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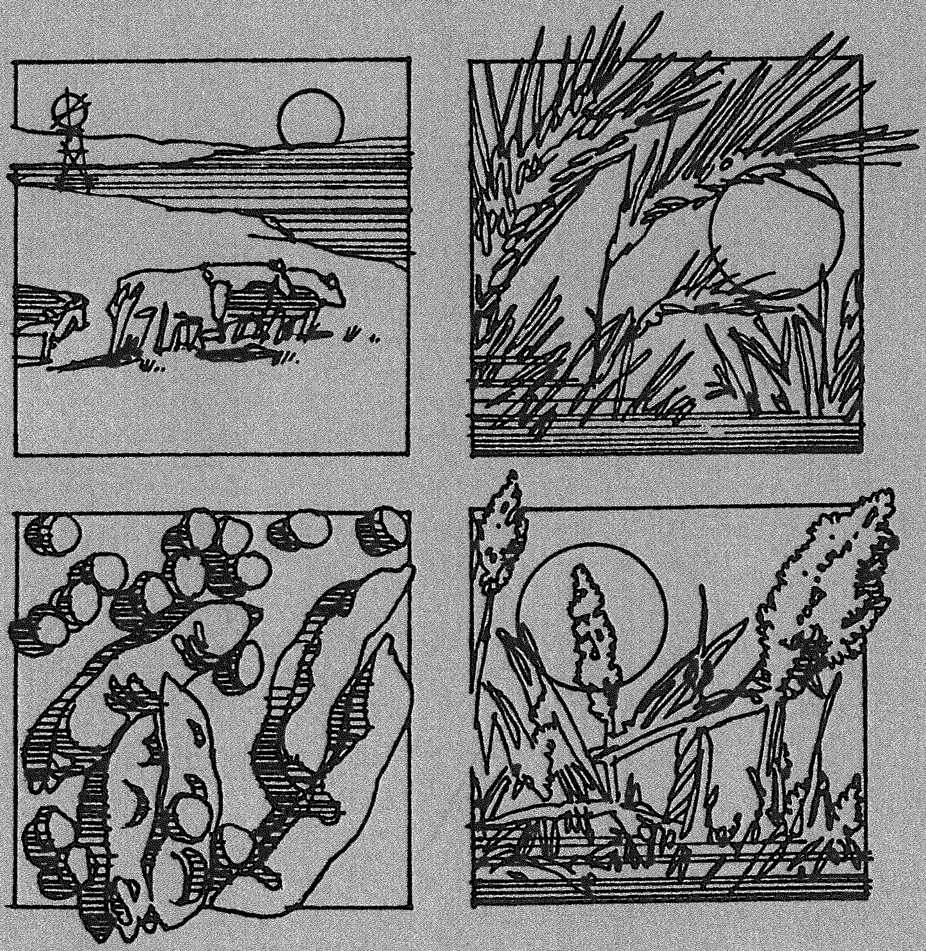

Report of
Progress
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Agricultural
Experiment
Station

Kansas
State
University,
Manhattan

Walter R.
Woods,
Director

SOUTHEAST KANSAS BRANCH STATION

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Contribution No. 87-354-S from the Kansas Agricultural Experiment Station.

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Additive-Treated Corn Silage for Growing Heifers[1]

Lyle W. Lomas

Summary

Thirty-six yearling heifers were equally divided into six groups and fed corn silage for 84 days. Three groups were fed corn silage treated with a microbial innoculant (Garst M-74$^{(R)}$) applied at the time of ensiling and three groups were fed untreated, control silage. Cattle consuming the innoculated and control silages had similar performance. Addition of the microbial additive at the time of ensiling resulted in 30 more lb of silage fed per ton ensiled than the control silage.

Introduction

Application of microbial innoculants to fresh, whole-plant material at the time of ensiling has been shown to be an effective way of reducing dry matter loss during the fermentation process. However, these additives have not resulted in consistent improvements in cattle performance.

Experimental Procedure

Corn silage treated with Garst M-74$^{(R)}$ innoculant at the time of ensiling was compared to control silage that contained no additives. Both silages were whole-plant corn silages made by the alternate load method in 16 x 50 ft concrete stave silos on August 6, 7, 8, 9, and 12, 1985 from a blend of 120-day Garst hybrids harvested in the mid to full-dent stage at 40 to 45% dry matter (DM). Garst M-74$^{(R)}$ innoculant was applied at the blower at the time of ensiling at the manufacturer's recommended rate. The silos were opened on September 25, 1985 and emptied at a uniform rate during the next 36 weeks. Samples were taken twice weekly for dry matter recovery and chemical analyses.

Each silage was fed to 18 yearling heifers (three pens of cattle per silage) in an 84-day growing trial, which began on March 5, 1986. Rations containing 90.0% corn silage and 10.0% supplement on a DM basis were fed *ad libitum*. Each ration was formulated to provide 13.0% crude protein (DM basis), 30 g of Bovatec$^{(R)}$ per ton of ration DM, and equal amounts of calcium, phosphorus, and vitamins A, D, and E. Silage and supplement were mixed in a feed wagon and fed as complete mixed rations. Feed offered was recorded daily for each pen. Feed not consumed was removed, weighed, and

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[1] Garst M-74 contains *Streptococcus faecium* M74, *Lactobacillus plantarum*, and *Pediococcus* sp. and is marketed by Garst Seed Co., Coon Rapids, IA 50058.

All heifers were fed supplemented control silage *ad libitum* for 8 days prior to the start of the feeding trial. At the beginning of the growing study, all heifers were implanted with Synovex-H(R) and dewormed with injectable levamasole hydrochloride. Initial and final weights were taken following a 16-hour shrink from both feed and water. One heifer receiving the Garst M-74(R) treated silage was removed from the study for reasons unrelated to experimental treatment. The growing study was terminated on May 28, 1986 (84 days).

Results

A summary of growing heifer performance is listed by silage treatment in Table 1. Performance was similar between heifers fed the control and those fed innoculated corn silages. Heifers fed the innoculated silage consumed 4.6% more dry matter and required 5.2% more feed per lb of gain than those that received the control silage. However, these differences were not significant (P>.20). Treatment of silage with the microbial innoculant resulted in 30 lb more silage being fed per ton ensiled than with the control silage.

Table 1. Effect of Treating Corn Silage with Garst M-74(R) Innoculant on Performance of Growing Heifers (84 days).

Item	Control	Innoculated
No. of heifers	18	17
Initial wt., lb	543	544
Final wt., lb	711	711
Total gain, lb	168	167
Average daily gain, lb	2.00	1.99
Daily feed intake, lb[1]	15.76	16.49
Silage, lb	14.18	14.84
Supplement, lb	1.58	1.65
Feed/gain[1]	7.88	8.29
Silage fed, lb/ton ensiled[2]	1732	1762
Silage/gain[2]	20.3	21.32
Cattle gain, lb/ton of crop ensiled[2]	85.3	82.6

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[1] 100% dry matter basis.
[2] Values are adjusted to the same silage DM content; 35 percent.

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Effect of Adding Wheat to Creep Feed on Performance of Suckling Calves

Lyle W. Lomas

Summary

Daily gains and creep feed consumption of fall-dropped calves creep fed a mixture of 2/3 oats and 1/3 hard red winter wheat or a mixture of 2/3 oats and 1/3 corn were compared in the second year of a 2-year study. Gains were similar for calves fed the two creep rations during both years (P>.15). Calves fed oats + wheat consumed 25% less creep feed during the first year and 20% more creep feed during the second year than those fed oats + corn. Based on this study, wheat appears to be a viable substitute for corn in creep rations.

Introduction

Creep feeding usually increases weaning weights of beef calves by 40 to 80 lb. Greatest response to creep feeding is obtained with fall calves or calves born to cows that are poor milkers, or when pasture conditions are poor. Cost of creep feed, feeder-calf prices, and age when calves are to be marketed determine the profitabililty of creep feeding. Corn and milo have been commonly used in creep rations. However, wheat may be a viable alternative, when market conditions are favorable. The performance of fall-dropped calves creep fed a mixture of 2/3 oats and 1/3 hard red winter wheat or 2/3 oats and 1/3 corn was compared in this study.

Experimental Procedure

Eighteen, fall-dropped, Simmental and Simmental x Angus calves (10 steers and 8 heifers) were allotted equally by weight, sex, and breed to two groups on November 19, 1985, and all steer calves were implanted with Ralgro(R). One group was creep fed a mixture of 2/3 oats and 1/3 hard red winter wheat, while the other group was creep fed a mixture of 2/3 oats and 1/3 corn. Each group of calves and their respective dams were wintered on 15-acre Kentucky 31 fescue pastures and were fed big round bales of mixed grass hay *ad libitum*. Calves were weaned on April 1, 1986 when they were approximately 6 months old.

Results

Results of this study are presented in Table 2. Average daily gains of calves creep fed oats + wheat and oats + corn were 2.35 and 2.30 lb per head daily, respectively. These gains were not statistically different (P>.20). Average daily consumption of oats + wheat and oats + corn were 6.0 and 5.0 lb per head, respectively. Results of this study are comparable to those of an earlier study (1986, Report of Progress 499) in which gains of calves creep fed oats + wheat and oats + corn were similar. However, in that study, calves fed oats + wheat and oats + corn consumed 3.3 and 4.4 lb per head daily, respectively.

Table 2. Oats + Wheat vs. Oats + Corn as Creep Rations (133 days).

Item	Oats + Wheat	Oats + Corn
No. of calves	9	9
Initial wt., lb	208	208
Final wt., lb	521	514
Total gain, lb	313	306
Average daily gain, lb	2.35	2.30
Average daily creep feed intake, lb	6.0	5.0

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Effect of Interseeding Ladino Clover and Feeding Monensin on Performance of Stocker Steers Wintered on Fescue Pasture

Lyle W. Lomas and Joseph L. Moyer

Summary

Performance of stocker steers wintered on fescue or fescue-ladino clover pastures and fed 0 or 150 mg of monensin per head daily were compared. Steers wintered on fescue-ladino clover pasture gained 19.8% more weight ($P<.05$) than those wintered on fescue pasture without clover. Feeding monensin resulted in a 26.2% increase (0.21 lb per head daily) ($P<.01$) in steer gains.

Introduction

Interseeding legumes into established stands of cool-season grasses is a management practice that has increased in popularity in recent years. Legumes fix nitrogen into the soil, thereby reducing nitrogen fertilizer requirements. Cool-season grass pastures interseeded with legumes also produce higher gains by grazing beef cattle during the summer months. Legumes interseeded in tall fescue pastures reduce the toxic effects caused by the endophyte *Epichloe typhina* and extend the length of the grazing season further into the summer months. Ladino clover is a legume that lends itself well to interseeding in established stands of tall fescue. Efforts to establish a legume into fescue pasture at this station have been more successful with ladino clover than with red clover.

Feed additives such as monensin and lasalocid have been effective in increasing gain of grazing stocker cattle. However, response from feeding these compounds is usually greatest when cattle are gaining more than 1 lb per head daily. Grazing stocker cattle usually gain more than this in the spring and early summer and less than this during other times of the year. The following study was conducted to compare performance of stocker cattle grazing fescue in a pure stand or fescue interseeded with ladino clover and to determine the effect of monensin on gains of stocker cattle during the winter months.

Experimental Procedure

On December 17, 1985, 72 steer calves (559 lb) were implanted with Synovex-S(R) and randomly allotted to eight 5-acre Kentucky 31 fescue pastures with nine head per pasture. These pastures had an *Epichloe typhina* infestation level of approximately 65%. Four of these pastures had been previously interseeded with Regal ladino clover, whereas the other four pastures contained fescue only. All pastures were fertilized with 31-78-78 lb of N-P_2O_5-K_2O per acre on August 20, 1985, and pastures with fescue only were fertilized with 90 lb of N per acre on October 24, 1985.

All steers were fed 4 lb of rolled milo and 1 lb of soybean meal per head daily. Cattle on two of the pastures interseeded with ladino clover and two of the pastures that contained fescue only received 150 mg of monensin per head daily, whereas steers on the other four pastures received no monensin. All cattle were fed mixed grass hay *ad libitum* from big round bales. The study was terminated on April 9, 1986. One steer was removed from the study for reasons unrelated to experimental treatment. Initial and final weights were taken following a 16-hour shrink from both feed and water.

Results

Performance of cattle grazing fescue pasture interseeded with ladino clover is compared with that of steers grazing pastures containing fescue only in Table 3. Steers wintered on fescue-ladino clover pasture gained 19.8% more weight (18 lb) (P<.05) than those grazing pastures containing fescue only. Hay consumption was similar between pasture types. Results of this study are in contrast with those of earlier studies at this station in which cattle grazing fescue pasture gained more weight and consumed less hay than steers on fescue-ladino clover pasture. Hay consumption was much less in this study than in the previous study, reflecting the mild winter conditions that prevailed during the current study and may partially account for these contrasting results.

Performance is listed by monensin treatment in Table 4. Steers that received 150 mg of monensin per head daily gained 26.2% more weight (24 lb) (P<.01) than those that received no monensin. Monensin resulted in a significant increase in gain, even though control cattle gained less than 1 lb per head daily.

Table 3. Fescue vs. Fescue-Ladino Clover Pasture for Wintering Stocker Steers (113 days).

Item	Pasture Type	
	Fescue	Fescue-Ladino
No. of steers	35	36
Initial wt., lb	561	559
Final wt., lb	653	669
Total gain, lb	92^a	110^b
Average daily gain, lb	$.81^a$	$.97^b$
Stocking rate, steers/acre	1.8	1.8
Liveweight gain, lb/acre	166^a	198^b
Daily hay consumption, lb	5.0	5.8

[a.b] Means with different superscripts differ significantly (P<.01).

Table 4. Effect of Monensin on Gains of Stocker Steers Wintered on Fescue Pasture (113 days).

Item	Monensin Level (mg/hd/day) 0	 150
No. of steers	35	36
Initial wt., lb	560	559
Final wt., lb	650	673
Total gain, lb	90	114
Average daily gain, lb	$.80^{c}$	1.01^{d}

^{c,d} Means with different superscripts differ significantly (P<.01).

SOUTHEAST KANSAS BRANCH STATION
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Effect of Treating Fescue Pasture with Mefluidide[1] on Subsequent Feedlot Performance of Grazing Steers

Lyle W. Lomas and Joseph L. Moyer

Summary

A finishing study was conducted to determine the effect of grazing fescue pasture treated with mefluidide on subsequent feedlot performance of stocker steers. Cattle that had previously grazed untreated control pastures gained more in the feedlot than those that had grazed mefluidide-treated pastures. As a result, overall performance from the beginning of the grazing period through the end of the finishing phase was similar for steers that had previously grazed control and mefluidide-treated pastures.

Introduction

Mefluidide is a plant growth regulator that is capable of improving forage quality and subsequently increasing weight gains of livestock consuming the forage. Mefluidide increases forage quality by delaying maturity and suppressing seed head formation. This study was conducted to determine the effect of treating tall fescue with mefluidide on grazing and subsequent feedlot performance of stocker steers.

Experimental Procedure

Four 5-acre, Kentucky 31 fescue pastures with an average *Epichloe typhina* endophyte level of 85% were used to evaluate the effect of mefluidide treatment on grazing steer performance during the summer and fall of 1985. All pastures were fertilized with 80-40-40 lb of $N\text{-}P_2O_5\text{-}K_2O$ fertilizer on January 23, 1985 and 46 lb of N per acre on August 25, 1985. On April 4, 1985, 1 pint of Embark 2-S$^{(R)}$ in 30 gallons of water per acre, plus X-77 surfactant at 1 pint per 100 gallons of spray solution, was applied to two of the pastures using a field sprayer with flat fan nozzles. At the time of mefluidide application, the fescue was approximately 4 inches tall. Two control pastures were not treated with mefluidide.

Thirty-two Angus x Hereford steers were used to graze these pastures. On April 4, all steers were implanted with Synovex-S$^{(R)}$, dewormed with levamasole hydrochloride, and randomly assigned to the four pastures (8 steers per pasture). Grazing was initiated on control pastures on April 4, but steers were not allowed to graze the mefluidide-treated pastures until April 18 because of a 14-day grazing restriction following mefluidide

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[1] Mefluidide (Embark 2-S^{R}) and partial financial assistance were provided by 3-M Agricultural Products, St. Paul, Minnesota 55144.

application. During the 14-day period, steers assigned to the mefluidide pastures were grazed on smooth bromegrass and then reweighed before they were turned onto the treated fescue pastures. All steers received 150 mg of Rumensin(R) in 2 lb of ground corn per head daily throughout the grazing phase and were reimplanted with Synovex-S(R) on August 15. The grazing phase was terminated on November 14, 1985 and the cattle were placed in the feedlot and all fed the same finishing ration.

During the finishing phase, all cattle were started on 65% corn silage, 30% dry whole shelled corn, and 5% supplement. The level of silage was decreased and the level of corn increased by 5% daily, until the final ration of 15% corn silage, 80% dry whole shelled corn, and 5% supplement on a 100% dry matter basis was reached. Bovatec(R) was fed at 30 grams per ton of ration dry matter. Cattle were fed <u>ad libitum</u> once daily in fenceline bunks in dirt lots with no cover or wind protection. All steers were implanted with Synovex-S(R) on November 14, 1985 and again on February 6, 1986. Initial and final weights were taken following a 16-hour shrink from both feed and water. Cattle were fed for 138 days and then slaughtered, and carcass data were collected for each steer.

Results

Results of the grazing phase are listed in Table 5. Average daily gains of steers grazing control and mefluidide-treated pastures were similar (1.25 and 1.38 lb per head daily, respectively).

Results of the finishing phase are listed in Table 6. During the finishing phase, cattle that had previously grazed the control pastures gained 15.9% more (51 lb) (P<.05) than those that had previously grazed mefluidide-treated pastures. No other differences in performance or carcass characteristics were observed.

Overall performance from the beginning of the grazing phase through the end of the finishing period is listed in Table 7. Overall performance was similar for steers that grazed the untreated control and mefluidide-treated fescue pastures.

Results of this study are similar to those of another study conducted at this station a year earlier. In the previous study, steers grazing mefluidide-treated fescue pastures gained more weight (P<.05) during the grazing phase than cattle grazing control pasture. However, during the finishing phase, the control cattle made compensatory gains and, as a result, overall performance of both groups was similar.

Table 5. Effect of Mefluidide on Grazing Steer Performance.

Item	Control	Mefluidide
No. of steers	16	16
Initial wt, lb	449	456
Final wt, lb	730	746
Total gain, lb	281	290
Days on experiment	224	210
Average daily gain, lb	1.25	1.38
Stocking rate, steers/acre	1.6	1.6
Liveweight gain, lb/acre	450	464

Table 6. Effect of Mefluidide Treatment of Fescue Pasture on Subsequent Finishing Performance of Grazing Steers (138 days).

Item	Control	Mefluidide
No. of steers	16	16
Initial wt., lb	730	746
Final wt., lb	1103	1068
Total gain, lb	373^a	322^b
Average daily gain, lb	2.70^a	2.33^b
Daily dry matter intake, lb	21.24	20.75
Dry matter intake/gain	7.90	9.00
Hot carcass wt., lb	688	662
Ribeye area, sq. in	12.5	12.6
Fat thickness, in	.57	.51
Quality grade	Ch	Ch$^-$
Yield grade	2.8	3.2

[a, b] Means with different superscripts differ significantly (P<.05).

Table 7. Effect of Mefluidide Treatment of Fescue Pasture on Overall Steer Performance.

Item	Control	Mefluidide
No. of steers	16	16
Initial wt., lb	449	456
Final wt., lb	1103	1068
Total gain, lb	654	612
Days on experiment	362	348
Average daily gain, lb	1.81	1.76

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Effect of Energy Supplementation on Subsequent Feedlot Performance of Steers Grazing Bermudagrass

Lyle W. Lomas

Summary

Stocker cattle that had been supplemented with 0, 2, or 4 lb of energy supplement per head daily while grazing bermudagrass pasture were placed in the feedlot and finished for slaughter in order to determine the effect of such supplementation on subsequent feedlot performance. Steers that received no supplemental energy during the grazing phase gained faster and more efficiently in the feedlot than those that received supplemental energy while on pasture. Overall performance from the beginning of the grazing phase to the end of the finishing phase favored feeding 4 lb of energy supplement during the grazing phase. Overall performance was similar between steers that received 2 and 4 lb of supplemental energy per head daily while grazing bermudagrass.

Introduction

Energy supplementation is an effective way of improving gains of stocker cattle. However, if a producer retains ownership of his cattle to slaughter, the profitability of this practice needs to be further evaluated. This study is the last of a series designed to evaluate subsequent feedlot performance of steers that received various levels of energy supplement while grazing bermudagrass.

Experimental Procedure

Forty-two, yearling, mixed crossbred steers with an initial weight of 680 lb were randomly allotted by weight, divided into three equal groups of 14 head each on June 11, 1985, and placed on three 5-acre Midland bermudagrass pastures. One group of steers received no energy supplementation, while the other two groups received 2 or 4 lb of rolled milo plus 150 mg of Rumensin(R) per head daily. On July 9, 1985, seven steers from each of the three groups were placed in one of three 5-acre Hardie bermudagrass pastures for the remainder of the study. Steers were rotated among pastures within each variety at 14-day intervals to minimize the effect of pasture differences. All pastures were fertilized on May 16, 1985 with 150-60-80 lb of N-P_2O_5-K_2O per acre. The Midland pastures were fertilized with an additional 50 lb of N per acre on July 25, 1985. All steers were implanted with Synovex-S(R) and dewormed with levamasole hydrochloride at the start of the study. Steers grazed bermudagrass until October 1, 1985 (112 days).

Following the grazing phase, all steers were placed in the feedlot and finished for slaughter. During the finishing phase, all cattle were started on 65% corn silage, 30% dry whole shelled corn, and 5% supplement. The level of silage was decreased and the level of corn increased by 5% daily, until the final ration of 15% corn silage, 80% dry whole shelled corn, and 5% supplement on a 100% dry matter basis was reached. Bovatec(R) was fed at 30 grams per ton of ration dry matter. Cattle were fed *ad libitum* once daily in fenceline bunks in dirt lots with no cover or wind protection. All steers were implanted with Synovex-S(R) and dewormed with levamasole hydrochloride on October 1, 1985. Initial and final weights were taken following a 16-hour shrink from feed and water. Cattle were fed for 140 days and then slaughtered, and carcass data were collected for each steer.

Results

Results of the 112-day grazing phase are listed in Table 8. During this phase, steers that received 2 and 4 lb of energy supplement per head daily gained 50% more (46 lb) ($P<.01$) and 98.8% more (98 lb) ($P<.01$), respectively, than the unsupplemented control group. Feeding 4 lb of supplement per head daily resulted in 32.5% more gain (44 lb) ($P<.01$) than feeding 2 lb per head daily.

Results of the finishing phase are listed in Table 9. During the finishing phase, steers that had received no energy supplement during the grazing phase gained 15.6% more (58 lb) ($P<.05$) and 9.9% more (39 lb) ($P<.05$) than those that received 2 lb and 4 lb of energy supplement per head daily, respectively, while grazing bermudagrass. Feed conversion also favored cattle that were not supplemented with grain during the grazing phase. Steers that received no supplemental energy during the grazing phase had larger ribeye areas ($P<.01$) than those that were fed 2 lb or 4 lb of supplement per head daily while grazing bermudagrass. Cattle supplemented with 4 lb of energy supplment per daily during the grazing phase had heavier hot carcass weights ($P<.05$) than steers that received 0 and 2 lb of energy supplement per daily while grazing bermudagrass. Feedlot performance and carcass characteristics were similar for steers that were supplemented with 2 lb and 4 lb of energy supplement per head daily while grazing bermudagrass.

Overall performance from the beginning of the grazing phase through the end of the finishing period is listed in Table 10. Overall performance favored feeding 4 lb of energy supplement per head daily during the grazing phase. Steers that received this level of energy supplement gained 9.6% more (51 lb) ($P<.05$) and 12.3% more (63 lb) ($P<.05$) than steers that received 0 and 2 lb of energy supplement per head daily while on pasture, respectively. Overall performance was similar between steers that received 0 and 2 lb of energy supplement per head daily while grazing bermudagrass.

This study was the third study conducted at this station in which the effect of energy supplementation of steers grazing bermudagrass on subsequent feedlot performance was evaluated. Results of this study agree closely with those of the 1983-84 study in which steers supplemented with 4 lb of energy supplement per head daily had the highest overall performance. However, in the 1984-85 study, steers that received no supplemental energy during the grazing phase had the highest overall gains. Feeding 2 lb of energy supplement per head daily during the grazing phase was never the most favorable treatment with regard to overall performance in any of the three studies.

Table 8. Energy Supplementation of Steers Grazing Bermudagrass (112 days).

Item	Level of Milo (lb/head/day) 0	2	4
No. of steers	14	14	14
Initial wt., lb	680	680	680
Final wt., lb	772	818	862
Total gain, lb	92^a	138^b	182^c
Average daily gain, lb	$.82^a$	1.23^b	1.63^c

[a,b,c]Means with different superscripts differ significantly (P<.01).

Table 9. Effect of Backgrounding Energy Supplementation on Finishing Steer Performance (140 days).

Item	Level of Backgrounding Energy Supplement (lb/head/day) 0	2	4
No. of steers	14	14	14
Initial wt., lb	772	818	862
Final wt., lb	1206	1194	1257
Total gain, lb	434^a	376^b	395^b
Average daily gain, lb	3.10^a	2.68^b	2.82^b
Daily dry matter intake, lb	21.34	22.68	24.06
Dry matter intake/gain	6.98	8.44	8.56
Hot carcass wt., lb	752^a	745^a	785^b
Ribeye area, sq. in	14.2^c	13.2^d	13.0^d
Fat thickness, in	.43	.49	.51
Quality grade	Gd^+	Ch^-	Ch
Yield grade	2.3	2.6	2.6

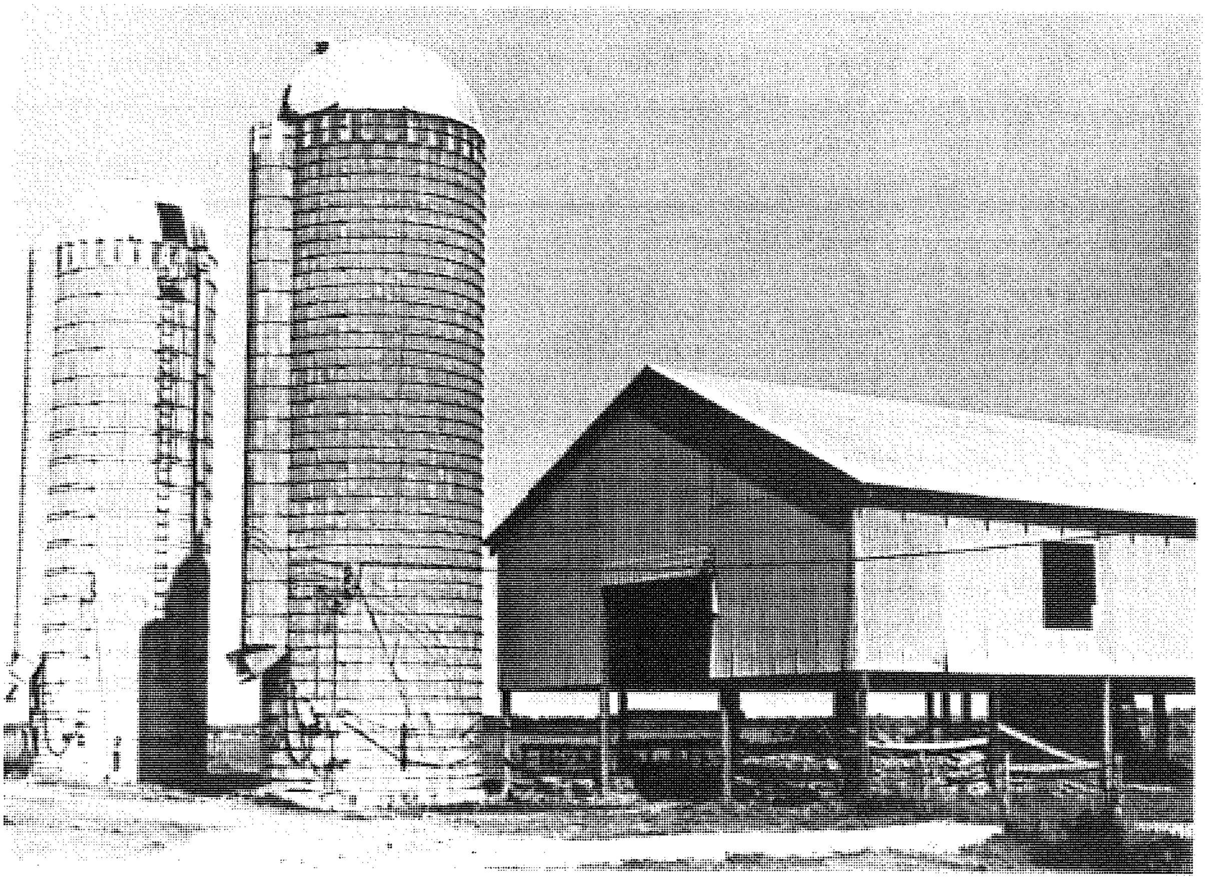
[a,b]Means with different superscripts differ significantly (P<.05).

[c,d]Means with different superscripts differ significantly (P<.01).

Table 10. Effect of Backgrounding Energy Supplement on Overall Steer Performance (252 days).

	Level of Backgrounding Energy Supplement (lb/head/day)		
Item	0	2	4
No. of steers	14	14	14
Initial wt., lb	680	680	680
Final wt., lb	1206	1194	1257
Total gain, lb	526	514	577
Average daily gain, lb	2.09^a	2.04^b	2.29^b

[a,b] Means with different superscripts differ significantly ($P<.05$).



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Grazing and Subsequent Feedlot Performance of Steers Offered Fescue, Fescue-Ladino Clover, or Bermudagrass Pastures

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

Summary

Yearling steers were allotted to either fescue, fescue-ladino clover, or bermudagrass pastures between late April and mid-September. The steers were then moved to drylots and offered a finishing ration to determine the effect of previous pasture type on feedlot performance. At the end of the pasture phase, steers that grazed fescue pastures had gained less $(P<.05)$ weight than those that grazed either bermudagrass or fescue-ladino clover pastures. Weight gain and feed efficiency during the feedlot phase were not affected $(P>.10)$ by previous pasture type. Therefore, steers grazing fescue pastures had lower slaughter weights and total weight gains for the entire study $(P<.05)$. However, feedlot performance and carcass characteristics were not significantly affected $(P>.10)$.

Introduction

Poor summer grazing performance from cattle grazing Kentucky 31 (KY31) tall fescue has been attributed to high levels of the endophytic fungus, *Acremonium coenophialum*, in the tall fescue. Attempts have been made to dilute the toxic effects of the fungus by adding legumes to the fescue pastures.

Recently, feedlot operators have become concerned that the toxic effects of the fungus may continue for an additional 30 - 60 days after the cattle are moved to the feedlot. Research to verify this has been limited and variable. The following study was conducted to compare pasture and feedlot performance of steers grazing KY31 tall fescue that was infected with endophytic fungus (approximately 70% infestation), similar fescue interseeded with Ladino white clover or bermudagrass.

Experimental Procedure

Seventy-two yearling Limousin crossbred steers were randomly allotted by weight to five replicates of 10 head and two replicates of 11 head each. Three replicates of 10 head were randomly assigned to the bermudagrass and two replicates of 10 head to the fescue-ladino clover pastures. The two replicates of 11 head were assigned to fescue pastures. Three replicates assigned to bermudagrass were continuously grazed on three 5-acre pastures and rotated through the pastures at 14-day intervals to minimize effects of pasture variation. Eight 5-acre pastures, four fescue and four fescue-ladino clover, were used for the other replicates. Each of the two replicates of steers assigned to each pasture type was rotated through the four pastures of each type at 14-day intervals. Steers were weighed at the beginning and end of the 140-day pasture phase following a 16-hour removal of feed and water. Two pounds of corn plus 150 mg of Lasalocid per head were offered daily to the steers while on pasture.

