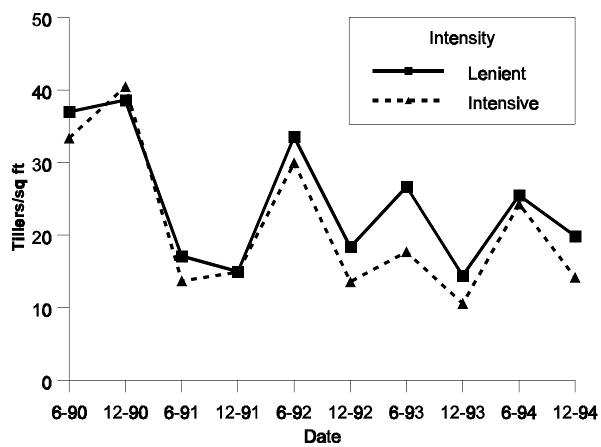


Figure 2. **Tiller Density during a Five-Year Period for Intensive and Lenient Harvest Systems, Southeast Agricultural Research Center.**



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 with or without nitrogen (N) after no clover (continuous sorghum) or red clover that was hayed (2.8 tons/a) or mulched. Sorghum grain production was greater after clover than after continuous sorghum. Nitrogen (100 lb/a) increased yields uniformly by about 40%. Plant stands were not affected by treatments, but heads/a were increased by N fertilization.

Introduction

Grain sorghum is a productive feed-grain 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, or provide top growth that could be used as a livestock supplement. Red clover is suitable as a green manure crop because of its yield potential and substantial N content.

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

Experimental Procedures

Red clover was seeded on designated plots on March 31, 1994. Hayed plots were cut on June 16, 1995, and all plots were offset-disked on June 22. Urea was applied at the rate of 100 lb N/a to appropriate plots, then all plots were tandem-disked two times and planted with Pioneer 8500 on June 23. Phosphate and potash (21 and 33 lb/a, respectively) were applied to all plots with the planter, and a preemergent application of 2 lb a.i./a of alachlor was used for weed control.

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

Results and Discussion

Hayed plots produced 2.83 tons/a (12% moisture) of red clover forage. Subsequent grain sorghum plant stands, head count, and grain yield are listed in Table 1. Sorghum plant populations were similar in all treatments. Head counts were significantly ($P < .05$) higher after 100 lb/a of N had been applied than where no N was added, but were similar for the previous cropping treatments.

Sorghum grain yield was increased ($P < .05$) by 40% after the application of 100 lb/a of N. Yield was 5% higher ($P < .05$) after the production of red clover than after continuous grain sorghum. No interaction occurred between cropping system and N application treatments.

Table 1. Grain Sorghum Plant and Head Populations and Grain Yield as Affected by Red Clover Management and N Application, SEARC, 1995.

Treatment	Population Plants	Population Heads	Grain Yield
	No./a (10^3)		bu/a
Clover Management			
None	45.2	45.9	34.0
Hayed	46.6	47.2	47.9
Mulched	43.3	49.0	51.9
$LSD_{.05}$	NS	NS	9.6
Nitrogen Rate			
None	44.9	44.8	37.3
100 lb/a	45.1	49.9	51.9
$LSD_{.05}$	NS	2.8	7.8
Clover treatment X nitrogen rate interaction	NS	NS	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 nitrogen (N) resulted in large increases in grain sorghum yield, with anhydrous ammonia often resulting in highest yields, especially with no tillage. In contrast, soybean yields have been little affected by tillage or the residual from N fertilization.

Introduction

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

Experimental Procedures

A split-plot design with four replications was initiated in 1983, with tillage systems as whole plots and N treatments as subplots. The three tillage systems were conventional, reduced, and no tillage. The conventional system consisted of chiseling, disking, and field cultivation. The reduced-tillage system consisted of disking and field cultivation. Glyphosate (Roundup) was applied in each year at 1.5 qt/a to the no-till areas. The four N treatments for the odd-numbered years from 1983 through 1995 were a) no N (check), b) anhydrous ammonia knifed to a depth of 6 inches, c) broadcast urea-ammonium nitrate (UAN - 28% N) solution, and d) broadcast solid urea. The N rate was 125 lb/a.

Results and Discussion

Averaged across the 7 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 1995 (Table 1). 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. Anhydrous ammonia has tended to result in highest yields, but the use of either urea or UAN for surface N fertilization generally has not resulted in large differences in grain sorghum yield except for occasional poor response with no tillage. In 1995, yield was affected by an interaction between tillage and N fertilization because urea applied in no tillage did not result in yield levels comparable to those obtained in the other tillage systems.

Although soybean yields in even-numbered years generally have tended to be less with no tillage, the differences have not been significant (data not shown). Residual N affected soybean yield only in 1984, but because of low yield levels, the 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, Southeast Agricultural Research Center.

Treatment	Yield 1995	Yield Avg. 1985-1995
	- - - - - bu/a - - - - -	
Tillage		
Conventional	86.9	69.4
Reduced	86.0	69.0
No tillage	79.6	54.7
LSD (0.05)	NS	
N Fertilization		
Check	62.1	43.2
Anhy. NH_3	93.1	74.2
UAN broadcast	89.6	67.9
Urea broadcast	91.8	71.8
LSD (0.05)	4.9	
T x N	*	

GRAIN SORGHUM RESPONSE TO LEGUME RESIDUAL AND FERTILIZER NUTRIENTS[1]

Daniel W. Sweeney, Joseph L. Moyer, David A. Whitney[2], and Douglas J. Jardine[3]

Summary

Type of legume residual did not affect the yield of subsequent first or second grain sorghum crops. In 1994, phosphorus (P) increased grain sorghum yields, but potassium (K) did not. In 1995, greater sorghum yield increases with P and K were obtained when nitrogen (N) also was supplied. Stalk rot severity was greater with P and N fertilization, whereas K additions as KCl reduced disease levels. Chloride maximized yield and reduced stalk rot and lodging when grain sorghum was fertilized with N.

Introduction

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

Experimental Procedures

The experiment was established on a Parsons silt loam in spring 1994. Since 1983, different soil test levels have been maintained in whole plots by fertilizer applications. Phosphorus levels at the start of this study ranged 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-split-plot. The whole plots comprised a factorial arrangement of P and K rates, in addition to selected Cl comparison treatments. Phosphorus rates were 0, 40, and 80 lb P_2O_5/a, and K rates were 0, 75, and 150 lb K_2O/a. Subplots were alfalfa and birdsfoot trefoil residuals. Chloride comparison treatments involved a 2x2 factorial combination of K and Cl by using KCl, K_2SO_4, $CaCl_2$, or no K or Cl. Sub-subplots were 0 and 100 lb N/a applied as urea. Three-year-old alfalfa and birdsfoot trefoil were killed by offset disking on March 22, 1994. Grain sorghum was planted at 62,000 seeds/a in June in 1994 and 1995. Visual lodging and stalk rot scores (bottom 10 nodes) were taken at harvest maturity in 1995.

Results and Discussion

In 1994, the first crop year after alfalfa and birdsfoot trefoil were killed, grain sorghum yield was not affected by type of legume residual or N application (data not shown), suggesting that N needs were being met by the decomposition of the legumes. Maintaining the P level with 40 and 80 lb P_2O_5/a increased yield to 119 and 128 bu/a, respectively, from 88 bu/a with no P application.

---

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

[2]Department of Agronomy, KSU.

[3]Department of Plant Pathology, KSU.

Potassium did not affect yields in 1994.

In 1995, grain sorghum yield also was not affected by type of legume residual nor the interaction with N, although the main effect of N did significantly increase yield (data not shown). This suggests that legume residual was not sufficient to meet the needs of the second grain sorghum crop, and any N contribution from the two legumes was likely similar. However, yield was affected by interactions of N with P and with K fertilization. Without added N, yield tended to increase with P_2O_5 application only up to 40 lb/a, but with N, yield increased from 79 bu/a with no P to 104 bu/a at the highest P rate (Fig. 1). Potassium fertilization without N application did not improve grain sorghum yields. With N, 75 lb K_2O/a increased yield by 14 bu/a, but additional K did not add additional yield.

In 1994, no plant lodging was observed. In contrast, in 1995, plant lodging suggested the possible presence of stalk rot. Visual inspection showed that most plants had some *Fusarium* stalk rot symptoms. The number of internodal spaces with visual evidence of stalk rot was affected by interactions of N with P and with K fertilization. Without N, stalk rot severity ranged between four and five nodes/plant (Fig. 2). However, with N fertilization adding P increased the average number of nodes showing stalk rot to more than six nodes/plant. With no K fertilization, adding N increased the number of nodes with stalk rot severity to nearly eight/plant compared to less than six/plant with no N. However, adding K fertilization regardless of N rate reduced the number to less than five nodes/plant showing visual signs of stalk rot.

Because the K added in the previous analysis was KCl, analyses of additional treatments provided data separating K and Cl effects on yield and stalk rot. Potassium as KCl or K_2SO_4 increased yield by 8 bu/a and reduced stalk rot (data not shown). Yield and stalk rot severity were affected by an interaction between Cl and N application (Fig. 3). Without Cl, yield was not significantly increased by N. With Cl, yield was increased by 24 bu/a with N fertilization compared to no N. Without Cl, stalk rot was apparent on more than eight nodes/plant when the grain sorghum was fertilized with N as compared to less than five nodes/plant with no N. Adding Cl reduced the number of nodes/plant with stalk rot symptoms regardless of N rate; however, the effect was greater with 100 lb /a. In addition, the absence of Cl when grain sorghum was fertilized with 100 lb N/a resulted in more than 20% of the plants lodged compared to negligible lodging with no N or with Cl (data not shown).

Fig. 1. Effects of Interactions of N with P and K Fertilization on Grain Sorghum Yield, Southeast Agricultural Research Center, 1995.

Fig. 2. Effects of Interactions of N with P and K Fertilization on Stalk Rot Severity in the Bottom 10 Nodes of Grain Sorghum Plants, Southeast Agricultural Research Center, 1995.

Fig. 3. Effects of Interaction of N with Cl Fertilization on Yield and Stalk Rot Severity of Grain Sorghum, Southeast Agricultural Research Center, 1995.

SOIL APPLICATION OF COMPOSTED MUNICIPAL SOLID WASTE FOR GRAIN SORGHUM PRODUCTION[1]

Daniel W. Sweeney and Gary Pierzynski[2]

Summary

Municipal solid waste compost did not affect grain yield in 1995, even though dry matter production at the boot stage was increased by compost. Cow manure and fertilizer applications generally increased growth and yield.

Introduction

One of the most pressing environmental issues that will face communities in the near future is solid waste disposal. In recent years, news media coverage of landfill problems has become common. With diminishing capacity of existing landfills and the reluctance of the general populace to create new landfills at their own "back door", other alternatives to straight landfilling of municipal solid waste (MSW) need to be explored. Incineration may reduce waste volume, but likely raises as many environmental concerns as landfilling. However, composting of MSW may be more environmentally acceptable and should substantially reduce waste volume. Landfill longevity could be extended further by finding alternatives to landfilling the composted MSW. Composted MSW has potential uses in agriculture, horticulture, silviculture, and reclamation. Thus, the objective of this study was to determine the effect of application rate of composted MSW, with or without cow manure and with or without commercial fertilizer, on the growth, composition, and yield of grain sorghum and on selected soil chemical properties.

Experimental Procedures

A field study was established in 1992 on a Zaar silty clay soil at an off-center site in Montgomery County. The experimental design was a split plot arrangement of a randomized complete block with three replications. The whole plots comprised a 4 x 2 factorial arrangement of four rates of MSW compost with or without cow manure. The four rates of MSW compost were 0 or 4.5, 9, and 13.5 ton/a applied each year. These rates were selected to be more in line with a "utilization" rather than a "disposal" mentality. The cow manure rates were 0 or 4.5 ton/a applied yearly. The subplots were with or without commercial fertilizer, 100-60-30 lb N-P_2O_5-K_2O/a. In 1995, compost, cow manure, and fertilizer were applied on June 28, but rain delayed planting grain sorghum until July 7.