Steers from pasture replicates remained separated and were placed into feedlot pens for the finishing phase of the experiment. Steers were initially offered diets containing 30% whole shelled corn, 6% supplement, and 64% corn silage on a dry matter basis. Whole shelled corn was increased 5% per day until it reached 50% of the diet dry matter. Coarsely ground wheat was then added at 5% of the diet dry matter and increased 5% daily until it comprised 24% of the diet dry matter. The supplement contained 75% soybean meal and 25% R-1500 commercial supplement with Monensin sodium. The total diet was formulated to provide 22.5 g/ton Monensin in the total diet. All steers were slaughtered following a 147-day feeding period. Carcass data were collected.

Results

Total weight gain and average daily gain during the pasture phase (Table 11) were lower (P<.05) for steers grazing fescue than for those grazing bermudagrass or fescue-ladino clover pastures. No differences were observed between fescue-ladino clover or bermudagrass treatments.

Total feed intake, feed efficiency, weight gain, and average daily gain (Table 12) were similar across all previous pasture treatments during the finishing phase of the experiment. Final weight of the steers previously grazing fescue pasture was lower (P<.05) than that of steers previously grazing either bermudagrass or fescue-ladino clover pastures. This difference was due to lower initial feedlot weights.

Weight gain and average daily gain for the entire pasture and feedlot experiment (Table 13) were lower (P<.05) for steers grazing fescue pastures because of reduced gains during the pasture phase.

Carcass weights (Table 12) were also lower (P<.05) for steers allowed to graze fescue pastures during the pasture phase. All other carcass characteristics were similar (P>.10) across pasture treatments.

These data indicate that pasture performance may be reduced by grazing pure stands of KY31 tall fescue containing high levels of endophytic fungus. However, subsequent feedlot performance may not be affected.

Table 11. Effect of Pasture Type on Performance of Grazing Steers.

Item	Bermudagrass	Fescue-Ladino	Fescue
No. of steers	22	20	30
Initial wt., lb	683	681	683
Final wt., lb	804^{a}	808^{a}	729^{b}
Total gain, lb	121^{a}	126^{a}	46^{b}
Average daily gain, lb/day	$.87^{a}$	$.91^{a}$	$.33^{b}$

^{a,b}Means followed by unlike superscripts differ (P<.05).

Table 12. Effect of Pasture Type on Feedlot Performance of Steers

Item	Bermudagrass	Fescue-Ladino	Fescue
No. of steers	22	20	30
Initial wt., lb	804^{a}	808^{a}	729^{b}
Final wt., lb	1200^{a}	1199^{a}	1096^{b}
Gain, lb	396	391	367
Average daily gain, lb/day	2.69	2.66	2.49
Dry matter intake, lb	3381	3415	3303
Feed efficiency, lb/lb	8.60	8.78	9.06
Hot carcass wt., lb	744^{a}	743^{a}	679^{b}
Backfat, in.	.33	.30	.31
Ribeye area, in^{2}	13.7	14.1	13.4
Quality grade	Ch-	Ch-	Ch-
Yield grade	1.8	1.6	1.6

^{a,b}Means followed by unlike superscripts differ ($P<.05$).

Table 13. Effect of Pasture Type on Overall Steer Performance

Item	Bermudagrass	Fescue-Ladino	Fescue
No. of steers	22	20	30
Initial wt., lb	683	681	683
Final wt., lb	1200^{a}	1199^{a}	1096^{b}
Total gain, lb	517^{a}	518^{a}	413^{b}
Average daily gain, lb/day	1.81^{a}	1.81^{a}	1.44^{b}

^{a,b}Means followed by unlike superscripts differ ($P<.05$).

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Grazing Performance of Steers Offered Kentucky 31 Tall Fescue With and Without Ladino White Clover or Missouri 96 Tall Fescue

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

Summary

Crossbred yearling steers were allotted to pastures containing either Kentucky 31 (KY31) tall fescue (65% endophyte infestation), Missouri 96 (MO96) tall fescue (less than 10% infestation), or KY31 tall fescue interseeded with Ladino white clover. Rectal temperatures were measured at 28-day intervals throughout the 240-day grazing study. Total weight gain and average daily gain were greatest ($P<.05$) for steers grazing MO96 tall fescue, lowest ($P<.05$) for steers grazing KY31 tall fescue, and intermediate ($P>.10$) for steers grazing fescue-ladino clover pastures. Average rectal temperatures were similar ($P>.10$), regardless of pasture type.

Introduction

Tall fescue is the predominant forage in the temperate portions of the United States. Although tall fescue has certain major advantages, such as longevity and high forage production, animal gains are usually suboptimal. In recent years, this problem has been attributed to high levels of the endophytic fungus, *Acremonium coenophialum*. Poor animal gains have encouraged producers to seek other alternatives, such as interseeding fescue with legumes or planting fungus-free varieties of fescue, such as MO96. This study was conducted to evaluate these management options for animal performance.

Experimental Procedure

Thirty-nine crossbred steers were randomly allotted by weight into six replicates. Three replicates contained seven steers and three replicates contained six steers. One replicate of six steers and one replicate of seven steers were randomly assigned to the two 5-acre pastures of either KY31 tall fescue (65% endophyte infestation), KY31 tall fescue (65% infestation) interseeded with Ladino white clover, or MO96 tall fescue (less than 10% infestation). Replicates within a pasture type were rotated at 14-day intervals to equilize the stocking rate on each pasture. All steers were offered 2 pounds of ground corn with 150 mg of lasalocid daily throughout the 240-day grazing experiment. The grazing period extended from April 15 through December 11, 1986.

Steers were weighed 16 hours following removal of feed and water at the initiation and termination of the study. Interim weights and rectal temperatures were taken at 28-day intervals. Steers were not shrunk prior to interim weights.

Results

Steers grazing MO96 gained 89 pounds more ($P<.05$) than those grazing KY31 at the end of the grazing period, gaining .37 pounds more per day (Table 14). Steers grazing fescue-ladino clover pastures gained 44 pounds less than those grazing MO96 but 45 pounds more than those grazing KY31 without ladino clover. Average rectal temperatures were similar across pasture types. Therefore, clover addition to the endophyte-infested fescue had some improving effect on animal performance but did not completely alleviate the problem. Further investigation to determine the effect of previous forage type on feedlot performance is presently being conducted.

Table 14. Effect of Pasture Type on Grazing Performance of Steers

Item	KY31	KY31-Ladino	MO96
No. of Steers	13	13	13
Initial wt., lb	508	508	509
Final wt., lb	624	669	714
Total gain, lb	116^{b}	161^{ab}	205^{a}
Average daily gain, lb/day	$.48^{b}$	$.67^{ab}$	$.85^{a}$

^{a,b}Means with unlike superscripts differ ($P<.05$).

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

BOVATEC for Stocker Cattle in Self-Fed Supplements[1]

Lyle W. Lomas and Kenneth P. Coffey

Summary

Sixty crossbred heifers were offered ad-libitum access to Perfect 36 mineral blocks, which contained no lasalocid or 600 mg of lasalocid per pound of mineral mix. The heifers grazed bermudagrass pastures for 98 days starting on June 4, 1986. Weight gain and mineral block consumption were similar (P>.10) between treatments.

Introduction

Lasalocid is a feed additive used to improve feed efficiency and rate of gain by feedlot cattle. Lasalocid has also been used to improve rate of gain by pasture cattle. However, a vehicle for delivery of acceptable levels of lasalocid from a free choice supplement have not been determined.

This study was conducted to determine weight gain and supplement intake by cattle offered one such vehicle: Perfect 36 mineral blocks with and without lasalocid.

Experimental Procedure

Sixty, yearling, Limousin crossbred heifers with an average initial weight of 686 lb were randomly allotted by weight to six groups of 10 head each on June 4, 1986 at the Mound Valley Unit of Southeast Kansas Experiment Station. Cattle then grazed Hardie bermudagrass pasture for 98 days to determine weight gain and voluntary intake of Farmland Industries Perfect 36 Mineral Block containing 600 mg of lasalocid per pound or no lasalocid (control). Each group of 10 head was placed in a separate 5-acre Hardie bermudagrass pasture. Three groups received the control mineral and three groups received the BOVATEC medicated mineral. Mineral blocks were fed in covered weathervane type mineral feeders. Cattle used in this study arrived at the Station in November, 1985 and had free access to unmedicated Perfect 36 mineral blocks for 3 weeks prior to June 4. During the study, mineral consumption was determined at weekly intervals. Cattle were rotated among pastures every 14 days and weighed at 28- day intervals. Initial and final weights were measured following a 16-hour shrink from both feed and water. Cattle were not shrunk for interim weights. All cattle were hand fed 3 lb of

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[1] Medicated mineral mixture and partial financial assistance for this study were provided by Farmland Industries, Inc., Kansas City, MO.

ground corn daily from August 6 until September 10, 1986 when the study terminated.

Results

Average daily intake of control and medicated Perfect 36 mineral blocks is listed by replicate in Table 15. Average daily intakes of control and medicated Perfect 36 mineral blocks were similar (P>.20), being 3.06 oz and 3.15 oz per head daily, respectively.

Average daily gains of heifers are listed in Table 16 by mineral treatment. Daily gains of heifers that consumed the control and BOVATEC medicated mineral were similar (P>.05), being .86 and .72 lb per head daily, repectively.

Table 15. Average Daily Consumption (oz/head/day) of Perfect 36 Mineral Block Containing 600 mg of Lasalocid per Pound or No Lasalocid (Control) by Grazing Heifers.[1]

Date	Control				Lasalocid			
	A	B	C	$\bar{X}$	X	Y	Z	$\bar{X}$
6- 4 to 6-11	6.34	2.17	4.26	4.26	1.83	2.77	4.37	2.99
6-11 to 6-18	6.54	2.91	5.54	5.00	3.71	5.14	5.54	4.80
6-18 to 6-25	3.51	2.77	5.00	3.76	1.49	5.46	5.57	4.17
6-25 to 7- 2	3.51	2.74	4.97	3.74	2.71	4.80	4.23	3.91
7- 2 to 7- 9	5.83	2.20	3.26	3.76	3.80	8.09	3.37	5.09
7- 9 to 7-16	3.60	3.94	4.54	4.03	3.40	3.09	2.86	3.12
7-16 to 7-23	2.60	4.03	2.86	3.16	3.63	4.88	2.63	3.71
7-23 to 7-30	3.14	2.29	1.83	2.42	1.77	4.63	1.89	2.76
7-30 to 8- 6	1.68	2.31	1.46	1.82	2.77	2.63	1.60	2.33
8- 6 to 8-13	2.20	3.20	1.14	2.18	2.83	2.40	2.37	2.53
8-13 to 8-20	3.49	1.77	.89	2.05	1.77	1.66	.89	1.40
8-20 to 8-27	2.26	1.06	.97	1.43	1.37	2.11	1.03	1.50
8-27 to 9- 3	4.80	2.80	2.74	3.45	3.94	2.54	5.37	3.95
9- 3 to 9-10	2.71	.69	1.86	1.75	1.54	2.29	1.83	1.89
$\bar{X}$	3.73	2.49	2.95		2.61	3.75	3.11	
				3.06				3.15

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

Table 16. Average Daily Gain (lb/day) by Heifers Offered Perfect 36 Blocks with and without Lasalocid (600 mg/lb) and Grazing Hardie Bermudagrass.[1]

	Control				Lasalocid			
	A	B	C	$\bar{X}$	X	Y	Z	$\bar{X}$
6- 4 to 7- 2	2.44	3.34	3.02	2.93	2.81	2.77	2.83	2.80
7- 2 to 7-30	.60	.52	-.31	.27	.59	-.24	.33	.23
7-30 to 8-27	.55	.45	.46	.49	.55	1.38	1.06	1.00
8-27 to 9-10	-1.65	-1.63	-2.69	-1.99	-3.25	-2.85	-2.84	-2.98
Cumulative	.79	1.00	.79	.86	.66	.71	.80	.72

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

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Consumption of Monensin in Crystalyx Fed Free Choice to Pastured Cattle and its Effectiveness in Improving Rate of Weight Gain[1]

Kenneth P. Coffey and Lyle W. Lomas

Summary

Sixty-four Charolais crossbred steers were used to determine monensin intake in pastured cattle fed Crystalyx free choice and to determine the effect of the monensin on rate of weight gain. Steers were allotted to smooth bromegrass pasture and were offered ad-libitum access to Crystalyx containing no monensin or 100 mg monensin/lb. Crystalyx consumption was determined weekly, and rate of gain was determined at 28-d intervals. Supplement intake was 106% greater ($P<.05$) by cattle receiving no monensin in the Crystalyx. Total gain and average daily gain were 55.0% greater ($P<.05$) by cattle receiving Crystalyx containing no monensin.

Introduction

Metabolism data indicate that supplemental energy would be more efficiently utilized if offered numerous times throughout the day. Practically, this is not possible with normal grain supplements. Crystalyx is a commercial supplement primarily composed of molasses. It limits supplement intake at one feeding and allows consumption at numerous times through the day. Monensin has been shown to improve feed efficiency in feedlot cattle and liveweight gain from pasture cattle. However, a good vehicle for monensin distribution to cattle on pasture has not been determined. This study was conducted to determine weight gain and monensin consumption by cattle offered free choice Crystalyx with and without monensin.

Experimental Procedures

Sixty-four Charolais crossbred steers were grouped into light or heavy weight replicates. These replicates were further grouped by body weight and then randomly assigned to one of four treatments, such that two lots within each replicate were offered ad-libitum access to Crystalyx supplement containing no monensin and two lots within each replicate were offered ad-libitum access to Crystalyx supplement containing 100 mg monensin/lb. Each lot of eight steers was allotted to one of eight, 10-acre, smooth bromegrass pastures. The lots were randomly assigned to pastures initially and rotated at 14-d intervals to minimize the effect of pasture variation.

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[1] Crystalyx is manufactured by Hubbard Milling Co. Supplement and partial financial assistance were provided by Livestock Energy Systems, Whitewood, SD and Elanco Products Co., Indianapolis, IN.

Full weights of the steers were measured on 2 consecutive days at both the initation of the study and at the end of a 98-d grazing period. Single, full, interim weights were measured at 28-d intervals throughout the first 84 d of the grazing period. The final period consisted of 14 d. Total weight gain and average daily gain were computed using the average of the double weights at the initiation and termination of the grazing experiment. Average daily consumption of the Crystalyx supplements was determined by difference from weekly weights of supplement barrels. New barrels of Crystalyx supplement were offered to steers when the previously offered barrel contained an amount equivalent to approximately 2 d consumption. Each barrel of Crystalyx supplement remained available to animals until all of the supplement was consumed.

At the termination of the study, one light and one heavy lot of steers within a treatment were combined to evaluate the effect of stocking rate (8 or 16 steers/barrel) on Crystalyx consumption. Weight gain was measured for a 28-d period and consumption was measured at 7-d intervals.

Results

Gain and consumption data for the 98-d study are shown in Table 17. Steers offered Crystalyx containing no monensin consumed 122.5 lb more supplement (P<.01) than those offered Crystalyx containing 100 mg monensin/lb and gained 37.3 lb more (P<.05) during the 98-d grazing period. The reason for the results is uncertain. Possibly the extra 1.25 lb/d of supplemental energy was adequate to stimulate greater fermentation of the forage fiber. The additional rapidly fermentable carbohydrate may have stimulated more rapid rumen microbial growth, without resulting in depressed rumen pH. The improved rate of fiber digestion should have resulted in greater forage consumption. However, these data were not collected. Further investigations to determine these factors are necessary.

Data from the post-trial 28-d period are shown in Table 18. No conclusive trends could be drawn during this short period. Initially, cattle in double-stocked pastures consumed more supplement. However, by the fourth week, cattle in the single-stocked pastures were consuming more supplement. Total and average daily consumption for the entire 28-d period tended to be greater by cattle stocked at eight per barrel. A treatment by stocking rate interaction tendency appeared for weight gain. Cattle receiving control Crystalyx and single-stocked gained 41% more weight than double-stocked, control cattle. Cattle that were double-stocked and offered monensin supplement gained almost 7% more than the single-stocked cattle offered monensin supplement.

Table 17. Weight Gain and Crystalyx Consumption by Steers Grazing Bromegrass Pastures and Offered Crystalyx with and without Monensin (98 D)

	Control	Monensin
No. Steers	32	32
Initial wt., lb	668.2	668.2
Final wt., lb	773.3	736.0
Total gain, lb/hd	105.1^a	67.8^b
Daily gain, lb/hd/day	1.07^a	.69^b
Total consumption, lb	238.6^c	116.1^d
Daily consumption, lb/hd/day	2.43^c	1.18^d

^{a,b} Means within the same row with unlike superscripts differ (P<.05).
^{c,d} Means within the same row with unlike superscripts differ (P<.01).

Table 18. Crystalyx Consumption and Weight Gain by Steers During the Post-Trial 28-Day Period and Stocked at Eight or 16 Steers Per Barrel of Supplement

	Control		Monensin	
Stocking rate	single	double	single	double
Total consumption, lb	43.4	37.2	13.7	12.5
Daily consumption, lb/d	1.55	1.33	.49	.45
Total gain, lb	80.0	56.6	62.8	66.9
Daily gain, lb/d	2.86	2.02	2.24	2.39

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

The Effects of Embark^{R} and Grain Supplementation on Gain of Steers Grazing Tall Fescue Pastures[1]

Frank K. Brazle[2]

Summary

A study was conducted to determine which would have the most effect on average daily gain of stocker steers grazing high endophyte-fungus, tall fescue pastures only in the spring: Embark^{R}-treatment or supplementation with grain. Embark^{R} did not improve steer gains, whereas, 4 lb of grain increased gain by .60 lb per head daily.

Introduction

Embark^{R} is a plant growth regulator that is capable of improving forage quality by delaying maturity and suppressing seed head formation. This study was conducted to determine if steer performance while grazing tall fescue pastures during the spring months would be affected by Embark^{R} treatment or grain supplement.

Experimental Procedure

Seventy-four mixed breed steers (750 lb) were randomly allotted to Embark^{R}-treated pastures, untreated pastures in which the steers received grain supplementation, or untreated pastures in which the steers received no grain supplementation (control). All pastures contained tall fescue that was 65 percent infested with the endophyte fungus. On April 10, 1986, 1 pint of Embark 2-S^{R} was applied per acre. No grazing occurred for 10 days, then the pastures were grazed from April 21 to June 20. The grain-supplemented group received 4 lb of a 15% soybean meal-85% grain mixture with 150 mg of Rumensin^{R} per head daily. Pastures were stocked at 1 steer per acre. Steers were weighed individually on April 21 and June 20. Their hair was scored on June 20. A hair score of 1 represents a slick-short haired animal, a score of 5 is average, and 10 is a long, rough, dead-haired steer.

Results

Results of this grazing study are shown in Table 19. Steers grazing tall fescue pastures supplemented daily with 4 lb of grain gained 52.1% more

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[1] Appreciation is expressed to Sheldon Delange and Dean Stites, Girard, Kansas, for providing cattle and helping to collect data.

[2] Extension Livestock Specialist, Southeast Kansas.

(.60 lb/head/day) than those on control or Embark^{R}-treated pastures. Each 1 lb of additional gain required 6.9 lb of supplement. The hair score for grain supplemented steers was half a score lower than that for controls. Available forage was less on the Embark^{R} pastures in May compared to either the control or grain-supplemented pastures. This may have affected animal performance. Under these conditions, steer gains can be improved by supplementing with grain on lush pastures in the spring months, but it is questionable if animal performance would be improved by spraying with Embark^{R} for spring grazing only. However, use of Embark^{R} during summer grazing of fescue has given good results.

Table 19. Effect of Embark^{R} and Grain Supplementation on Grazing Steer Performance (60 days).

Item	Control	Embark^{R}	Grain Supplement
No. of steers	16	31	27
Initial wt., lb	755	746	748
Final wt., lb	824	815	852
Total gain, lb	69^{a}	69^{a}	104^{b}
Average daily gain, lb	1.15^{a}	1.15^{a}	1.74^{b}
Grain fed/additional lb of gain, lb	----	----	6.9
Hair score	5.83^{c}	5.76^{c}	5.31^{d}

^{a,b}Means in same row with different superscripts are significantly different (P<.0001).

^{c,d}Means in same row with different superscripts are significantly different (P<.01).

The Effect of MGA in a Mineral Mixture on Performance of Heifers Grazing Native Grass[1]

Frank K. Brazle

Summary

MGA added to a mineral mixture resulted in only 41% of the heifers showing estrous as compared to 77% for the control when checked for 41 days (June 24 - August 4). MGA did not improve weight gain of the heifers.

Introduction

Grazing heifers continually come into estrous, which attracts bulls from neighboring pastures. Melengestrol acetate (MGA) has been shown to keep heifers out of estrous when fed at .5 mg per head per day. The objective of this trial was to evaluate the effect of MGA fed in a mineral mixture on suppression of estrous and gains of yearling heifers.

Experimental Procedure

On April 22, 1986, 44 yearling heifers were randomly allotted to native grass pastures and fed either a control mineral mixture or a mineral mixture containing MGA. The pastures were stocked at the rate of one animal per 3.6 acres. The heifers were fed a combination of a commercial mineral mixture with and without MGA and ground grain-sorghum at the rate of .5 lb per head daily. At that level, the heifers received .4 mg of MGA per head daily. On June 24, gomer bulls with chin-ball markers were turned into each pasture and remained until August 4. The number of heifers marked was the method of determining the percentage of heifers showing estrous. The heifers were weighed off pasture on August 20.

Results

When MGA was added to a mineral mixture, it did not affect average daily gain. However, it did reduce the percentage of heifers showing estrous during a 41-day period from 77% to 41%. The level of MGA the animals received was borderline, and all animals may not have consumed the mineral at the desired rate each day. Higher levels of MGA might have helped overcome the variable of mineral intake. However, mineral intake may not be regular enough for MGA to constantly suppress estrous during a grazing program.

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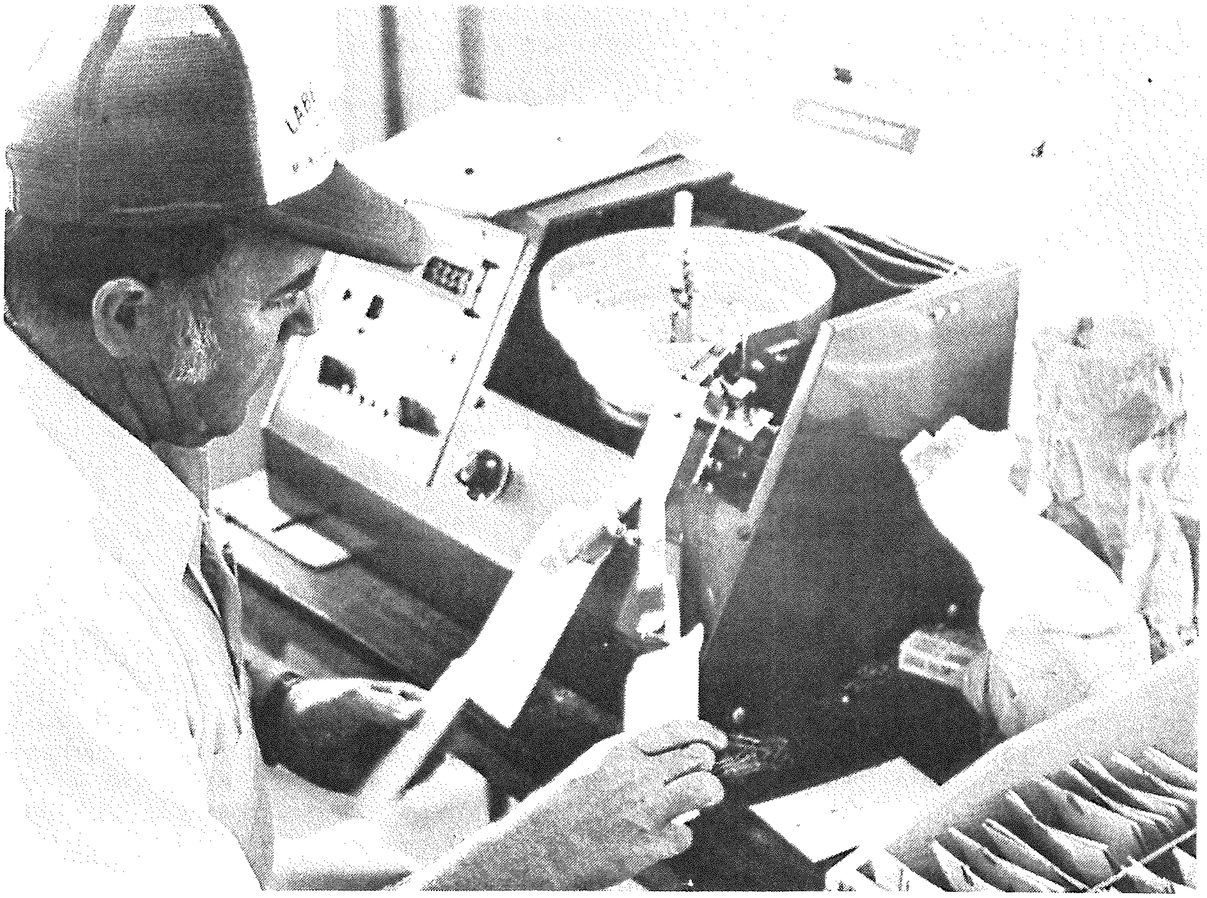
[1] Appreciation is expressed to Price Ranch, Reading, Kansas, for providing cattle and helping to collect data.

Table 20. MGA in Mineral Mixtures for Heifers (120 days).

Item	Control	MGA
Initial wt., lb	541	542
Final wt., lb	761	758
Total gain., lb	220	216
Average daily gain, lb	1.83	1.80
% Showing estrous	77%	41%
Mineral intake, lb/day	.48	.52
MGA intake, mg/day	----	.41



SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

The Effect of Rotational Grazing On Native Grass Gain of Steers and Calves

Frank K. Brazle and Jeff Davidson[1]

Summary

A 2-year study on the effect of short-duration, rotational grazing gave mixed results. In 1985, there was no difference in steer gains between rotated and continuously grazed pastures. In 1986, the control cattle gained .15 lb more (P<.001) per day than those in the rotated pastures. When cows with calves at side were rotated (25 days) during 1986, there was no difference in calf gains.

Introduction

Rotational grazing and stocking rate for cattle grazing native grass has produced mixed results. The object of this study was to look at effects of rotational grazing on animal gains.

Experimental Procedure

On April 29, 1985, 85 steers were randomly allotted to either rotated or continuously grazed, native grass pastures that had previously been burned. The rotational group of steers was rotated every 3-6 days through four pastures. The stocking rate was the same for each group (3.25 acres per steer). Steers were weighed off the pastures on September 4.

On April 29, 1986, 144 steers were randomly allotted to one rotational grazed group or two continuously grazed groups. The continuously grazed pastures were stocked at lighter stocking rates (15%) than the rotated pastures. Stocking rates for the continuously and rotationally grazed pastures were 3.75 and 3.25 acres per steer, respectively. The rotation schedule for four pastures was the same as in 1985. All pastures were burned prior to the start of the study. Steers were weighed off the pastures on August 13.

On May 21, 1986, 200 cow-calf pairs were randomly allotted to rotational or continuously grazed pastures and the calves were individually weighed. The rotational-grazed cattle were rotated between two pastures on an average of every 25 days. The continuously grazed pastures were stocked at 7.1 acres per cow-calf pair and the rotational grazed pastures at 7.2 acres per pair. The cows were predominantly Hereford with calves out of Brangus, Braford, and Simmental bulls. The calves were weighed on

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[1] Agricultural Extension Agent, Greenwood County.

October 20. The breed and sex of cattle were included in the model when the data were analyzed.

Results

Results of the steer grazing data are presented in Table 21. In 1985, there was no difference in steer gains between rotational and continuously grazed pastures. In 1986, the continuously grazed steers gained .15 lbs. more (P<.001) than the rotational-grazed steers. In 1986, there was less precipitation in May and June and the continuously grazed pastures were stocked lighter than in 1985.

There was no difference in gains of suckling calves grazed on rotational and continuously grazed pastures in 1986 (Table 22). However, there was visual evidence that the rotationally grazed pastures were more uniformly grazed than the continuously grazed pastures.

Table 21. Effect of Rotational Grazing on Gains of Steers Grazing Native Grass Pasture.

Item	Rotational	Continuous
1985 (128 days)		
No. of steers	50	35
Initial wt., lb	594	593
Final wt., lb	824	830
Total gain, lb	230	237
Average daily gain, lb	1.80	1.85
1986 (106 days)		
No. of steers	75	69
Initial wt., lb	577	575
Final wt., lb	752	766
Total gain, lb	175	191
Average daily gain, lb	1.65[a]	1.80[b]

[a,b] Means in the same row with different superscripts are significantly different (P<.001).

Table 22. Effects of Rotational Grazing of Native Grass on Gains of Suckling Calves (152 days).

Item	Rotational	Continuous
No. of calves	110	90
Initial wt., lb	292	293
Final wt., lb	581	580
Total gain, lb	289	287
Average daily gain, lb	1.90	1.89

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Effects of Intensive Management Practices for Selected Winter Wheat Varieties

Kenneth Kelley

Summary

Selected winter wheat varieties were compared over three nitrogen application periods (fall, late-winter, and fall + late-winter). A systemic foliar fungicide (Tilt) was also evaluated over all varieties as an additional spring treatment with the split N application. In 1986, neither time nor rate of N application had any significant effect on wheat yield or grain quality, even though total rainfall was well above normal for the fall and late-winter periods. However, the fungicide treatment significantly increased yield and grain quality, especially with the varieties that were most susceptible to leaf rust and septoria spot.

Experimental Procedure

Effects of intensive management practices for selected wheat varieties were evaluated in a split-plot design at the Parsons field in 1986. Main plots consisted of three nitrogen application periods (fall, late-winter, and fall + late-winter), plus a fourth main plot including a systemic foliar fungicide (Tilt) application with split application of N. Nitrogen rates were 50 and 100 lb/a, although an additional 25 lb/a of N was applied with the drill as 18-46-0. The broadcast N source was urea. Subplots consisted of 10 selected varieties and/or hybrids of winter wheat.

Results

Winter wheat in southeast Kansas was plagued with an excessive amount of rainfall during late-fall and again in February, which caused severe crop injuries from plant heaving. In addition, a severe outbreak of leaf rust at the time of grain filling reduced yield and grain quality significantly. Time and rate of nitrogen application had no significant effect on yield or grain quality in 1986. The most dramatic increase in wheat yield and grain quality resulted from the foliar application of Tilt at the rate of 4 oz/a in late-April. Tilt is still pending label clearance for wheat at this time. Grain yields were increased by 10 bu/a and test weights increased nearly 2 lb/bu from the Tilt application, when averaged over all varieties. Yield components revealed that Tilt did not change the number of kernels/spike, but did increase the size and weight of individual kernels, as noted by the higher thousand kernel weight. Grain protein, however, was not significantly affected by the fungicide treatment. Results are presented in Tables 23 through 26.

Table 23. Effects of Intensive Management Practices on Yield and Test Weight of Winter Wheat, Parsons Field, 1986.

Variety or Brand Name	Yield Time and Rate of N, lb/A					Test Weight Time and Rate of N, lb/A				
	F 50	LW 50	F+LW 100	F+LW* 100	(Avg.)	F 50	LW 50	F+LW 100	F+LW* 100	(Avg.)
	-------- bu/A ------------					------- lb/Bu ------------				
Hard Wheat										
Agripro Mustang	28.2	26.7	28.7	41.0	(31.2)	54.7	54.7	54.7	57.4	(55.4)
Arkan	38.9	35.9	36.9	47.1	(39.7)	55.1	55.5	54.8	55.8	(55.3)
Bounty 205	31.5	35.5	35.8	48.7	(37.9)	54.7	54.8	53.9	55.6	(54.8)
Chisholm	39.4	36.7	43.1	47.7	(41.8)	55.4	54.9	55.4	56.6	(55.6)
Garst HR-48	37.2	30.7	34.4	47.1	(37.4)	53.8	53.4	53.6	56.2	(54.3)
Pioneer 2165	40.8	37.2	40.8	49.7	(42.1)	54.8	54.4	55.1	56.8	(55.3)
Rohm & Haas 830	28.8	25.4	23.9	33.5	(27.9)	53.9	55.4	54.8	55.3	(54.9)
Tam 107	44.2	43.1	44.7	59.1	(47.8)	55.2	55.9	55.4	57.7	(56.0)
Soft Wheat										
Caldwell	39.4	41.1	46.2	46.8	(43.4)	56.3	56.1	56.3	56.8	(56.4)
McNair 1003	36.5	39.6	33.2	46.2	(38.9)	51.4	51.3	49.7	53.8	(51.5)
(Means)	36.5	35.2	36.8	46.7		54.5	54.7	54.4	56.2	

LSD .05	(Grain Yield)	(Test Weight)
Main factor (N & Fung.) means	= 7.8 bu/a	1.3 lb/bu
Wheat variety means =	3.9 bu/a	0.8 lb/bu
Comparing varieties within each main factor =	7.8 bu/a	1.6 lb/bu
Main factor x variety int.	= n.s.	n.s.
C.V.	= 12.4%	1.7%

(*) A systemic fungicide (Tilt) was applied at 4 oz/a on April 28, 1986.

Time of N applications: F= fall (Oct. 9), LW= late winter (Mar. 11),
F + LW = fall + late winter.

Other fertility applications: 25 lb/a of N and 50 lb/a of P_2O_5 at planting,
75 lb/a of K_2O broadcast before planting.

Nitrogen source: Urea
Planting date: Oct. 28, 1985.
Seeding rate: 75 lb/a

Table 24. Effects of Intensive Management Practices on Winter Survival and Leaf Disease Rating of Winter Wheat, Parsons Field, 1986.

Variety or Brand Name	Winter Survival Time & Rate of N, lb/A F 50	 LW 50	 F+LW 100	 (Avg.)	Ht.	Leaf Disease Rating Fungicide No	 Yes	Date Headed
Hard Wheat	------ % -------				(in.)			
Agripro Mustang	71	67	79	(74)	29	3.9	1.7	May 2
Arkan	87	85	87	(87)	32	2.2	1.5	May 2
Bounty 205	87	87	89	(88)	37	2.2	1.4	May 7
Chisholm	87	81	86	(85)	30	4.2	1.7	April 28
Garst HR-48	86	77	87	(85)	31	3.9	1.6	May 2
Pioneer 2165	82	83	83	(83)	31	2.1	1.4	May 2
Rohm & Haas 830	96	91	93	(93)	37	2.9	1.4	May 7
Tam 107	94	87	90	(90)	31	4.0	1.7	April 28
Soft Wheat								
Caldwell	72	68	71	(70)	33	1.5	1.2	May 5
McNair 1003	91	86	90	(89)	35	2.2	1.6	May 5
(Means)	85	81	86		--	---	---	

LSD .05 (Winter survival)
Comparing means of N & fungicide factors = n.s.
Comparing variety means = 3.9
Main factor x variety interaction = n.s.

Leaf disease rating: Scale of 1 to 5, 1 = no diseases on the flag leaf, 5 = flag leaf completely infected with leaf diseases.
Leaf diseases present: Septoria leaf spot and leaf rust.
Time of N: F = fall, LW = late-winter.

Table 25. Effects of Intensive Management Practices on Kernels/Spike and 1000 Kernel Weight of Winter Wheat, Parsons Field, 1986.

Variety or Brand Name	Kernels / Spike					Thousand Kernel Wt.				
	Time and Rate of N, lb/A					Time and Rate of N, lb/A				
	F 50	LW 50	F+LW 100	F+LW* 100	(Avg)	F 50	LW 50	F+LW 100	F+LW* 100	(Avg)
Hard Wheat						---------		gr.	------------	
Agripro Mustang	34.6	36.6	35.6	36.6	(35.9)	30.0	29.8	31.0	40.3	(32.8)
Arkan	31.8	29.0	31.6	31.3	(30.9)	30.8	33.1	32.2	33.6	(32.4)
Bounty 205	46.0	44.2	43.4	45.1	(44.7)	31.3	32.7	31.6	36.2	(33.0)
Chisholm	34.3	34.3	34.6	34.6	(34.5)	32.8	34.9	32.5	38.9	(34.8)
Garst HR-48	33.0	35.8	36.5	39.2	(36.2)	29.4	29.0	28.4	34.4	(30.3)
Pioneer 2165	37.0	37.1	39.5	36.3	(37.4)	33.2	33.1	34.4	38.0	(34.7)
Rohm & Haas 830	38.4	40.7	42.0	42.4	(40.9)	27.2	26.9	25.4	29.4	(27.2)
Tam 107	33.7	34.9	34.4	36.8	(34.9)	35.1	35.2	35.4	42.0	(36.9)
Soft Wheat										
Caldwell	47.3	43.1	45.4	46.7	(45.6)	28.0	29.0	27.9	28.8	(28.4)
McNair 1003	43.2	45.5	46.3	44.8	(45.0)	33.3	31.0	32.3	38.9	(33.9)
(Means)	37.9	38.1	38.9	39.4		31.1	31.5	31.1	36.0	

LSD .05	(Kernels / spike)	(TKW)
Main factor means (N & Fung.) =	n.s.	0.6
Wheat variety means =	2.3	1.3
Comparing varieties within each main factor =	4.6	2.6
C.V. =	7.3%	5.0 %

(*) Plots received a systemic fungicide application (Tilt) in late April.
Time of N: F = fall, LW = late-winter.

Table 26. Effects of Intensive Management Practices on Lodging and Grain Protein of Winter Wheat, Parsons Field, 1986.

Variety or Brand Name	Lodging					Grain Protein				
	Time and Rate of N, lb/A					Time and Rate of N, lb/A				
	F	LW	F+LW	F+LW*		F	LW	F+LW	F+LW*	
	50	50	100	100	(Avg)	50	50	100	100	(Avg)
Hard Wheat	%					%				
Agripro Mustang	10	12	10	7	(10)	12.2	12.4	12.2	13.1	(12.5)
Arkan	22	27	17	28	(23)	13.6	14.0	13.6	13.7	(13.7)
Bounty 205	27	23	35	25	(28)	12.9	13.5	13.7	13.1	(13.3)
Chisholm	7	7	10	7	(8)	10.9	10.6	10.9	11.5	(11.0)
Garst HR-48	12	8	17	15	(13)	12.9	12.7	12.7	12.8	(12.8)
Pioneer 2165	5	5	5	5	(5)	12.0	12.0	12.4	13.0	(12.3)
Rohm & Haas 830	27	20	23	18	(22)	12.4	12.4	12.1	12.9	(12.5)
Tam 107	20	25	27	20	(23)	11.6	12.5	12.1	12.0	(12.1)
Soft Wheat										
Caldwell	12	12	13	10	(12)	12.0	11.6	12.0	11.7	(11.8)
McNair 1003	13	23	18	18	(18)	11.6	11.1	11.9	12.2	(11.7)
(Means)	15	16	18	15		12.2	12.3	12.3	12.6	

LSD .05	(Lodging)	(Grain Protein)
Main factor means (N & Fung.) =	ns	n.s.
Comparing variety means =	5%	0.3%
Comparing variety within main factor=	10%	0.6%

(*) Plots received a systemic fungicide application (Tilt) in late-April.
Time of N: F = fall, LW = late-winter

SOUTHEAST KANSAS BRANCH STATION
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Effects of N Fertilization on Spring Oat Growth Following Wheat, Soybeans, and Grain Sorghum

Kenneth Kelley

Summary

The objective of this study was to evaluate the effects of N fertilization on wheat following wheat, soybeans, and grain sorghum; however, the wheat stand was severely injured during the 1985-86 winter, so spring oats were planted on the same plots in late-winter. Results showed that leaf N concentration, grain yield, and grain protein were significantly lower when oats followed grain sorghum, as compared to oats following wheat or soybeans in the crop rotation.

Experimental Procedure

Effects of N fertilization on spring oats following wheat, soybeans, and grain sorghum were evaluated in a split-plot design with four replications. Main plots consisted of the previous crop rotation - wheat, soybeans, and grain sorghum. Subplots contained four N rates (0, 20, 40, and 60 lb/a), which were fall applied. Wheat was the intended crop in the fall following the other three crops, but severe winter injury to the wheat resulted in spring oats being planted in late February. Since oats can lodge severely with high N rates, no additional N was applied in the spring.

Results

Visual observation of early spring oat growth showed that there was an apparent nitrogen deficiency in the plots where grain sorghum was previously grown. This was particularly evident on the check plots that had received no nitrogen fertilizer. Leaf tissue analyses (Table 28) at the fully tillered stage confirmed that the leaf N concentration was lower in the grain sorghum plots and was higher where wheat was previously grown, whereas the soybean crop rotation effect was intermediate.

Grain yield (Table 27), as well as grain protein, showed the same trend from the crop rotation effect as was noted in the leaf N analyses. Again, highest yield and protein levels were from the plots that previously had been in wheat and were lowest where grain sorghum was the previous crop.

Nitrogen fertilizer rates significantly affected leaf N concentration, grain yield, and grain protein, although 60 lb/a of N was the optimum rate. Soil tests (0 to 12-inch depth) taken in the fall prior to the initial wheat seeding showed the following residual N levels from each of the main crop rotation blocks: ammonium concentration was 2.7, 2.4, and 2.2 ppm and nitrate concentration was 5.4, 2.5, and 12.5 ppm for soybean, grain sorghum, and wheat, respectively.

More information is needed to assess the effect of the previous crop rotation on N fertilization requirements for winter wheat or spring oats. However, there appears to be either a crop rotation response or possibly a tie-up of available nitrogen in the residue of the previous crop rotation.

Table 27. Effects of N Fertilization on Spring Oat Yield and Test Weight following Wheat, Soybeans, and Grain Sorghum, Parsons Field, 1986.

Previous Crop Rotation	Spring Oat Yield Nitrogen Rate, lb/A 0	20	40	60	(Avg)
	bu/A				
Soybeans	69.3	76.5	79.0	82.0	(76.7)
Grain Sorghum	53.6	64.8	68.8	67.9	(63.8)
Wheat	77.8	82.6	84.2	86.3	(82.7)
(Means)	(66.9)	(74.6)	(77.3)	(78.7)	

LSD .05:
Crop rotation means = 11.0 bu/a
Nitrogen rate means = 4.7 bu/a
Comparing N rates with crop rotation = 8.1 bu/a
Crop rotation x N rate interaction = n.s.
C.V. = 7.5%

	Spring Oat Test Wt. Nitrogen Rate, lb/A 0	20	40	60	(Avg)
	lb/bu				
Soybeans	31.0	32.3	32.1	31.6	(31.8)
Grain Sorghum	31.3	31.8	31.5	31.6	(31.5)
Wheat	32.2	32.6	32.1	32.1	(32.2)
(Means)	(31.5)	(32.2)	(31.9)	(31.8)	

LSD .05:
Crop rotation = n.s
Nitrogen rate = n.s
C.V. = 1.7%

Table 28. Effects of N Fertilization on Spring Oat Leaf N Levels and Grain Protein following Wheat, Soybeans, and Grain Sorghum, Parsons Field, 1986.

Previous Crop Rotation	Leaf N Nitrogen Rate, lb/A 0	20	40	60	(Avg)
	%				
Soybeans	3.67	3.64	3.90	4.10	(3.83)
Grain Sorghum	3.29	3.51	3.54	3.68	(3.51)
Wheat	3.85	4.04	4.12	4.28	(4.07)
(Means)	(3.60)	(3.73)	(3.85)	(4.02)	

LSD .05:
Crop rotation means = 0.26%
Nitrogen rate means = 0.18%
Comparing N rates within crop rotation = 0.32%
Crop rotation x N rate interaction = n.s.
C.V. = 5.8%

Previous Crop Rotation	Grain Protein Nitrogen Rate, lb/A 0	20	40	60	(Avg)
	%				
Soybeans	12.6	12.9	13.4	13.9	(13.2)
Grain Sorghum	12.5	12.8	13.2	13.1	(12.9)
Wheat	12.8	13.4	13.6	14.5	(13.6)
(Means)	(12.6)	(13.0)	(13.4)	(13.8)	

LSD .05:
Crop rotation means = 0.3%
Nitrogen rate means = 0.3%
Comparing N rates within crop rotation = 0.5%
Crop rotation x N rate interaction = n.s.
C.V. = 7.5%

SOUTHEAST KANSAS BRANCH STATION
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Effects of Cropping Sequence on Soybean Yields

Kenneth Kelley

Summary

Full-season soybean yields were compared for four different cropping rotations: (1) wheat - doublecrop soybeans, (2) grain sorghum - soybeans, (3) wheat - fallow - soybeans, or (4) continuous soybeans. There have been no significant yield differences over a 5-year period when soybeans follow wheat, grain sorghum, or a wheat - doublecrop rotation. Yields of soybeans following soybeans, however, have been significantly lower, even though annual applications of phosphorus and potassium were made.

Introduction

Soybeans are the major cash crop for many farmers in southeastern Kansas. Typically, they are grown in several cropping sequences with wheat and grain sorghum or in a doublecropping rotation with wheat. More information is needed to determine the agronomic effects of cropping sequences on soybeans.

Experimental Procedure

In 1979, four cropping rotations were initiated at the Columbus field: (1) [wheat - doublecrop soybeans] - soybeans, (2) wheat - fallow - soybeans, (3) grain sorghum - soybeans, and (4) continuous soybeans. Full-season soybean yields were compared across all four cropping systems in even-numbered years. Beginning in 1984, an identical study was started adjacent to the initial site so that full-season yield effects could also be compared in odd-numbered years. Fertilizer (80 lb N/A, 80 lb P_2O_5/A, and 80 lb K_2O/A) was applied only to the wheat or grain sorghum crop, with the exception of continuous soybeans, which were fertilized annually with 40 lb/A of P and K.

Results

Effects of four different cropping sequences on soybean yields and soil properties are shown in Table 29. Continuous soybeans typically have yielded 2 to 4 bu/a less than the other cropping rotations. In the spring of 1986, soil bulk density measurements at the 0-15 cm depth showed that over the short-term period of the study, the various cropping sequences have not significantly altered soil compaction.

Table 29. Effects of Four Different Cropping Sequences on Soybean Yields and Soil Properties, Columbus Field.

Cropping Sequence	Soybean Yield 1980	 1982	 1984	 1985	 1986	 5-yr avg.	Seed Size	Soil Bulk Density	1985 Soil Data Avail. P	 Exch. K
	bu/A						gr/100	gr/ml	lb/A	
Soybeans following [Wheat - Doublecrop soybeans]	12.6	28.0	11.8	31.9	21.9	21.2	13.6	1.62	39	147
Soybean following Grain Sorghum	13.3	30.4	10.8	30.9	23.6	21.8	14.7	1.58	44	127
Soybeans following Wheat	12.8	31.9	12.0	29.5	23.9	22.0	14.4	1.65	39	127
Soybeans following Soybeans	10.3	27.2	12.1	27.9	21.8	19.9	13.8	1.55	53	123
LSD .05	1.0	3.0	ns	3.2	1.8	----	ns	ns	--	---

Fertilizer applied only to wheat or grain sorghum (80 N - 80 P_2O_5 - 80 K_2O lb/A), except for continuous soybeans, which receive a yearly application of phosphorus and potassium (0 - 40 - 40).
Bulk density core samples (15-cm depth) were taken in the spring of 1986 before any tillage operation.
Soil data represent the nutrient level after the 1985 fall harvest.

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Agronomic Effects of Three Different Wheat and Soybean Cropping Sequences on Crop Yields

Kenneth Kelley

Summary

Three different cropping sequences involving wheat and soybeans have been compared from 1982-86. The rotations include: (1) continuous doublecropping, (2) doublecropping once every 2 years, or (3) full-season crops with no doublecropping. Four N rates (25, 50, 75, and 100 lb/a) also have been evaluated within the wheat cropping sequences. Doublecropped soybeans have averaged 3- to 4-bushels/a less than full-season soybeans over the 6-year period, and in 1986 none of the soybeans in the crop rotations responded to the residual N treatments that had been previously applied to the cereal crop.

Introduction

In southeastern Kansas, wheat and soybeans are the sole cash crops for many producers, who do not grow feed-grain crops like milo or corn. They are typically grown in three different types of cropping sequences: (1) continuous doublecropping, (2) doublecropping once every 2 years, or (3) full-season crops with no doublecropping.

The objectives of this study were: (1) to determine the agronomic effects (short and long-term) of continuous doublecropping soybeans after wheat and (2) to determine the amount of N contributed to the wheat crop by the soybeans in different cropping sequences.

Experimental Procedure

Beginning in 1982, a cropping rotation study involving wheat and soybeans was established at the Parsons field with a silt loam soil type. Three different cropping sequences were initiated: (1) wheat - doublecrop soybeans, (2) wheat - doublecrop soybeans - full season soybeans, and (3) wheat - wheat - full season soybeans. Group V maturity (Essex) was used for the full-season variety and a group IV maturity (Crawford) was used for doublecropping. Wheat straw was burned and disced when soybeans were doublecropped.

All fertilizer was applied to the wheat crop in each of the cropping sequences. Five N treatments (0, 25, 50, 75, & 100 lb/a) were included as subplots for each of the main cropping sequence plots. Nitrogen, as urea, was applied preplant or as a late-winter topdressing. Phosphorus and potassium were broadcast and incorporated prior to planting.

Results

Wheat plants were severely injured in January, 1986 when an unusual warming period resulted in plant heaving as the frost layer was leaving the ground surface. Because of this severe plant injury, the wheat was destroyed and spring oats were planted in late February.

Previous wheat and soybean cropping sequences had no significant effect on spring oat yields in 1986, although yields were significantly higher with increasing rates of nitrogen. Leaf tissue samples, however, revealed that the previous crop rotation significantly affected the N concentration in the leaf. Spring oats following wheat had higher leaf N concentrations than wheat following soybeans. However, in the spring of 1985, wheat had also been disced up because of damage from water standing on the plots for a prolonged period, so there may have been more soil residual N when wheat followed wheat in 1986.

Climatic conditions in 1986 were favorable for doublecropped soybeans, although yields averaged 3- to 5-bushels/a less than for full-season soybeans. Full-season soybeans following wheat had the highest yields. In 1986 the N fertilizer treatment effects were also evaluated for the doublecropped soybeans, but the previous N treatments did not affect yield or soybean seed size in 1986. Results are presented in Tables 30 through 34.

Soil samples were taken after the fall harvest in each cropping sequence, but results have not shown any significant trends from crop rotations.

More data are needed before any valid conclusions are made regarding the agronomic effects of doublecropping or how wheat yields are influenced by cropping rotations and applied nitrogen rates.

Table 30. Effects of Wheat and Soybean Cropping Sequences on Soybean Yield, Parsons Field, 1981-86.

	Soybean Yield							1986 Soil Data		
Cropping Sequence	1981	1982	1983	1984	1985	1986	6-yr avg.	pH	Avail. P	Exch. K
	bu/A								lb/A	
[Wheat - doublecrop soy]	18.7	23.6	17.9	2.1	33.2	19.9	19.2	7.1	32	103
[Wheat - doublecrop soy] - full season soy	18.0	23.0	16.9	2.0	31.6	17.6	18.2	7.0	23	103
[Wheat - doublecrop soy] - full season soy	25.8	24.3	15.5	11.1	32.6	21.2	21.8	7.3	30	97
Wheat - Wheat - full season soy	25.7	24.9	14.5	12.8	32.1	23.9	22.3	7.1	34	113
LSD .05	3.7	n.s.	n.s.	2.9	n.s.	3.8	---	---	--	---

Underlined crop indicates the crop for which soybean yields are reported. Fertilizer applied only to the wheat crop in each rotation.
Full season and doublecrop soybeans were planted on the same dates in 1982 and 1985.

Table 31. Residual Effects of Nitrogen Fertilizer on Soybean Yield following Wheat, Parsons Field, 1986.

Cropping Sequence	Nitrogen Rate, lb/A					
	0	25	50	75	100	Avg.
	bu/A					
[Wheat - soybean]	20.3	20.1	19.2	20.0	19.8	19.9
[Wheat - soybean] - soybean	18.1	17.9	17.3	17.2	17.3	17.6
[Wheat - soybean] - soybean	20.7	21.0	21.4	22.2	20.5	21.2
Wheat - wheat - soybean	24.4	22.4	24.4	23.7	24.4	23.9
Means	20.9	20.3	20.6	20.8	20.5	

LSD .05
Crop sequence = * (significant at P<.05)
N rate = n.s.
Crop seq. x N rate interaction = * (significant at P<.05)
Any comparison = 4.0 bu/A

Table 32. Residual Effects of Nitrogen Fertilizer on Soybean Seed Size following Wheat, Parsons Field, 1986.

Cropping Sequence	Nitrogen Rate, lb/A					
	0	25	50	75	100	Avg.
	gr/100					
[Wheat - soybean]	17.4	18.1	18.6	18.5	17.6	18.0
[Wheat - soybean] - soybean	17.9	16.9	18.4	17.9	18.3	17.9
[Wheat - soybean] - soybean	9.3	9.6	9.2	9.2	9.2	9.3
Wheat - wheat - soybean	9.7	9.8	9.5	9.4	9.1	9.5
Means	13.6	13.6	12.5	13.8	13.6	

LSD .05
Crop sequence = * (significant at P<.05)
N rate = n.s.
Crop seq. x N rate interaction = n.s.
Comparing cropping sequence means = 2.3 gr/100 seeds

Table 33. Effects of Cropping Sequences and Nitrogen Rates on Spring Oat Yield, Parsons Field, 1986

Cropping Sequence	Nitrogen Rate, lb/A 0	25	50	75	100	Avg.
	------------	-----	bu/A	-----	-----	------------
[<u>Wheat</u> - soybean]	81.9	87.6	88.4	91.3	89.9	87.8
[<u>Wheat</u> - soybean] - soybean	78.4	82.4	85.3	90.8	93.9	86.2
<u>Wheat</u> - wheat - soybean	83.8	84.9	92.2	87.4	93.0	88.3
Wheat - <u>wheat</u> - soybean	80.2	84.8	85.8	84.3	87.5	84.5
<u>Means</u>	81.1	84.9	87.9	88.4	91.1	

LSD .05
Crop sequence = n.s.
N rate means = 2.7 bu/A
Crop seq. x N rate interaction = n.s.
Comparing N rates within crop sequence = 5.4 bu/A

Table 34. Effects of Cropping Sequences and Nitrogen Rates on Spring Oat Leaf-N Concentration, Parsons Field, 1986.

Cropping Sequence	Nitrogen Rate, lb/A 0	25	50	75	100	Avg.
	------------	-----	% N	-----	-----	------------
[<u>Wheat</u> - soybean]	3.62	4.05	4.02	4.16	4.58	4.09
[<u>Wheat</u> - soybean] - soybean	3.59	3.77	4.41	4.32	4.52	4.12
<u>Wheat</u> - wheat - soybean	3.44	3.63	4.30	4.67	4.95	4.20
Wheat - <u>wheat</u> - soybean	4.88	4.80	4.93	5.18	5.47	5.05
<u>Means</u>	3.88	4.06	4.42	4.59	4.88	

LSD .05
Crop sequence means = 0.49 %
N rate means = 0.28 %
N rate among same crop sequence = 0.56%

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Comparisons of Tillage Methods for Doublecrop Soybeans and Subsequent Effects on Full-Season Soybeans and Wheat

Kenneth Kelley

Summary

Four tillage methods (plow, burn - disc, disc, and chisel - disc) have been compared for doublecrop soybeans. Plowing the stubble under has given slightly higher doublecrop yields than the other three methods over a 4-year period. However, none of the tillage methods has significantly affected the yield of the subsequent crops that follow in the rotation.

Introduction

Producers in southeastern Kansas typically grow doublecrop soybeans after wheat, where soil moisture and time permit. Various tillage methods are used, depending to some degree on the type of equipment that is available. The primary goals of doublecropping are to plant soybeans as quickly as possible after wheat harvest and produce acceptable grain yields as economically as possible. However, the long-term effects from the doublecrop tillage methods should also be considered.

Experimental Procedure

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

Results

Environmental conditions in 1986 were excellent for the establishment of doublecrop soybeans, but only 0.50-inch of rainfall fell during July. However, rainfall during the remainder of the season was above normal. In 1986, doublecrop yield and soybean seed size (Tables 35 and 36) were highest where stubble was plowed under. Evidently, soybeans were more moisture stressed during the July period and plowing provided for better root growth. However, the doublecrop tillage method has not affected the yield of full-season soybeans that follow in the rotation. Soil bulk density measurements also have not shown any differences because of doublecrop tillage methods.

Table 35. Comparison of Tillage Methods for Doublecrop Soybeans, Columbus Field, 1982-86.

Doublecrop Tillage Method	Doublecrop Soybean Yield 1982	1983	1985	1986	Avg.	Seed Size	Soil Bulk Density
	bu/A					gr/100	gr/ml
Plow, disc, roller harrow	26.1	25.2	32.9	20.2	26.1	13.2	1.53
Burn, disc, field cultiv.	25.8	24.2	32.1	14.7	24.2	12.5	1.58
Disc (2x)	26.6	23.2	30.3	15.2	23.8	12.0	1.56
No-till	26.3	20.5	24.7	--	--	---	1.51
Chisel, disc	--	--	--	15.3	--	12.5	--
LSD .05	ns	3.6	4.9	1.3	--	ns	ns

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

Table 36. Effects of Doublecrop Tillage Methods on the Subsequent Yield of Full-Season Soybeans in the Cropping Rotation, Columbus Field.

Doublecrop Soybean Tillage Method	Soybean Yield 1985	1986	Seed Size 1985	1986
	bu/A		gr/100	
Plow	32.1	25.8	14.3	13.4
Burn, disc	32.5	26.0	14.5	13.4
Disc	32.3	24.7	14.7	13.4
No-till	33.3	25.7	14.4	13.6
LSD .05	ns	ns	ns	ns

Cropping sequence is a [wheat-doublecrop soybean] - full season soybean rotation. The doublecrop tillage practices have been repeated through two cropping cycles prior to the soybean yields that are reported. The primary tillage method for the full-season soybeans was chiseling over all previous doublecrop tillage methods.

Effects of Foliar Fungicides for Late-Planted Wheat

Kenneth Kelley and George Granade

Summary

Foliar fungicide effects were compared over six winter wheat varieties that were planted in mid-January. The fungicide applications in early May significantly increased individual kernel weight and reduced disease on the flag-leaf at the time of grain filling for all varieties.

Introduction

Leaf diseases (powdery mildew, septoria leaf spot, and leaf rust) are a major problem when wheat is grown in a more humid climate, such as in eastern Kansas. When wheat plants are infected with these foliar leaf diseases at the time of grain filling, both grain yield and grain quality are severely affected. The losses from leaf diseases are usually more severe for late-planted wheat because of the delayed maturity effect. Our objective was to evaluate the effects of foliar fungicide treatments on late-planted wheat.

Experimental Procedure

Six winter wheat cultivars were planted in strip plots in mid-January at the Parsons field. Five fungicide treatments were applied to each variety in early May after the flag-leaf had fully emerged. Yield components [kernels/spike and 1,000 kernel weight (TKW)] were measured from each variety and fungicide treatment, as well as a disease rating. Since the study was not replicated, grain yield, test weight, and grain quality measurements were averaged over all fungicide treatments.

Results

In 1986, there was a severe outbreak of leaf rust in mid-May. All of the fungicide treatments significantly reduced the level of leaf rust on the flag leaf while the head was filling grain. Even though Dithane M-45 is not a systemic fungicide and has a shorter residual benefit, it still increased individual kernel weight substantially. Bayleton and Tilt, both systemic fungicides with longer residual effects, also were effective in reducing the level of leaf rust on the flag leaf. Results are shown in Tables 37 and 38.

This was a preliminary study, and a more detailed evaluation of foliar fungicides on cultivars planted at different dates is planned in the future.

Table 37. Effects of Fungicides on Wheat Yield Components when Applied to January Planted Wheat, 1986.

Variety or Brand Name	Fungicide Treatment	Fungicide Rate	Kernels/ Spike	1,000 Kernel Wt.	Leaf Disease Rating
		Product/A		(gr)	
<u>Hard Wheat</u>					
(Agripro Mustang)					
	No fungicide	----	28	26	4.5
	Dithane M-45	2 lb.	29	31	3.5
	Dithane M-45 + Bayleton	2 lb. + 2 oz.	30	33	3.0
	Dithane M-45 + Tilt	2 lb. + 2 oz.	30	36	2.8
	Bayleton	4 oz.	30	32	3.0
	Tilt	4 oz.	31	36	2.7
(Bounty 205)					
	No fungicide	----	35	34	3.0
	Dithane M-45	2 lb.	32	38	2.0
	Dithane M-45 + Bayleton	2 lb. + 2 oz.	33	37	1.5
	Dithane M-45 + Tilt	2 lb. + 2 oz.	36	38	1.5
	Bayleton	4 oz.	32	35	1.8
	Tilt	4 oz.	32	35	1.5
(Chisholm)					
	No fungicide	----	29	33	4.5
	Dithane M-45	2 lb.	24	33	3.0
	Dithane M-45 + Bayleton	2 lb. + 2 oz.	29	38	2.8
	Dithane M-45 + Tilt	2 lb. + 2 oz.	28	41	2.8
	Bayleton	4 oz.	28	35	3.0
	Tilt	4 oz.	31	38	2.5
(Pioneer 2157)					
	No fungicide	----	30	29	3.8
	Dithane M-45	2 lb.	29	34	3.3
	Dithane M-45 + Bayleton	2 lb. + 2 oz.	29	36	3.0
	Dithane M-45 + Tilt	2 lb. + 2 oz.	31	35	2.0
	Bayleton	4 oz.	32	34	2.8
	Tilt	4 oz.	33	34	2.2
(Tam 107)					
	No fungicide	----	30	32	4.5
	Dithane M-45	2 lb.	30	39	3.0
	Dithane M-45 + Bayleton	2 lb. + 2 oz.	31	36	3.0
	Dithane M-45 + Tilt	2 lb. + 2 oz.	29	31	3.0
	Bayleton	4 oz.	29	38	3.0
	Tilt	4 oz.	30	36	2.7

Table 37. (continued)

Variety or Brand Name	Fungicide Treatment	Fungicide Rate	Kernels/ Spike	1,000 Kernel Weight	Leaf Disease Rating
		Product/A		(gr)	
<u>Soft Wheat</u>					
(Rohm & Haas HW3007)					
	No fungicide	----	30	22	4.0
	Dithane M-45	2 lb.	25	28	2.5
	Dithane M-45 + Bayleton	2 lb. + 2 oz.	33	32	2.0
	Dithane M-45 + Tilt	2 lb. + 2 oz.	32	30	2.0
	Bayleton	4 oz.	33	27	2.5
	Tilt	4 oz.	34	30	2.0

Treatments were strip plots with no replications.
Date of planting: Jan. 14, 1986.
Planting rate: 120 lb/A.
Fungicides applied May 7,1986. Flag leaf was fully emerged.
Leaf disease rating: 1 = no diseases on flag leaf, 5 = flag leaf completely covered with leaf rust and septoria leaf spot.

Table 38. Comparisons of Selected Winter Wheat Varieties when Planted in January, 1986.

Variety or Brand Name	Yield	Test Weight	Grain Protein
	bu/A	lb/bu	%
<u>Hard Wheat</u>			
Agripro Mustang	40	56.3	12.3
Bounty 205	49	55.9	11.3
Chisholm	50	56.9	10.2
Pioneer 2157	50	56.6	11.1
Tam 107	56	56.9	10.8
<u>Soft Wheat</u>			
Rohm & Haas HW3007	39	51.0	10.7

Wheat was harvested and yields were averaged over all of the above treated and untreated fungicide plots.

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Comparisons of Herbicides and Application Methods for Velvetleaf Control in Soybeans

Kenneth Kelley

Summary

Velvetleaf was controlled successfully with several different herbicide tankmixes and application methods. Of the newer herbicide products, Command, Canopy, Scepter, and Gemni all provided excellent velvetleaf control. Split-applications with Sencor/and or Lexone also gave good control. Postemergent applications with Basagran gave excellent control, if the applications were made before veveltleaf reached the 4- to 6-leaf stage of growth.