Results and Discussion

Adding MSW compost did not increase dry matter accumulation at the 9-leaf or soft dough growth stages as compared with no compost (Table 1). However, at the boot stage, adding 4.5 ton/a of compost increased dry matter production compared to no compost, but higher compost rates did not further increase dry matter. Late planting and dry weather resulted in low dry matter production at soft dough stage and subsequent grain yields. The addition of MSW compost did not increase grain sorghum yield. Adding cow manure or fertilizer generally increased growth and yield of grain sorghum.

---

[1]With the cooperation of Resource Recovery, Inc.

[2]Department of Agronomy, KSU.

Table 1. Effect of Composted Municipal Solid Waste (MSW), Cow Manure (CM), and Fertilizer on Grain Sorghum Growth and Yield, Southeast Agricultural Research Center, 1995.

Treatment	Dry Matter Production			
	9-Leaf	Boot	Soft Dough	Yield
	-------------------- lb/a	---------------------		bu/a
MSW (t/a)				
0.0	850	2330	3760	31.9
4.5	980	2930	3510	30.8
9.0	960	2920	3760	34.9
13.0	1060	2920	4020	31.4
LSD 0.05	NS	480	NS	NS
CM (t/a)				
0.0	810	2390	3480	28.2
4.5	1120	3140	4040	36.2
LSD 0.05	170	340	510	7.4
Fertilizer (lb/a)				
0	840	2420	3610	27.2
100-60-30	1090	3100	3920	37.2
LSD 0.05	90	380	NS	3.3
Interaction(s)	NS	MxC	NS	CxF

EFFECT OF FOLIAR-APPLIED METHANOL ON YIELD OF SOYBEANS

Daniel W. Sweeney and Herbert D. Sunderman[1]

Summary

In the 2 years of this study, little evidence was obtained to support producers incorporating methanol applications into their farming operations for soybean production.

Introduction

Recent research in Arizona showed that large increases in yield of selected C_3 plants were obtained with applications of dilute methanol. This work also concluded that foliar-applied methanol reduced the plant requirement for water. Thus, methanol may enable the crop to be less affected by droughty periods when planted dryland in southeastern Kansas. Soybean is also a C_3 plant, but it was not tested in the Arizona research. Methanol is highly flammable and would require appropriate cautions. This technology needs to be tested under southeastern Kansas conditions for high acreage crops like soybean.

Experimental Procedures

The experiment was established on a Parsons silt loam in spring 1994 at the Mound Valley field of the Southeast Agricultural Research Center. The experiment was a 7x2 factorial arrangement of a randomized complete block with four replications. The seven times of application were at i) R1; ii) R3; iii) R5; iv) R1 and R3; v) R3 and R5; vi) R1 and R5; and vii) R1, R3, and R5. The two concentrations of methanol solutions were 20% and 40% v/v. Methanol solutions were sprayed through flat fan nozzles at 20 gal/a. In addition, a control receiving no methanol was included in each block. Flyer soybean was planted on May 27, 1994, but planting was delayed by wet weather in 1995 until June 22.

Results and Discussion

Soybean yields in 1994 were approximately double those in 1995 (Table 1). However, methanol application timing or concentration did not affect yields in either year. Even though some measured parameters were affected by methanol, responses were few (data not shown). In the first 2 years of this study, little evidence was obtained to support producers incorporating methanol applications into their farming operations for soybean production.

---

[1]Northwest Research-Extension Center, KSU.

Table 1. Effect of Methanol Application Timing and Concentration on Soybean Yield, Southeast Agricultural Research Center.

Methanol Treatment	Yield 1994	1995
	----- bu/a -----	
Timing		
R1	29.4	15.2
R3	28.7	15.1
R5	29.8	15.4
R1-R3	27.5	14.9
R1-R5	29.5	14.5
R3-R5	26.3	13.7
R1-R3-R5	27.4	14.3
LSD (0.05)	NS	NS
Concentration (v/v)		
20%	28.6	14.8
40%	28.1	14.6
LSD (0.05)	NS	NS
T x C	NS	NS
Control	27.6	14.7
Control vs R1	NS	NS
Control vs R3	NS	NS
Control vs R5	NS	NS

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

Daniel W. Sweeney and Charles W. Marr[1]

Summary

Limited irrigation had little effect on popcorn yields, but increasing plant density tended to increase yields.

Introduction

Field corn responds to irrigation, and timing of water deficits can affect yield components. Popcorn is considered as a possible, value-added, alternative crop for producers and is being developed in western Kansas, but less so in the southeastern part of the state. Literature is lacking on effects of both irrigation management and plant density on the performance of popcorn.

Experimental Procedures

The experiment was established on a Parsons silt loam in spring 1995 as a split-plot arrangement of a randomized complete block with three replications. The whole plots included six irrigation managements: i) no irrigation, ii) 1 in. at R1 (silk), iii) 2 in. at R1, iv) 1 in. at R3 (milk), v) 2 in. at R3, and vi) 1 in. at both R1 and R3. The subplots consisted of three plant densities; 15000, 20000, and 25000 plants/a. Plots were overplanted with P-410 popcorn on May 16, 1995 and thinned to the desired populations on June 14. Plots were harvested on October 4.

Results and Discussion

Popcorn yields were little affected by irrigation management in 1995 (Table 1). The depression in yield by the R1-2 in. irrigation may have been caused by 3.5 in. of rain that occurred during the next 3 days. Popcorn yields tended to increase with higher populations; the highest population of 25,000 plants/a resulted in higher yield than 15,000 plants/a, with 20,000 plants/a resulting in intermediate yields.

Table 1. Effect of Timing of Irrigation and Plant Density on Popcorn Yield, SEARC, 1995

Treatment	Yield
	lb/a
Timing	
None	2200
R1-1 in.	2300
R1-2 in.	2010
R3-1 in.	2230
R3-2 in.	2180
R1-R3-1 in. at each	2180
LSD (0.05)	160
Plant Density (per acre)	
15,000	2070
20,000	2200
25,000	2280
LSD (0.05)	150

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

EFFECT OF PREVIOUS CROP, NITROGEN RATE, AND NITROGEN METHOD ON NITROGEN REQUIREMENT FOR WHEAT

Kenneth W. Kelley and Daniel W. Sweeney

Summary

Previous crop, nitrogen (N) rate, and N placement had significant effects on wheat yield and leaf N, whereas effects of tillage on grain yield were small. In 1995, grain yields were reduced severely by excessive spring rainfall near heading time, which resulted in water-logged soils. Wheat yields following corn or soybeans were significantly higher than those following grain sorghum. Leaf N results suggested that yield responses were largely due to differences in N availability among previous crops and N placement methods.

Introduction

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

Experimental Procedures

Conventional Tillage Study

The experiment was a split-plot design, in which the main plots were previous crops (corn, grain sorghum, or soybean) and subplots included a factorial arrangement of three N rates (40, 80, and 120 lb N/a) with four placement methods - 1) broadcast urea, 2) broadcast liquid 28% N, 3) dribbled liquid 28% N on 15-in. centers, and 4) knifed liquid 28% N on 15-in. centers at a depth of 4 to 6 in. All N treatments were fall-applied and incorporated by shallow disking prior to wheat planting. Soil type was a Parsons silt loam with 2.8% organic matter. All plots also received 60 lbs/a of P_20_5 and 75 lbs/a K_20.

Conventional and No-Tillage Study

The experiment was a split-plot design with previous crop (soybean and grain sorghum) and tillage method (no-till and conventional) as main plots and a factorial arrangement of N rates (60 and 120 lbs N/a) and N placement method (broadcast and knifed) as subplots. All N treatments were fall-applied and, in conventional tillage, were shallow incorporated with a disk prior to wheat planting. Urea ammonium nitrate 28% N solution (UAN) was the N source, except for one comparison treatment where urea was applied as a split application (fall and late-winter). Knifed N treatments were banded on 15-in centers at a depth of 4 to 6 in.

Results and Discussion

Conventional Tillage Study (Table 1)

Both wheat yield and leaf N concentration at Feekes 5 (early spring greenup) were influenced significantly by previous crop and applied N fertilizer, even though yields were severely reduced by excessive spring rainfall before and after heading. Grain yield and leaf N for wheat were highest following corn and lowest following grain sorghum. In 1995, differences between corn and grain sorghum may have been due to higher residual soil nitrate-N levels following corn (nearly 70 lb/a in the top 12 in. of soil) compared to grain sorghum (less than 10 lb/a). Both grain yield and leaf N increased with increasing N rates, regardless of previous crop. Leaf N results, however, indicated that the highest N rate (120 lb/a) was not high enough for wheat following grain sorghum. Research has shown that leaf N concentration at Feekes 5 should be 3.5% or higher for optimum grain yield. Soybean yields also were highest at the 120 lb/a N rate, although previous research on a similar soil type showed that 80 lb N/a normally was adequate for wheat following soybean. However, in the fall of 1994, some fertilizer N likely was lost from the topsoil profile when over 12 in. of rain fell during October and November.

In 1995, grain yield differences between N placement methods were small and somewhat variable. However, leaf N was generally higher when UAN was knifed below crop residues, indicating that N was more readily available for nutrient uptake.

Conventional and No-Till Study (Table 2)

Wheat yield and leaf N were influenced significantly by previous crop, N rate, and N placement. Because soils remained water-logged after wheat had headed, grain yield differences between tillage systems were small in 1995, regardless of previous crop. However, results indicated that wheat can be successfully planted no-till into high residue crops, such as grain sorghum, although grain yields are influenced significantly by rate and placement of fertilizer N. More research is needed in eastern Kansas to evaluate wheat N responses in conservation tillage systems under varying climatic conditions.

Table 1. Effects of Previous Crop, N Rate, and N Method on N Requirement for Winter Wheat, Southeast Agricultural Research Center, 1995.

N Rate	N Method	Grain Yield of Wheat after Corn	Sorgh	Soy	Leaf N Conc. of Wheat after Corn	Sorgh	Soy
lb/a		------------ bu/a -----------			--------- % N -----------		
0	----	20.9	11.5	18.0	2.90	2.54	2.78
40	B'Cast-Urea	29.5	19.4	21.4	3.21	2.70	2.87
80	B'Cast-Urea	32.3	21.9	29.7	3.48	2.98	3.15
120	B'Cast-Urea	39.5	26.6	30.7	3.81	3.12	3.46
40	B'Cast-UAN	25.4	20.1	22.5	3.00	2.48	2.84
80	B'Cast-UAN	31.8	21.4	25.9	3.23	2.82	3.07
120	B'Cast-UAN	35.4	26.9	30.8	3.76	3.25	3.48
40	Dribble-UAN	23.4	19.9	23.3	3.15	2.59	2.96
80	Dribble-UAN	28.3	25.9	29.0	3.31	2.91	3.15
120	Dribble-UAN	30.6	29.0	31.0	3.61	3.22	3.35
40	Knife-UAN	29.5	19.3	24.6	3.20	2.66	3.14
80	Knife-UAN	32.2	24.8	27.5	3.56	3.00	3.35
120	Knife-UAN	35.3	27.3	34.9	3.73	3.44	3.53
Avg*		31.1[a]	23.5[c]	27.6[b]	3.42[a]	2.93[c]	3.17[b]
Means:							
40 lb/a N		27.0	19.7	22.9	3.14	2.61	2.95
80 lb/a N		31.2	23.5	28.0	3.39	2.93	3.10
120 lb/a N		35.2	27.5	31.8	3.72	3.26	3.45
LSD (0.05):		1.2	1.2	1.2	0.10	0.10	0.10
B'Cast Urea		33.8	22.6	27.3	3.50	2.93	3.16
B'Cast UAN		30.8	22.8	26.4	3.33	2.85	3.13
Dribble-UAN		27.4	24.9	27.8	3.35	2.91	3.04
Knife-UAN		32.3	23.8	29.0	3.49	3.04	3.33
LSD (0.05):		1.4	1.4	1.4	0.12	0.12	0.12

*Means followed by a different letter are significant at the 5% level of probability.
All N treatments were fall-applied and incorporated with tillage prior to wheat planting.
UAN = urea ammonium nitrate 28% N solution.
All plots received 60 lb/a P_20_5 and 75 lb/a K_20.
Planting date: Oct. 13, 1994.