Introduction

Velvetleaf has become a serious broadleaf weed problem in many fields of southeastern Kansas. When the velvetleaf population is moderately heavy and germinates at the same time as soybeans emerge, it competes with soybeans for available light and soil moisture and can reduce yields significantly. Our objective in this study was to evaluate many of the relative newer soybean herbicide products and application methods for control of velvetleaf.

Experimental Procedure

Preplant incorporated treatments were applied with a field cultivator equipped with a tine-mulcher on June 10. Soybeans were planted on June 16 and preemergent treatments were applied the same day. Postemergent herbicides were applied on July 2, when the velvetleaf was in the 2- to 4-leaf stage. The plot area was heavily infested with velvetleaf. Soil texture was a Parsons silt loam with 1.3% organic matter.

Results

Nearly all of the herbicide tankmixes gave good to excellent control of velvetleaf, although crop injury was more severe with some treatments. Command, applied preplant incorporated or preemergent, gave the best control with the least amount of crop injury. Canopy and Scepter (applied preplant or preemerge) and Gemni (applied preemerge) also provided good control, but crop injury was more evident. Metribuzin (Lexone/Sencor), applied as a split application or in a tank-mix with Lorox, gave good control. Postemergent treatments with Basagran and other additives (crop oil, 28% liquid N, and liquid 10-34-0 fertilizer) gave good to excellent weed control, provided they were applied when the velvetleaf were still small (2- to 4-leaf stage). Results are shown in Table 39.

Table 39. Comparisons of Herbicides and Application Methods for Velvetleaf Control in Soybeans, Columbus Field, 1986.

Herbicide Treatment	When Applied	Rate	Soybean Yield	Velvet-leaf		Crop Inj.
		a.i./A	bu/A	%	Pl/m^2	
Lasso + Sencor	S. PPI	2.0 + .38	20.2	99	.1	1.2
(Lasso + Sencor) + Sencor	S.PPI + PRE	2.0+.25+.12	19.0	99	.2	1.3
(Lasso + Sencor) + Sencor	S.PPI + PRE	2.0+.25+.25	20.7	99	.1	1.3
Prowl + Scepter	PPI	1.0 + .125	14.0	99	0	2.0
Dual + Scepter	S. PPI	1.5 + .125	16.2	97	.3	1.9
Lasso + Canopy	S. PPI	2.0 + .28	20.0	99	0	1.1
Lasso + Command	S. PPI	2.0 + 1.0	19.3	99	.1	1.0
Lexone + Command	S. PPI	.25 + 1.0	18.2	99	.1	1.2
Scepter + Command	S. PPI	.125 + 1.0	17.1	99	0	1.9
Reward + Treflan	PPI	2.4 + .75	18.3	88	1.5	1.7
Weedy Check	---	---------	10.3	0	17.8	1.0
Cultivation alone (2x)	---	---------	12.4	60	7.0	1.0
Lasso + Gemni	PRE	2.0 + .6	15.6	100	0	1.4
Dual + Canopy	PRE	1.5 + .28	16.6	100	0	1.2
Lasso + Scepter	PRE	2.0 + .125	16.9	97	.3	1.8
Lasso + Command	PRE	2.0 + 1.0	18.7	99	0	1.0
Lorox + Command	PRE	.5 + 1.0	16.2	99	0	1.2
Sencor + Command	PRE	.25 + 1.0	18.2	99	0	1.2
Dual + Lexone	PRE	1.5 + .25	16.3	99	0	1.1
Dual + Lexone + Lorox	PRE	1.5 + .38 + .25	16.7	99	0	1.4
Cinch + Lorox	PRE	1.0 + .5	14.7	99	0	1.7
Cinch + Sencor	PRE	1.0 + .25	16.4	99	0	1.7
Weedy Check	---	---------	9.4	0	20.2	1.0
Cultivation alone (2x)	---	---------	12.3	65	8.0	1.0
Basagran + COC *	POST	.75 + 1 qt	18.4	91	1.4	3.5
Basagran + COC *	POST	1.0 + 1 qt	20.2	98	.6	3.7
Basagran + COC *	POST(Seq)	1.0 + 1 qt	18.0	84	1.8	2.9
Basagran + 28% Liq N *	POST	.75 + 1 gal	19.9	95	.5	3.0
Basagran + Blazer + 10-34-0 *	POST	.5 + .25 + 1 qt	19.6	91	1.5	3.5
Basagran + Blazer + 10-34-0 *	POST	.5 + .38 + 1 qt	19.2	94	1.0	3.8
Basagran + Blazer + 28% Liq N *	POST	.5 + .25 + 1 qt	19.3	90	1.8	3.8
Basagran + Blazer + COC *	POST	.5 + .25 + 1 pt	16.7	86	3.3	3.8
Classic *	POST	.125 (oz)	14.0	58	10.0	1.6
Amiben + COC *	POST	2.4 + 1 pt	11.5	52	16.1	2.2
Weedy Check	----	----------	5.0	0	27.7	1.0
Cultivation alone (2x)	----	----------	11.4	60	8.8	1.0
LSD .05			3.5	6	6.0	0.3

Crop injury rating: 1 = no injury, 10 = all plants killed.
(*) Treflan was also applied preplant to the postemergent treatments.

Comparison of Soybean Herbicides for Cocklebur Control in Narrow and Wide Row Spacings

Kenneth Kelley

Summary

Soybean herbicides were evaluated for cocklebur control both in narrow (7-inch) and wide (30-inch) row spacings. Yields averaged 5 bu/a higher in narrow rows when weeds were controlled early with herbicides and later weed growth was surpressed by the soybean canopy. When soybeans were planted in 30-inch rows, cultivation also increased yields an average of 4 bu/a over non-cultivated plots with the same herbicide application. Cocklebur that was controlled within 4 weeks of planting did not reduce yields significantly.

Introduction

Cocklebur is one of the major problem weeds in many soybean fields of southeastern Kansas. It is a strong competitor for available water, light, and nutrients. When cockleburs are allowed to compete with the soybean plant for the entire growing season, yields in many cases are reduced by 50% and the weeds also cause mechanical harvesting problems. Our objectives were to evaluate various herbicides and application methods both in narrow and wide row spacings and also to determine the benefit of cultivation.

Experimental Procedure

Cocklebur control was evaluated in three different studies. At the Columbus field, 10 herbicide treatments were compared in 7-inch rows, in 30-inch rows, and in 30-inch rows with cultivation. Herbicide treatments consisted of preplant incorporated, preemergent, and postemergent applications. Postemergent soybean herbicides were also evaluated at the Columbus field and at a nearby off-station site.

Results

(Narrow & Wide Row Spacing)

In the narrow- and wide-row study, yields and cocklebur control were significantly better in the 7-inch row spacing (Table 40). Good, early-season, cocklebur control was obtained with nearly all of the preplant, preemergent, and postemergent herbicide applications. There were some cockleburs that emerged later, but the narrower rows closed the soybean canopy quicker, which reduced the weed competition. When soybeans were planted in 30-inch rows, cultivation increased yields by nearly 4 bu/a compared to noncultivated plots with the same herbicide treatment. Cultivation controlled some of the weeds that escaped and also improved soil aeration of compacted soil conditions.

Canopy and Scepter (applied preplant and preemerge) both gave excellent early cocklebur control, but Scepter had a longer residual effect. Scepter and Classic also gave good postemergent cocklebur control; however, yields of both treatments were reduced somewhat by the poor control of teaweed, which was also a weed competitor at this site.

Basagran was evaluated with three different postemergent additives - crop oil, liquid 28% N, and 2,4-DB. There was no significant difference in weed control among the additives, although crop injury was somewhat less with liquid N. Dyanap + 2,4-DB also gave good cocklebur control; however, initial leaf burning was more severe than with Basagran. However, yields were not reduced from the early herbicide injury.

Rescue, as the name implies, is intended as a rescue type herbicide treatment and was applied when cockleburs were about 12-inches tall. The soybeans were somewhat drought-stressed at the time of application, which resulted in more crop injury than normally experienced. Yields with the Rescue treatment were significantly lower because of the longer cocklebur competition and crop injury effects.

(Postemergent Studies)

Results of the two postemergent studies are shown in Tables 41 and 42. Cocklebur control was generally good to excellent with nearly all of the herbicides; however, acifluorfen (Blazer & Tackle) by itself gave only fair to poor cocklebur control. Cobra, a herbicide similar in activity to Blazer and Tackle, gave fair to good weed control. When Classic was tank-mixed with Blazer, there was an antagonistic effect and cocklebur control was reduced compared to Classic alone.

Table 40. Comparison of Herbicides for Cocklebur and Teaweed Control with Soybeans Planted in Narrow and Wide Row Spacings, Columbus Field, 1986

Herbicide Treatment	Product/A	When Applied	Yield Row Spacing N			Coc. Popul. Row Spacing N			Teaweed Control Row Spacing N			Crop Injury
			N	W	WC	N	W	WC	N	W	WC	
			----- bu/A -----			--- pl/m² ---			---- % ---			
Canopy	0.50 lb	S.PPI	35.2	24.4	28.9	0.1	5.1	0	98	97	98	1.3
Canopy	0.50 lb	PRE	35.8	27.7	29.6	0.2	4.3	0.1	97	98	98	1.3
Scepter	0.67 pt	S.PPI	33.0	27.1	27.5	T	1.5	0.1	98	98	98	1.8
Scepter *	0.67 pt	POST	31.3	23.9	30.0	0	T	0	30	30	86	1.4
Classic *	0.50 oz	POST	28.5	19.3	29.4	0	T	0	20	0	86	1.7
Basagran + Crop Oil	1 pt + 1 pt	POST	34.9	26.6	28.5	T	1.7	T	78	82	95	2.2
Basagran + Liq 28% N	1 pt + 1 gal	POST	36.9	25.4	32.7	T	0.2	T	97	91	98	1.8
Basagran + 2,4-DB *	1 pt + 2 oz	POST	32.3	27.3	31.4	0.2	1.8	0	68	72	93	2.1
Dyanap + 2,4-DB	3 qt + 2 oz	POST	35.0	26.5	27.0	0	0.1	1.0	70	68	80	2.9
Rescue *	3 qt	POST	28.8	12.3	18.7	2.7	6.0	1.2	30	10	78	3.7
No Herbicide	---	---	14.1	5.6	18.8	7.2	28.3	7.3	20	0	70	1.0
(Means)			31.4	22.4	27.9	1.0	4.5	0.9	64	59	89	---
LSD .05												
Row spacing				*			*			*		---
Herbicide treatment				*			*			*		---
Row sp x herb trt interaction				*			*			*		---
Herbicide trt within same row spacing				3.1			3.4			5		---
Any comparison				3.3			4.5			6		---

(*) Surfactant (AG-98) was added to indicated postemergent treatments at the rate of 0.25%, volume basis.

Variety: Essex; Planting date: June 20, 1986

Row spacing: N = 7-inch, W = 30-inch, WC = 30-inch + cultivation.

Date of herbicide applications: Shallow preplant incorporated and preemergent treatments (June 20); Basagran, Classic, & Scepter postemergent treatments (July 8); Dyanap treatment (July 15), and Rescue treatment (July 24).

Crop injury rating: 1 = no injury, 10 = all plants dead.

Table 41. Comparisons of Postemergent Soybean Herbicides for Cocklebur Control, Columbus Field, 1986.

Herbicide Treatment	Amount Applied	Yield	Cocb Control	Crop Injury
	Product/A	bu/A	%	
Basagran + AG-98	1 pt	21.7	90	1.8
Basagran + Liq. 28% N	1 pt + 1 gal	24.2	95	1.5
Basagran + Crop Oil	1 pt + 1 qt	22.3	95	2.0
Basagran + 2,4-DB	1 pt + 2 oz	21.6	92	1.3
Basagran + Crop Oil (seq.)	1 pt + 1 pt	23.8	99	2.0
Basagran + Blazer + 10-34-0	.5 pt + .5 pt + 1 pt	19.4	85	2.0
Tackle + Basagran + AG-98	1 pt + 1 pt	20.9	90	2.4
Blazer + AG-98	2 pt	13.5	50	2.0
Blazer + 2,4-DB + AG-98	2 pt + 2 oz	14.5	60	2.2
Tackle + X-77	1.5 pt	12.7	40	2.0
Tackle + X-77	2 pt	13.8	50	2.4
Blazer + Scepter + AG-98	1.5 pt + .5 pt	20.7	90	2.0
Blazer + Scepter + AG-98	1.5 pt + .67 pt	21.5	90	2.0
Scepter + AG-98	.67 pt	23.4	95	1.3
Cobra	.8 pt	18.9	80	2.7
Classic + AG-98	.5 oz	22.0	95	1.5
Cultivation (2x)	----	14.8	70	---
No Herbicide	----	6.5	0	---
LSD .05		4.3	8	0.3

Surfactant applied at the rate of 0.25% on a spray volume basis.
Variety: Essex
Planting date: June 16, 1986
Date of herbicide application: July 9, 1986
Crop injury rating: 1 = no injury, 10 = all plants killed.

Table 42. Comparisons of Postemergent Soybean Herbicides for Cocklebur Control, Cherokee County, 1986.

Herbicide Treatment	Amount Applied	Cocb Control	Crop Injury
	Product/A	%	
Basagran + AG-98	1 pt	90	1.8
Basagran + Liq. 28% N	1 pt + 1 gal	92	2.0
Basagran + Crop Oil	1.5 pt + 1 qt	94	2.2
Basagran + 2,4-DB	1.5 pt + 2 oz	95	1.5
Basagran + Blazer + AG-98	1 pt + 1 pt	90	2.2
Basagran + Blazer + Crop Oil	1 pt + 1 pt + 1 pt	95	2.5
Basagran + Blazer + Liq. 28% N	1 pt + 1 pt + 1 qt	94	3.0
Blazer + AG-98	1.5 pt	75	2.5
Blazer + 2,4-DB + AG-98	1.5 pt + 2 oz	80	2.8
Blazer + Scepter + AG-98	1.5 pt + .5 pt	80	2.5
Blazer + Scepter + AG-98	1.5 pt + .67 pt	80	2.5
Scepter + AG-98	.67 pt	92	1.3
Cobra	.8 pt	80	3.0
Classic + AG-98	.5 oz	95	1.5
Classic + Blazer + AG-98	.5 oz + 1.5 pt	85	2.5
Dyanap + 2,4-DB	2 qt + 2 oz	80	3.0
Dyanap + 2,4-DB	3 qt + 2 oz	85	3.5

Variety: Essex
Planting date: June 1, 1986
Date of herbicide treatments: June 25, 1986
Weed control rating: June 29; 1 = no injury, 10 = all plants dead.
Plots were not replicated, but sprayed in strips 10′ by 150′.

Comparisons of Soybean Herbicides and Application Methods

Kenneth Kelley

Summary

Preplant incorporated, preemergent, and postemergent soybean herbicides were compared in narrow- and wide-row spacings to evaluate weed control and crop injury effects on grain yield and seed size. Annual grass and broadleaf weed control was generally good to excellent for most herbicide tank-mixes.

Introduction

Annual grass and broadleaf weeds can become a serious problem for soybean producers in southeastern Kansas. When they compete for available light, water, and soil nutrients during the entire growing season, soybean yields are reduced significantly. Crop rotations are helpful in breaking some weed cycles, but proper selection and application of herbicides are essential for obtaining optimum soybean yields in most fields. Herbicide performance studies are useful to compare the currently labelled products under the climatic conditions of southeastern Kansas.

Experimental Procedure

Soybean herbicides and application methods were compared in five separate studies: - (1) preplant incorporated and preemergent comparisons, (2) postemergent comparisons, (3) postemergent effects on yield in the absence of weeds, (4) herbicide systems compared in 7- and 30-inch row spacings, and (5) doublecrop soybean comparisons planted in 7-inch row spacing. Preplant herbicide treatments were mixed in the soil with a field cultivator equipped with a 3-bar tine-mulcher. All herbicide treatments were applied in 20 gallons of water per acre. Soil texture was a Parsons silt loam with 1.0 to 1.5% organic matter. Major weed competition was smooth pigweed at most of these sites in 1986, although cocklebur and morningglory species also competed at several sites. Grass competition was generally light at all sites.

Results

Results of weed control ratings, effects on yield and seed size, and crop injury ratings for the various herbicide performance studies are shown in Tables 43 through 48. <u>Not all of the treatments are cleared for farmer use</u>.

Good to excellent smooth pigweed control was achieved with nearly all of the herbicide tank-mixes, when applied preplant (Table 43) or preemerge (Table 44). Of the postemergent herbicide comparisons (Table 45), acifluorfen (Blazer /Tackle) and Cobra gave the best pigweed control, although the Classic + Blazer tank-mix resulted in reduced pigweed and cocklebur control because of an antagonistic effect.

Soybean injury from herbicide applications is a concern to producers because of possible effects on yield. However, crop injury effects are normally only short-term, and yield losses from herbicides injuries are rarely significant. Postemergent herbicide injury effects were evaluated over 11 different treatments in the absence of weed competition in 1986. Even though substantial leaf burning occurred with several of the herbicides, yields were not significantly reduced (Table 46). In 1986, there was more crop injury from Scepter when applied preplant or preemerge, and yields were reduced significantly at several sites. Studies are planned in 1987 to further evaluate the environmental conditions that cause Scepter injury.
Crop injury effects were also observed with Gemni and Cinch.

Soybean herbicides also were compared in 7-inch rows, in 30-inch rows with no cultivation, and in 30-inch rows with cultivation at the Columbus field (Table 47). Smooth pigweed control was generally good to excellent, regardless of application method. However, soybean yields averaged 2 to 4 bu/a less in 30-inch rows without cultivation compared to 7-inch rows or 30-inch rows with cultivation. Even though weeds were controlled adequately in all three row spacings, cultivation evidently improved soil aeration.

Herbicides and application methods were compared in narrow rows where doublecrop soybeans were planted at the Parsons field (Table 48). Pigweed competition was moderately high, but dry soil conditions during most of July and August reduced the weed growth. Command and Cinch gave only fair to poor pigweed control. Some herbicides (Dual and Surflan) also did not receive enough rainfall after planting to be activated and gave poor weed control.

In summary, there are many soybean herbicides that can be applied to selectively control annual grass and broadleaf weeds. Selection of a particular herbicide or tank-mix and application method may depend on the weed species present in a particular field, the soil and climatic conditions, the cropping rotation, and the herbicide cost. Even though some form of herbicide application is normally needed to control weeds and obtain optimum soybean yields, cultivation can sometimes supplement the existing herbicide program and increase yields by providing better soil aeration when soils are compacted. Also, crop rotations are often beneficial in helping to control problem weeds, such as cocklebur, velvetleaf, and johnsongrass.

Table 43. Comparisons of Preplant Incorporated Soybean Herbicides for Smooth Pigweed Control, Columbus Field, 1986.

Herbicide Treatment	Rate	When Applied	Yield	Smpw	Seed Size	Crop Injury
	lb a.i./A		bu/A	%	gr/100	
Treflan + Sencor	.75 + .38	PPI	28.6	92	13.0	1.2
Treflan + Scepter	.75 + .125	PPI	22.4	97	12.7	1.9
Prowl + Lexone	1.0 + .38	PPI	27.2	94	12.7	1.2
Prowl + Scepter	1.0 + .125	PPI	23.7	96	12.4	2.2
Sonalan + Sencor	.75 + .38	PPI	28.7	94	13.0	1.2
Sonalan + Scepter	.75 + .125	PPI	21.1	97	12.8	1.8
Treflan + Reward + Lexone	.5 + 2.3 + .38	PPI	21.8	89	12.6	2.7
Command + Lexone	1.0 + .38	S.PPI	26.9	94	13.0	1.2
Command + Scepter	1.0 + .125	S.PPI	21.5	98	12.7	1.7
Command + Canopy	1.0 + .25	S.PPI	23.2	99	12.6	1.6
Lasso + Sencor	2.0 + .38	S.PPI	24.3	87	12.9	1.3
Lasso + Scepter	2.0 + .125	S.PPI	25.3	95	12.9	1.6
Lasso + Canopy	2.0 + .28	S.PPI	26.1	95	13.5	1.5
Dual + Lexone	1.5 + .38	S.PPI	26.2	88	12.7	1.2
Dual + Scepter	1.5 + .125	S.PPI	21.4	97	13.3	2.0
Dual + Canopy	1.5 + .28	S.PPI	24.9	92	12.7	1.5
Weedy check	------	----	4.3	--	12.9	1.0
LSD .05			4.3	7	ns	0.3
C.V. %			11.1	5	3.0	10.7

Variety: Essex
Planting date: June 16,1986
Date of herbicide treatment: June 16,1986
Weed species: Predominantly smooth pigweed (Smpw).
PPI = prelant incorporated; S.PPI = shallow preplant incorporated.
Crop injury rating: 1 = no injury, 10 = all plants dead.

Table 46. Effect of Postemergent Herbicides on Soybean Yield in the Absence of Weed Competition, Columbus Field, 1986.

Herbicide Treatment	Rate	Yield	Seed Size	Crop Injury
	Product/A	bu/A	gr/100	
Basagran + Liq. 28% N	1.5 pt + 1 gal	22.5	14.0	1.4
Basagran + 2,4-DB	1.5 pt + 2 oz	23.8	13.6	1.6
Blazer + Basagran (*)	1 pt + 1 pt	21.7	13.5	2.7
Cobra	0.8 pt	22.0	13.5	2.7
Dyanap	3 qt	21.5	13.3	2.1
Dyanap + 2,4-DB	3 qt + 2 oz	23.4	13.7	2.2
Rescue	3 qt	20.5	13.3	3.4
Scepter (*)	0.67 pt	21.4	13.7	1.4
Classic (*)	0.5 oz	21.3	13.7	1.4
Blazer + Classic (*)	1.5 pt + 0.5 oz	22.5	13.7	2.5
2,4-DB	0.5 pt	20.0	13.1	3.4
No herbicide	----	21.6	13.8	1.0
LSD .05		ns	ns	0.2
C.V. %		14.1	3.9	5.8

(*) Surfactant added at the rate of 0.25% spray volume basis.
Variety: Essex
Planting date: June 17, 1986
Date of herbicide treatments: July 2; bright, sunny day - 90F, 40% humidity.
Plant stage: 1st trifoliate fully expanded, 2nd trifoliate was forming.
Rescue & 2,4-DB applied July 24; bright, sunny day - 92F, 45% humidity.
Plant stage: plant height was 14 to 16 inches.
Crop injury rating: (3 days after herbicide treatment); 1 = no injury, 10 = all plants dead.
All plots were cultivated once after the final postemergent application.

Table 47. Herbicide Systems Compared for Pigweed Control in Soybeans with Narrow- and Wide-Row Spacings, Columbus Field, 1986.

Herbicide Treatment	Rate	When Applied	Yield			Smpw Control			Seed Size		
			N	W	WC	N	W	WC	N	W	WC
	lb a.i./A		-----	bu/A	-----	-----	%	-----	----	gr/100	----
Prowl + Scepter	1.0 + .125	PPI	19.3	15.8	17.7	100	100	100	12.7	12.7	12.4
Command + Scepter	1.0 + .125	S. PPI	23.2	14.3	17.1	100	100	100	12.5	12.4	12.8
Dual + Canopy	1.5 + .28	PRE	21.0	17.6	21.1	100	100	100	12.5	13.2	12.6
Verdict + Blazer + Basagran	.125 + .25 + .5	POST	20.6	16.1	21.5	96	100	100	12.9	13.0	12.8
Lasso + Sencor + (Sencor)	2.0 + .25 + .125	S.PPI + PRE	22.7	18.0	21.5	100	100	100	13.4	13.0	12.8
Lasso + Gemni + (Blazer)	2.0 + .6 + .25	PRE + POST	18.6	17.7	18.3	100	100	100	12.6	13.0	13.0
Sonalan + Classic	.75 + .008	S. PPI + POST	22.4	18.2	19.1	100	100	100	13.1	12.6	12.5
Treflan	.75	PPI	23.8	16.2	19.6	100	96	97	13.3	13.0	12.6
Lexone	.25	PRE	20.8	18.2	20.7	90	95	100	12.7	12.6	12.8
Blazer + Basagran	.25 + .25	POST	20.1	15.4	20.5	97	97	100	12.5	12.1	12.3
No Herbicide	----	----	13.2	4.7	19.9	50	0	90	13.4	11.8	13.2
(Means)			20.5	15.7	19.7	94	89	99	12.9	12.7	12.7
LSD .05											
Row spacing				*			*			ns	
Herbicide treatment				*			*			*	
Row spacing x herbicide treatment interaction				*			*			*	
Herbicide treatment within row spacing				2.6			3			.8	
Any comparison				2.7			3			1.1	
C.V. %				8.0			7			4.0	

Variety: Essex
Planting date: June 20, 1986
Row spacing: N = narrow rows, 7-inch; W = wide rows, 30-inch; WC = wide rows with cultivation.
Date of herbicide treatments: June 19 (PPI & S. PPI), June 21 (PRE), July 8 (POST).
Weed species: Predominantly smooth pigweed (Smpw).

Table 48. Comparisons of Soybean Herbicides for Weed Control in Doublecrop Soybeans Planted in Narrow Rows, Parsons Field, 1986.

Herbicide	Rate	When Applied	Yield	Pigweed Control		Seed Size	Crop Injury
	lb a.i./A		bu/A	%	pl/m^2	gr/100	
Lorox	0.75	PRE	16.1	93	0.7	13.8	1.3
Sencor	0.38	PRE	15.6	94	1.0	14.2	1.2
Gemni	0.6	PRE	15.2	97	0	14.3	1.4
Canopy	0.25	PRE	15.7	94	2.3	14.0	1.5
Scepter	0.125	PRE	14.1	85	2.0	13.7	1.9
Lasso	2.0	PRE	15.8	97	1.7	14.2	1.1
Dual	1.5	PRE	12.2	74	12.7	13.3	1.0
Surflan	0.75	PRE	11.1	47	17.0	13.1	1.0
Command	1.0	PRE	13.0	72	7.0	13.1	1.0
Cinch	1.0	PRE	11.7	33	16.3	13.3	1.5
No herbicide	---	---	9.2	0	21.7	13.8	1.0
Lasso + Canopy	1.5 + 0.25	PRE	16.2	99	0	13.8	1.5
Dual + Scepter	1.5 + 0.125	PRE	15.0	93	0.3	13.3	1.9
Lasso + Gemni	1.5 + 0.5	PRE	16.7	99	0	13.7	1.3
Command + Scepter	1.0 + 0.125	PRE	17.3	94	0.3	13.8	1.9
Surflan + Lorox	0.75 + 0.5	PRE	15.1	89	1.7	14.0	1.2
Surflan + Sencor	0.75 + 0.25	PRE	15.2	89	2.3	14.0	1.2
Assure + Blazer	0.1 + 0.25	POST	14.0	91	5.0	13.6	2.1
Poast + Blazer	0.18 + 0.25	POST	15.2	87	4.3	13.5	1.9
Verdict + Blazer	0.125 + 0.25	POST	16.1	87	3.3	13.5	1.9
Fusilade 2000 + Blazer	0.18 + 0.25	POST	16.7	87	3.0	13.4	1.9
No herbicide	---	----	8.2	0	18.0	12.9	1.0
LSD .05			3.1	9	--	1.0	0.3
C.V.%			12.8	7	--	5.1	5.0

Variety: Essex

Planting date: June 19, 1986

Date of herbicide treatments: June 19 and July 10.

Weed species: Smooth pigweed; there was a heavy population over the entire plot area, although droughty conditions during mid-summer prevented the pigweed from getting tall and growing vigorously.

Tillage: Wheat stubble was burned, disced, and field cultivated prior to planting soybeans in 7-inch rows with a wheat drill.

Crop injury rating: 1 = no injury, 10 = all plants dead.

SOUTHEAST KANSAS BRANCH STATION
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Comparisons of Wheat Herbicides for Cheatgrass Control

Kenneth Kelley

Summary

Winter wheat yields were increased by 20 bu/a where cheatgrass was effectively controlled by herbicide treatments. When applied mid-winter, Tycor and a tank-mix of Tycor + Sencor controlled more than 90% of the cheatgrass competition.

Introduction

Cheatgrass, which is a winter annual grass, has become a problem in many continuous wheat fields or when wheat has been planted following idled layout land from the government programs. Since it often emerges at the same time as the wheat, it can become a strong competitor for moisture and soil nutrients. Our objective was to evaulate Tycor for cheatgrass control in southeastern Kansas.

Experimental Procedure

A hard red winter wheat cultivar (Chisholm) was planted in early October on a site that was heavily infested with cheatgrass. The herbicide treatments were applied in mid-January, after air temperatures had been above 50 F for over a week. Cheatgrass height at the time of spraying was less than 2 inches.

Results

Climatic conditions were excellent for obtaining good cheatgrass control from the herbicide treatments in 1986. The wheat had become well established from the early October planting, and unusually warm temperatures in January were favorable for bringing the wheat and cheatgrass out of dormancy prior to spraying. After herbicides were applied, an inch of rainfall occurred, which was ideal for getting the herbicide into the soil for root absorption.

Tycor applied at 1.0 to 1.5 lb/a of active ingredient controlled more than 90% of the cheatgrass population (Table 49). When Tycor was tank-mixed with Sencor, somewhat better cheatgrass control was obtained than when Tycor was applied alone. Tycor also did not cause any wheat injury, although there was some early injury when it was tank-mixed with Sencor. At this time, Tycor is still pending full-label clearance for use as a wheat herbicide.

Table 49. Comparison of Postemergent Herbicides for Cheat Control in Winter Wheat, Parsons Field, 1986.

Herbicide Treatment	Rate	Yield	Test Wt.	Cheat Control	Crop Injury
	a.i./A	bu/A	lb/bu	%	
Tycor	0.75	50.2	59.1	83	1.0
Tycor	1.00	52.9	59.4	90	1.0
Tycor	1.25	52.0	59.5	93	1.0
Tycor	1.50	53.3	59.5	97	1.0
Sencor	0.38	52.9	59.3	91	2.5
Sencor	0.50	49.0	59.5	95	3.0
Tycor + Sencor	1.0 + .06	57.4	59.6	95	1.0
Tycor + Sencor	1.0 + .125	56.1	60.4	96	1.0
Tycor + Sencor	1.0 + .25	54.7	59.7	99	2.0
No Herbicide	---	32.0	52.1	0	1.0
LSD .05		7.9	2.3	4	0.5
C.V. %		9.1	2.3	3	5.0

Variety: Chisholm
Planting date: October 3, 1985.
Date of herbicide application: Jan. 16, 1986.
Crop injury rating: 1 = no injury, 10 = all plants dead

SOUTHEAST KANSAS BRANCH STATION
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Herbicide Effects on Winter Wheat Yield and Subsequent Effects on Doublecrop Soybean Growth

Kenneth Kelley

Summary

Wheat herbicides were evaluated to determine effects on grain yield and any subsequent crop injury effects on doublecrop soybeans following wheat. Herbicide treatments that included Banvel caused some reduction in wheat plant height, but grain yields were not affected by any of the herbicide treatments that were compared. However, Surflan treatments did result in significant wheat lodging. Glean was the only wheat herbicide that caused doublecrop soybean injury in 1986.

Introduction

Several new herbicides have recently been made available to producers for weed control in winter wheat. In southeastern Kansas, soybeans are often doublecropped after wheat. Our objectives were to determine if any of the herbicides would affect wheat yields and also doublecrop soybean growth following wheat.

Experimental Procedure

Herbicides were applied to winter wheat after it was fully tillered in late March. There was not enough weed pressure at this site to evaluate the herbicides for weed control, but grain yield and lodging notes were taken. After wheat harvest, the site was prepared for doublecrop soybeans by burning the wheat straw and field cultivating twice. Essex soybeans were planted with a grain drill in 7-inch row spacing. After seed emergence, soybean growth was observed for one month to assess the effects of the previous wheat herbicide applications.

Results

The only noticeable herbicide effects on wheat growth occurred from the treatments involving Banvel and Surflan. Since the active ingredient in Banvel contains a growth hormone, plant height can sometimes be reduced. However, the reduced plant height did not affect grain yield. Surflan has been promoted as a herbicide that can be applied to wheat for doublecrop soybean weed control; however, under certain climatic conditions, Surflan can cause wheat lodging to occur, which was the case in 1986. The only wheat herbicide that severely affected doublecrop soybean growth was Glean, which is not labelled for wheat when doublecrop soybeans follow in the rotation.

Table 50. Effects of Wheat Herbicide Applications on Winter Wheat Yield and Crop Injury Effects on Doublecropped Soybeans, Parsons Field, 1986.

Herbicide Treatment	Rate	Wheat Yield	Wheat Lodging	Doublecrop Soybean Plant Injury	Doublecrop Soybean Pigweed Control
	Product/A	bu/A	%		%
2,4,-D amine	1.0 pt.	45.4	0	1.0	0
Buctril	1.0 pt.	49.4	0	1.0	0
Banvel	0.25 pt.	42.7	0	1.0	0
Buctril + 2,4,-D amine	1.0 pt. + 1.0 pt.	48.1	0	1.0	0
Banvel + 2,4,-D amine	0.125 pt. + 0.5 pt.	45.7	0	1.0	0
Surflan	2.0 pt.	48.0	50	1.0	0
Surflan + 2,4,-D amine	1.5 pt. + 0.5 pt.	44.9	40	1.0	0
Express	0.33 oz.	47.3	0	1.0	0
Matrix	0.33 oz.	46.6	0	1.0	0
Harmony	0.33 oz.	45.3	0	1.0	0
Glean	0.25 oz.	45.0	0	8.0	100
No herbicide	---	44.2	0	1.0	0
LSD .05		n.s.	-	-	-
C.V. %		6.0	-	-	-

Variety: Chisholm
Date of herbicide application: March 26, 1986. A non-ionic surfactant (X-77) was added to each treatment at 0.25%.
Wheat stubble was burned and field cultivated prior to drilling soybeans.
Soybean injury rating: 1 = no injury, 10 = all plants dead.
Doublecrop soybeans (Essex variety) were planted June 19, 1986.
Wheat weed pressure was mainly winter annuals, and there was not enough competition to affect wheat yields.

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Comparisons of Grain Sorghum Herbicides for Weed Control

Kenneth Kelley

Summary

Twenty-five grain sorghum herbicide treatments were compared using conventional tillage methods. Good to excellent weed control was obtained with nearly all of the herbicide applications. Without herbicides, grain yield was reduced nearly 25%, even though only moderate weed pressure existed at the test site.

Introduction

Grain sorghum is an important grain and feed crop for many producers of southeastern Kansas. It is often grown in rotation with wheat and soybeans, which helps in breaking up the weed cycle that often exists when a monocrop is grown. The use of safened seed has also allowed producers a wider choice of herbicides with the ability to control a wider array of weed species. Our objective was to evaluate grain sorghum herbicides and various tank-mixes for weed control and crop injury effects for the climatic conditions of the area.

Experimental Procedure

Safened grain sorghum seed was planted on a site at the Parsons field where the previous crop was soybeans. Twenty-five herbicide treatments were compared as preplant incorporated, preemergent, and postemergent applications. Preplant treatments were incorporated with a field cultivator equipped with a 3-bar tine mulcher. Weed competition was primarily from smooth pigweed and to a lesser extent from large crabgrass.

Results

Heavy rainfall before seed emergence resulted in compacted soil conditions, but seedling injury was minimal from the herbicide treatments. Bladex combinations caused the most seedling injuries. However, crop injury was more severe with postemergent treatments of 2,4-D, where leaf curling and plant stunting occurred, resulting in reduced grain yields.

Since smooth pigweed was the predominant weed, many of the herbicides (Table 51) gave excellent control without being tank-mixed with other herbicides. However, with more normal weed pressures, a tank-mix combination is often needed to provide adequate grass and broadleaf weed control, unless cultivation is used to supplement the herbicide program.

Table 51. Comparisons of Grain Sorghum Herbicides for Weed Control, Parsons Field, 1986.

Herbicide Treatment	Rate	When Applied	Yield	Test Wt.	Weed Control Smpw	Weed Control Lacg	Crop Injury
	a.i./A		bu/A	lb/bu	-- % --		
Atrazine	1.5	S. PPI	52.4	56.1	100	85	1.0
Dual	2.0	S. PPI	55.9	56.3	99	99	1.0
Lasso	2.5	S. PPI	54.9	55.9	97	95	1.0
Lasso + Bladex	2.0 + 1.0	S. PPI	54.5	55.4	96	97	1.3
Dual + Bladex	1.5 + 1.0	S. PPI	54.1	55.9	96	99	1.3
Lasso + Atrazine	2.0 + 1.0	S. PPI	56.5	55.2	100	99	1.0
Atrazine + Bladex	1.0 + 1.0	S. PPI	56.7	55.8	100	92	1.3
Bicep	2.7	S. PPI	57.2	55.9	100	99	1.0
Atrazine	1.5	PRE	56.8	56.5	100	90	1.0
Dual	2.0	PRE	57.8	56.1	99	98	1.0
Lasso	2.5	PRE	57.7	55.5	100	98	1.0
Lasso + Bladex	2.0 + 1.0	PRE	58.3	55.6	100	99	1.5
Dual + Bladex	1.5 + 1.0	PRE	59.6	55.4	100	99	1.5
Lasso + Atrazine	2.0 + 1.0	PRE	61.6	56.3	100	99	1.0
Atrazine + Bladex	0.75 + 0.75	PRE	55.4	55.7	100	97	1.5
Bicep	2.7	PRE	56.4	57.5	100	99	1.0
Ramrod/atrazine	4.0	PRE	57.8	56.6	100	92	1.0
Atrazine	1.50	POST	53.5	57.3	96	40	1.3
2,4-D amine	0.38	POST	43.7	55.8	91	0	4.0
Buctril	0.25	POST	52.3	55.3	89	0	1.5
Buctril + 2,4-D amine	0.25 + 0.25	POST	45.3	54.8	97	0	3.5
Buctril + atrazine	0.25 + 0.5	POST	52.3	56.4	98	50	1.4
Banvel	0.25	POST	44.4	55.8	94	0	3.0
Banvel + atrazine	0.25 + 0.75	POST	50.9	56.0	96	50	2.5
Basagran + atrazine	0.5 + 0.5	POST	50.4	56.6	97	50	1.3
Weedy check	----	----	41.2	54.6	0	0	---
LSD .05			8	1.3	4	4	0.4
C.V. %			9	2	3	4	5

Planting date: April 29, 1986
Hybrid: Garst 5511
Date of herbicide treatments: Shallow PPI and preemergent = April 29
Postemergent = May 27 & 29, 1986
Weed species: Smpw (smooth pigweed) and lacg (large crabgrass).
Crop injury rating: 1 = no injury, 10 = all plants completely killed.

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Performance Testing of Small Grain Varieties

George V. Granade and Ted Walter[1]

Summary

Wheat and barley were planted in November, and spring oats, spring barley, and spring wheat were planted in February. All were harvested in late June. Recently released wheat varieties and hybrids seem to be well adapted to southeastern Kansas. However, disease resistant and yield potential are significantly different even among new releases. Schulyer, a barley developed in New York, continues to have good yield potential and straw strength. Ogle, a spring oat, has a high yield potential as well as good straw strength. Bates, also a spring oat, has a high yield potential, but does not appear to have such strong straw strength. The spring barleys have lower yields than the winter barleys, thus, they are not very promising for southeastern Kansas. Yields of spring wheat were lower than those of winter wheat. The spring wheats do not appear very promising because of the warm humid conditions in early spring in southeastern Kansas, which increase the potential for diseases.

Introduction

The small grain variety tests are conducted to help southeastern Kansas growers select varieties best adapted for the area. The small grains tested in 1986 included wheat, barley, spring oats, spring wheat, and spring barley.

Experimental Procedure

Forty-two wheat varieties, five barley varieties, seven spring oats, three spring wheats, and four spring barley varieties were grown in 1985-1986. Wheat and barley were planted on October 9 and October 28, respectively, whereas the spring small grains were planted on February 27. Seeding rates were 1,080,000 seeds per acre for both wheat types, 70 lb. per acre for both barley types, and 90 lb. per acre for the spring oats. Winter wheat and barley were fertilized with 78 lb. N per acre, 72 lb. P_2O_5 per acre, and 72 lb. K_2O per acre. The spring small grains were fertilized with 78 lb. N per acre, 72 lb. P_2O_5 per acre, and 72 lb. K_2O per acre.

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Wheat Results

Average yield for all varieties tested was 38 bu per acre. The fall of 1985 was wet and planting was late. A hard freeze in December and a warmer than normal January and February caused some heaving of the wheat. Thus, stands were reduced. In May, the conditions were very favorable for diseases. Yields of the more commonly grown varieties or hybrids are found in Table 52. More complete results for Kansas are compiled in Agric. Expt. Station Report of Progress 505.

Barley Results

Barley yields ranged from 56 to 86 bu per acre (Table 53). Lodging was very high for Kanby and was lowest for Schuyler. Schuyler and Post were the highest yielding varieties for 1986 and the 3-year average.

Spring Oats Results

Yields and yield components of the spring oats may be found in Table 54. Average yield of the test was 86 bu per acre, and test weights averaged 33 lb per bushel. Yields of spring oats ranged from 76 to 99 bu per acre, with Ogle being the highest yielding variety. Lodging was relatively low for all varieties, with Larry and Ogle having the lowest percentages.

Spring Barley Results

Yields for the spring barley averaged 44 bu per acre (Table 55). Robust was the highest yielding variety and Lud had the lowest lodging percentage. Lud and Otis are two-row barleys, whereas Bowers and Robust are six-row barleys. Robust is a barley used for malting. These spring barleys have lower yields than the winter barleys, thus,the potential of growing these in southeastern Kansas does not appear to be good.

Spring Wheat Results

Yields and yield components for Guard and Olso can be found in Table 56. The spring wheat yields were approximately 65 percent of the average yield for the winter wheat. WS-3 is a purple wheat that is high in lysine and protein.

Table 52. Wheat Variety Yields, Parsons, 1986

Brand	Variety or Hybrid	1986 Yield	Winter Survival	1984-1986 Yield
		bu/a	%	bu/a
AGC	101	42	65	--
AGC	102	43	66	--
AgriPro	Stallion	50	66	--
AgriPro	Thunderbird	62*	89	--
AgriPro	Victory	45	73	54*
AgriPro	Wrangler	54	89	52
----	Arkan	42	63	52
Bounty	122	51	74	--
Bounty	205	43	65	--
Bounty	301	48	70	56*
----	Century	40	39	--
----	Larned	40	73	43
RHS	7837	39	59	--
----	Siouxland	53	66	--
----	Sumner	39	58	--
----	TAM 107	51	76	55*
----	TAM 108	42	59	46
----	Triumph 64	44	71	46
----	Caldwell (S)	44	54	--
----	Compton (S)	41	60	--
	LSD (0.05)	7.1	15.3	3.7

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*Upper L.S.D. group. Differences among these values marked with asterisk are not statistically significant.

Planted: October 28, 1985
Harvested: June 17, 1986
Fertilizer: 300 lb/a of 6-24-24 and 57 lb/a N as urea applied before planting.

Table 53. Yield and Yield Components of Winter Barley, 1986.

Variety	Maturity	Test Weight	Lodging	1986 Yield	1984-86 Yield	Plant Height
	Mon. Day	Lb/bu	%	Bu/a	Bu/a	In
Dundy	April 25	39.5	28	56.2	58.2	27
Hitchcock	April 26	37.9	15	58.1	----	30
Kanby	April 26	40.0	71	59.9	50.2	33
Post	April 27	39.9	40	85.8	69.0	36
Schuyler	May 3	41.8	6	72.3	69.5	29
Test Average		39.7	33	66.7	----	31
LSD $_{(0.05)}$		ns	33	11.8	----	2

Planted: October 9, 1985
Harvested: June 10, 1986
Fertilizer: 300 lb/a of 6-24-24 and 57 lb/a N as urea applied before planting.

Table 54. Yield and Yield Components of Spring Oats, 1986.

Variety	Maturity	Test Weight	Lodging	1986 Yield	1984-86 Yield	Plant Height
	Mon. Day	Lb/bu	%	Bu/a	Bu/a	In
Bates	May 9	34.6	18	92.0	82.0	35
Don	May 10	33.5	33	78.5	----	36
Hazel	May 12	33.2	26	75.7	----	36
Larry	May 8	33.0	6	86.0	78.7	33
Ogle	May 13	32.2	9	98.7	87.4	36
Starter	May 8	33.3	19	91.7	----	34
Webster	May 7	32.9	10	82.4	----	35
Test Average		33.2	17	86.4	----	35
LSD $_{(0.05)}$		ns	10	11.5	----	2

Planted: February 27, 1986
Harvested: June 19, 1986
Fertilizer: 300 lb/a of 6-24-24 and 57 lb/a N as urea applied in the fall.

Table 55. Yield and Yield Components of Spring Barley, 1986.

Variety	Maturity	Test Weight	Lodging	1986 Yield	1985-86 Yield	Plant Height
	Mon. Day	Lb/bu	%	Bu/a	Bu/a	In
Bowers	May 9	42.2	24	58.8	49.2	33
Lud	May 16	43.8	9	52.7	46.8	26
Otis	May 7	43.4	92	44.8	39.3	30
Robust	May 8	45.6	16	49.7	43.1	33
Test Average		43.8	35	51.5	----	31
LSD (0.05)		1.6	10	8.6	----	2

Planted: February 27, 1986
Harvested: June 18, 1986
Fertilizer: 300 lb/a of 6-24-24 and 57 lb/a N as urea applied in the fall.

Table 56. Yield and Yield Components of Spring Wheat, 1986.

Variety	Maturity	Test Weight	Lodging	1986 Yield	1985-86 Yield	Plant Height
	Mon. Day	Lb/bu	%	Bu/a	Bu/a	In
Guard	May 12	52.7	5	30.2	25.2	28
Olso	May 6	54.4	6	27.4	25.1	28
WS-3	May 13	48.4	10	20.0	----	31
Test Average		51.8	7	25.8	----	ns
LSD (0.05)		1.2	2	2.0	----	ns

Planted: February 27, 1986
Harvested: June 19, 1986
Fertilizer: 300 lb/a of 6-24-24 and 57 lb/a N as urea applied in the fall.

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Corn Hybrid Performance Test

George V. Granade, Kenneth Kelley, and Ted Walter[2]

Summary

A corn performance test was planted in Montgomery County under irrigation to determine how corn hybrids respond in southeastern Kansas. Several hybrids appear to have potential for southeastern Kansas with irrigation. However, this is the second year for this test and more results are needed to make any conclusions about which hybrids respond best to irrigation in the area.

Introduction

Some corn hybrids are grown in southeastern Kansas under irrigation. Determining which hybrids will perform best in southeastern Kansas is of prime importance to area farmers with irrigation facilities.

Experimental Procedure

In 1986, 53 corn hybrids were planted in an off-station test under irrigation. The corn was planted on March 28 in 30-inch rows in Montgomery County. The corn was irrigated four times on June 19, June 23, June 26, and July 2 with 1, 1.25, 1, and 0.75 inches, respectively.

Results

Moisture was adequate for most of the growing season. The test averaged 160 bu per acre, with a range of 144 to 199 bu per acre. Table 57 shows the yields and yield components of some of the highest yielding hybrids. Complete results are compiled in Agric. Expt. Stn. Report of Progress 510.

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[1] Department of Agronomy, KSU.

Table 57. Corn Hybrids Yields, Montgomery County, 1986

Brand	Hybrid	Yield 1986	 2-yr.	Lodging	Days to Silting
		----Bu/a----		%	
Asgrow/OS Gold	RX860	173	---	3	86
Asgrow/OS Gold	RX892	168	157	6	87
Cargill	971	168	---	3	86
Cargill	126016 Exp	170	---	5	85
DeKalb	DK636	164	151	2	86
Funk's	G-4673A	175	168	5	87
Funk's	G-4635	163	---	5	88
Funk's	RA-1505	163	155	7	88
Garst	8344	164	---	0	87
Garst	8315	177	---	10	90
Golden Acres	T-E 6994	172	146	1	86
Golden Acres	T-E 6996	165	161	3	88
Jacques	8400	178	166	7	88
Jacques	5124 Exp.	170	---	5	87
Northrup-King	6685 Exp.	165	---	8	88
Paymaster	9427	192*	---	7	87
Stauffer Seeds	S8505	199*	---	1	89
Stauffer Seeds	7859 Exp.	168	---	3	88
Terra	TR 3303	166	---	2	85
Terra	TR 1160	166	---	2	86
Triumph	1595	163	148	4	86
Triumph	2020	168	158	3	90
Warner	W-2192	169	---	2	85
Test Mean		160	147	4	87
LSD 0.05		18	---	6	2

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*Upper L.S.D. group. Differences among these values marked with asterisk are not statistically significant.

Planted: March 28, 1986
Harvested: September 9, 1986
Fertilizer: 250 lb/a of 12-30-20 and 190 lb/a N as ammonia applied before planting.
Herbicide: Eradicane Plus at a rate of 6 2/3 pt/a and Aatrex Nine O at a rate of 1.8 lb/a.
Irrigation and Amounts: June 19, June 23, June 26, and July 2 with 1, 1.25, 1, and 0.75 inches, respectively.

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Soybean Variety Performance Test

G. V. Granade and W. T. Schapaugh[1]

Summary

Soybeans from maturity groups III, IV, and V were planted in mid-June at the Columbus Field of the Southeast Kansas Branch Station. Weather conditions were good for soybean growth during the early part of the growing season, but were dry for July and August during flowering and pod setting. Maturity group V soybean varieties continue to show the most consistent high yields in southeastern Kansas. The early maturing soybeans resulted in low yields because of charcoal rot and dry conditions during July and August.

Introduction

Soybeans are an important crop for southeastern Kansas, which has approximately one-third of the state's acreage. Testing and developing varieties that are adapted to the area is of prime importance to area farmers.

Experimental Procedure

Maturity groups III, IV, and V were tested in 1986 at the Columbus Field of the Southeastern Kansas Branch Experiment Station. Soybeans were planted on June 10 in 30-inch rows.

Results

Moisture was good during some of the growing season, with low rainfall in July and August and a wet period during late September. Yields were good for maturity group V soybean, with a test average of 27 bu per acre. However, the group III and IV soybeans yielded much lower. Some of the more commonly grown varieties are listed in Table 58. Complete variety results are compiled in Agric. Expt. Stn. Report of Progress 513.

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[2] Department of Agronomy, KSU.

Table 58. Soybean Cultivar Yields, Columbus Field

Brand	Variety	Maturity Group	1986 Yield Bu/a	1985-86 Yield Bu/a	1984-86 Yield Bu/a
NECO	950	III	18.1	28.4	----
Ohlde	3380	III	14.0	25.1	----
Rohm & Haas	Coker 393	III	15.7	----	----
S-Brand	S-62	III	17.0	----	----
S-Brand	S-67	III	15.1	----	----
----	Williams 82	III	14.3	26.5	21.9
----	Zane	III	12.3	26.7	23.3
	Test mean		14.1	----	----
	LSD 0.05		ns	----	----
----	Crawford	IV	15.0	26.4	22.3
DeLange	DS49	IV	17.0	27.7	21.3
Merschman	Dallas	IV	19.7	----	----
NECO	1350	IV	21.2	31.1	25.4
Ohlde	4386	IV	20.6	32.2	26.1
Rohm & Haas	Mitchell 450	IV	18.0	----	----
----	Sparks	IV	17.6	26.5	22.1
Stine	4190	IV	19.4	----	----
	Test mean		16.7	----	----
	LSD 0.05		3.7	----	----
Asgrow	A5147	V	28.7	----	----
----	Bay	V	28.4	34.7	27.3
Delange	DS51	V	32.3	33.9	----
----	Forrest	V	40.3	40.3	32.2
----	Narow	V	28.2	32.2	26.8
Ohlde	5000 Exp.	V	30.8	34.5	----
----	Pershing	V	25.3	35.3	28.0
----	Stafford	V	26.5	----	----
----	Toano	V	29.6	34.9	----
----	V78-184	V	34.0	37.4	----
	Test mean		27.4	----	----
	LSD 0.05		4.7	----	----

Planted: June 10, 1986.
Fertilizer: 100 lb 18-46-0/a and 100 lb 0-0-60/a on March 17, 1986.
Herbicide: 0.33 lb Lexone DF/a + 1.5 pt Dual/a.

Maturity Group V and VI Soybean Varieties

George V. Granade

Summary

Soybean varieties from maturity groups V and VI were obtained from private and public sources and planted in early June. Several maturity group V soybeans, which are not currently marketed in the area, have potential for southeastern Kansas. Maturity group VI soybeans did as well as the group V soybeans in 1986 because of the late summer rains.

Introduction

Many maturity group V soybean varieties are not currently grown in southeastern Kansas. Some private companies have not promoted group V soybeans in the area. The possibility exists that maturity group VI soybean varieties might be grown.

Experimental Procedure

Soybeans varieties from maturity group V and VI were obtained from public and private breeders. These were planted at the Columbus field on 2 June in 30-inch rows with eight viable seeds per foot in a linear row (139,000 seeds per acre). Lexone DF at the rate of 0.33 lb/a and Dual at the rate of 1.5 pt/a were applied after planting.

Results

Soybean yields ranged from 10 to 32 bu. per acre, with Hartz 6130, a group VI soybean, having the highest yield (Table 59). The highest yielding group V was Forrest with 30 bu. per acre. A half-inch rain following planting, which may have caused some surface compaction, along with metribuzin damage, reduced stands. Two-year averages ranged from 20 to 34 bu. per acre, with Forrest having the highest yield (Table 59).

Table 59. Maturity Group V and VI Soybean Cultivars Yield and Yield Components, Columbus, 1986

Brand-Variety	Maturity Group	Yield 1986	Yield 2-year	Yield 3-year	Plant Height	Maturity	Number of seed	Herbicide Rating[1]
		-------Bu/a	--------		In	Mo-day	/lb	
Bay	V	25.0	32.7	25.6	26	10- 4	2980	5.0
Coker 425	V	24.5	31.8	24.0	20	10- 3	3300	4.3
Coker 485	V	26.9	32.0	----	29	10-22	2440	5.3
Coker 575	V	25.3	31.0	----	27	10-17	3300	5.7
Deltapine 105	V	24.7	30.5	23.7	29	10-19	2890	8.0
Essex	V	14.2	23.0	17.0	20	9-29	4470	4.6
Forrest	V	29.9	34.2	26.4	27	10-17	3620	5.0
Hartz 5171	V	23.7	29.8	----	32	10-21	3190	4.7
Hartz 5252	V	26.4	31.6	----	31	10-15	3360	2.3
Hartz 5370	V	25.6	31.2	----	29	10-17	3330	3.7
Hartz X5164	V	24.7	----	----	30	10-18	2980	4.3
K-77-50-53 I	V	19.0	27.0	----	34	10-13	3000	3.7
Narow	V	20.4	29.4	----	19	10-14	3460	8.0
Pershing	V	25.3	30.4	----	22	10- 1	3940	3.0
RA 451	V	9.9	20.0	----	28	10- 6	3030	3.0
Terra-Vig 515	V	25.1	31.4	----	27	10-22	2810	5.0
Yield King 503	V	19.5	26.0	----	31	10-18	2910	4.0
Yield King 577	V	27.4	----	----	35	10-14	3370	5.3
Asgrow A6242	VI	27.0	----	----	30	10-23	3000	2.3
Asgrow A6381	VI	28.2	----	----	32	10-27	3580	2.7
Bradley	VI	25.6	28.6	21.3	26	10-19	3880	4.0
Coker 156	VI	20.2	26.9	20.5	27	10-25	3220	9.0
Coker 606	VI	24.9	----	----	37	10-26	3140	4.7
Davis	VI	25.5	26.3	19.0	38	10-26	2680	2.7
Hartz 6130	VI	32.2	33.1	----	32	10-22	3620	2.7
RA 604	VI	27.2	30.0	----	36	10-28	2580	3.3
Terra-Vig 553	VI	22.2	23.9	----	30	10-20	2640	3.0
Terra-Vig 606	VI	24.4	26.4	----	30	10-27	2930	8.0
Terra-Vig 616	VI	23.2	25.4	----	32	10-28	4030	4.3
Tracy M	VI	21.9	26.2	19.1	34	10-27	2570	2.3
Yield King 593	VI	27.5	30.2	----	34	10-27	2590	4.0
Yield King 613	VI	25.5	25.7	----	40	10-21	3700	4.0
Yield King 696	VI	23.8	----	----	34	10-27	3390	4.7
L.S.D.$_{.05}$		6.2			5		397	1.8
Test mean		24.0			30		3240	4.4
C.V. (%)		15.7			10.4		7.5	24.8

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[1] Soybeans were rated for metribuzin damage on a scale of 1 to 10, with 1 being no damage and 10 complete kill.

Planted: June 2, 1986.
Herbicide: 0.33 lb/a of Metribuzin + 1.5 pt/a Dual on June 2, 1986.
Fertilizer: 100 lb of 18-46-0/a; 100 lb of 0-0-46/a on March 24, 1986.

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Performance of Popcorn Hybrids

G. V. Granade and J. P. Shroyer[1]

Summary

Nine popcorn hybrids were planted in mid-April to examine the potential of growing popcorn in southeastern Kansas. Yields ranged from 1000 to 1560 lb per acre, with IOPOP 12 having the highest yield. Popping quality ranged from 27 to 31 cc/g, thus, this was not generic popcorn. Popping quality was probably affected by the dry conditions in July and August.

Introduction

Alternate crops are being sought to provide some relief from the poor economic situation. One possible crop to grow in southeastern Kansas is popcorn. Popcorn could probably be grown on the same ground as field corn. The objective of this test was to examine the yield potential of popcorn in southeastern Kansas.

Experimental Procedures

Nine popcorn hybrids were obtained and planted on April 18 in 30-inch rows on the Parsons' field. The area was in soybeans in 1985 and popcorn was planted at a target population of 23,200 plants per acre. Data collected include mid-silk date, plant population, percent lodging, test weight, number of kernels per 10 grams, and yield per acre. After harvesting, a popping test was conducted to determine the quality of the popcorn. This was done by weighing 250 grams of seeds and placing them in a Cretors' popper at 480 F in a half a cup of salad oil. After popping, the volume was measured. Generic popcorn has a popping quality of 32 cc/g or higher.

Results

Rainfall was good until July, when conditions became dry. IOPOP 12 had the highest yield, and 9304, P203, and P405 had the highest popping quality (Table 60). Lodging was high for all hybrids, with 03196 having the lowest percentage. More testing is needed in order to determine which hybrids are best adapted to southeastern Kansas.

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[1] Department of Agronomy, KSU.

Table 60. Yield and Yield Components of Popcorn Varieties, 1986.

Variety	Yield*	Lodging	Test Weight	Population	Silk Date	Popping Quality	Number of Kernels
	lb/a	%	lb/bu	plants/a	month day	cc/g	/10g
03196	995	39	59.2	22,000	July 1	30.0	107
9304	1155	50	61.6	20,600	June 30	31.0	106
42235a	1536	42	62.0	20,200	June 28	29.5	85
73102A	1535	54	62.3	24,500	July 2	28.0	111
IOPOP 12	1559	66	63.4	25,000	July 1	27.5	103
P203	1404	45	60.9	21,400	June 28	31.0	97
P405	1197	60	62.6	22,100	June 29	31.0	106
P410	1052	75	61.4	22,600	July 4	27.0	97
P608	1258	64	62.6	24,000	July 2	29.5	92
LSD 0.01	346	18	2.0	3,200	----	2.0	11

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* Yield is adjusted to 15.5 per cent moisture.

Planted: April 18, 1986.
Herbicide: 1.25 qt Atrazine 4L/a.
Fertilizer: 300 lb 6-24-24/a plus 82 lb N/a as urea.

Soybean Cultivar Responses to Different Tillage Systems in Southeastern Kansas[1]

G.V. Granade, D.W. Sweeney, and W.T. Schapaugh[2]

Summary

In 1986, dry conditions in July and August reduced the yields of soybean cultivars drastically. Tillage systems resulted in significantly different plant populations and plant height. There was no interaction of tillage system with soybean cultivar for any measured parameter.

Introduction

Doublecropping of soybeans in southeastern Kansas is a common practice, when time and soil moisture are available. Selection of the best cultivar is usually based on the results from the soybean performance report, which is for full-season soybeans. Several states have reported that the results from the performance tests can be used for doublecrop systems; however, other states have indicated that there are differences. A study was undertaken to examine the response of different soybean cultivars after wheat in three different tillage systems.

Experimental Procedures

Chisholm wheat was planted in October, 1985, and harvested in June, 1986, with a yield of 45 bu per acre. Soybeans were planted in 30-inch rows in three tillage systems: a) burn (burn, wheat stubble, disc several times), b) minimum tillage (disc twice with offset disc), and c) no-tillage. Soybean cultivars included Coker 393, Williams 82, Zane (all maturity group III); Crawford, Northrup King S42-40, Pioneer 9441, Sparks (all maturity group IV); and Bay, Essex, K77-50-53, Narow, and Pershing (all maturity group V).

Soybeans were planted at a target population of 139,000 plants per acre. Data collected were stand count, plant height, maturity, number of seeds per pound, and yield. Number of seed per pound was determined by the conversion of 100-seed weight.

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[1] This research is supported by a grant from the Kansas Soybean Commission.
[2] Department of Agronomy, Kansas State University.

Results

Rainfall for July and early August, 1986 was low; thus, yields of most field crops, including soybeans, were reduced from their potential. Yields for this study averaged 8.8 bu/a, with Bay being the highest yielder (Table 61). Bay had the largest seed and Pioneer 9441 and Coker 393 had the smallest seed (Table 61).

There was a significant difference between tillage systems for plant populations and plant height (Table 62). The burn system had the highest population, whereas the no-tillage system had the lowest. Since all systems were planted for the same target population, this indicates that plant populations in the minimum and no-tillage systems were probably reduced by poor soil-to-seed contact. This poor contact was due to the straw residue, which was either mixed or left on the surface of the soil. Soybean plants averaged over cultivars were taller in the no-tillage system than in the burn system.

Table 61. Seed per Pound and Yield for Soybean Cultivars, 1986.

Soybean Cultivar	Yield	Seed Number
	Bu/a	/lb
Coker 393	5.4	3720
Williams 82	6.4	3250
Zane	6.8	3020
Crawford	8.1	3000
NK S42-40	8.0	3560
Pioneer 9441	6.5	3780
Sparks	6.3	3250
Bay	15.4	2310
Essex	9.2	2820
K77-50-53 I	10.0	2740
Narow	13.6	2990
Pershing	9.9	3160
LSD $_{.05}$	2.1	279
Test mean	8.8	3140

Table 62. Effect of Tillage Systems on Soybean Plant Population and Plant Height.

System	Plant Population	Plant Height
	Plants/A	Inches
Burn	103,330	19
Minimum	82,840	21
No-tillage	57,750	23
$LSD_{.05}$	23,256	1.8
Test mean	81,530	21

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Phosphorus, Potassium, and Chloride Effects on Different Soybean Cultivars[1]

G.V. Granade, C.A. Pearson[2], F.W. Schwenk[2], and W.T.Schapaugh[3]

Introduction

Approximately 33 percent of Kansas' soybeans are grown in the southeastern part of the state. Soil test results from 1980 and 1981 indicated that over half of the soils from southeastern Kansas were low to medium in K, and 78 percent were low to medium in P. Charcoal rot is a major disease in southeastern Kansas and recently has been estimated to reduce yields by as much as 50 percent in some fields. In a study initiated in 1985 and continued in 1986, we examined the effects of P, K, or Cl levels individually, or the P-K interaction, on several yield parameters and on the incidence of charcoal rot in different soybean cultivars.

Experimental Procedure

The experimental design was a split plot with a factorial arrangement of P, K, and Cl as whole plots and soybean cultivars as split plots with three replications. Rates of P were 0, 60, and 120 lb P_2O_5 per acre; K rates were 0, 75, and 150 lb K_2O per acre; and Cl rates were 0 and 118 lb Cl per acre. Phosphorus was applied as triple superphosphate; K was applied as muriate of potash (potassium sulfate was used in plots receiving K but not Cl); and Cl was applied as calcium chloride where K was not added. Six soybean cultivars from three maturity groups were used: Harper and Sprite (maturity group III), Desoto and Douglas (maturity group IV), and Bay and Essex (maturity group V).