Table 2. Effects of Previous Crop, Tillage Method, N Rate, and N Placement on N Requirement for Winter Wheat, Southeast Agricultural Research Center, 1995.

			Wheat Yield after				Leaf N Conc. of Wheat after			
N	N	N	Gr Sorghum		Soybean		Gr Sorghum		Soybean	
Rate	Method	Source	NT	CT	NT	CT	NT	CT	NT	CT
lb/a			----------- bu/a -----------				----------- % N -----------			
0	----	----	11.9	14.2	19.8	18.7	2.85	2.87	3.09	2.91
60	B'Cast	UAN	17.8	19.8	24.3	23.8	3.15	2.92	3.15	3.30
120	B'Cast	UAN	23.3	25.4	29.1	30.0	3.45	3.39	3.47	3.49
60	Knife	UAN	21.6	22.5	26.7	26.4	3.12	3.15	3.47	3.49
120	Knife	UAN	27.2	28.4	30.0	31.9	3.43	3.45	3.71	3.80
120[1]	B'Cast	Urea	30.6	31.8	31.6	33.0	4.16	4.24	4.30	4.20
Avg*			22.1[c]	23.7[b]	26.9[a]	27.3[a]	3.36[b]	3.37[b]	3.53[a]	3.53[a]
Means:										
60 lb N/a			19.7	21.1	25.5	25.1	3.00	3.03	3.31	3.40
120 lb N/a			25.3	26.9	29.5	30.9	3.25	3.42	3.59	3.64
LSD (0.05):			1.4	1.4	1.4	1.4	0.11	0.11	0.11	0.11
B'Cast			20.5	22.6	26.7	26.9	2.98	3.15	3.31	3.40
Knife			24.4	25.5	28.4	29.2	3.28	3.30	3.59	3.64
LSD (0.05):			1.4	1.4	1.4	1.4	0.11	0.11	0.11	0.11

*Means followed by a different letter are significant at the 5% level of probability.

[1]60 lb N/a applied in fall and 60 lb N/a topdressed in Feb.

All plots received 60 lbs/a P_20_5 and 75 lbs/a K_20.

NT = no tillage, CT = conventional tillage (disk)

Planting date: Oct. 14, 1994.

EFFECTS OF NITROGEN RATE AND TIME OF APPLICATION ON NO-TILL WHEAT

Kenneth W. Kelley

Summary

Grain yields were highest for wheat planted no-till following grain sorghum when 160 lb N/a was applied as a split application (fall + late winter) or as a single treatment in the fall. However, when wheat was planted no-till following soybeans, fertilizer N (urea) was most efficiently utilized when 80 lb N/a was split-applied or all applied in late winter.

Introduction

Conservation cropping systems are becoming more popular in Kansas. In southeastern Kansas, planting wheat no-till after harvest of fall crops saves time and reduces soil erosion. Research has shown that fertilizer N placed below crop residues increases N availability in no-till systems. However, where wheat follows a fall-harvested crop, management of time becomes more critical. This research seeks to determine if urea can be used successfully as a fertilizer N source in no-till wheat cropping systems, even though surface-applied urea potentially could be more subject to N loss through ammonia volatilization.

Experimental Procedures

In the fall of 1994, fertilizer N applications were evaluated in two separate wheat cropping studies. In the first study, wheat was planted no-till following grain sorghum. In the second study, wheat was planted both no-till and with conventional tillage (disk) following soybeans. In both studies, fertilizer N (urea) applications were: 1) all fall preplant, 2) split - 1/2 fall and 1/2 late winter, and 3) all late winter. Phosphorus (60 lb/a P_20_5) and potassium (75 lb/a K_20) were applied on all plots. Plant samples (leaf and whole-plant) were collected and analyzed for N concentration. Nitrogen uptake was calculated by multiplying whole-plant N concentration by dry matter yield per unit area at flowering time.

Results and Discussion

Grain yield and plant N data for wheat planted no-till following grain sorghum are shown in Table 3. Yields were reduced because of excessive spring rainfall before and after heading, which produced water-logged soils. However, significant yield and plant N responses occurred with various N rates and times of N application. When averaged over N rates, grain yields were highest when N was split-applied (1/2 fall and 1/2 late winter), although the fall 160 lb/a N rate gave the highest overall yield. Leaf N and whole-plant N uptake were higher from split and late winter N applications, suggesting that some fall-applied N likely was lost when over 12 in. of rainfall occurred during October and November. Results suggest that, for optimum no-till wheat yields following grain sorghum, a fall N application of 60 to 80 lb N/a is needed to promote root and tiller development, followed by another 60 to 80 lb N/a in late winter as wheat begins early greenup.

Grain yield and plant N data for wheat following soybeans are shown in Table 4. Grain yields were low because of excessive spring rainfall. Tillage had no significant effect on grain yield, but whole-plant N uptake was slightly lower for no-till planted wheat. Nitrogen uptake increased with increasing N rates, suggesting that volatilization losses from surface-applied urea were minimal in 1995. However, grain yields declined somewhat at the highest N rate (120 lb

N/a) when all of the fertilizer N was applied at one time in late winter or with the split application. Previous research has shown that wheat yields declined when excess fertilizer N has been applied in late winter.

Table 1. Effects of N Rate and Time of Application for Wheat Planted No-Till in Previous Grain Sorghum Stubble, Southeast Agricultural Research Center, 1995.

N[1] Rate	N[2] Time	Grain Yield	Leaf N[3] Concentration	Whole Plant[4] N Uptake
lb/a		bu/a	%	lb/a
0	---	9.2	2.83	10.6
40	Fall	13.8	2.90	26.4
80	Fall	17.1	3.05	54.0
120	Fall	23.2	3.30	78.0
160	Fall	35.7	3.54	86.1
40	Split (F + LW)	12.2	3.71	31.0
80	Split (F + LW)	19.3	4.10	73.3
120	Split (F + LW)	31.0	4.55	98.8
160	Split (F + LW)	33.6	4.56	104.0
40	Late winter	17.9	5.13	50.9
80	Late winter	21.2	5.30	76.9
120	Late winter	22.4	5.42	93.3
160	Late winter	24.5	5.61	104.8
Means:				
40 lb N/a		14.6	3.91	36.1
80 lb N/a		19.2	4.15	68.1
120 lb N/a		25.5	4.42	90.0
160 lb N/a		31.3	4.57	98.3
LSD (0.05):		1.3	0.10	4.2
Fall		22.4	3.20	61.1
Split (F + LW)		24.0	4.23	76.6
Late Winter		21.5	5.36	81.5
LSD (0.05):		1.2	0.09	3.7

[1] N source: urea
[2] Time of N application: fall (F) = Oct. 13; late winter (LW) = Feb. 22
[3] Leaf N on March 22 (Feekes 5, early spring greenup stage)
[4] Whole-plant aboveground N uptake at Feekes 10.5 (flowering stage)
Planting date: Oct. 14, 1994

Table 2. Effects of N Rate, Time of N Application, and Tillage on Winter Wheat Yield and Whole-Plant N Uptake Following No-Till Soybeans, SEARC, 1995.

N[1] Rate	N[2] Time	Yield CT	Yield NT[3]	N Uptake[4] CT	N Uptake[4] NT
lb/a		---- bu/a ----		---- lb/a ----	
0	----	11.5	13.0	26.4	25.1
40	Fall	16.0	16.6	52.5	43.2
80	Fall	20.4	18.8	78.5	58.7
120	Fall	25.2	24.2	102.9	80.3
40	Split (F + LW)	18.5	18.7	73.9	62.6
80	Split (F + LW)	25.1	25.5	105.4	101.1
120	Split (F + LW)	23.1	23.7	122.0	113.9
40	Late winter	18.8	20.1	76.7	62.7
80	Late winter	25.4	25.5	139.9	123.9
120	Late winter	24.1	23.7	153.1	137.8
Avg		21.8	21.9	100.5	87.1
Means:					
40		17.7	18.5	67.7	56.2
80		23.6	23.3	108.0	94.6
120		24.1	23.8	126.0	110.7
LSD (0.05):		1.0	1.0	7.1	7.1
Fall		20.5	19.9	78.0	60.7
Split (F + LW)		22.2	22.6	100.4	92.5
Late winter		22.8	23.1	123.2	108.1
LSD (0.05):		1.0	1.0	7.1	7.1

[1] N source: urea

[2] Time of N time: fall (F) = Oct. 13; late winter (LW) = Feb. 22

[3] CT = conventional tillage (disc); NT = no-till

[4] Whole-plant aboveground N uptake at Feekes 10.5 (flowering stage)

Previous crops: no-till full-season soybean planted into grain sorghum stubble

Planting date: Oct. 28, 1994.

EFFECTS OF PLANTING DATE AND FOLIAR FUNGICIDE ON WINTER WHEAT

Kenneth W. Kelley

Summary

Grain yields were highest for the mid-October planting at Parsons and for the late October planting at Columbus. Wheat planted in late September was infected severely with barley yellow dwarf virus (BYDV), which significantly reduced both grain yield and grain quality. A foliar fungicide application (Tilt) increased grain yields by an average of 5 to 10 bu/a for the October plantings and increased test weight by 1 to 2 lb/bu.

Introduction

Wheat often is 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 typically is planted from early October through early November. This research seeks to determine how planting date affects grain yield of selected hard and soft winter wheat cultivars with variable disease resistance.

Experimental Procedures

In 1995, six winter wheat cultivars were planted on four different dates at the Parsons Unit and on three different dates at the Columbus Unit. Cultivars selected included: 1) soft wheat cultivars ('Caldwell' and Pioneer 2551), 2) susceptible hard wheat cultivars ('Chisholm' and 'TAM 107'), and 3) slightly to moderately resistant hard wheat cultivars ('Karl' and 2163). Cultivars were seeded at the recommended rate for each planting date (850,000 seeds/a for late September through early October; 1,050,000 seeds/a for mid- to late Oct; and 1,500,000 seeds/a for early December). 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 Feekes' growth stage 8 (flag leaf just visible from the boot).

Results and Discussion

In 1995, excessive rainfall occurred both in the fall (mid-Oct. through late November) and in late spring (late April through mid-June), resulting in water-logged soil conditions and premature death of wheat plants prior to harvest. Because of wet soil conditions in the fall, the mid-October planting at Columbus and the November planting at both Parsons and Columbus were omitted.

Grain yields were highest for the mid-October planting at Parsons and for the late October planting at Columbus. Planting in late September produced higher grain yield than the early December planting; however, wheat planted in late September was infected severely with barley yellow dwarf virus (BYDV), which significantly reduced both grain yield and grain quality. The foliar fungicide application (Tilt) increased grain yields by an average of 5 to 10 bu/a for the October plantings and increased test weight by 1 to 2 lb/bu. Tilt had no effect on BYDV disease infection.

Table 1. Effects of Planting Date and Foliar Fungicide (FF) on Wheat Yield and Test Weight of Selected Cultivars, Parsons Unit, SEARC, 1995.

Planting Date Cultivar	Grain Yield No FF	 FF	Test Weight No FF	 FF	Heading Date
	-- bu/a --		-- lb/bu --		
September 29					
2163	31.2	35.3	56.1	56.9	April 29
Caldwell (S)	34.1	36.1	55.0	56.3	April 30
Chisholm	30.3	35.1	55.5	56.6	April 25
Karl	29.6	30.7	56.7	57.2	April 25
Pioneer 2551 (S)	35.1	37.0	54.8	55.4	May 1
TAM 107	19.8	30.0	55.0	55.6	April 25
(AVG)	30.0	34.0	55.5	56.3	
October 12					
2163	40.7	48.6	56.6	58.6	April 30
Caldwell (S)	35.9	48.1	55.3	56.6	April 30
Chisholm	38.8	45.5	56.9	57.9	April 26
Karl	39.5	44.5	58.5	57.7	April 26
Pioneer 2551 (S)	44.5	51.9	54.7	55.2	May 3
TAM 107	28.9	35.4	55.0	56.1	April 26
(AVG)	38.1	45.7	56.2	57.0	
October 27					
2163	25.6	35.3	51.2	51.0	April 30
Caldwell (S)	17.9	27.4	49.7	50.3	May 1
Chisholm	25.4	38.6	51.8	55.4	April 26
Karl	19.3	28.0	52.8	55.0	April 26
Pioneer 2551 (S)	15.7	18.2	46.2	48.8	May 5
TAM 107	15.6	22.0	51.0	52.6	April 26
(AVG)	19.9	28.2	50.4	52.2	
December 1					
2163	23.7	26.3	49.0	50.6	May 2
Caldwell (S)	18.9	21.2	48.5	49.5	May 5
Chisholm	19.6	28.6	51.8	55.2	April 30
Karl	15.8	21.2	52.4	53.4	April 30
Pioneer 2551 (S)	13.3	14.1	45.2	47.8	May 10
TAM 107	13.3	16.9	50.5	51.4	April 30
(AVG)	17.4	21.4	49.6	51.3	
LSD (0.05):					
(DOP) means for same or different fungicide and cultivar:	4.2		1.7		
Fungicide means for same (DOP) and same or different cultivar:	4.0		1.7		

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

Table 2. Effects of Planting Date and Foliar Fungicide (FF) on Wheat Yield and Test Weight of Selected Cultivars, Columbus Unit, SEARC, 1995.