The experiment was conducted on a Parsons silt loam at the Parsons field. Fertilizer was broadcast by hand and incorporated on 22 May, 1985 and 13 May, 1986, and soybeans were planted on 23 May, 1985 and 14 May, 1986. Six weeks after planting, 20 leaflets per treatment were collected and analyzed for N, P, and K, and roots from four plants per treatment were collected to determine the amount of charcoal. Sampling was continued during the growing season at 3-week intervals until seed harvest. Whole plant samples were taken at the R6 growth stage and analyzed for N, P, K, and Cl. Plant height, seeds per pound, and yield per acre were measured.

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[1] This research was supported by a grant from the Potash and Phosphorus Institute.

[2] Department of Plant Pathology, KSU.

[3] Department of Agronomy, KSU.

Results

The mean test yield was 39 bu/a in 1985 and 19 bu/a in 1986. Rainfall in August and September, 1985 was higher than normal, whereas rainfall patterns in 1986 were more typical for the area.

P and K Effects

A soybean cultivar-by-P_2O_5 interaction was significant for yield in 1985 and for P uptake in 1986 (Table 63). Sprite and Essex had significant yield increases at 60 lb P_2O_5/a, whereas yields of Harper, Desoto, and Bay did not increase significantly until P_2O_5 levels were increased by 120 lb/a. In 1986, P uptake levels were signficantly higher in all cultivars, except Essex, in treatments in which P_2O_5 was applied at 120 lb/a. The uptake of N, P, and K was significant for P_2O_5 (Table 64). In 1985, P uptake was increased with increasing amounts of added P_2O_5, and, in 1986, increasing amounts of of added P_2O_5 increased the amount of N, P, and K in the plant at the R6 growth stage.

Application of K_2O significantly affected yield, number of seeds per pound, and K uptake by the plant at the R6 growth stage (Table 65). In 1985, 75 lb K_2O/a significantly increased soybean yield over the control. Although not significant, in 1986, 75 lb K_2O produced a higher yield than the check. Seed size was increased (i.e., number of seeds per pound was decreased) as K_2O was increased. Although not significant, the largest seeds in 1986 were produced with 150 lb K_2O/a. Potassium levels were significantly higher in plants from plots treated with 150 lb K_2O than from either the 75 lb/a treatment or the control. However, the minimal increase of the 75 lb K_2O/a treatment (0.6 bu/a increase in 1985 and 0.1 bu/a increase in 1986), without corresponding increasing in yield, would suggest that luxury consumption is occurring in the plants or that the soil is limited to the amount of available K.

The effect of P, K, and soybean cultivar on the rate of colonization of the charcoal rot fungus can be seen in Table 66. P and K did not significantly affect the colonization rate in 1985 or 1986. Douglas and Harper had the highest rate of colonization in all treatments.

K and Cl Effects

The effects of K_2O, Cl, and cultivar on yield, plant height, and number of seeds per pound are shown in Table 67. The yield decreases from Cl were not signficant. K_2O at 150 lb/a increased yields significantly in both 1985 and 1986. Desoto and Harper were the highest yielding cultivars in 1985, whereas Bay and Essex were in 1986. The amount of Cl taken up by a cultivar could be significantly increased by applying Cl, depending upon cultivar (Table 68). Sprite and Desoto showed no significant increase in Cl uptake in either 1985 or 1986, whereas Harper, Bay, and Essex did in both years. Chloride effects on the rate of colonization of the charcoal rot fungus can be found in Table 69. In 1985, chloride significantly increased the rate of colonization; no differences were observed in 1986.

Table 63. Soybean Yield, and Phosphorus Uptake as Influenced by Phosphorus and Cultivar Selection, 1985 and 1986

P_2O_5	Soybean Cultivar					
	Harper	Sprite	Desoto	Douglas	Bay	Essex
lb/a			Yield, Bu/a			
			1985			
0	40.8	29.9	43.0	42.6	34.0	34.2
60	37.7	33.7	44.3	42.7	35.5	38.6
120	45.2	33.4	46.3	44.3	37.5	40.3
$LSD_{(0.05,\ \text{any comparison})}$		3.2				
			1986			
0	19.0	17.2	17.9	20.2	19.7	20.8
60	18.6	16.7	18.6	19.2	18.4	20.2
120	19.1	17.5	18.9	20.5	20.4	20.8
$LSD_{(0.05,\ \text{any comparison})}$			NS			
			Phosphorus Uptake, lb/a			
			1985			
0	12.4	8.5	13.6	13.4	13.0	12.3
60	16.3	9.6	19.1	13.7	17.3	17.0
120	16.0	11.0	19.5	18.5	20.6	20.6
$LSD_{(0.05,\ \text{any comparison})}$		NS				
			1986			
0	6.6	5.6	7.2	7.6	9.3	7.4
60	7.0	7.2	8.1	7.1	11.2	7.7
120	9.7	8.4	11.3	9.2	16.2	8.8
$LSD_{(0.05,\ \text{any comparison})}$		2.1				

Table 64. Phosphorus Effects on Plant Uptake of Nitrogen, Phosphorus, and Potassium at the R6 Stage, 1985 and 1986.

P_2O_5	Nitrogen		Phosphorus		Potassium	
	1985	1986	1985	1986	1985	1986
lb/a	-----lb/a-----		----lb/a----		----lb/a-----	
0	173.7	118.8	12.2	7.3	53.0	40.6
60	193.3	113.1	15.5	8.0	57.5	36.3
120	208.4	133.4	17.7	10.6	60.6	45.1
$LSD_{(0.01)}$	22.4	ns	2.0	1.3	ns	5.2
$LSD_{(0.05)}$	----	14.7	---	---	ns	---

Table 65. Potassium Effects on Yield per Acre, Number of Seeds per Pound, and Potassium Uptake, 1985 and 1986.

K_2O	Yield		Number of Seeds per Pound		Potassium Uptake	
	1985	1986	1985	1986	1985	1986
Lb/a	----Bu/a----				----Lb/a----	
0	36.6	18.4	2705	3149	43.5	30.8
75	40.1	19.4	2622	3148	58.4	42.3
150	40.7	19.5	2596	3075	69.3	48.9
$LSD_{(0.01)}$	2.7	ns	--	ns	9.8	6.8
$LSD_{(0.05)}$	---	ns	34	ns	---	---

Table 66. Phosphorus, Potassium, and Soybean Cultivar Effects on the Rate of Colonization of Charcoal Rot Fungus, 1985 and 1986.

Fertilizer or Cultivar	Rate of Colonization 1985	Rate of Colonization 1986
P_2O_5 lb/a		
0	0.328	0.286
60	0.295	0.273
120	0.306	0.242
$LSD_{(0.05)}$	NS	NS
K_2O lb/a		
0	0.304	0.262
75	0.312	0.272
150	0.313	0.268
$LSD_{(0.05)}$	NS	NS
Cultivar		
Harper	0.344	0.357
Sprite	0.285	0.280
Desoto	0.335	0.283
Douglas	0.410	0.291
Bay	0.236	0.189
Essex	0.248	0.203
$LSD_{(0.01)}$	0.159	0.127

Growth rate denotes the rate at which the fungus colonizes the soybean root. This was determined from linear regression of Log_{10} transformed data with respect to host growth stage.

Table 67. Yield and Yield Components as Influenced by K, Cl, and Soybean Cultivars for 1985 and 1986.

Soybean Cultivar	K_2O	Cl	Yield		Plant Height		Number of Seed per Pound	
			1985	1986	1985	1986	1985	1986
	Lb/a	Lb/a	----Bu/a----		----In----			
Harper	0	0	41.6	17.1	24	20	1995	2593
	0	118	34.8	17.5	23	22	2260	2636
	150	0	46.6	20.5	24	21	1861	2356
	150	118	46.4	21.0	23	22	1947	2405
Sprite	0	0	28.6	15.3	16	17	2341	3003
	0	118	30.2	18.6	15	17	2539	3036
	150	0	37.7	19.6	16	19	2046	3019
	150	118	34.8	19.0	15	18	2072	2909
Desoto	0	0	43.4	19.8	32	25	2400	3305
	0	118	39.3	17.8	31	24	2616	3277
	150	0	53.3	20.4	32	27	2215	3174
	150	118	48.4	21.2	32	26	2283	3226
Douglas	0	0	41.4	18.3	31	26	2370	2884
	0	118	40.8	17.2	29	25	2482	3099
	150	0	53.0	21.3	29	27	2100	2752
	150	118	46.2	19.5	30	26	2417	2784
Bay	0	0	36.6	20.0	34	27	3073	2946
	0	118	34.2	19.5	34	26	3104	3210
	150	0	41.4	21.4	34	31	3041	2992
	150	118	38.0	22.0	35	30	2979	2986
Essex	0	0	37.7	18.6	24	20	3957	4525
	0	118	34.4	19.0	24	20	3845	4680
	150	0	44.6	23.8	26	25	3659	4209
	150	118	42.5	23.2	26	23	3884	4133
$LSD_{(0.05)}$			ns	ns	ns	ns	ns	ns
Main Effects								
		0	42.2	19.7	27	24	2588	3146
		118	39.2	19.6	27	23	2702	3198
$LSD_{(0.05)}$			ns	ns	ns	ns	ns	ns
	0		36.9	18.2	26	22	2749	3266
	150		44.4	21.1	27	25	2542	3079
$LSD_{(0.01)}$			6.8	2.2	ns	1	ns	ns
$LSD_{(0.05)}$			---	---	ns	-	ns	138
Harper			42.3	19.0	23	21	2016	2497
Sprite			32.8	18.1	16	18	2250	2992
Desoto			46.1	19.8	32	25	2379	3246
Douglas			45.4	19.1	32	26	2342	2880
Bay			37.6	20.7	34	29	3049	3034
Essex			39.8	21.1	25	22	3836	4387
$LSD_{(0.01)}$			4.7	2.1	2	1	146	175

Table 68. Chloride and Soybean Cultivar Effect on the Uptake of Chloride at R6 Growth Stage.

	1985		1986	
Cultivar	0	118	0	118
	----Lb/a-----		-----Lb/a-----	
Harper	3.1	11.4	1.6	8.9
Sprite	0.9	1.4	0.8	1.2
Douglas	2.7	11.5	1.8	3.0
Desoto	2.5	5.0	1.9	4.5
Essex	3.9	13.2	2.0	11.7
Bay	3.9	13.3	3.3	19.4
$LSD_{(0.01)}$	2.6		4.2	

Table 69. Chloride Effects on the Rate of Colonization of the Charcoal Rot Fungus

	Rate of Colonization	
Cl	1985	1986
Lb/a		
0	0.194	0.260
118	0.297	0.269
$LSD_{(0.05)}$	0.130	NS

Growth rate denotes the rate at which the fungus colonizes the soybean root. This was determined from linear regression of Log_{10} transformed data with respect to host growth stage.

Sulfur Effects on Different Soybean Cultivars[1]

G. V. Granade and D. W. Sweeney

Summary

Four soybean cultivars differed in yield and yield components. Sulfur did not affect any yield components and there was no interaction between sulfur and cultivar.

Introduction

Results from an unrelated 1985 fertility study suggested that sulfur-containing fertilizer might increase soybean yields. Based on this limited data, a study was initiated in 1986 to determine whether selected soybean cultivars would respond to different rates of S fertilization.

Experimental Procedure

The experimental design was a split plot with sulfur rates as whole plots and soybean cultivars as subplots. Sulfur rates were 0, 25, 50, and 75 lb S per acre and soybean cultivars were DeSoto and Douglas from maturity group IV and Bay and Essex from maturity group V. Sulfur was applied as $(NH_4)_2SO_4$ and broadcast by hand before planting. Since N was applied with S (even though not recommended for soybeans), N was balanced with urea in all plots to equal the N rate that resulted from the 75 lb S per acre application. All plots received P_2O_5 at the rate of 60 lb per acre as triple superphosphate and K_2O at the rate of 90 lb per acre as muriate of potash.

The experiment was conducted on a Parsons silt loam (Mollic Albaqualf) at the Parsons' field. This site was in soybeans in 1985 and wheat in 1984. The site was chiseled and disced before planting on 3 June 1986. At the R6 growth stage, 18 inches of the border row were harvested for measuring leaf area, then leaves were dried for specific leaf weight. Plant height, seeds per pound, and yield per acre were some of the yield components that were measured.

Results

A significant difference ($P<0.01$) was found for leaf area index, specific leaf weight, plant height, seeds per pound, maturity, and yield per

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[1] Research is partially supported by grants from The Sulphur Institute and The Allied Corporation.

acre for soybean cultivars (Table 70). Bay was the highest yielding cultivar and latest maturing variety. Douglas was the lowest yielding cultivar, but had the second largest size seeds. Bay and Douglas had the greatest leaf area, whereas Bay and Essex had the thickest leaves, as indicated by specific leaf weight.

Sulfur did not significantly affect any of the yield components and there was no interaction between sulfur and cultivar. Even though these first-year data suggest minimal, if any, response to sulfur, the experiment will be continued to determine the long-term response.

Table 70. Yield and Yield Components for Soybean Cultivars.

Cultivar	Yield	Plant Height	Maturity	Number of Seed	Leaf Area Index	Specific Leaf Wt.
	lb/a	inches	Julian Day	/lb		mg/cm^2
DeSoto	22.1	26	256	3120	2.52	4.69
Douglas	21.0	26	260	2660	2.90	5.36
Bay	27.5	28	276	2450	2.96	5.87
Essex	22.8	21	269	3520	2.04	5.86
$LSD_{0.01}$	2.1	1	1	130	0.44	0.50

Comparisons of Grain Sorghum, Soybean, and Sunflower Cultivars when Doublecropped after Wheat

George V. Granade and Kenneth Kelley

Summary

Five sunflower cultivars at two nitrogen levels and 10 cultivars of grain sorghum and soybeans were evaluated in a doublecrop study. Yields of grain sorghum ranged from 25 to 53 bu/a, with Paymaster 1022 being the highest yield. Soybean yields ranged from 8 to 18 bu/a, with K77-50-63 being the highest yield. Sunflower yields ranged from 600 to 1200 lb/a, with PAG 100 having the highest yield.

Introduction

Doublecropping after wheat is a common practice in southeastern Kansas. Typically, soybeans are the major crop grown after wheat; however, interest has been renewed in using grain sorghum and even sunflowers. The objective of this study was to examine the yield potential of different cultivars of soybeans, grain sorghum, and sunflower grown at two nitrogen levels after wheat harvest.

Experimental Procedures

Grain sorghum, soybeans, and sunflowers were planted after Arkan wheat at the Parsons field. This area was fallowed during the summer of 1985 and was in alfalfa during the previous 3 years. After wheat harvest, the wheat stubble was burned and then disced twice. Ten soybean cultivars and 10 grain sorghum hybrids were planted on June 19. Grain sorghum received 75 lb of N as urea, which was disced in prior to planting. Five cultivars of sunflowers were planted at two N levels on June 30. Nitrogen rates were 0 and 50 lb applied as urea on June 19.

Results

Rainfall was fairly typical of the area in 1986, except in July and August when conditions were dry. Yields of the three crops reflect this, as indicated in Table 71. Grain sorghum yields ranged from 25 to 53 bu/a, soybean yields ranged from 8 to 18 bu/a, and sunflower yields ranged from 600 to 1200 lb/a.

Wetter than average September and October caused some molding and sprouting in the grain sorghum and, to a lesser extent, in the soybeans and sunflowers. Grain sorghum cultivars that bloomed in late August had an increase in yield over cultivars blooming in early August. However, these late blooming cultivars had a higher percent moisture at harvest than the early blooming cultivars. Soybean cultivars in maturity groups IV and V had a higher yield than the group III soybeans because of the rain in late September and early October. Sunflowers did not respond to the N applied, probably because of the residual N from the alfalfa. However, there were significant differences between cultivars regardless of N applied.

More yield data comparisons are needed over more varying climatic conditions to determine which crop or crops are best suited for growing as a doublecrop in the soil and climate of southeastern Kansas.

Table 71. Comparisons of Selected Grain Sorghum, Soybean, and Sunflower Cultivars Doublecropped after Wheat, Parsons Field, 1986.

Brand-Cultivar		Yield bu/a	Test Weight lb/bu	Plant Height inches	Half Bloom Date month day	Harvest Moisture %
			Grain Sorghum			
DeKalb 39Y		42.5	51.6	37	August 9	16.3
DeKalb 42Y		45.3	54.1	38	August 18	20.5
Funks 499		41.2	47.8	35	August 12	16.2
Garst 5517		52.0	52.9	40	August 16	18.5
NC +163		42.5	47.7	38	August 10	16.1
Northrup King 2030		34.2	50.7	32	August 4	16.1
Paymaster 1022		53.3	51.5	36	August 14	19.5
Pioneer 8790		32.5	52.9	38	August 9	17.0
PAG 4433		25.0	47.2	34	August 8	15.9
Stauffer 9525		43.3	53.5	42	August 8	16.1
LSD 0.05		4.8	2.5	--	---- --	2.5
			Soybeans			
	Maturity Group				Maturity	Seed/ pound
Sherman	III	7.6	56.7	16	September 20	3520
Zane	III	10.3	56.5	17	September 20	2690
Crawford	IV	16.8	56.0	24	October 25	2850
Douglas	IV	13.1	54.5	22	October 25	2810
Pioneer 9441	IV	16.0	55.6	20	October 2	3700
Sparks	IV	17.3	55.2	28	October 7	3080
Essex	V	11.4	53.6	19	October 27	3270
K77-50-53	V	18.0	50.0	24	October 30	2840
K77-50-63	V	17.5	52.4	21	October 30	2950
Pershing	V	16.3	56.1	16	October 26	3810
LSD 0.05		5.1	3.5	3	------- --	351
			Sunflowers			
	Nitrogen Rate lb/a	lb/a		Oil Content %	Population plants/a	Lodging %
Cargill 205	0	897	25.7	44.5	21,780	12
Cargill 205	50	795	26.5	44.4	21,580	10
Interstate 7000	0	619	22.8	42.0	21,380	16
Interstate 7000	50	604	22.5	40.8	18,410	17
PAG 100	0	1022	26.8	43.5	22,970	7
PAG 100	50	1170	27.0	43.2	23,460	6
Stauffer 1300	0	609	25.9	41.5	23,070	24
Stauffer 1300	50	666	26.8	41.9	20,990	24
Triumph 548	0	752	21.5	44.0	22,970	16
Triumph 548	50	773	22.4	44.4	23,260	19
LSD 0.05		ns	ns	ns	ns	ns

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Early Maturity Soybeans in Southeastern Kansas

George V. Granade

Summary

Soybeans from maturity groups 00, 0, and I were planted in late April in two locations of Southeastern Kansas. Yields at one location averaged 29 bu per acre and at the second location averaged 20 bu per acre. Asgrow A1937 and Hodgson 78 were the highest yielding varieties at both locations.

Introduction

Interest has increased in growing early soybeans and then following them with wheat in the fall. Maturity group 00, 0, and I soybeans are normally grown in the northern part of the United States; however, the possibility exists of growing these soybeans in southeastern Kansas. The growing season will be shorter and plant height will be reduced. The objective of this study was to examine yield potential of soybeans from maturity group 00, 0, and I.

Experimental Procedures

Four soybean cultivars from maturity groups 00, 0, and I were obtained and planted on 25 April in Mr. Calvin Flaherty's field, McCune and the Columbus field of the Southeast Kansas Branch Experiment Station. Soybeans were drilled in 7-inch rows at the rate of 2 bushels per acre. Plant height, maturity, yield per acre, and number of seeds per pound were recorded.

Results

Yields at McCune ranged from 27 to 29 bu per acre, whereas the yields at Columbus ranged from 18 to 24 bu per acre (Table 72). All varieties at both McCune and Columbus matured during mid-July and were harvested in early August. Asgrow A1937 was the highest yielding variety at both locations. Low rainfall during late June and early July reduced yields.

Table 72. Yield and Yield Components of Early Soybeans Planted at Columbus and McCune, 1986.

Soybean Cultivar	Maturity Group	Yield[1]	Plant Height	Maturity		Number of Seeds per pound
		bu/a	inches	Month	Day	
			McCune			
A1937	I	29.5	24	July	27	4460
Dawson	0	27.2	18	July	19	4280
Hodson 78	I	29.5	23	July	25	4070
McCall	00	29.3	19	July	15	4460
Test mean		28.9	21			4320
			Columbus			
A1937	I	23.6	21	July	25	4960
Dawson	0	18.3	16	July	17	4520
Hodson 78	I	20.0	18	July	24	4310
McCall	00	19.0	18	July	12	4690
Test mean		20.2	18			4620

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[1] Yield is adjusted to 60 lb per bushel and 13 % moisture.

Planted: April 25, 1986 both locations.

Herbicide: McCune -- Dual at 1.5 pt per acre -- April 22.
Columbus -- 1 pt Blazer + 1.5 pt Poast + 1 pt crop Oil -- June 2.

SEK SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Warm-season Annual Grasses for Hay Production

Joe L. Moyer

Summary

Sudan-type grasses were evaluated from three cuttings for hay production and quality. Twenty-four entries, including seven millets, were evaluated for yield, leaf:stem ratio, crude protein content, and grazing preference. Millets yielded about 75% as much as the sudan-sorghums, but had an 85% greater leaf:stem ratio, and almost a percentage point higher crude protein content. Millets were grazed less than sudan types in a free-choice situation, however. Differences for each trait were found within each species group.

Introduction

A sudan-type hay test, which included both yield and quality evaluations, was offered in 1986 for commercial entrants on a fee basis. Check lines and public experimentals were added to the 14 commercial entries to comprise 24 entries, seven of them millets.

Experimental Procedure

The test was seeded in 25'x5'(six 10-inch rows) plots at the rate of 450,000 live seeds/acre, replicated three times. Two seedings were necessary because the May 9 planting received heavy rain on the 2 lb/a propazine preemergent herbicide, resulting in poor millet stands. The second planting (May 29) was cut on 3 and 31 July and 22 September for hay yield and quality determinations. Both plot areas received preplant applications of 100-40-40 lb/a of N-P_2O_5-K_2O, and the hay plots also received 60 lb N/a (as urea) immediately after the first cutting. Plots were grazed on 23 June, clipped, grazed again on 4-6 August, and evaluated on 7 August.

Hay plots were cut with a 3' flail harvester, and whole plants for leaf:stem ratio determination were cut from either side of the harvest strip. Subsamples were collected from the flailed material for moisture determination, and dried subsamples were ground for lab analyses.

Results

Forage yields from each cut and from the season are shown in Table 73. All sudans and sorghum-sudan hybrids yielded more than any millet, except for a few cases in cut 3. Millets' yields differed significantly (P>.95) in cuts 1 and 3, but the differences were cancelled for total production. Occansionally, a commercial line was higher yielding than the standard sudangrasses ('Greenleaf' and 'Piper', but none yielded significantly more than the check hybrid, NB280S.

Estimates of forage quality generally favored the millets (Table 74). Leaf:stem ratio was usually higher in millets than in the sudan types. The greatest differences occurred in the first cutting, but by cut 3 the differences were few. Within the millets, 'Hy-Per-Mil' was generally less leafy than most other entries, whereas 'Tifleaf I' was usually most leafy at immature stages. In the sudan types, 'Tx623A x Dw. Ga337' was most leafy in the first two cuttings, whereas 'Piper' was least leafy. Crude protein contents varied less, but millets were higher than the sudan types, especially in the first cutting. The millet-napier hybrid was generally highest in crude protein content. No trends were obvious within the sudan group.

Grazing intensity was lower for millets than for the sudan types (Table 75). Among the millets, the napier-millet hybrid was used most, and 'Gahi III' was least consumed. 'Greenleaf' was the sudan-type selected most by cattle, whereas NB280S generally seemed least preferred.

Table 73. Hay Yields of Sudan-type Forage Lines, 1986.

	Forage Yield (tons/acre @ 12% moisture)			
Entry	Cut 1	Cut 2	Cut 3	Total
85 DA x 383	0.89	1.19	1.34	3.42
Tifleaf I	0.96	1.18	1.37	3.51
Gahi III	0.89	1.16	1.61	3.66
23A x Napier	0.56	1.37	1.67	3.60
Hy-Per-Mil	1.23	1.39	1.06	3.67
Milhy 100	1.18	1.36	1.02	3.55
3 Mil-X	0.92	1.40	1.12	3.44
Greenleaf (Ck)	1.28	1.88	1.39	4.55
Piper (Ck)	1.44	2.11	1.36	4.92
Bravo II	1.53	2.13	1.32	4.98
Sweeter Su II	1.75	1.83	1.87	5.45
J-51	1.61	1.89	1.46	4.96
Grazex	1.88	1.97	1.83	5.68
Piper x Redlan (Ck)	1.54	1.78	1.45	4.77
877-F	1.83	1.81	1.79	5.43
Do Mor	2.01	1.63	1.65	5.29
Gro-N-Graze	1.90	1.66	1.60	5.16
GSA 1757	1.82	1.58	1.67	5.07
NB280S (Ck)	1.64	2.06	1.77	5.47
SSX643	1.96	1.97	1.90	5.83
SSX343	1.88	1.92	1.79	5.58
Tx623A x Ga337	1.62	1.78	1.53	4.93
Tx623A x Dw Ga337	1.77	1.71	1.54	5.02
757	1.89	1.66	1.52	5.08
LSD(.05)	0.41	0.52	0.38	0.90
Test Average	1.50	1.68	1.53	4.71

Table 74. Forage Quality Parameters of Sudan Hays, 1986.

Entry	Leaf:Stem Ratio			Crude Protein Content		
	Cut 1	Cut 2	Cut 3	Cut 1	Cut 2	Cut 3
				- - - - - -	% - - - - - -	
85 DA x 383	6.73	3.24	2.78	22.0	10.0	9.7
Tifleaf I	10.49	3.63	1.39	20.0	9.7	9.9
Gahi III	7.42	1.93	1.78	18.4	9.0	8.0
23A x Napier	4.04	2.46	1.88	21.2	12.1	11.9
Hy-Per-Mil	3.54	0.92	0.72	18.4	9.5	9.4
Milhy 100	4.34	1.52	1.06	17.8	9.7	9.1
3 Mil-X	5.90	2.02	0.91	20.1	9.9	9.7
Greenleaf (Ck)	1.50	1.16	1.23	21.2	8.1	9.6
Piper (Ck)	1.08	0.81	0.69	20.1	8.9	9.5
Bravo II	1.15	1.01	1.16	18.5	9.0	9.6
Sweeter Su II	1.51	1.19	0.90	20.9	10.3	8.7
J-51	1.56	1.09	0.97	18.3	8.9	10.5
Grazex	1.30	1.03	0.70	15.3	9.2	7.3
Piper x Redlan (Ck)	1.36	1.15	0.49	16.4	8.3	8.2
877-F	1.60	1.35	0.92	15.0	9.1	8.7
Do Mor	1.34	1.32	0.84	15.3	10.8	9.7
Gro-N-Graze	1.26	1.13	0.65	16.1	10.0	8.4
GSA 1757	1.68	1.34	0.83	14.5	9.3	9.2
NB280S (Ck)	1.28	1.10	0.52	18.2	10.2	8.2
SSX643	1.49	1.04	0.82	15.2	8.8	8.2
SSX343	1.46	1.13	0.81	16.0	9.1	9.0
Tx623A x Ga337	1.46	1.33	0.85	15.7	8.7	8.3
Tx623A x Dw Ga337	2.06	1.56	0.77	18.9	9.6	8.6
757	1.37	1.30	0.92	15.4	8.8	8.2
LSD(.05)	2.35	0.53	0.66	4.1	3.2	NS
Test Average	2.79	1.49	1.03	17.9	9.5	9.1

Table 75. Grazing Intensity by Heifers of Sudan-type test.

	Grazing Intensity Rating (0-5)	
Entry	Cut 1	Cut 2
85 DA x 383	1.6	0.9
Tifleaf I	1.1	1.0
Gahi III	1.0	0.7
23A x Napier	1.8	1.2
Hy-Per-Mil	1.5	1.1
Milhy 100	1.1	0.8
3 Mil-X	1.1	0.9
Greenleaf (Ck)	4.1	3.5
Piper (Ck)	3.6	2.8
Bravo II	3.0	3.1
Sweeter Su II	2.6	3.2
J-51	3.1	3.2
Grazex	1.4	3.2
Piper x Redlan (Ck)	2.1	2.8
877-F	1.8	3.2
Do Mor	1.5	3.1
Gro-N-Graze	1.9	3.1
GSA 1757	1.9	2.6
NB280S (Ck)	1.5	2.5
SSX643	1.6	3.0
SSX343	2.0	3.0
Tx623A x Ga337	2.6	3.5
Tx623A x Dw Ga337	3.6	3.8
757	2.1	3.0
LSD(.05)	0.6	0.8
Test Average	2.1	2.5

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Warm-season Perennial Forage Grass Testing

Joe L. Moyer

Summary

Two separate tests of warm-season, perennial grasses were harvested twice for forage production, and some analyses were performed on the second cutting. Total production was similar among the entries, averaging about 1.5 tons/acre.

Introduction

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

Experimental Procedure

Warm-season grass plots were broadcast-seeded on 19 June, 1984 at the Mound Valley Unit, Southeast Kansas Experiment Station. Old World bluestems ('W.W. Spar' and OWB 535) were obtained from Dr. Chet Dewald, USDA Southern Plains Station, at 5 lb material/acre. Bluestem and indiangrass were seeded at 10 lb material/acre. Plots were clipped to control weeds in 1984 and early 1985, and harvested for total yield and quality determination on 4 September, 1985.

Big bluestem was seeded with a cone planter on 20 June, 1985 at 12 lb PLS/acre in plots adjacent to those previously described. Stand counts, plant heights, and other seedling measurements were taken after the first growth season.

Both sets of plots were sprayed with 1 lb/acre of 2,4-D on 13 June, 1986. The first cutting of hay was taken on 24 June and the second on 21 August. Subsamples were saved from the second cutting for laboratory analysis of crude protein.

Results

Forage yields from both cuttings and crude protein contents from cut 2 of the warm-season cultivar test are shown in Table 76. Plots with incomplete stands were not harvested, so significant differences were difficult to obtain. Only W.W. Spar had solid stands in all four replications, and that cultivar also tended to yield best. The big bluestem cultivar, Kaw, had the highest crude protein content in second-cut forage, significantly higher than Osage indiangrass at that stage.

The big bluestem test (Table 77) was harvested at the same times as the warm-season cultivar test. No differences in forage yield were found among the cultivars in 1986.

Table 76. Forage Yield and Crude Protein of Warm-season Grass Cultivars, 1986.*

Cultivar	Forage Yield June 24	Aug 21	Total	Crude Protein**
	- - tons/a @ 12% moisture -			- %
W.W. Spar	1.43a	0.36a	1.79a	6.2ab
OWB 535	1.40a	0.17a	1.57a	6.1b
Kaw***	1.00a	0.27a	1.27a	7.1a
Osage***	1.16a	0.30a	1.46a	5.9b
Average	1.25	0.28	1.52	6.3

*Means within a column followed by the same letter not significantly (P>.95) different.

**Cut 2 forage assayed.

***Big bluestem and indiangrass, respectively.

Table 77. Big Bluestem Variety Forage Yields, 1986.

Entry	Cut 1	Cut 2	Total
	- tons/a @ 12% moisture -		
Rountree	0.91	0.79	1.70
Kaw	0.88	0.85	1.73
T04237	0.81	0.84	1.65
Pawnee	0.86	0.53	1.40
Average	0.87	0.76	1.62
LSD(.05)	NS	NS	NS

SEK SOUTHEAST KANSAS BRANCH STATION
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Alfalfa Variety Performance in Southeastern Kansas

Joe L. Moyer

Summary

In the 1982 seeding, stand assessments from readings taken in 1985 and 1986 were similar. A new test was seeded in spring, 1986, and three cuttings were obtained, totalling an average 3.77 tons/acre.

Introduction

The importance of alfalfa as a feed crop and/or cash crop has increased in recent years. The worth of a particular variety is determined by many factors, including pest resistance, adaptability, and longevity under specific conditions and its productivity. Stand ratings of a fee-test seeded in fall, 1982 should help determine the relative longevity of the varieties included in the heavy soils of the plot area. A new test was also established to further help producers decide which variety to select for their needs.

Experimental Procedure

In fall, 1982, a 20-line test was seeded, and the plots were cut for 3 years for forage determination. On 7 August, 1985, plots were rated on a 0-5 scale, where 5 was a complete stand. Plots were maintained by an occasional clipping for the remainder of the year and in 1986. Plots were rated for stands again on 21 August, 1986 on a 0-3 scale, where 0 was practically no plants in a plot and 3 was the maximum number of plants/plot.

A 15-line test was seeded (12 lb/acre) on 24 April, 1986 at the Mound Valley Unit, after preplant fertilization with 15-40-40 lb/acre of $N-P_2O_5-K_2O$ and treatment with Eptam. Plots were cut on 24 June, 7 August, and 3 November for yield determination.

Results

Stand ratings of the 1982-seeded test in 1985 and 1986 are shown in Table 78. The ratings for the 2 years were similar relative to the differences among varieties, showing a highly significant correlation between years ($r=0.73$, $P>0.99$). Two cultivars were considered to have complete stand loss, and two others had few plants left.

Table 78. Alfalfa Stand Ratings of the 1982 Test, August, 1985 and 1986.

		Stand Rating	
Source	Variety	1985	1986
DeKalb-Pfizer	120	2.1	1.8
"	130	1.4	1.5
"	ADVANTAGE	3.5	2.5
NAPB	ARMOR	2.9	2.5
Northrup-King	PIKE	1.2	1.2
"	RAIDOR	0.5	0.8
Paymaster	EXPO	3.2	2.8
Pioneer	555	1.5	1.5
"	531	0.9	0.6
"	532	1.1	1.5
Waterman-Loomis	318	3.8	2.0
"	SOUTHERN SPECIAL	2.5	2.2
USDA-KSU	RILEY	0.5	0.5
"	KANZA	0.6	1.0
"	K81-7	2.2	1.8
"	K81-10	1.5	1.6
"	K81-17	1.2	1.2
"	K80-11	1.1	0.8
"	K80-17	2.1	1.8
"	KS157	0.6	0.5
	LSD(.05)	0.7	0.7
	Average	1.7	1.5

In the 1986 test (Table 79), first-year yields were significantly higher for 'Endure' and K82-21 than for five of the other entries. Total and first-cut yields were closely related, since that was the largest cutting. Performance of alfalfa cultivars should not be evaluated until further years of testing are completed.

Table 79. Forage Yields of the 1986 Alfalfa Variety Test.

Source	Variety Name	Yield (t/a @12% moist.) 6/24	8/7	11/3	Total
Agripro	Arrow	1.61	0.95	1.02	3.58
Agripro	Dart	1.75	0.96	1.01	3.72
Asgrow/O's GOLD	Eagle	1.62	1.18	0.95	3.75
Cargill	EXP 339	1.56	1.06	0.94	3.56
Garst	630	1.67	0.97	1.00	3.64
Garst	636	1.52	1.01	0.97	3.50
Garst	655	1.68	1.17	1.10	3.95
Great Plains Res.	Cimarron	1.85	1.00	1.04	3.89
PAG Seeds	Endure	1.88	1.16	1.03	4.06
Waterman-Loomis	WL-320	1.65	1.00	1.13	3.78
Waterman-Loomis	Southern Special	1.75	1.09	1.11	3.96
USDA-KSU	Riley	1.46	1.20	1.06	3.71
USDA-KSU	Kanza	1.48	1.14	0.92	3.53
USDA-KSU	KS196 EXP	1.68	1.15	1.03	3.86
USDA-KSU	K82-21 EXP	1.74	1.29	1.02	4.04
LSD(.05)		NS	0.21	0.11	0.38
Average		1.66	1.09	1.02	3.77

Effect of Fluid Fertilizer Placement and Fertilization Schemes on Yield and Nutrient Content of Tall Fescue

Joe L. Moyer and Daniel W. Sweeney[1]

Summary

Three methods of liquid fertilizer placement were compared for forage production and nutrient uptake. Knifing fertilizer into the soil resulted in slower, but usually more total uptake, especially of N and S. Final yields were sometimes increased, but N (hence, crude protein) concentration was usually increased when N was knifed into the soil. Surface banding ("dribble") application was usually intermediate in effects between knife and surface broadcast applications.

Introduction

Since nitrogen is usually the most limiting nutrient for tall fescue production, often the only fertilization is nitrogen applied by continual topdressing. The supply of other plant nutrients thus may become limiting to optimum plant growth, especially below a shallow surface zone. In southeastern Kansas, fescue nitrogen fertilization is usually applied early in the spring. The objectives of this study were to determine the influence of 1) supplemental fertilization with P, K, S, B, and Zn with UAN, 2) broadcast, dribble, or knifed methods of fluid fertilizer application, and 3) single or split application of N.

Experimental Procedure

The experiment was established at an off-station location in southeastern Kansas in spring 1984. The site was a Parsons silt loam (Mollic Albaqualf, fine, mixed, thermic). Background soil samples indicated 8 lb/acre available P, 310 lb/acre exchangeable K, 3.0 ppm Zn, 2.9% soil organic matter, and a pH of 6.0.

The experiment was a 6 x 3 factorial arrangement of a randomized block design with three replications. A treatment summary is given in Table 80. The first treatment factor consisted of six fertilization schemes; spring applications of either N, N-P, N-P-K, N-P-K-S-B-Zn, P-K-S-B-Zn without N fertilization, or P-K-S-B-Zn with 2/3 of the N in spring but 1/3 in a fall application. The second factor was application methods consisting of

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

Table 80. Description of Fertilization and Placement Treatment Variables.

Fertilization Treatment	Fertilizer Amounts N Spring	 Fall	 P_2O_5	 K_2O	 S	 B	 Zn
	lb/a						
N	150	-	-	-	-	-	-
N, P	150	-	40	-	-	-	-
N, P, K	150	-	40	40	-	-	-
N, P, K, S, B, Zn	150	-	40	40	30	2	1
N / N, P, K, S, B, Zn	100	50	40	40	30	2	1
P, K, S, B, Zn	-	-	40	40	30	2	1
Check	-	-	-	-	-	-	-

Fertilizer Placement	Depth 1984	 1985-86	Spacing
	inches		
Broadcast	-	-	-
Dribble	-	-	10
Knife	6	4	10

broadcast, dribble (surface banding), or knifing (subsurface banding). The annual N rate was 150 lb/acre, either all in the spring or split-N plots receiving 100 lb N/acre in the spring and 50 lb in the fall. In plots where P and K were applied, the rate was 40 lb P_2O_5 and 40 lb K_2O/acre. Designated plots also received 30 lb S, 2 lb B, and 1 lb Zn/acre. A check plot was also included in each replication. Fertilizer sources included appropriate mixes of the fertilizer liquids 28-0-0, 10-34-0, 3-10-10, 12-0-0-26, 0-26-25, and a 10% Zn chelate, as well as dissolved sodium borate to provide B. The materials were metered through a positive-displacement liquid fertilizer pump driven from a tractor's ground-speed power take-off. Broadcast solutions were sprayed through flat-fan nozzles. Knifed solutions were injected behind narrow profile anhydrous ammonia type shanks on a 10-inch spacing. Knifing was at 6 inches in 1984, whereas the knifed depth was reduced to 4 inches for 1985. Dribble applications on a 10-inch spacing were applied through the knife shanks held above ground level. Fertilizer solutions were applied on 24 February 1984, 26 March 1985, and 3 March 1986. Nitrogen was applied to split-N plots on 2 October 1984 and 5 September 1985.

Plots were 8 by 25 ft, whereas only 3 by 20 ft were harvested for spring yields. Yields were collected on 30 May 1984, 16 May 1985, and 19 May 1986. Grass was cut with a flail harvester at a height between 2 and 3 inches. In 1985 and 1986, a strip 1.2 by 9.2 ft (10.8 ft^2) in each plot was harvested approximately a month after fertilization to estimate growth responses at an intermediate time between fertilizer application and final spring harvest.

Results

Intermediate sampling yields were lower in 1986 than in 1985, but showed similar response to fertilization scheme (Table 81). The lowest early yield both years was obtained with P, K, S, B, and Zn but without N. In 1986, early yield was lower with the split-N scheme than from treatment areas that received P, or P and K. N content in early forage samples was higher when 150 lb N/acre was applied with all supplemental nutrients in spring than when the N was split-applied. N uptake from split-N areas tended to be lower than from other N application areas.

As in 1985, early forage yields in 1986 were lower with knifed method than with either surface application method (Table 81). N content was affected by an interaction between fertilization schemes because of high N content values when N only was dribble applied. This trend also influenced a significant interaction between fertilization scheme and placement on N uptake at the early sampling time.

In 1986, fertilizing with N, P, and K as well as N, P, K, S, B, and Zn resulted in approximately a 0.5 ton/acre higher final yield than fertilizing with N only (Table 81). Also, the addition of N, regardless of supplemental fertilization, gave at least a fourfold increase in yields above the check. Yields with split-N applications were not significantly lower than when N and other nutrients were applied in the spring. However, N content and uptake were lower with split-N applications. Highest N uptake was obtained with N, P, and K fertilization, and this was 78 lb/acre higher than in the check.

Highest yield, N content, and N uptake in 1986 were obtained with knifed application of nutrients (Table 81). However, there were no significant differences in these parameters as influenced by the two surface methods. N content and uptake were affected by an interaction between fertilization scheme and application method. N content was lower when all nutrients except N were knifed than when P, K, S, B, and Zn were broadcast or dribbled. However, knifing of nutrients in any of the N-containing schemes resulted in higher N content values than broadcast or dribble applications.

Forage P levels for 1984 and 1985 are shown in Table 82. Fertilization effects on forage P concentration were due to P addition. Treatments without added P had lower forage P concentrations than those that received 40 lb P_2O_5/acre. Uptake of P was lower in the low-yielding no-N fertilizer treatment than in other P-fertilized plots. N-only treatments generally had less P uptake than those receiving N and P, because P concentrations in N-only forage were about as low as check levels. Final P uptake in check plots was less than that in any fertility treatment. Uptakes of P in the 1985 intermediate sampling were similar among checks, no N, and N minus P treatments. However, the check plots had no further net P uptake before final harvest, whereas the other treatments had net increases in P.

The primary effect of fertilizer placement on forage P level was that P concentration and uptake in the intermediate sampling were less in knifed

Table 81. Mean Values of Fertilization and Placement Method Effects on Fescue Forage Yield, N Content, and N Uptake in 1986.

	Intermediate Sampling			Final Harvest		
Treatment Means	Yield @ 12% Moisture	N Content	N Uptake	Yield @ 12% Moisture	N Content	N Uptake
	-ton/a-	-%-	-lb/a-	-ton/a-	-%-	-lb/a-
Fertilization						
N	0.89	2.38	37	2.24	1.75	69
N, P	0.98	2.34	40	2.58	1.73	78
N, P, K	1.01	2.38	41	2.77	1.87	91
N, P, K, S, B, Zn	0.87	2.59	38	2.72	1.82	88
N / N, P, K, S, B, Zn	0.70	2.24	27	2.48	1.62	71
P, K, S, B, Zn	0.61	1.41	15	0.96	1.32	22
LSD 0.05	0.21	0.32	7	0.37	0.15	10
Placement						
Broadcast	0.93	2.00	34	2.04	1.54	56
Dribble	0.93	2.11	35	2.17	1.63	63
Knife	0.68	2.56	30	2.66	1.88	91
LSD 0.05	0.15	0.22	NS	0.26	0.10	7
Fert. x Place.						
F Value	NS	*	**	NS	**	*
Check	0.49	1.23	11	0.58	1.31	13

than in surface application methods (Table 82). By final harvest, however, the banded plots (knife and dribble) seemed higher in forage P content and uptake than did broadcast plots.

Forage K levels for 1984 and 1985 are listed in Table 83. Fertilizer treatments significantly affected forage K concentration, but not as distinctly nor in the same ways that P fertilization affected P content. The no-N fertilization scheme often produced forage with lower forage K concentration than the N-only treatment, despite the fact that the latter had no added K, whereas the no-N plots had excess K (cf. K uptakes). Further, forage K content in the N-P-K treatment never differed significantly from that of the N-P treatment. Differences in 1985 forage K uptake were more clear-cut than those of K content, indicating that the more complete fertilizers enhanced K uptake, and that fertilization without N inhibited K uptake. Check plots appeared lowest in K content and uptake.

Fertilizer placement affected K levels only in the intermediate sampling (Table 83). Knifing produced early forage with lowest K content and K uptake values, but by final harvest, no differences were found among methods in forage K level.

Forage S levels for 1984 and 1985 are shown in Table 84. Concentrations in 1984 were highest when all nutrients (including S) except N were applied, followed by treatments in which all nutrients were applied. Control plots had apparently lower S uptake than plots receiving N without S. In 1985, forage S concentrations were higher when all nutrients were included than when all nutrients except N were applied. Uptake of S in 1984 forage was greatest when S was applied with the high N rate and lowest when no N was applied. In 1985, both N application regimes with S were higher in forage S uptake than all other treatments, whereas S without N was as low in S uptake as the controls. Fertilizer placement affected forage S levels in ways similar to the effects on forage N; i.e., knifing produced generally higher forage S content and uptake at final harvest, but intermediate sampling showed lower S uptake in knifed than in broadcast or dribbled plots.

Forage Zn contents and uptake values are listed in Table 85. Neither Zn concentration nor uptake in forage seemed related to fertilization scheme. Concentrations of Zn in forage had significant differences only in the 1985 intermediate sampling, and the N-P-K regimen had higher Zn concentrations than did some plots receiving Zn. The no-N fertilizer (with Zn) produced forage that was generally lowest in Zn, practically the same as the controls. Similar patterns were found for forage Zn uptake, with high levels found for the N-P-K treatment and low levels for the fertilizer with all nutrients but N. Methods of fertilizer placement affected forage Zn levels only in the intermediate sampling, when knifing produced forage with lower Zn content and uptake than did broadcast or dribble methods. By final forage harvest, no differences in forage Zn level were found.

Table 82. Effects of Fertilizer and Placement Method on Tall Fescue Forage Phosphorus Concentration and Uptake.

	1984 Final		1985 Int.		1985 Final	
Treatment Means	Content	Uptake	Content	Uptake	Content	Uptake
	-%-	lb/ac	-%-	lb/ac	-%-	lb/ac
Fertilization						
N	.174	11.4	.215	4.2	.185	8.1
N, P	.192	12.8	.294	7.3	.236	11.2
N, P, K	.198	13.3	.281	7.0	.244	12.0
N, P, K, S, B, Zn	.201	15.1	.292	7.7	.248	12.4
N / N, P, K, S, B, Zn	.209	14.1	.282	6.8	.239	13.4
P, K, S, B, Zn	.221	7.5	.267	2.7	.238	4.7
LSD(.05)	.024	2.2	.029	1.7	.027	1.7
Placement						
Broadcast	.186	11.0	.288	6.6	.222	9.5
Dribble	.207	13.2	.290	7.4	.240	10.5
Knife	.205	12.8	.243	4.0	.235	10.8
LSD(.05)	.017	1.6	.020	1.2	NS	NS
Fert. x Place.						
F Value	NS	NS	NS	NS	NS	NS
Check	.185	4.7	.212	2.7	.209	2.5

Table 83. Effects of Fertilizer and Placement Method on Tall Fescue Forage Potassium Concentration and Uptake.

	1984 Final		1985 Int.		1985 Final	
Treatment Means	Content	Uptake	Content	Uptake	Content	Uptake
	-%-	lb/ac	-%-	lb/ac	-%-	lb/ac
Fertilization						
N	1.63	106	1.96	42	1.38	61
N, P	1.77	118	2.07	51	1.41	67
N, P, K	1.71	114	2.19	54	1.44	71
N, P, K, S, B, Zn	1.72	128	2.18	56	1.70	84
N / N, P, K, S, B, Zn	1.76	120	2.05	49	1.53	87
P, K, S, B, Zn	1.57	54	1.81	19	1.42	30
LSD(.05)	0.14	16	0.15	10	0.13	10
Placement						
Broadcast	1.64	99	2.11	50	1.50	66
Dribble	1.69	112	2.10	53	1.43	63
Knife	1.74	109	1.93	32	1.52	71
LSD(.05)	NS	NS	0.10	7	NS	NS
Fert. x Place.						
F Value	NS	NS	*	NS	NS	NS
Check	1.42	37	1.72	22	1.33	16

Table 84. Effects of Fertilizer and Placement Method on Tall Fescue Forage Sulfur Concentration and Uptake.

	1984 Final		1985 Int.		1985 Final	
Treatment Means	Content	Uptake	Content	Uptake	Content	Uptake
	ppm	lb/ac	ppm	lb/ac	ppm	lb/ac
Fertilization						
N	810	5.3	1090	2.3	750	3.0
N, P	820	5.4	1150	2.8	730	3.1
N, P, K	820	5.4	1210	2.9	760	3.4
N, P, K, S, B, Zn	940	7.0	2010	5.2	1230	5.6
N / N, P, K, S, B, Zn	880	5.9	1570	3.8	1210	6.2
P, K, S, B, Zn	1130	3.8	1050	1.1	940	1.8
LSD(.05)	100	0.7	240	0.8	140	0.8
Placement						
Broadcast	850	4.9	1470	3.5	920	3.7
Dribble	910	5.7	1330	3.4	930	3.7
Knife	930	5.8	1250	2.1	960	4.1
LSD(.05)	70	0.5	NS	0.5	NS	NS
Fert. x Place.						
F Value	NS	NS	NS	*	NS	NS
Check	990	2.5	930	1.2	880	1.0

Table 85. Effects of Fertilizer and Placement Method on Tall Fescue Forage Zinc Concentration and Uptake.

	1984 Final		1985 Int.		1985 Final	
Treatment Means	Content	Uptake	Content	Uptake	Content	Uptake
	ppm	lb/ac	ppm	lb/ac	ppm	lb/ac
Fertilization						
N	34	.22	26	.06	23	.10
N, P	21	.14	26	.06	29	.13
N, P, K	34	.22	38	.10	31	.16
N, P, K, S, B, Zn	21	.15	32	.08	30	.15
N / N, P, K, S, B, Zn	21	.14	28	.07	27	.16
P, K, S, B, Zn	18	.06	26	.03	23	.05
LSD(.05)	NS	.11	6	.02	NS	.06
Placement						
Broadcast	25	.15	31	.08	29	.13
Dribble	23	.16	32	.08	28	.13
Knife	26	.17	25	.04	26	.12
LSD(.05)	NS	NS	4	.02	NS	NS
Fert. x Place.						
F Value	NS	NS	NS	NS	NS	NS
Check	34	.09	20	.02	23	.03

Effect of Liquid Nitrogen Placement and N Rate on Tall Fescue Forage Yield amd Quality[1]

Joe L. Moyer and Daniel W. Sweeney

Summary

Nitrogen placement affected time and amount of N recovery. Deep (6") placement retarded N uptake as compared to surface and shallower applications. However, N recovery and N concentration of forage were usually increased by 4" placement. When forage yield advantage from N placement was found, dribble and 4" applications were highest.

Introduction

Several million acres of seeded, cool-season grasses exist in eastern Kansas, mostly in tall fescue and smooth bromegrass pastures. Similar kinds and acreages of cool-season grass occur in other states of the region. Other regions of the country also have significant amounts of some type of cool-season, perennial grass. Much of the cool-season grass in southeast Kansas has been in long-term production and continually fertilized by top-dressing. This could result in low soil fertility beneath a narrow surface zone. Drought and other soil conditions that inhibit nutrient uptake near the soil surface could cause most of the nutrients to be unavailable for plant growth.

The objectives of this experiment were to determine how tall fescue forage yield and N use were affected by 1) depth and method of UAN placement; 2-, 4-, and 6-inch depths of subsurface band placement ("knifed"), as well as surface broadcasting and banding ("dribble") and 2) N rates when using broadcast, dribble, or knifed N application methods.

Experimental Procedure

The objectives were addressed by applying UAN broadcast, dribble, or at one of three knife depths, with 75 or 150 lb. N/acre. In addition to a zero nitrogen check, check plots were included in which the applicator knives were passed through the soil at the three depths. Uniform broadcast applications of 39 lb P_2O_5/acre and 77 lb K_2O/acre were made to all plots. Dribble and knife spacings were 10 inches.

Except for 1983, approximately 1 month after fertilization, forage samples were clipped from two small subplots within each plot to estimate N

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

uptake. Total forage production was harvested at or near full bloom for determination of yield and N content.

Results

The estimate of early fescue forage production taken in 1986 indicated significant yield increases with both incremental increases of N application (Table 86). The previous 2 years showed increases with the first 75-lb N application, but no further yield increase when the fertilization rate was increased to 150 lb/acre. Final forage yields in 1986 had practically the same N response as did the intermediate yields: i.e., more than doubling of yield with the first 75-lb N increment, but only a 16% yield increase from the next 75-lb increment (Table 86). Methods of N application significantly affected intermediate yield in 1986 as they did in 1985, with a decrease in early yield from the deepest knife treatment. However, full-season 1986 yields were not significantly affected by N application method, unlike 1985 yields, nor were trends the same as in any other year. In 1986, the broadcast method seemed inferior to the other methods, whereas in previous years, knifing UAN at 2" depth resulted in lowest forage yields compared to other application methods (Table 86).

Nitrogen uptake at intermediate and final harvests is shown in Table 87. Except for 1983, increasing N rate from 75 to 150 lb/acre produced higher nitrogen uptake values, but these increases in N uptake were not as large as those between the checks and the 75 lb N/acre rate. Fertilization with 75 lb N/acre resulted in about a twofold increase in N uptake over the checks, whereas a further increase from 75 to 150 lb N/acre usually increased N uptake by less than 50%. Deep (6") placement of UAN generally resulted in lower N uptake early in the spring than did surface applications (Table 87). However, by final harvest, N uptake was highest when UAN was knifed at the 4-inch depth. No significant differences in N uptake were found among the other placement methods, except that in 1986, uptake was higher with the 6" and the 4" knife methods than with the two surface application methods. The interactions in forage N uptake between N application method and N rate were caused by different trends in 1986 than in previous years. In 1986, most of the difference was found in N uptakes at the high N rate, with the 4" knife treatment being highest in the early sampling and both the 4" and 6" knife treatments being highest at the final harvest. The 2" knife treatment had N uptake similar to those of the surface application methods at both N rates. However, in previous years, the N method by rate interaction was caused by relatively low N uptake when 75 lb N/acre was knifed at 2".

Table 86. Tall Fescue Forage Yield as Affected by N Rate and Placement.

	1983	1984		1985		1986	
Treatment Means	Final	Int.	Final	Int.	Final	Int.	Final
	- - - - - - - ton/a @ 12% moisture - - - - - -						
N Rate (lb/acre)							
75	3.16	0.89	2.35	0.95	2.20	0.98	2.14
150	2.98	0.91	2.52	1.03	2.68	1.15	2.49
F Value	NS	NS	NS	NS	*	*	*
N Placement							
Broadcast	3.14	0.96	2.32	1.18	2.64	1.12	2.05
Dribble	3.14	1.05	2.61	1.16	2.44	1.10	2.30
Knife - 2"	2.89	0.75	2.01	0.99	2.20	1.06	2.35
Knife - 4"	3.22	0.91	2.77	0.95	2.63	1.27	2.46
Knife - 6"	2.95	0.81	2.42	0.69	2.29	0.75	2.45
LSD(0.05)	NS	NS	0.44	0.25	0.29	0.24	NS
Rate by Placement							
F Value	NS	NS	NS	NS	*	NS	NS
Avg. of Checks	2.19	0.61	1.46	0.55	1.09	0.48	1.03

* $P<0.05$

Table 87. Nitrogen uptake by fescue as affected by N rate and placement.

	1983	1984		1985		1986	
Treatment Means	Final	Int.	Final	Int.	Final	Int.	Final
	- - - - - -	- - - - - -	- - - lb/a	- - - - - -	- - - - - -	- - - - - -	- - - - - -
N Rate (lb/acre)							
75	85.7	36.2	57.8	46.2	59.4	37.1	49.8
150	86.7	44.8	80.1	59.4	93.6	48.9	73.0
F Value	NS	*	*	*	*	**	**
N Placement							
Broadcast	84.0	41.5	63.0	60.0	67.7	40.7	52.6
Dribble	80.6	52.5	70.9	63.6	71.3	41.1	54.5
Knife - 2"	71.8	35.9	59.1	54.5	69.0	44.5	58.1
Knife - 4"	100.7	41.8	90.0	50.4	98.2	53.2	72.9
Knife - 6"	94.1	30.6	61.6	35.7	76.3	35.2	71.5
LSD(0.05)	NS	11.5	15.8	14.5	12.0	10.4	15.4
Rate by Placement							
F Value	NS	*	*	*	*	*	*
Avg. of Checks	49.5	16.9	30.0	19.4	23.6	12.8	19.6

* P<0.05

Other Forage Research

Joe L. Moyer

Summary

Fescue pastures at the Mound Valley Unit have been monitored for endophyte fungus level since 1983. Pasture treatments have had no obvious effect on endophyte levels. In 1986, samples were collected several times and assayed by this and other labs. Some time-of-year and laboratory variation occurred in relative values of endophyte frequency.

Results from the 1985-86 study of fall-applied herbicides for eliminating endophyte-infested fescue have been published, along with the previous year's study, see: "Fall-applied Herbicides for Eliminating Endophyte-infested Fescue", Keeping Up With Research 88, Kansas Agricultural Experiment Station.

A study of the effect of fescue seed storage conditions on seed germination and live endophyte levels is near completion. Short storage times at 104 F were not particularly harmful to seed germination or the endophyte under dry conditions, but in high-moisture conditions, both germination and live endophyte level in viable seed declined rapidly.

Silage-type sorghums were tested in cooperation with the KSU Agronomy Department. Results are listed in Report of Progress 511, 1986 Kansas Sorghum Performance Tests. Yields were good in 1986, averaging 22 tons/acre (70% moisture), with entries ranging from 16 to 29 tons/acre. Lodging was considerable in one entry and noticeable in two others.

Fluid N-P-K Placement for Grain Sorghum in Selected Reduced Tillage Systems[1]

D.W. Sweeney

Summary

Tillage systems (reduced, ridge, and no-till) had no significant effect on grain sorghum yields at two locations in 2 years. However, at a low soil fertility site, highest yield was obtained in both years when a N-P-K suspension was knifed with 50% of the N applied preplant and the remaining applied as a sidedress, as compared to other fertilizer application methods. At a high soil fertility site, yields were increased by the addition of fertilizer, but the method of application had little effect on yields.

Introduction

Both economic and soil conservation concerns have influenced the interest in reduced tillage systems. The advancement of reduced tillage methodology has made it necessary to define soil fertility options. Several methods exist for the application of fluid fertilizers. Broadcasting and surface (dribble) or subsurface (knifing) banding of fluid fertilizers are some of the application alternatives. Split applications of applied N may also affect the yield of grain sorghum. The objectives of this study were to determine the effect of fluid fertilizer placement and split applications of N on grain sorghum yield in ridge-plant, no-till, and reduced tillage systems.

Experimental Procedure

Tillage methods comprise the main or whole plot treatments and fluid N-P-K application methods are the subplot treatments of a split-plot experimental arrangement. Table 88 describes the treatment variables. The experiment was conducted at two different sites of a Parsons silt loam at the Parsons field of the Southeast Kansas Branch Experiment Station. At Location 1, native meadow was first cultivated in fall 1983. Initially, avail-

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[1] Research partially supported by grant funding from the Potash & Phosphate Institute.

able soil P was 6 lb P/a and available soil K was 100 lb K/a in the surface 6 inches. The total fertilizer rate for all plots at Location 1 was 150-100-150 (lb/a of N-P_2O_5-K_2O), whereas plots receiving split N applications received 75 lb N/a preplant and 75 lb N/a dribble sidedress. Location 2 had been under cultivation for more than 10 years; thus, available soil P was 44 lb/a and available soil K was 210 lb/a in the surface 6-inch zone. The total fertilizer rate for all plots at Location 2 was 150-50-100, with the split N applications applied as 75 lb N/a preplant and 75 lb N/a dribble sidedress. Both locations were treated as described above and harvested for yield in 1985, whereas in 1986, planter problems resulted in poor stands in the ridge-plant and no-till plots at Location 2, so yields were only taken from reduced tillage areas. Garst 5525c grain sorghum seed was planted in 1985 at both locations and Garst 5521c in 1986 at 66,000 seed/a.

Results

Tillage systems did not significantly affect grain sorghum yields at either location (Table 89). However, the application of fertilizer suspensions did result in significant increases in yield as compared to areas receiving no fertilizer. At the low fertility site, Location 1, N-P-K fertilization resulted in approximately a 15 to 35 bu/a increase in yield above the checks for both years. In 1985 at Location 1, knifed applications of fertilizer suspensions with split N applications resulted in significantly higher yields than with other fertilizer options. Similarly in 1986, the knifed - split N treatment resulted in higher yields than all other treatments, except the knifed treatment that had all N applied preplant. In both years, all other fertilizer options resulted in yields that were not significantly different. At the high fertility site, Location 2, the response to fertilizer as compared to the checks was not as great as at Location 1. However, in 1986, check plots at Location 2 resulted in yields that were 13 to 26 bu/a less than those in fertilized reduced tillage plots. No differences in yield because of application method were found at Location 2 in 1985, whereas in 1986 the only significant difference was that the knifed - split N treatment resulted in higher yield than the broadcast - split N treatment. These data suggest that in low soil fertility areas, subsurface placement of fluid fertilizer suspensions, especially when N is split-applied, may result in higher grain sorghum yields. However, when soil fertility is in the medium to high range, additional fertilizer may increase yields but application method becomes less critical.

Table 88. Description of Tillage and N-P-K Application Variables.

Tillage Methods	Application Methods	
Reduced - disc, field cultivate	Check	
	Check with applicator knives passed through soil	
Ridge-plant	Broadcast -	100% N, P, K preplant
No-tillage	Dribble	100% N, P, K preplant
	Knife	100% N, P, K preplant
	Broadcast -	100% P, K 50% N preplant 50% N dribble sidedress
	Dribble	100% P, K 50% N preplant 50% N dribble sidedress
	Knife	100% P, K 50% N preplant 50% N dribble sidedress

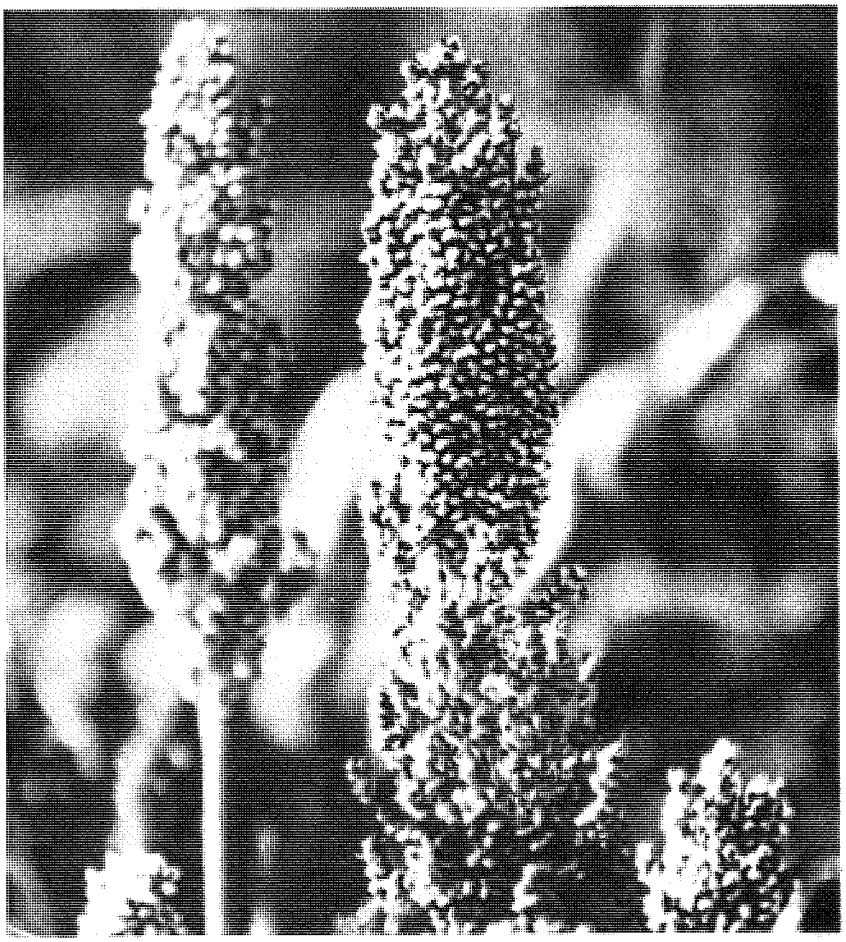

Table 89. Effect of Tillage and Fluid N-P-K Application Methods on Grain Sorghum Yields at Two Locations in 1985 and 1986.