Planting Date Cultivar	Grain Yield No FF	 FF	Test Weight No FF	 FF	Heading Date
	-- bu/a --		-- lb/bu --		
September 28					
2163	26.6	27.6	54.7	55.4	April 29
Caldwell (S)	22.9	27.3	54.8	55.7	April 30
Chisholm	28.3	30.5	56.6	58.0	April 25
Karl	17.3	18.7	58.2	58.3	April 25
Pioneer 2551 (S)	26.1	28.8	52.8	55.1	May 1
TAM 107	17.0	20.3	54.4	55.9	April 25
(AVG)	23.0	25.5	55.2	56.4	
October 27					
2163	41.7	48.8	52.9	55.1	April 29
Caldwell (S)	32.2	41.3	51.1	52.9	April 30
Chisholm	42.7	52.0	56.1	57.9	April 26
Karl	30.5	36.2	55.6	57.6	April 26
Pioneer 2551 (S)	35.4	43.8	50.3	52.3	May 1
TAM 107	32.1	41.8	50.8	54.5	April 26
(AVG)	35.8	44.0	52.8	55.1	
December 2					
2163	24.9	29.6	49.3	50.5	May 3
Caldwell (S)	17.4	20.8	45.9	47.2	May 5
Chisholm	21.5	31.2	50.4	54.0	May 1
Karl	15.6	19.7	52.0	53.7	May 1
Pioneer 2551 (S)	6.8	11.5	40.9	42.2	May 7
TAM 107	12.3	18.4	46.5	50.7	May 1
(AVG)	16.4	21.8	47.5	49.7	
LSD (0.05):					
(DOP) means for same or different fungicide and cultivar:	5.3		1.3		
Fungicide means for same (DOP) and same or different cultivar:	3.2		1.1		

S = soft wheat cultivar

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

WHEAT AND SOYBEAN ROTATIONS COMPARED

Kenneth W. Kelley and James H. Long

Summary

Full-season soybeans have averaged 6 bu/a higher yields than double-crop soybeans over the 15-year period. However, when both full-season and double-crop soybeans were planted at the same time, yields were nearly the same. Full-season soybean yields were significantly higher following [wheat - summer fallow] compared to [wheat - double-crop soybean]. Soybean yields have been highest with maturity group 4 cultivars in both full-season and double-crop systems. Wheat following early-maturing soybeans (Maturity Groups I and III) has yielded nearly the same as wheat following wheat.

Introduction

In southeastern Kansas, producers often rotate wheat after full-season soybeans or plant double-crop soybeans following wheat harvest. Soybean maturity also has a significant effect on grain yield in both full-season and double-crop systems, and cultivar maturity affects wheat planting date following soybean 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 rotations on yield and soil properties.

Experimental Procedures

Beginning in 1981, three different wheat and soybean rotations were established at the Parsons Unit: 1) [continuous wheat - double-crop soybean, 2) [wheat - double-crop soybean] - full-season soybean, and 3) wheat - wheat - full-season soybeans. Prior to 1988, full-season soybeans were Maturity Group (MG) V and double-crop, MG III or IV. Beginning in 1988, MG I, III, IV, and V were compared in both full-season and double-crop rotations (Rotation # 2). Maturity Group I was planted in early May in 7-inch row spacing, whereas the other full-season maturity groups normally were planted in late May or early to mid-June. Double-crop soybeans were planted in late June or early July after wheat. However, when wet soil conditions occurred during June, both full-season and double-crop soybeans were planted on the same dates in late June or early July. Prior to 1988, wheat was planted after all double-crop and full-season soybeans had matured, regardless of rotation. However, since 1988, wheat has been planted at different times with respect to individual crop rotations. Fertilizer (phosphorous and potassium) has been applied in various amounts according to amount of nutrients removed in harvested grain from different rotations.

Results and Discussion

Table 1 shows the yearly soybean yields for the three wheat and soybean rotations for the past 15 years. Double-crop soybean yields have averaged slightly over 20 bu/a, with no difference in yield from continuous double-cropping versus double-cropping every other year. Full-season soybean yields following summer-fallowed wheat have averaged 2.6 bu/a higher than those following double-crop soybeans. Full-season soybeans have averaged about 5 bu/a higher than double-crop soybean yields, but the variation from year to year has been significant. During the years when wet weather conditions delayed full-season planting (1982, 1985, 1989, 1992, and 1995) until the same time as double-crop planting, no significant differences occurred in yields among rotations.

Wheat yield as affected by the different crop rotations is shown in Table 2. Yield differences have been more pronounced since wheat has been planted at different dates according to the particular rotation scheme. Since 1988, wheat yields have averaged 8 bu/a higher following wheat compared to wheat following full-season soybeans (MG 5). Wheat following 2 years of soybeans (double-crop and full-season) has yielded nearly the same as wheat following only 1 year of full-season soybeans. Wheat yields have been lowest in the continuous double-crop system. Wheat planted after early-maturing soybeans (MG I and III) has yielded nearly the same as wheat following wheat, whereas wheat yields have been lowest following late-maturing soybeans (MG V), Table 3.

Since 1988, soybean maturity has significantly influenced full-season (Table 4) and double-crop soybean (Table 5) yields; however, yield variation between years has been greater than when averaged over 8 years. Stafford maturity (late MG IV) has yielded the highest over the 8-yr period for both full-season and double-crop soybeans. Soybean cyst nematode has not been detected at this site.

Table 1. Effects of Wheat and Soybean Cropping Systems on Soybean Yield, Parsons Unit, Southeast Agricultural Research Center.

Crop Year	(Rot.-1) Wh-DC Soy	(Rot.-2) Wh-DC Soy FS Soy	(Rot.-2) Wh - DC Soy FS Soy	(Rot.-3) Wh - Wh FS Soy	LSD (0.05)
	bu/a				
1981	18.7	18.0	25.8	25.7	3.7
1982*	23.6	23.0	24.3	24.9	NS
1983	17.9	16.9	15.5	14.5	NS
1984	2.1	2.0	11.1	12.8	2.9
1985*	33.2	31.6	32.6	32.1	NS
1986	19.9	17.5	21.2	23.9	3.8
1987	19.5	19.3	35.4	42.6	2.5
1988	9.1	8.4	22.7	25.1	1.5
1989*	27.6	28.0	28.3	29.8	1.7
1990	22.1	23.9	19.6	22.0	1.2
1991	18.6	15.2	24.9	27.3	0.8
1992*	36.6	35.0	37.1	38.7	2.3
1993	22.1	22.5	28.9	35.3	1.3
1994	30.9	29.1	39.6	45.9	3.8
1995*	27.9	26.4	25.4	30.9	2.5
Avg.	22.0	21.1	26.2	28.8	

(*) Full-season (FS) and double-crop (DC) soybeans were planted on the same dates in 1982, 1985, 1989, 1992, and 1995.
Cultivar maturity: Double-crop (MG IV); full-season (MG 5).

Table 2. Effect of Wheat and Soybean Cropping Systems on Wheat Yield, Parsons Unit, Southeast Agricultural Research Center.

Year	(Rot.-1) Wh-DC Soy	(Rot.-2) Wh-DC Soy FS Soy	(Rot.-3) Wheat Wheat FS Soy	(Rot.-3) Wheat Wheat FS Soy	LSD (0.05)
	----	----	bu/a	----	
1982	58.9	55.4	52.1	51.6	4.1
1983	48.4	53.4	51.6	51.9	1.4
1984	51.4	55.1	55.0	54.6	1.6
3-yr avg	52.9	54.6	52.9	52.7	
1988	49.5	52.6	60.5	61.6	6.2
1989	50.3	64.8	64.3	68.6	6.5
1990	30.4	29.5	33.4	23.7	4.5
1991	39.4	46.1	39.5	60.0	6.6
1992	56.1	56.6	56.2	72.9	3.0
1993	10.2	14.2	13.9	39.8	2.4
1994	44.6	38.3	39.3	36.8	3.0
1995	16.3	16.1	15.6	24.1	1.9
8-yr avg	37.1	39.8	40.3	48.4	

Wheat was not harvested from 1985 through 1987 because of wet soil conditions.
Spring oats were planted in 1986 and 1987 as a substitute for wheat.
Soybean maturity group: Rotation 1 (MG IV), Rotations 2 and3 (MG V)
From 1982 - 1984, wheat for all rotations was planted on the same date, which was after the lastest maturing soybeans (MG V).
Since 1988, wheat has been planted at different times according to the particular cropping system.

Table 3. Effects of Soybean Maturity Group on Wheat Yield, Parsons Unit, Southeast Agricultural Research Center.

Soybean Maturity	Wheat Yield 1989	1990	1991	1992	1993	1994	1995	Avg.
	bu/a							
MG I	71.4	25.1	58.2	69.1	43.1	40.5	24.8	47.5
MG III	68.1	27.5	54.9	67.5	40.5	41.8	26.7	46.7
MG IV	71.9	36.0	48.3	65.7	17.9	42.1	15.7	42.5
MG V	64.8	29.5	46.1	57.6	14.2	38.3	16.1	38.1
Wheat after wheat	68.6	23.7	60.0	72.9	39.8	36.8	24.1	46.6
LSD (0.05):	5.8	5.1	5.8	2.4	2.5	3.0	1.9	

Crop rotation: [Wheat - double-crop soybean] - full-season soybean
Planting dates:
1989: Oct. 14, 1988 (MG I,III, & IV) & wheat after wheat
Oct. 24, 1988 (MG V)
1990: Oct. 16, 1989 (MG I & III) & wheat after wheat
Oct. 27, 1989 (MG IV & V)
1991: Oct. 5, 1990 (MG I & III) & wheat after wheat
Oct. 16, 1990 (MG IV & V)
1992: Oct. 7, 1991 (MG I, III, & IV) & wheat after wheat
Oct. 23, 1991 (MG V)
1993: Oct. 14, 1992 (MG I & III) & wheat after wheat
Nov. 2, 1992 (MG IV & V)
1994: Oct. 11, 1993 (MG I & III) & wheat after wheat
Oct. 28, 1993 (MG IV & V)
1995: Oct. 14, 1994 (MG I & III) & wheat after wheat
Oct. 28, 1994 (MG V)

Table 4. Comparison of Soybean Maturity Groups in a Full-Season Soybean Crop Rotation, Parsons Unit, Southeast Agricultural Research Center.

MG	Cultivar	Full-Season Soybean Yield 1988	1989	1990	1991	1992	1993	1994	1995	Avg.
		----------	----------	----------	----------	bu/a	----------	----------	----------	
I	Weber 84	31.8	31.5	22.0	3.9	38.8	24.4	27.2	18.3	24.7
III	Flyer	24.0	30.8	14.5	23.8	36.4	28.9	38.1	26.5	27.9
IV	Stafford	26.9	28.8	16.0	24.0	36.5	30.0	45.7	26.8	29.3
V	Hutcheson	22.7	28.3	19.6	24.9	37.1	28.9	39.6	25.4	28.3
	LSD (0.05)	1.5	1.8	1.3	0.8	2.2	1.3	3.8	2.5	

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

Table 5. Comparison of Soybean Maturity Groups in a Double-Crop Soybean Crop Rotation, Parsons Unit, Southeast Agricultural Research Center.

MG	Cultivar	Double-Crop Soybean Yield 1988	1989	1990	1991	1992	1993	1994	1995	Avg.
		----------	----------	----------	----------	bu/a	----------	----------	----------	
I	Weber 84	2.0	28.7	10.9	4.2	29.3	13.4	19.9	14.8	15.4
III	Flyer	2.2	28.9	16.6	14.7	31.6	19.4	35.1	20.9	21.2
IV	Stafford	8.4	28.0	23.9	15.1	35.0	22.5	29.1	26.4	23.6
V	Essex	6.5	22.8	20.7	12.1	32.7	19.6	26.6	24.9	20.7
	LSD (0.05)	1.5	1.8	1.3	0.8	2.2	1.3	3.8	2.5	

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

LONG-TERM EFFECTS OF CROPPING SYSTEMS ON SOYBEAN YIELDS

Kenneth W. Kelley and James H. Long

Summary

Soybean yields have been highest following grain sorghum or wheat - fallow, regardless of soybean cyst nematode (SCN) infection. In the presence of SCN, continuous soybeans have yielded 25 to 40 % less than soybeans grown in rotation, whereas, in the absence of SCN, continuous soybeans have yielded nearly 15% less. SCN populations at harvest time were significantly higher following early-maturing susceptible cultivars than following late- maturing resistant cultivars.

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; however, spring rainfall conditions and federal farm programs sometimes force producers to plant soybeans after soybeans. With the recent arrival of soybean cyst nematode (SCN) into extreme southeastern Kansas, more information is needed to determine how crop rotations and cultivar resistance can be used to manage around the nematode problem.

Experimental Procedures

In 1979, four cropping rotations were started at the Columbus Unit: 1) [wheat - double-crop soybean] - soybean, 2) [wheat - summer fallow] - soybean, 3) grain sorghum - soybean, and 4) continuous soybean. Full-season soybean 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 also could be compared in odd-numbered years. In 1989, SCN were detected at this second site. Beginning in 1994, cultivars with different maturity and SCN resistance were compared across all four rotations. All rotations received the same amount of phosphorus and potassium fertilizers (80 lb/a each), which were applied to the crop preceeding the full-season soybeans.

Results and Discussion

Soybean yield responses across all rotations in the presence of SCN are shown in Tables 1 and 2 and in the absence of SCN, in Table 3. Soybean yields have been highest following grain sorghum or wheat - fallow, regardless of SCN infection. In the presence of SCN, continuous soybeans have yielded 25 to 40 % less than soybeans grown in rotation, whereas, in the absence of SCN, continuous soybeans have yielded nearly 15% less. However, in 1995, under a lower yielding environment, yield differences between crop rotations were smaller than in previous years.

Soybean cyst nematode populations also were influenced significantly by soybean maturity. In the fall of 1994, SCN egg counts (#/100 cm^3 soil) for susceptible cultivars were 7,100 for Sherman (early MG III); 5,700 for Flyer (late MG III); 8,700 for Stafford (MG IV); and 550 for Hutcheson (MG V). SCN egg counts for resistant cultivars were 150 for Jack (MG II), 300 for DelSoy 4210 (MG III), 150 for Manokin (late MG IV), and 350 for Forrest (MG V).

Table 1. Effects of Long-Term Cropping Rotations on Soybean Yield in the Presence of Soybean Cyst Nematode, Columbus Unit, SEARC.

Year	Full-Season Soybean Following: Wheat DC Soy	Grain Sorgh	Wheat Fallow	Cont. Soy	LSD
	------------------------ bu/a ------------------------				
1985	31.9	30.9	29.5	27.9	3.2
1987	30.7	31.5	33.2	28.2	3.8
1989 *	27.0	27.5	33.4	20.7	4.5
1991	33.4	39.1	39.4	30.6	5.1
1993	32.5	36.9	37.1	25.3	3.8
5-yr Avg[1]	31.1	33.2	34.5	26.5	

* SCN was detected in continuous soybean rotation beginning in 1989.
[1] Soybean cultivar, MG V - SCN susceptible.

Table 2. Comparison of Soybean Cultivars with Different Maturity and SCN Resistance in Four Crop Rotations in the Presence of SCN, Columbus Unit, SEARC, 1995.

Cultivar	MG	SCN	Full-Season Soybean Following: Wheat DC Soy	Grain Sorgh	Wheat Fallow	Cont. Soy	Avg.
			------------------- bu/a -------------------				
Jack	2	Yes	20.1	18.2	21.0	20.1	19.9
Sherman	3	No	21.0	22.6	25.5	23.9	23.3
Flyer	3	No	20.6	22.7	26.0	21.3	22.6
DelSoy 4210	4	Yes	23.5	22.0	24.2	24.7	23.6
Stafford	4	No	21.1	23.6	26.8	24.0	23.9
Manokin	5	Yes	29.3	27.7	30.3	26.9	28.6
Hutcheson	5	No	22.6	24.2	25.0	27.2	24.7
Forrest	5	Yes	25.8	23.7	26.8	24.9	25.3
Avg			23.0	23.1	25.7	24.1	
LSD (0.05):							
Comparing cultivars within same rotation:							3.4
Comparing means of different crop rotations:							NS
Comparing means of soybean cultivar:							1.7

Table 3. Effects of Long-Term Cropping Rotations on Soybean Yield in the Absence of Soybean Cyst Nematode, Columbus Unit, SEARC.

Year	Full-Season Soybean Following				LSD
	Wheat DC Soy	Grain Sorgh	Wheat Fallow	Cont. Soy	(0.05)
	------------------------ bu/a ------------------------				
1980	12.6	13.3	12.8	10.3	1.0
1982	28.0	30.4	31.9	27.2	3.0
1984	11.8	10.8	12.0	12.1	NS
1986	21.9	23.6	23.9	21.8	1.8
1988	31.3	30.1	32.8	25.2	3.0
1990	22.4	23.4	24.9	22.4	NS
1992	44.1	42.8	43.8	35.6	3.8
1994	41.8	45.2	49.1	38.1	3.0
8-yr Avg[1]	26.7	29.1	28.9	24.1	

[1] Soybean cultivar, MG V.

GRAIN SORGHUM AND SOYBEAN CROPPING SEQUENCES COMPARED

Kenneth W. Kelley

Summary

Grain sorghum and soybeans were compared in various cropping sequences. First- year crop yields following 3 years of the other crop yielded nearly the same as yields of crops that were grown in a 2-yr rotation. Soybean yields were not significantly different for 2nd, 3rd, or 4th year soybeans. However, grain sorghum yields declined as frequency of monocropping increased.

Introduction

Crop rotation is an important management tool; however, we do not know whether grain sorghum and soybeans differ in sensitivity to continuous cropping or increased frequency within a rotation. If differences do occur, rotation sequences could be developed that include the relatively "monocropping-insensitive" crop more frequently than the "monocropping-sensitive" crop. Further research also is needed to determine if environmental growing conditions affect the observed "rotation effect" with grain sorghum and soybean crops.

Experimental Procedures

Beginning in 1992, various cropping sequences of soybean and grain sorghum have been compared at the Parsons Unit. Treatments include: 1) continuous soybeans and grain sorghum; 2) 2-yr rotation of grain sorghum - soybean; and 3) 1,2,3,4, and 5 years of one crop following 5 years of the other. Yearly fertilizer applications for grain sorghum include 100 lb N, 50 lb P_20_5, and 50 lb K_20/a and for soybean 50 lb P_20_5 - 50 lb K_20/a.

Results and Discussion

Grain yield responses for the various soybean and grain sorghum cropping sequences are shown in Tables 1 and 2. For both grain sorghum and soybeans, first-year crop yields following 3 years of the other crop were nearly the same as yields of crops that were grown in a 2-yr rotation. Soybean yields were not significantly different for 2nd, 3rd, or 4th year soybeans. However, grain sorghum yields declined as frequency of monocropping increased. It is unclear why the grain sorghum response to monocropping was different.

Table 1. Comparison of Soybean Yields in Various Cropping Sequences, Parsons Unit, Southeast Agricultural Research Center, 1995.

Soybean Sequence[1]	1995 Soybean Yield
	bu/a
Continuous soybean (4th yr)	28.5
Third-year soybean	29.3
Second-year soybean	28.2
First-year soybean (following 3 yrs of grain sorghum)	32.4
Soybean - grain sorghum (2-yr rotation)	33.2
LSD (0.05):	2.4

[1] Rotations consist of 1,2,3,4, and 5 years of soybeans following 5 years of grain sorghum. Rotations started in 1992; previous crop was native prairie grass.

Table 2. Comparison of Grain Sorghum Yields in Various Cropping Sequences, Parsons Unit, Southeast Agricultural Research Center, 1995.

Grain Sorghum Sequence[1]	1995 Grain Sorghum Yield
	bu/a
Continuous grain sorghum (4th yr)	49.0
Third-year grain sorghum	61.4
Second-year grain sorghum	69.6
Firs- year grain sorghum (following 3 yrs of soybean)	77.8
Grain sorghum - soybean (2-yr rotation)	79.4
LSD (0.05):	8.0

[1] Rotations consist of 1,2,3,4, and 5 years of grain sorghum following 5 years of soybeans. Rotations started in 1992; previous crop was native prairie grass.

EFFECT OF SOIL pH ON CROP YIELDS

Kenneth W. Kelley

Summary

Both grain sorghum and soybean yields increased as soil acidity decreased. However, wheat yield decreased when soil pH was greater than 7.0 in the top 3-inches of soil.

Introduction

In Southeast Kansas, nearly all topsoils are acidic (pH less than 7.0) in nature. Agricultural limestone is applied to correct soil acidity and to improve nutrient availability. However, applying too much lime results in alkaline soil conditions (pH greater than 7.0), which also reduces nutrient availability, increases herbicide persistence, and may increase incidence of root-rot diseases in wheat. This research seeks to evaluate soil pH effects for the different field crops typically grown in southeastern Kansas.

Experimental Procedures

Beginning in 1989, five soil pH levels (5.5, 6.0, 6.5, 7.0, and 7.5) were established on a native grass site at the Parsons Unit in a 4-yr crop rotation consisting of wheat - [wheat - double-crop soybean] - grain sorghum - soybean.

Results and Discussion

Grain yield responses for the various soil pH treatments are shown in Table 1. Grain sorghum and soybean yields increased as soil acidity decreased; however, wheat yield appeared to decrease at the higher pH range. In future years, lime treatments will be monitored for possible effects on root-rot disease infections, herbicide persistence, and nutrient availability for the various crops grown in the 4-yr rotation.

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

Soil pH			Grain Yield		
			1993	1994	1995
0-3"	3"-6"	6"-12"	Grain Sorghum	Soybean	Wheat
			-------------- bu/a --------------		
5.4	5.3	5.2	59.4	25.0	18.8
5.7	5.5	5.2	65.6	25.9	22.4
6.5	5.9	5.2	70.3	35.6	26.0
7.0	6.3	5.2	82.6	36.2	29.0
7.5	6.7	5.2	84.2	38.3	25.5
LSD (0.05):			4.5	3.7	2.6

4-yr crop rotation: Grain sorghum - soybean - wheat - [wheat - double-crop soybean]

SOYBEAN HERBICIDE RESEARCH[2]

Kenneth W. Kelley

Summary

Various soybean herbicide treatments and application methods were compared for weed control in conventional-tillage and no-till conditions. Weed control and grain yields were influenced by early spring rainfall and droughty conditions in late summer.

Introduction

Soybeans occupy approximately 40% of the crop acreage in southeastern Kansas. Herbicide studies are conducted to compare herbicide performance and application methods for the control of annual broadleaf and grassy weeds in soybeans. Because of the interest in conservation tillage practices, herbicides also are evaluated in no-till conditions.

Experimental Procedures

Soybean herbicide trials were conducted at the Columbus Unit and at an off-station site infected with soybean cyst nematode (SCN) in Cherokee County. 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. Plots were 4 rows wide by 30 ft. long and replicated three times. The center two rows of each plot were harvested for yield. Preplant treatments were incorporated with a three-bar tine mulcher. Weed ratings were visual estimates of percent weed control.

Results and Discussion

SCN-Infected Site

Grain yield and weed control results for the SCN site are shown in Table 1. Because of wet soil conditions during May and early June, early preplant herbicide treatments were not possible. Rainfall shortly after planting activated preemergent herbicide treatments; however, weed control was less than ideal for postemergent treatments because of dry soil conditions in mid-July. Grain yields varied among herbicide treatments, although yields appeared to be influenced more by degree of weed control than time of application. This study will be conducted again in 1996 at the same site to further evaluate soybean response to different herbicide modes of action in a soil infected with SCN.

No-Till Site

No-till herbicide results are shown in Table 2. Early preplant herbicide treatments containing Roundup and Gramoxone were applied in late May; however, because of wet soil conditions, planting was delayed nearly 3 weeks. As a result, a contact herbicide was needed prior to planting to burn down existing weeds that had emerged after the initial herbicide treatment in late May. Rainfall shortly after planting activated preemergent herbicide treatments. Because plots were not cultivated, postemergent herbicides also were applied as needed to control late-emerging broadleaf and grassy weeds. However, grassy weed control was less than ideal with postemergent herbicide treatments because of dry soil conditions during mid-July. Grain yields

---

[2]Products without label registration are mentioned for informational purposes only and are not recommended for use.

were low because of drought conditions from mid-August through physiological maturity.

Postemergent Test

Postemergent herbicides were compared for large crabgrass and ivyleaf morningglory control at the Columbus Unit (Table 3). Weed control was reduced because of dry soil conditions at time of herbicide applications in mid-July. Treatments involving Pursuit or Scepter OT gave best morningglory control, but large crabgrass control was poor with both herbicides. When Select or Assure II was added to tank-mixes, grass control generally was good.

Table 1. Effects of Herbicides and Time of Application on Soybean Yield and Weed Control on Soil Infected with Soybean Cyst Nematode, Cherokee County, KS, 1995.

Trt	Time	Herbicide	Rate	Cocb Control 7/20	Cocb Control 8/28	Gr Control 7/20	Gr Control 8/28	Yield
				%	%	%	%	bu/a
1	PP	Command	1.5 pt	82	57	81	65	10.7
	PP	Authority	0.4 lb					
2	PP	Dual	1.5 pt	79	43	95	83	18.9
	PP	Authority	0.4 lb					
3	PP	Squadron	3 pt	97	90	98	87	23.2
4	PP	Treflan	1.5 pt	98	98	97	90	24.0
	PP	Canopy	6 oz					
5	PP	Treflan	1 qt	97	80	98	80	22.8
	PP	Broadstrike						
6	PP	Treflan	1.5 pt	98	82	87	72	25.1
	PP	Sencor	6 oz					
	PO	Basagran	1 pt					
7	PP	Frontier	16 oz	95	84	98	81	21.6
	PP	Scepter	2.8 oz					
8	PP	Lasso	2 qt	98	96	98	87	23.7
	PP	Canopy	6 oz					
9	PP	Dual	2.25 pt	93	82	98	89	22.3
	PP	Broadstrike						

(continued)

Table 1. Continued.

Trt	Time	Herbicide	Rate	Cocb Control 7/20	Cocb Control 8/28	Gr Control 7/20	Gr Control 8/28	Yield
				%	%	%	%	bu/a
10	PP	Dual	1.5 pt	98	85	98	87	23.4
	PP	Sencor	6 oz					
	PO	Basagran	1 pt					
11	PP	Prowl	2.4 pt	97	88	92	81	23.0
	PO	Scepter	1.4 oz					
	PO	Cobra	6 oz					
12	PP	Lasso	2 qt	98	84	92	80	22.0
	PO	Classic	0.5 oz					
	PO	Cobra	6 oz					
13	PRE	Frontier	16 oz	98	85	98	86	24.0
	PRE	Scepter	2.8 oz					
14	PRE	Lasso	2 qt	84	63	95	80	18.2
	PRE	Authority	0.4 lb					
15	PRE	Frontier	16 oz	93	63	98	85	20.2
	PRE	Authority	0.4 lb					
16	PRE	Lasso	2 qt	98	98	98	92	22.8
	PRE	Canopy	5 oz					
17	PRE	Dual	2.25 pt	97	88	98	91	22.3
	PRE	Broadstrike						
18	PRE	Dual	1.5 pt	98	91	98	90	25.2
	PRE	Sencor	5.33 oz					
	PO	Basagran	1 pt					
19	PO	Storm	1 pt	93	52	89	65	8.4
	PO	Poast Plus	1.5 pt					
	PO	Crop oil	1 pt					
20	--	Control	---	0	0	0	0	2.0
		LSD (0.05)		6	13	6	13	3.6

PP = preplant incorporated (6/23), PRE = preemergent (6/23), PO = postemergent (7/13).
Cocb = cocklebur, Gr = large crabrass and giant foxtail.
Crop oil concentrate (1 pt/a) added to all postemergent broadleaf treatments.

Table 2. Comparison of Herbicides and Time of Application for Soybeans Planted No-till in Grain Sorghum Stubble, Columbus Unit, SEARC, 1995.

				Weed Control			
				WA	GR	BL	
Trt	Time	Herbicide	Rate	6/10	8/28	8/28	Yield
				%	%	%	bu/a
1	EPP	Roundup + 2,4-DE	1 qt + 1 pt	95	95	95	16.4
	EPP	Pursuit Plus	2.5 pt				
	PO-E	Basagran	1 pt				
	PO-L	Select	8 oz				
2	EPP	Roundup + 2,4-DE	1 qt + 1 pt	99	95	95	18.0
	EPP	Lasso + Canopy	2 qt + 6 oz				
	PO-L	Fusion	10 oz				
3	EPP	Roundup + 2,4-DE	1 qt + 1 pt	98	95	95	18.1
	EPP	Command + Squadron	1 pt + 3 pt				
	PO-L	Select	8 oz				
4	EPP	Roundup + 2,4-DE	1 qt + 1 pt	100	92	90	14.9
	EPP	Dual + Broadstrike	2.25 pt				
	PO-E	Basagran + 2,4-DB	1 pt + 2 oz				
	PO-L	Fusion	10 oz				
5	EPP	Roundup + 2,4-DE	1 qt + 1 pt	100	70	70	13.0
	EPP	Frontier + Sencor	18 oz + 8 oz				
	PO-L	Storm + Poast Plus	1 pt + 1.5 pt				
6	EPP	Roundup + 2,4-DE	1 qt + 1 pt	100	85	95	16.8
	EPP	Command + Canopy	1.5 pt + 6 oz				
	PO-L	Assure	8 oz				
7	EPP	Gramoxone Extra	2 pt	100	95	90	17.6
	EPP	2,4-DE	1 pt				
	PRE	Roundup	1.5 pt				
	PRE	Pursuit Plus	2.5 pt				
8	EPP	Gramoxone Extra	2 pt	100	92	95	15.7
	EPP	2,4-DE	1 pt				
	PRE	Roundup	1.5 pt				
	PRE	Lasso + Canopy	2 qt + 6 oz				

(continued)

Table 2. Continued.

Trt	Time	Herbicide	Rate	Weed Control WA 6/10	Weed Control GR 8/28	Weed Control BL 8/28	Yield
				%	%	%	bu/a
9	EPP	Gramoxone Extra	2 pt	99	82	95	14.0
	EPP	2,4-DE	1 pt				
	PRE	Roundup	1.5 pt				
	PRE	Squadron	3 pt				
10	EPP	Gramoxone Extra	2 pt	99	92	90	14.9
	EPP	2,4-DE	1 pt				
	PRE	Roundup	1.5 pt				
	PRE	Dual + Broadstrike	2.25 pt				
11	EPP	Gramoxone Extra	2 pt	100	92	95	14.7
	EPP	2,4-DE	1 pt				
	PRE	Roundup	1.5 pt				
	PRE	Frontier + Sencor	16 oz + 6 oz				
	PO-L	Cobra + 2,4-DB	8 oz + 2 oz				
12	PP	Roundup + 2,4-DE	1 qt + 1 pt	96	95	98	16.1
	PO-E	Resource + Cobra	4 oz + 4 oz				
	PO-E	Basagran	1 pt				
	PO-L	Poast Plus	1.5 pt				
13	PP	Roundup + 2,4-DE	1 qt + 1 pt	97	70	90	14.0
	PO-E	Classic	0.5 oz				
	PO-E	Pinnacle	0.125 oz				
	PO-L	Fusilade 200	1.5 pt				
14	PP	Roundup + 2,4-DE	1 qt + 1 pt	98	95	95	17.1
	PO-E	Pursuit + Cobra	1.44 oz + 4 oz				
	PO-L	Select	8 oz				
15	PP	Roundup + 2,4-DE	2 pt + 1 pt	97	50	70	13.0
		LSD (0.05)		NS	6	5	3.5

Nonionic surfactact (0.5% v/v) added to all Roundup treatments.
Crop oil concentrate (1 qt/a) added to postemergent grass treatments.
EPP = early preplant (5/30), PP = preplant (6/13), PRE = preemergent (6/22), PO-E = early postemergent (7/18), PO-L = late postemergent (7/28).
WA = winter annuals (Carolina foxtail, shepherd's purse, smallflowered bittercress, bushy wallflower).
Bl = broadleaf (cocklebur, velvetleaf, pigweed), GR = annual grass (crabgrass).
Weed rating: WA (6/10), BL and GR (8/20)

Table 3. Comparison of Postemergent Herbicides for Weed Control in Soybeans, Columbus Unit, SEARC, 1995.

Trt	Herbicide	Rate	Weed Control			
			GR-E	GR-L	MG-E	MG-L
		Product/a	%	%	%	%
1	Pursuit	1.44 oz	30	10	80	80
	Cobra	4 oz				
	28% N + Crop oil	1 qt + 1 qt				
2	Pursuit	1.44 oz	30	10	78	82
	Cobra	6 oz				
	28% N + Crop oil	1 qt + 1 qt				
3	Scepter	1.44 oz	0	0	35	30
	Cobra	4 oz				
	28% N + Crop oil	1 qt + 1 qt				
4	Scepter	1.44 oz	0	0	40	30
	Cobra	6 oz				
	28% N + Crop oil	1 qt + 1 qt				
5	Pursuit	1.44 oz	80	50	80	88
	Select	6 oz				
	28% N + Crop oil	1 qt + 1 qt				
6	Scepter	1.44 oz	0	0	80	40
	Pinnacle	0.25 oz				
	NIS	0.125%				
7	Scepter	1.44 oz	80	80	20	25
	Select	7 oz				
	Crop oil	1 qt				
8	Cobra	8 oz	80	90	30	20
	Select	6 oz				
	Crop oil	1 qt				
9	Pursuit	1.44 oz	80	70	80	85
	Cobra	4 oz				
	Select	6 oz				
	28% N + Crop oil	1 qt + 1 qt				

(continued)

Table 3. Continued.

Trt	Herbicide	Rate	Weed Control			
			GR-E	GR-L	MG-E	MG-L
		Product/a	%	%	%	%
10	Scepter OT	1 pt	10	5	85	80
	Crop oil	1 pt				
11	Scepter OT	1 pt	82	75	85	80
	Select	7 oz				
	Crop oil	1 qt				
12	Scepter	1.44 oz	80	74	35	25
	Cobra	6 oz				
	Select	7 oz				
	28% N + Crop oil	1 qt + 1 qt				
13	Scepter	1.44 oz	80	80	78	20
	Pinnacle	0.25 oz				
	Select	7 oz				
	Crop oil	1 qt				
14	Storm	1.5 pt	50	30	80	40
	Poast Plus	1.5 pt				
	Crop oil	1 qt				
15	Concert	0.5 oz	80	75	80	30
	Assure II	5 oz				
	Crop oil	1 qt				
16	No herbicide	---	0	0	0	0
	LSD (0.05)	---	5	5	6	6

GR = crabgrass (E = early rating, July 24; L = later rating, Aug. 9)
MG = ivyleaf and pitted morningglory.
Planted June 22 and postemergent herbicides applied July 12.

SOYBEAN VARIETY TRIAL FOR CYST NEMATODE RESISTANCE

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

Summary

Soybeans varieties with resistance to cyst nematodes have prevented as much as 50 % of grain yield loss compared to varieties without such resistance in Cherokee County, Kansas since 1991. Severe drought occurred in 1995, whereas 1992, 1993, and 1994 were wet years. Several varieties in both Maturity Groups IV and V had very good yield potential and adequate soybean cyst nematode resistance. These could be used in suitable rotations to combat the pest.

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. Ongoing trials to identify adapted resistant varieties were established in an area of the southeast region, Cherokee County, known to have damaging populations of the pest.

Experimental Procedures

Forty seven varieties of soybeans, some rated as resistant to cyst nematode, were planted on June 20, 1995. The 1995 trial was grown in cooperation with Roger Draeger on the Wilkinson Farm located at Pittsburg, Kansas. Seed were planted at eight per row foot in 30-inch rows. Maturities were rated in September and October, and plots were harvested with a plot combine on October 16, 1995. Test weight and seed moisture were measured with a Dickey-John analyzer, and grain yields were adjusted to 13% moisture.

Results and Discussion

Varieties with resistance to soybean cyst nematode prevented yield losses of 40 % or more during the years 1992 - 1995 (Table 1). Resistant varieties such as 'Manokin', and 'Pioneer 9521' averaged yields over 37 bu/a over the 4-year period. Susceptible varieties of similar maturity, such as 'Essex', had average yields of only 20 to 25 bu/a during the same period. Soybean maturity grouping also may have played a role in grain yield. Over a 4-year period, susceptible varieties such as Maturity Group V 'Hutcheson' averaged yields of 25.4 bu/a, whereas the earlier maturing, late Group IV 'Stafford' averaged yields only of 22.5 bu/a and the early Group IV 'Flyer' averaged 18.1 bu/a (Table 1). More variety test information can be found in Report of Progress 752, 1995 Kansas Performance Tests with Soybean Varieties.

[1]Department of Agronomy, KSU.

[2]Formerly Cherokee County Extension Agent.

[3]Department of Plant Pathology, KSU.

Table 1. Grain Yield of Cyst Nematode-Resistant and -Susceptible Soybean Varieties in Southeastern Kansas, 1992 through 1995 and Summaries.

			Grain Yield				Average Yield		
Brand	Variety	MG	1992	1993	1994	1995	2-yr	3-yr	4-yr
			bu/a						
Asgrow	A4715	IV	32.4	32.8	39.4	26.3	32.9	32.8	32.7
Asgrow	A4922	IV	--	--	--	27.4	--	--	--
Dekalb	CX469C	IV	--	--	34.5	27.3	30.9	--	--
Golden Harvest	X454 EXP	IV	--	--	--	25.6	--	--	--
Golden Harvest	X500 EXP	V	--	--	--	30.4	--	--	--
Lewis	431	IV	--	--	--	27.6	--	--	--
Merschman	Richmond III	IV	--	--	--	27.0	--	--	--
Merschman	Houston III	IV	--	--	35.9	25.2	30.6	--	--
Midland	EXP 481 IV	--	--	--	21.9	--	--	--	
Midland	EXP 48N	IV	--	--	--	25.4	--	--	--
Midland	8475	IV	--	--	39.3	28.4	33.8	--	--
Midland	EXP 453 IV	--	--	--	27.5	--	--	--	
Mycogen	429	IV	--	--	--	25.6	--	--	--
NC +	4A27	IV	--	--	41.3	30.3	35.8	--	--
NC +	5A15	V	--	--	38.1	27.7	32.9	--	--
NeCo	7395N	IV	--	--	--	25.3	--	--	--
NeCo	7415N	IV	--	--	--	28.5	--	--	--
NeCo	7445N	IV	--	--	--	28.0	--	--	--
Northrup King	S46-44	IV	--	--	33.6	27.3	30.5	--	--
Northrup King	S52-25	V	--	--	41.3	30.2	35.8	--	--
Northrup King	S57-11	V	--	--	--	28.4	--	--	--
Pioneer	9444	IV	--	--	--	23.1	--	--	--
Pioneer	9491	IV	--	--	39.5	28.8	34.1	--	--
Pioneer	9521	V	38.0	39.2	42.5	31.2	36.9	37.6	37.7
Ohlde	5020N	V	41.0	--	39.6	28.4	34.0	--	--
Ohlde	5200N	V	--	--	41.8	28.4	36.0	--	--
Terra	TS4292	IV	--	--	34.8	27.3	31.0	--	--
Terra	TS4792	IV	--	33.4	33.8	27.5	30.7	31.6	--
Terra	TS504	V	--	--	--	30.2	--	--	--
Willcross	9544N	IV	--	--	--	26.9	--	--	--
Willcross	9547N	IV	--	--	--	30.3	--	--	--
Willcross	9552N	V	--	--	--	28.2	--	--	--
Public	Flyer	IV	16.0	18.8	20.2	18.1	19.2	18.8	18.1
Public	Stafford	IV	18.0	21.8	29.3	20.9	25.1	24.0	22.5
Public	Essex	V	22.4	22.9	28.8	19.3	24.1	23.7	23.4
Public	Holladay	V	--	--	34.9	22.1	28.5	--	--
Public	Hutcheson	V	21.4	25.4	31.5	23.2	27.4	26.7	25.4
Public	Avery	IV/V	33.5	31.1	36.6	29.7	33.1	32.5	32.7
Public	Delsoy 4210	IV	--	--	38.8	24.4	31.6	--	--
Public	Delsoy 4500	IV	--	--	36.4	26.4	31.4	--	--
Public	Delsoy 4710	IV	--	--	39.2	26.9	33.1	--	--
Public	Delsoy 4900	IV	35.7	35.7	36.9	29.3	33.1	34.0	34.4
Public	Manokin	IV/V	37.7	36.2	42.2	32.3	37.3	36.9	37.1
Public	Forrest	V	34.5	34.7	39.5	31.2	35.3	35.1	35.0
Public	Hartwig	V	37.9	34.5	36.1	30.5	33.3	33.7	34.8
Public	KS 5292	V	43.3	--	--	28.7	--	--	--
Public	Stressland	IV	--	--	--	19.3	--	--	--
Average			31.6	29.5	35.6	26.9	31.3	30.7	30.9
LSD (.05)			2.9	5.5	NS	NS	--	--	--
LSD (.10)			--	--	2.3	3.6	--	--	--

PERFORMANCE TRIAL OF DOUBLE-CROP SOYBEAN VARIETIES

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

Summary

Twenty double-crop soybean varieties were planted following winter wheat in Columbus, Kansas and evaluated for yield and other agronomic characteristics throughout the summer of 1995. Grain yields were low, and variety differences were seen under the poor growing conditions. Yields ranged from 10.9 bu/a to near 20 bu/a. The short-season MG (Maturity Group) III and IV varieties matured during the first week of October, whereas long-season varieties in MG V matured as much as 2 weeks later. Generally, the longer the maturity, the higher the pod set. However, some exceptions occurred in 1995. Varieties such as S44-77, with early maturity, still set pods 5 inches above the soil.

Introduction

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

Experimental Procedures

Twenty soybean varieties were planted to moisture following winter wheat harvest at the Columbus unit of the Southeast Agricultural Research Center on a Parsons silt loam soil. Wheat was harvested on June 25, 1995. The wheat stubble was burned, and the soil field-cultivated twice prior to planting. Squadron was applied at 3.0 pt/a before the field cultivations. Soybeans then were planted on July 6, 1995 at 10 seed per foot of row. The soybeans were harvested on October 18, 1995. Very dry conditions during the growing season and warm, windy conditions prior to harvest caused limited shattering in the earliest maturing varieties.

Results and Discussion

Yields ranged from 10.9 bu/a to 19.8 bu/a. Several varieties yielded 17 bu/a or more, good for this very dry, growing season. Careful consideration should be given to plant height, the height to the first pod, and maturity during years such as 1995. Overall plant height ranged from only 15.3 to 23.9 in., and the height to the first pod ranged from 1.8 in. to 7.3 in. Most varieties matured before October 10.

---

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

Table 1. Yield of Double-Crop Variety Trial for Soybeans at Columbus and Parsons, Kansas, 1993-1995.

Brand	Variety	Yield 1995	Yield 2 yr avg	Yield 3 yr avg	1995 Characteristics Ht	Ht to 1st pod	Mat + /-	Mat 2 yr
		----------bu/a---------			------in------		Oct 1	Oct
Midland	X481	17.7	--	--	22.2	1.8	9.8	--
Midland	8413	15.3	18.0	--	17.0	1.8	0.5	1.0
Mycogen	395	14.1	--	--	15.3	1.8	1.5	--
Mycogen	427	15.3	--	--	18.3	2.0	3.5	--
Mycogen	467	12.6	--	--	19.8	2.5	5.8	
N K	S44-77	16.5	19.7	21.1	19.0	5.0	1.5	7.6
N K	S46-44	17.7	--	--	18.5	3.0	6.3	--
Ohlde	3374	14.5	--	--	21.5	2.0	-2.8	--
Ohlde	3996	10.9	--	--	18.8	1.8	1.3	--
Ohlde	4386	17.1	23.4	24.1	20.8	2.3	5.0	7.0
Pioneer	9412	16.8	--	--	15.3	2.3	-0.3	--
Pioneer	9472	16.9	--	--	20.0	2.8	6.5	--
Stine	3680	12.3	--	--	17.0	1.8	1.5	--
Stine	4650	17.4	--	--	20.8	2.5	10.0	--
Terra	TS 4292	13.5	--	--	15.5	1.8	5.0	--
Terra	TS 4792	18.3	--	--	22.8	3.5	5.8	--
Terra	TS 474	17.3	--	--	20.8	3.3	10.5	--
Public	Flyer	14.9	16.0	17.6	17.3	2.3	3.8	2.8
Public	Manokin	19.8	23.2	--	22.5	7.3	12.0	13.2
Public	KS5292	13.8	19.6	21.1	20.5	5.8	14.0	17.3
	Averages	15.6	--	--	19.2	2.9	5.4	--
	(LSD .05)	2.5	--	--	2.9	1.2	2.0	--

VARIETY RESISTANCE AND ROTATIONS FOR SOYBEAN CYST NEMATODE

James H. Long and Timothy Todd[1]

Summary

The keys to reducing the effect of soybean cyst nematode include the use of resistant soybean varieties and rotation of crops to minimize its impact. Results from the cyst nematode management studies at the Martin Farms Research Area in Columbus indicate that the effect of using resistant varieties is greater than previously thought. The use of resistant varieties also prevents the buildup of the pest. However, results from 5 years show that holding a field out of susceptible soybean varieties for 2 or even 3 years may not be sufficient time to overcome the problem. The resulting poor yield of susceptible varieties is probably due to the explosive growth of the nematode population during the summer growing season.

Introduction

The soybean cyst nematode (SCN) is a serious problem in the eastern U.S. It is persistent in the soil and will continually rob soybean yield if good management practices are not used each year. Many cropping strategies, including resistant varieties, have been used to overcome this pest, yet it has now spread to Kansas.

Each region of the U.S. has had to develop locally adapted soybean varieties and cropping rotations suited for that area's agricultural soils and climate. Southeast Kansas is a region with shallow clay-pan soils that are drought prone and a climate that permits growth of long maturity crops such as MG (Maturity Group) V soybeans. Because of the need to develop cropping strategies and evaluate varietal resistance under southeast Kansas conditions, a study was started in 1991 at the Martin Farms Cyst Nematode Research Area in Columbus.

Experimental Procedures

Six cropping systems ranging from 0 to 3 years out of susceptible soybeans and with no soybeans were started in 1991. The systems include:

1. Continuous susceptible soybeans. (No crop rotation)
2. Grain sorghum followed by susceptible soybeans (1 year out of susceptible soybeans).
3. Grain sorghum followed by a small grain that is followed by susceptible soybeans (2 years out).
4. Grain sorghum followed by resistant soybeans followed by grain sorghum and then susceptible soybeans (3 years out).
5. Grain sorghum followed by a small grain that is double-cropped to resistant soybeans followed by grain sorghum and then a small grain double-cropped to susceptible soybeans (3 years out).
6. Grain sorghum followed by a small grain (no rotation to soybeans).

During the period 1991-1994, the susceptible soybean variety was 'Bay' and the resistant

[1]Department of Plant Pathology, KSU.

variety was 'Pioneer 9531 '. In 1995 the susceptible variety grown was 'Stafford' and the resistant variety was 'Manokin'. Two sister studies with the same rotations were run. One was on heavily infested soils at the Martin Farms Cyst Nematode Research Area, and the second was at the Southeast Agricultural Research Center - Columbus Field, an area that has no detectable levels of the cyst nematode.

Results and Discussion

After 5 years, differences between resistant and susceptible soybean varieties grown in rotation 4 could be seen clearly (Table 1). The susceptible soybeans grown in rotation at Martin Farms have yielded only two-thirds as much as the resistant varieties that are being grown in rotation. The susceptible varieties also had tremendous numbers of the soybean cyst nematode at the end of the season (Figure 1). In 1994 and 1995, this rotation had been held out of susceptible soybeans for 3 years, yet grain yields were still affected severely. This is due to egg and cyst levels developing rapidly during the growing season on susceptible soybeans, even when crop rotation gave relatively low early-season levels of the pest. Indications are that holding fields out of susceptible soybeans for 3 years may not be enough time to completely overcome the cyst nematode and allow the planting of susceptible soybeans.

Selection of a resistant variety had the most consistent and largest effect on grain yield.

Figure 1. Effect of a Susceptible Soybean Variety on Cyst Nematode Egg Numbers in Infected Soils, Columbus KS.

THE EFFECT OF CROPPING SYSTEM AND VARIETY SELECTION ON CHARCOAL ROT AND SOYBEAN GRAIN YIELD

James H. Long, Timothy Todd[1], and Daniel W. Sweeney

Summary

Rotating from grain sorghum to soybean benefits both crops; however, the positive effects on the soybean crop are not well understood. Levels of the plant disease charcoal rot (*Macrophomina phaseolina*) were followed on soybeans grown continuously and in rotation with grain sorghum. Soybean grain yield increased 14 % when a Maturity Group IV soybean, Delsoy 4210, was grown in rotation with grain sorghum. In addition, Delsoy 4210 yielded less than a full-season Maturity Group V soybean, KS 5292, in 1994 and 1995.

Introduction

Charcoal rot, a plant disease widespread in Kansas, can reduce the yield of soybean and other crops. It rapidly infests the plant during early reproductive growth and adversely affects the plant's root system and lower stem. No genetic resistance is known, although longer maturity varieties may escape the most devastating effects of the disease by setting pods later in the summer when rainfall is more likely and temperatures are cooler.

Crop rotation is known to increase the yield of soybeans, although the reasons are uncertain. In an effort to better define the effect of crop rotation on soybean, a field study was begun in 1993 to compare grain yield and plant disease levels of continuously grown soybean versus soybean following grain sorghum.

Experimental Procedures

Several cropping systems were established in 1988 at the Columbus unit of the Southeast Agricultural Research Center to help determine the effect of crop rotation on soybean. Two of the systems will be discussed:

1. Continuous soybeans.
2. Soybeans for 1 year then grain sorghum.

The early MG (Maturity Group) IV variety Delsoy 4210 and a full season MG V variety KS 5292, have been grown since 1993 as part of a study looking at cropping systems, soybean varieties, and plant populations. Data were recorded from 1993, 1994, and 1995 and included grain yield, yield components, and charcoal rot from the roots of the soybean plants. The soil was a Parsons silt loam (Mollic Albaqualf). Rainfall averages 41 in/yr at the site. Data on soybean grain yield from two Maturity Groups (IV and V) and the cropping systems are reported here.

Results and Discussion

The effects of charcoal rot on soybeans could be clearly seen in 1994 and 1995, especially in the Maturity Group IV variety Delsoy 4210. The variety KS5292 outyielded Delsoy 4210 by 34 % in 1994 and 25% in 1995 (Table 1). Rotation also had a great effect in these years, with continuous Delsoy 4210

[1]Department of Plant Pathology, KSU.

yielding 14 % less than Delsoy 4210 grown in rotation with grain sorghum. Crop rotation did not have as great an effect on the full-season KS 5292.

Table 1. Effect of Variety and Maturity on Soybean Grain Yield, Columbus Unit, SEARC.

	Year		
Variety	1993	1994	1995
	-----------bu/a----------		
Delsoy 4210	29.1	20.8	15.2
KS 5292	29.5	31.6	20.4
LSD(.05)	---------	5.0	---------

Table 2. Effect of Cropping System on Soybean Grain Yield During the Period 1993-1995, Columbus Unit, SEARC.

	Cropping System	
Variety	Soy/Soy	Soy/Sorghum
	----------bu/a----------	
Delsoy 4210	20.2	23.4
KS 5292	26.6	27.9
LSD(.10)	-------- 2.8 --------	

ANNUAL WEATHER SUMMARY FOR PARSONS - 1995

Mary Knapp[1]

1995 DATA

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Max	42.9	51.6	57.4	65.3	69.2	81.5	89.9	91.2	78.1	73.6	57.1	44.5	66.9
Avg. Min	23.1	27.2	35.8	42.6	52.6	61.9	67.3	69.1	56.9	44.3	29.0	25.4	44.6
Avg. Mean	33.0	39.4	46.6	54.0	60.9	71.7	78.6	80.1	67.5	59.0	43.1	34.9	55.7
Precip	1.27	0.72	0.45	5.2	10.44	10.45	4.1	4.02	1.77	0.25	0.16	2.32	41.17
Snow	2.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	10.0
Heat DD*	993	717	574	337	162	5	0	0	110	214	659	933	4700
Cool DD*	0	0	3	6	35	206	422	469	184	27	0	0	1351
Rain Days	7	3	7	13	15	13	8	7	6	4	1	5	89
Min < 10	2	0	1	0	0	0	0	0	0	0	0	2	5
Min ≤ 32	28	23	10	1	0	0	0	0	0	2	20	25	109
Max ≥ 90	0	0	0	0	0	0	20	24	6	0	0	0	50

NORMAL (1961-1990 Average)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Max	40.5	46.6	57.1	68.2	76.8	85.2	91.7	90.1	81.5	71.3	56.8	44.5	67.5
Avg. Min	19.3	24.8	34.2	45.8	55.5	64.1	69.0	66.4	59.1	47.3	35.7	24.8	45.5
Avg. Mean	29.9	35.7	45.7	57.0	66.2	74.7	80.3	78.3	70.3	59.4	46.3	34.7	56.5
Precip	1.32	1.46	3.40	3.80	5.26	4.61	3.15	3.63	4.80	3.92	2.91	1.76	40.02
Snow	2	3	1.5	0	0	0	0	0	0	0	2	0	8.5
Heat DD*	1088	820	598	261	88	0	0	0	31	220	561	939	4606
Cool DD*	0	0	0	21	125	294	474	412	190	46	0	0	1562

DEPARTURE FROM NORMAL

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg. Max	2.4	5.0	0.3	-2.9	-7.6	-3.7	-1.8	1.1	-3.4	2.3	0.3	0.0	-0.7
Avg. Min	3.8	2.4	1.6	-3.2	-2.9	-2.2	-1.7	2.7	-2.2	-3.0	-6.7	0.6	-0.9
Avg. Mean	3.1	3.7	0.9	-3.0	-5.3	-3.0	-1.7	1.8	-2.8	-0.4	-3.3	-2.1	-1.0
Precip	-0.05	-.74	-2.95	1.42	5.18	5.84	0.95	0.39	-3.03	-3.67	-2.75	0.56	1.15
Snow	0.0	-3.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2.0	5.0	1.5
Heat DD*	-96	-103	-25	76	74	5	0	0	79	-7	98	-7	94
Cool DD*	0	0	3	-15	-91	-88	-52	57	-6	-20	0	0	-212

* Daily values were 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.

WEATHER SUMMARY FOR PARSONS

1994

1995

ACKNOWLEDGEMENTS

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

ABI Alfalfa, Ames, IA
AgriPro Biosciences, Inc., Shawnee Mission, KS
AGSECO, Girard, KS
American Cyanamid Co., Wayne, NJ
Bartlett Coop Association
BASF Wyandotte Corp., Parsippany, NJ
Bayer Corp., Kansas City, MO
Buffalo Farm Equipment Co., Columbus, NE
Cal-West Seeds, Woodland, CA
CIBA Corp., Greensboro, NC
Columbus Chamber of Commerce, Columbus, KS
Dairyland Research International, Clinton, WI
Deer Creek Seed, Ashland, WI
DeKalb Plant Genetics, DeKalb, IL
DeLange Seed Co., Girard, KS
Dow Elanco, Indianapolis, IN
Roger Draeger, Weir, KS
DuPont Agrichemical Co., Wilmington, DE
Farmland Industries, Kansas City, MO
Fermenta Animal Health, Kansas City, MO
FMC Corp., Philadelphia, PA
Forage Genetics, Minneapolis, MN
Ft. Dodge Animal Health, Overland Park, KS
Germain's Seeds, Hill City, KS
Great Plains Research Co. Inc., Apex, NC
Greenbush Seed & Supply, Inc., Hutchinson, KS
Joe Harris, Erie, KS
Hartzler Seed Co., Harrisonville, MO
Harvest Brands, Inc., Pittsburg, KS
Hoechst-Roussel Agri-Vet, Sommerville, NJ
Hoffmann-LaRoche, Nutley, NJ
HybriTech Seed Intl., Inc., Wichita, KS
J.D. Cattle Co., Havana, KS
Johnson Seed Co., Mound Valley, KS
Jones Farm Services, Willard, MO
Kansas Soybean Commission, Topeka, KS
Kinnaird Distributing, Salina KS
Mallinckrodt Veterinary, Terre Haute, IN
Markley Seed Farms, Dennis, KS
Martin Farms, Columbus, KS
Merck & Co, Inc., Rahway, NJ
Micro-Lite Inc., Chanute, KS
Monsanto Agricultural Products, St. Louis, MO
Mycogen Plant Sciences, Tulia, TX
Northrup King Co., Victoria, TX
Ohlde Seed Co., Palmer, KS
Parsons Livestock Market, Parsons, KS
Pfizer, Inc., Lee's Summit, MO
Pioneer Hi-Bred International, Johnston, IA
Poli-Tron, Inc., Pittsburg, KS
Resource Recovery, Inc., Coffeyville, KS
Richard Porter, Reading, KS
R & F Farm Supply, Erie, KS
Sandoz Agro. Inc., Des Plaines, IL
Dee Shaffer, Columbus, KS
Syntex Agribusiness, Inc., Des Moines, IA
Terra International, Inc., Champaign, IL
The Upjohn Co., Kalazamoo, MI
Urbana Laboratories, St. Joseph, MO
Wilkinson Farms, Pittsburg, KS
Zeneca Ag Products, Wilmington, DE

NOTE

Trade names are used to identify products. No endorsement is intended, nor is any criticism implied of similar products not mentioned.

Contribution No. 96-422-S from the Kansas Agricultural Experiment Station.

RESEARCH CENTER PERSONNEL

Lyle Lomas	Research Center Head
Larry Buffington	Custodial Worker
Larry Ellis	Animal Science Technician I
TaLana Erikson	Laboratory Technician III
Robert Middleton	Animal Science Technician II
Tommie Phillippi	Office Assistant II
Marla Sexton	Accounting Specialist
Kenneth Coffey	Animal Scientist
Fredrick Black	Animal Science Technician I
Terry Green	Animal Science Technician I
Ronald McNickle	Animal Science Technician II
James Long	Crop Variety Development Agronomist
Joyce Erikson	Plant Science Technician I
Charles Middleton	Plant Science Technician II
Kenneth Kelley	Crops and Soils Agronomist
Michael Dean	Plant Science Technician II
Bobby Myers	Plant Science Technician II
Joseph Moyer	Forage Agronomist
Mike Cramer	Plant Science Technician II
Kenneth McNickle	Plant Science Technician I
Daniel Sweeney	Soil and Water Management Agronomist
Phillip Markley	Plant Science Technician II
David Kerley	Plant Science Technician I

Agricultural Experiment Station, Kansas State University, Manhattan 66506-4008

SRP 761 April 1996