	Yield @ 12.5% Moisture			
	Location 1		Location 2	
Treatment Means	1985	1986	1985	1986[1]
	-----------------	bu/a	-----------------	
Tillage				
Reduced	72.7	70.7	96.9	77.4
Ridge	75.1	69.9	93.1	--
No-tillage	72.1	75.8	90.8	--
LSD 0.05	NS	NS	NS	--
N-P-K Application Method				
Check	55.2	56.5	84.0	59.8
Check-Knife	53.2	55.8	85.9	62.5
Broadcast	78.0	74.9	96.1	84.6
Dribble	75.7	75.0	95.8	82.7
Knife	80.6	81.1	94.7	78.9
Broadcast - Split N	74.6	70.9	98.0	75.6
Dribble - Split N	79.8	75.7	97.7	84.0
Knife - Split N	89.2	85.4	96.8	86.2
LSD 0.05	6.6	8.9	5.9	10.1
Tillage by Method Interaction				
F Value	NS	NS	NS	--

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[1] 1986 data include only reduced tillage areas.

Effect of Previous Residue Management and N Rate on Yields in a Continuous Small Grain - Doublecrop Soybean Rotation

D.W. Sweeney

Summary

Since 1983, wheat straw management affected doublecrop soybean yields only once (1985). However, in 1984, 1985, and 1986, the previous residue management for doublecrop soybeans affected the subsequent small grain yields. When soybeans were grown no-till, wheat or oat yields were as much as 21 bu/a lower than when the previous residue was either disced or burned then disced.

Introduction

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

Experimental Procedure

Three wheat residue management systems for doublecrop soybeans with three replications were established in spring 1983: no-tillage, disc only, and burn then disc. After the 1983 soybean harvest, the entire area was disced, field cultivated, and planted to wheat. Before field cultivation, 300 lb/a of 6-24-24 was broadcast in all areas. In spring 1984, 67 lb N/a as urea was broadcast as a topdress to all plots. Wheat yield was determined in areas where the previous doublecrop residue management systems were imposed. In spring 1985, residue management plots were split so that two topdress N rates were applied. Topdress N rates of 57 and 103 lb N/a gave total yearly N applications for wheat of 83 and 129 lb N/a, respectively. These residue management and N rate treatments were continued through 1986;

however, because of poor stands of late-planted wheat, spring oats were planted in 1986.

Results

Wheat residue management had no significant effect on the yield of soybeans in 1983 (data not shown). Drought conditions resulted in an overall mean yield of 5.4 bu/a. Soybeans planted doublecrop in 1984 were also severely affected by drought conditions. Soybean plants were too small to allow for harvest; therefore, no harvest data were obtained. Even though rainfall conditions were more favorable in 1985, no rain for approximately 3 weeks after planting resulted in poor weed control in no-till plots and, thus, no yield. Soybeans planted after discing the wheat residue yielded 21.1 bu/a in 1985, whereas soybeans planted after burning and then discing yielded 14.4 bu/a. The topdress N rate for the previous wheat crop did not affect the doublecrop soybean yields. Soybeans in 1986 were not affected by residue management or residual N rate, resulting in a mean yield of 10.4 bu/a (data not shown).

Management of wheat residue in 1983 significantly influenced the 1984 wheat yields (Table 90). When soybeans were planted no-till in 1983, the 1984 wheat crop yielded 16 and 20 bu/a less than when the residue had been disced or burned then disced, respectively. (No significant occurrence of disease, including tan spot, was evident in the plots.) The percent protein in the grain was also lower ($p<0.10$) when no-tillage had been used for the doublecrop soybeans than with the other systems. This suggested a possible N immobilization when the previous years' wheat straw is tilled into the soil after no-till doublecrop soybeans, immediately prior to wheat planting.

Because of the above results, two N rates were applied to the wheat grown in 1984-85 and 1985-86. Since work during the past several years by Ken Kelley at the Southeast Branch Station has shown no yield advantage to N rates exceeding 90 to 100 lb/a, total N rates were established at 83 and 129 lb/a. This was done so that if immobilization were a factor in limiting wheat yields in areas where no-tillage doublecrop soybeans were previously grown, yield responses to N rate would be likely in those plots but not in the burn-disc or disc-only plots. Wheat harvested in 1985 yielded 7 and 11 bu/a less when the previous doublecrop soybeans were planted no-till rather than disc-only or burn-then-disc, respectively. (All plots showed moderate disease pressure; however, no differences were noted between tillage systems.) Yield was not affected by N rate nor was there an interaction between residue management systems and N rate. In addition, there was no statistical difference in protein level as affected by any treatment factor.

In late winter 1986, the wheat stands in all areas were poor, therefore, all areas were tilled and planted to spring oats. Oat yields in 1986 were also affected by the previous years' residue management system when planting doublecrop soybeans. Oat yields were 15 and 21 bu/a less when doublecrop soybeans had been planted no-till as compared to a burn-then-disc or disc-only system, respectively. Similar to the 1985 wheat crop, oat yields were not significantly affected by N rate or the interaction between residue management and N rate. Protein values in oats were affected by residue management and N rate but not by the interaction of these factors. Since the above data show that increasing N rate from 83 to 129 lb/a does not increase yields of small grain crops, regardless of residue management system, if immobilization is a problem in "residual" no-till areas, other factors may limit the effectiveness of additional N.

Table 90. Yield and Protein Content of Wheat in 1984 and 1985 and Oats in 1986 as Influenced by Previous Residue Management and N Application Rates.

Treatment	Yield at 12% Moisture			Protein in Grain		
	1984	1985	1986	1984	1985	1986
	--------bu/a--------			---------%----------		
Previous residue mgmt.						
Burn, then disc	63	59	79	15	15	13
Disc only	59	55	85	15	15	13
No-tillage	43	48	64	13	14	11
LSD 0.05	13	8	6	NS	NS	1
LSD 0.05	-	-	-	1	NS	-
N Rate (lb/a)						
83	-	53	77	-	14	12
129	-	55	75	-	15	13
F Value		NS	NS		NS	**
Interaction						
F Value		NS	NS		NS	NS

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Tillage and Nitrogen Fertilization Effects on Yields in a Grain Sorghum - Soybean Rotation

D.W. Sweeney

Summary

Tillage did not affect either grain sorghum or soybean yields, except in 1985 when poor weed control resulted in lower grain sorghum yields with no-tillage as compared to conventional and reduced tillage. Nitrogen fertilization method did not affect 1983 grain sorghum or 1986 soybean yields, but did produce a slight residual effect on soybean yields in 1984. Grain sorghum yields in 1985 were more affected by N fertilization methods with no-tillage than with conventional or reduced tillage.

Introduction

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

Experimental Procedure

A split-plot design with four replications was initiated in 1983 with tillage systems as whole plots and N treatments as subplots. The three tillage systems were conventional, reduced, and no-tillage. The conventional system consisted of chiseling, discing, and field cultivation. The reduced tillage system consisted of discing and field cultivation. Glyphosate was applied each year at 1.5 qt/a to the no-till areas. The four nitrogen treatments applied to the 1983 and 1985 grain sorghum were a) zero N applied, b) anhydrous ammonia knifed to a depth of 6 inches, c) broadcast urea-ammonium nitrate (UAN - 28% N) solution, and d) broadcast solid urea. N rates were 125 lb/a. Pioneer 8585c grain sorghum seed was planted in 1983 and 1985 at 66,000 seed/a whereas Essex soybean seed was planted in 1984 and 1986 at 130,000 seed/a. Seeds were harvested from each subplot for both grain sorghum and soybean crops, even though N fertilization was applied only to grain sorghum crops.

Results

No significant differences as affected by tillage or N fertilization were found for grain sorghum yield in 1983 (Table 91). Dry growing conditions resulted in an overall mean yield of 45 bu/a. Soybean yields in 1984 were not affected by tillage but were affected by the residual effect of 1983 N fertilizer application. However, since drought conditions existed in 1984 as well as in 1983, these yield differences were small. Tillage and N fertilization options significantly interacted to affect grain sorghum yields in 1985. For both conventional and reduced tillage, the addition of N (regardless of source) resulted in an approximately 20 bu/a increase in yield as compared to the check. However, with no-tillage, the application of anhydrous ammonia resulted in 40 bu/a higher yield than in the check and 10 to 20 bu/a higher yield than from the application of solid urea or UAN solution. Even though from different N sources, these data may suggest that deep placement of N fertilizer may produce higher grain sorghum yields in no-tillage systems. The lower mean yields obtained with no-tillage as compared to reduced or conventional tillage systems in 1985 may be due to increased weed competition. The lack of precipitation for over 3 weeks after application reduced the effectiveness of the preemergent herbicides. Soybean yields in 1986 were not affected by tillage or residual N from grain sorghum fertilization. The trend for lower yield in no-tillage areas may have been due to moderate weed pressure.

Table 91. Effect of Tillage and N Fertilization on Yields in a Grain Sorghum - Soybean Rotation.

		Yield			
Treatments		Grain Sorghum 1983	Soybean 1984	Grain Sorghum 1985	Soybean 1986
		-------------bu/a-------------			
Tillage	**N Fertilization**				
Conventional	Check	45.1	5.6	81.3	18.4
	Anhydrous NH_3 - knifed	47.5	6.1	99.5	21.2
	UAN solution - broadcast	47.9	5.4	98.3	18.6
	Urea solid - broadcast	46.8	6.5	102.6	20.6
Reduced	Check	46.2	5.3	80.0	19.2
	Anhydrous NH_3 - knifed	48.0	5.0	101.2	18.4
	UAN solution - broadcast	43.2	6.2	100.6	18.5
	Urea solid - broadcast	46.7	7.7	98.6	17.4
No-tillage	Check	44.0	5.4	35.7	14.7
	Anhydrous NH_3 - knifed	40.9	6.7	76.3	16.8
	UAN solution - broadcast	40.5	4.2	57.8	14.1
	Urea solid - broadcast	45.7	5.9	65.5	17.4
LSD 0.05 (any comparison)		NS	NS	11.0	NS
LSD 0.05 (same tillage)		NS	NS	9.5	NS
Means, Tillage					
Conventional		46.8	5.9	95.4	19.7
Reduced		45.9	6.0	95.0	18.4
No-tillage		42.8	5.5	58.8	15.7
LSD 0.05		NS	NS	7.3	NS
Means, N Fertilization					
Check		45.0	5.4	65.6	17.4
Anhydrous NH_3 - knifed		45.2	5.9	92.3	18.8
UAN solution - broadcast		43.9	5.3	85.6	17.1
Urea solid - broadcast		46.4	6.7	88.9	18.4
LSD 0.05		NS	1.0	5.5	NS

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Effect of Irrigation Timing and N Application Method on Grain Sorghum

D.W. Sweeney

Summary

In 1984, grain sorghum yields were not affected by irrigation timing; however, earlier irrigations tended to produce more kernels per head, whereas later irrigations tended to produce higher kernel weights. Since rainfall was adequate in 1985, no irrigations were made. In 1986, when rainfall was received during the later part of the grain-filling period, yields were higher in areas where limited-amount irrigation had been applied at the 9-leaf stage because of the increased number of kernels per head. Applying part of the nitrogen through the irrigation system never resulted in higher yields or yield components than applying all nitrogen preplant.

Introduction

Irrigation of grain sorghum is not extensive in southeastern Kansas. This is due, in part, to the lack of large irrigation sources. Limited irrigation, such as could be supplied by the substantial number of ponds in the area, could be used to help increase grain sorghum yields. The objectives of this experiment were to determine the optimum growth stage for irrigation with a limited water supply and to determine if applying 50% of the N fertilizer through irrigation could increase yield.

Experimental Procedure

The experiment was established as a 6 x 2 factorial arrangement of a completely randomized design replicated three times to examine irrigation timing by plant growth stage and N application method. The six irrigation systems were at the 9-leaf stage (9L), boot (B), soft dough (SD), 9L-B, 9L-SD, and B-SD. A total application of 2 inches was planned; thus, either 2 inches were applied at one growth stage or 1 inch was applied at each of two growth stages. The N application was either 100 lb/a applied preplant or 50 lb/a applied preplant with 25 lb/a injected with each inch of irrigation. Thus, each treatment area received 100 lb N/a. Also included were two check treatments; one receiving 100 lb N/a preplant with no supplemental irrigation and the other receiving neither nitrogen nor irrigation. The nitrogen source for this study was a urea-ammonium nitrate (UAN - 28% N) solution.

In 1984, all treatments were applied, in 1985 no irrigations were applied because of high rainfall, and in 1986 irrigations were applied at the 9-leaf and soft dough stages but not at the boot stage because of adequate rainfall. In all years, Pioneer 8585c grain sorghum seed was planted at 66,000 seed/a.

Results

1984

Total precipitation values for July and August were very low, 1.09 and 0.69", respectively. Thus, the primary source of water for the grain sorghum was irrigation. With one exception, all irrigation treatments showed a response ($p<0.10$) in yield as compared to the checks (Table 92). However, no significant response in yield to either irrigation timing or N application was found. This can be explained, in part, by response of kernel weight and kernels per head to the different irrigation timings. In general, earlier irrigations (i.e., 9-leaf stage) resulted in lower kernel weight but greater number of kernels per head, whereas the reverse was true for later irrigations (boot and soft dough). Injection of a portion of the applied N through the irrigation system (fertigation) did not significantly increase yield or yield components. In contrast, applying 100% of the N preplant resulting in an increase in kernel weight as compared to fertigation.

1985

No irrigations were applied because of ample rainfall during the majority of the growing season, especially at the specified grain sorghum growth stages. Plots were maintained with appropriate N applications by manual sidedressing with UAN instead of applying through the irrigation. No significant differences in grain sorghum yield were measured among treatments that received N either all at preplant or by sidedressing (data not shown). However, there was a 12 to 22 bu/a increase from N fertilization as compared to the no-N check.

1986

Irrigations were applied at planned growth stages except at the boot stage. This was due to a rainfall of over 2" in early August. The 9L-B and B-SD treatment areas were to receive 1" irrigations at two growth stages. However, the omission of boot stage irrigations resulted in the 9L-B and B-SD treatment areas receiving 1" of irrigation only at the 9-leaf and soft dough stages, respectively. This allowed a limited comparison of 1 versus 2" of irrigation applied at either the 9-leaf or soft dough stages in areas that received 100 lb N/a preplant.

With the exception of one treatment, all areas that received N showed a 16 bu/a or higher grain sorghum yield than the no irrigation - no nitrogen check (Table 93). In contrast, only when 50 lb N/a was applied preplant with 50 lb N/a applied through the irrigation system at the 9-leaf stage were yields higher than in the no irrigation - 100 lb N/a preplant check. Mean values indicate that systems including irrigation at the 9-leaf stage resulted in higher yields than irrigation applied only at the soft dough stage. This may be due to the greater number of kernels per head when the plants received irrigation at the 9-leaf stage. Even though mean values suggest that kernel weight may be increased by irrigations at the soft dough stage, since rainfall exceeded 8" through August to mid-September, the effect was minimized.

Yield and yield components in 1986 were analyzed using irrigation at the 9-leaf or soft dough stage and amounts of 1 or 2" in systems that only received N preplant. For these conditions, yield and kernel weight were not affected by irrigation timing or amount (mean data not shown). However, the interaction between irrigation timing at the 9-leaf or soft dough stage and application amounts of either 1 or 2" when grain sorghum received 100 lb N/a preplant suggests that 2" irrigation results in more kernels per head than 1" when applied at the 9-leaf stage but produces no effect at the soft dough stage (Table 93).

As in 1984, fertigation in 1986 did not significantly affect yields or kernels/head (Table 93). However, applying 100% of the N preplant resulted in higher kernel weight than the fertigation systems ($p<0.10$).

Table 92. Yield and Yield Components of Grain Sorghum in 1984 as Affected by Irrigation Timing and N Application Method.

Irrigation by Growth Stage[1]	N Application[2]	Yield @12.5%	Kernel Weight	Kernels per Head
	-----lb/a----	-bu/a-	-mg-	
9-leaf (9L)	100P	58.0	17.6	2730
	50P - 50I	65.3	17.7	2520
Boot (B)	100P	70.3	23.9	2630
	50P - 50I	63.4	18.8	2340
Soft Dough (SD)	100P	64.2	24.7	2190
	50P - 50I	69.2	23.1	2310
9L - B	100P	65.0	18.3	3150
	50P - 50I	64.1	18.7	2770
9L - SD	100P	68.4	25.1	2620
	50P - 50I	68.7	20.8	2570
B -SD	100P	66.3	25.6	2370
	50P - 50I	62.6	21.7	2180
None	100P	51.0	20.6	2330
	--	47.7	17.8	2210
LSD 0.05		NS	4.7	NS
LSD 0.10		11.3	--	490
Mean Values:				
Irrigation by Growth Stage				
9L		61.6	17.7	2630
B		66.9	21.4	2490
SD		66.7	23.9	2250
9L - B		64.5	18.5	2970
9L - SD		68.6	23.0	2600
B - SD		64.4	23.7	2280
LSD 0.05		NS	2.9	430
N Application Method				
100 P		65.4	22.5	2620
50P -50I		65.5	20.1	2450
F Value		NS	**	NS

---

[1] All irrigation systems received a total of 2"; 2" at one growth stage or 1" at two growth stages.

[2] 100P indicates 100 lb N/a applied preplant; 50P - 50I indicates 50 lb N/a applied preplant, 50 lb/a applied through the irrigation at a rate of 25 lb N/a per inch of irrigation water.

Table 93. Yield and Yield Components of Grain Sorghum in 1986 as Affected by Irrigation Timing, Irrigation Amount, and N Application Method.

Irrigation by Growth Stage[1]	N Application[2]	Irrigation Total	Yield @12.5%	Kernel Weight	Kernels per Head
	-----lb/a----	-inches-	-bu/a-	-mg-	
9-leaf (9L)	100P	2	72.5	25.5	1260
	50P - 50I	2	83.4	25.5	1520
Soft Dough (SD)	100P	2	59.1	27.2	1020
	50P - 50I	2	62.4	25.7	1060
9L - SD	100P	2	72.8	26.7	1320
	50P - 50I	2	72.9	25.2	1300
9L	100P	1	62.9	25.4	980
SD	100P	1	67.2	24.9	1210
None	100P	-	66.4	26.2	1100
	--	-	46.3	23.7	940
LSD 0.05			14.6	NS	300
Mean Values:					
Irrigation (2" Total) by Growth Stage					
9L			78.0	25.5	1390
SD			60.7	26.4	1040
9L - SD			72.8	25.9	1310
LSD 0.05			10.4	NS	260
N Application Method (2" Total Irrigation)					
100P			68.1	26.5	1200
50P - 50I			72.9	25.4	1290
F Value			NS	10%	NS
Irrig. Timing x Amount Inter. (100P)					
LSD 0.05			NS	NS	250

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[1] All 2" total irrigation systems received either 2" at one growth stage or 1" at two growth stages.

[2] 100P indicates 100 lb N/a applied preplant; 50P - 50I indicates 50 lb N/a applied preplant, 50 lb/a applied through the irrigation at a rate of 25 lb N/a per inch of irrigation water.

SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

Effect of Tillage, Variety, and N Application Method on Wheat Yields

D.W. Sweeney and J.B. Sisson[1]

Summary

At the Parsons field and the Columbus field in 1986, higher wheat yields were obtained by planting wheat uniformly with 10-inch row spacing across ridges on 30-inch centers than with either reduced or conventional tillage. Intermediate yields were obtained by planting paired 10-inch rows on ridges (i.e., skip-furrow). Dribble urea-ammonium nitrate solution applications resulted in more kernels per head and higher grain N content than broadcast at both locations. Greater yields were obtained with Chisholm than Arkan; however, grain protein content was higher with Arkan.

Introduction

Ridge-planting is gaining interest in several areas of the state and country. Row crops grown in soils that have a high clay content subsoil under a shallow topsoil, as in southeastern Kansas, may benefit from ridge-planting not only because of better drainage and/or warmer spring soil temperatures, but also from a deeper topsoil for rooting. These justifications for ridge-planting may have even more impact on small grain crops that are grown in the cool, wet months of late fall and early spring. In addition, when establishing possible new tillage systems like ridge-planting for wheat, fertilizer application methods may influence wheat response. Varieties may respond differently to these tillage and fertilizer variables. The objectives of this study were a) to determine how two wheat varieties respond to different ridge-planted or "flat" reduced or conventional tillage systems and b) to determine the effect of broadcast or dribble urea-ammonium nitrate (UAN - 28% N) spring topdress applications on wheat grown in the ridge-planted or "flat"-planted systems.

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[1] Soil Physicist, Department of Agronomy, KSU

Experimental Procedure

In 1985-86, a study was initiated at two locations to compare four tillage systems, two wheat varieties, and two urea-ammonium nitrate (UAN - 28% N) solution application methods. The four tillage systems were 1) wheat uniformly planted on 10-inch centers on ridges made with a 'Buffalo' cultivator on 30-inch centers - i.e., no-skip ridge-planted wheat; 2) wheat planted at the same population (90 lb/a) on ridges on 30-inch centers with a 20 inch unplanted area between ridges - i.e., skip-furrow ridge-planted wheat; 3) reduced tillage (consisting of discing and field cultivation); and 4) conventional tillage (chisel, disc, and field cultivate). The two hard red winter wheat varieties were 'Arkan' and 'Chisholm'. The spring topdress N was UAN applied as broadcast or dribble (surface banding).

Results

Highest yield ($p<0.05$) was obtained with no-skip ridge-planted wheat at Location 1 (Table 94). Yield in the no-skip ridge system was between 14 and 32 % higher than in any other tillage system. Second highest yield was obtained with skip-furrow ridge-planted wheat. The "flat"-planted reduced and conventional tillage systems resulted in yields that were 5.7 to 12.7 bu/a lower than those obtained with ridge-planted systems. The same trend existed at Location 2; however, the no-skip ridge-planted wheat yields were only significantly higher than those obtained with reduced or conventional tillage (Table 95). Intermediate yields were obtained with skip-furrow ridge-planted wheat but did not differ significantly from yields of the other tillage systems.

At Location 1, the spring topdress UAN application method did not affect Chisholm wheat yields; however, Arkan yields were 5 bu/a higher with dribble than with broadcast applications (Table 94). Both Arkan and Chisholm wheat yields were higher with dribble than broadcast applications at Location 2 (Table 95). Yield components from both locations suggest that higher yields with ridge-planting may be due to either better stands and/or more tillering, as reflected by the trend of more heads per m^2 at harvest. UAN application method appeared not to influence yield components, except that kernels per head were more ($p<0.10$) at both locations with dribble applications. In addition to yield increases with ridge-planting, the quality of the grain as measured by grain N content tended to be higher with ridge-planted wheat than with "flat" tillage systems. Dribble applications of UAN resulted in significantly higher grain N content levels than those obtained with broadcasting UAN fertilizer. The several positive responses from ridge-planting may be due to lower soil moisture and higher soil temperatures. Gravimetric soil moisture measurements and soil temperatures taken in February and April (data not shown) showed statistically lower soil moisture levels and often higher soil temperatures in ridge systems as compared to the two "flat" tillage systems. Even though the measured differences were not large, the data suggest that soil moisture may be lower and soil temperature may be higher during the typically cool, wet spring months in ridge-planted systems. Therefore, these results suggest that higher yield and higher quality grain may be obtained with ridge-planting and dribble applications of UAN.

Table 94. Wheat Yields, Yield Components, and Grain N Content as Affected by Tillage, UAN Application Method, and Wheat Variety at Location 1 in 1986.

Treatment Means	Yield	$Heads/m^2$	Kernel Weight	Kernels/ Head	Grain N Content
	-bu/a-		-mg-		- % -
Tillage					
Ridge: skip-furrow	46.2	660	32.0	19.6	2.01
Ridge: no-skip	52.5	657	32.2	20.6	1.93
Reduced	40.5	518	32.4	20.0	1.83
Conventional	39.8	586	32.6	19.7	1.88
LSD 0.05	3.4	NS	NS	NS	0.09
LSD 0.10	--	91	NS	NS	--
UAN Application Method					
Broadcast	44.1	609	32.1	19.5	1.88
Dribble	45.6	601	32.6	20.4	1.94
F Value	NS	NS	NS	10%	*
Variety					
Arkan	39.8	590	30.3	19.8	2.08
Chisholm	50.1	620	34.3	20.2	1.75
F Value	**	NS	**	NS	**
Interaction(s)	UxV	NS	NS	NS	NS

Table 95. **Wheat Yields, Yield Components, and Grain N Content as Affected by Tillage, UAN Application Method, and Wheat Variety at Location 2 in 1986.**

Treatment Means	Yield	Heads/m^2	Kernel Weight	Kernels/ Head	Grain N Content
	-bu/a-		-mg-		- % -
Tillage					
Ridge: skip-furrow	36.0	458	31.7	19.2	1.78
Ridge: no-skip	41.7	464	32.7	20.9	1.75
Reduced	32.8	448	32.5	20.1	1.59
Conventional	34.7	400	33.1	17.6	1.63
LSD 0.05	NS	NS	NS	1.7	0.13
LSD 0.10	5.5	NS	0.8	--	--
UAN Application Method					
Broadcast	33.8	433	32.7	18.6	1.62
Dribble	38.9	452	32.3	20.3	1.75
F Value	*	NS	NS	10%	**
Variety					
Arkan	34.3	425	30.6	19.2	1.72
Chisholm	38.4	460	34.4	19.7	1.65
F Value	*	*	**	NS	**
Interaction(s)	NS	NS	NS	NS	NS

SEK SOUTHEAST KANSAS BRANCH STATION
KANSAS STATE UNIVERSITY

The Weather for Southeast Kansas in 1985 and 1986

L. Dean Bark[1]

The charts that follow show graphically the daily weather in Parsons during the last 2 years. Each chart has three smooth curves to represent the average weather conditions at Parsons based on 30 years of records from the Experiment Station files. The actual temperature and accumulated precipitation totals that occurred throughout 1985 and 1986 are also plotted by the rough lines on these charts so that the "weather" can be compared with the climatic averages.

Table 96 summarizes the monthly average values for weather conditions at the station. These values are also compared to the monthly normal values.

The charts and table indicate that after the very cold December in 1985, the temperatures warmed up in January, February, and March, with occasional short periods below normal. Summer temperatures were also near normal, until the end of July when a 2-week hot spell was followed by below normal temperatures in August. Fall temperatures ranged from near normal in the early part to much below normal in November. The last 32-freeze in the spring occurred on April 22nd, when a reading of 28 F occurred. The first freeze in the fall was very late in 1986 (November 10th), but it was the beginning of a severe cold period in which temperatures dropped to 9 F on the 13th. Such a severe freeze occurring before dormancy has been induced has the potential for damaging trees and shrub in the area.

Extreme temperatures during the year were not of record magnitude. Highest temperature was 108 F on July 31st. A total of 5 days with temperature reading over 100 F occurred during the last week of July. August, traditionally a hot month, averaged over 5 degrees below normal in 1986, contributing greatly to the below normal energy requirements for air conditioning for the year. The low temperature for the year was a reading of 4 F, which occurred on January 27th.

Precipitation was light during the first 8 months of 1986. The rains commenced in September and continued heavy through November. In one 8-day period, September 27 - October 4, 15.60 inches of rain fell at Parsons. There was that much or more in all of southeastern Kansas, which produced record floods in the area. Even after the floods subsided, wet fields slowed or prevented harvest of fall crops. The frequent rains during this period caused soybeans and sorghum to sprout in the field. At year's end, many crops were still not harvested.

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[1] Climatologist for the Agricultural Experiment Station, Department of Physics

TABLE 96. ANNUAL SUMMARY OF WEATHER DATA FOR PARSONS - 1986

1986 DATA

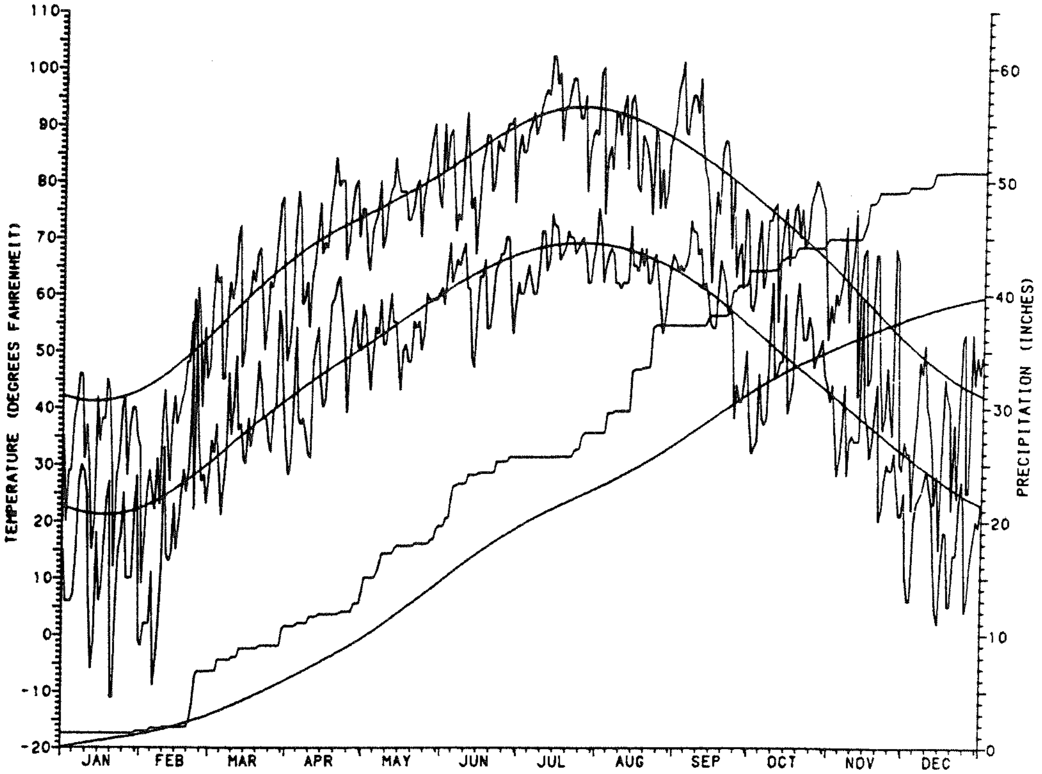
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVG MAX TEMPERATURE	50.1	49.5	63.1	70.4	76.6	87.7	94.6	87.6	81.3	67	49.1	44.2	68.5
AVG MIN TEMPERATURE	22.2	27.6	37.3	46.8	55.5	65.7	69.8	61.4	63.7	48.5	30.6	28	46.5
AVG MEAN TEMPERATURE	36.2	38.6	50.2	58.6	66.1	76.7	82.2	74.5	72.5	57.8	39.8	36.1	57.5
TOTAL PRECIPITATION	T	1.34	1.61	3.89	4.87	3.11	1.24	3.27	11.17	12.15	3.82	1.27	47.74
TOTAL SNOWFALL	.0	4.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	4.0
HEATING DEGREE DAYS	885	734	462	214	48	0	0	9	10	237	820	896	4315
COOLING DEGREE DAYS	0	0	10	30	87	359	542	311	244	20	0	0	1603

NORMAL VALUES (1951- 80 AVERAGE)

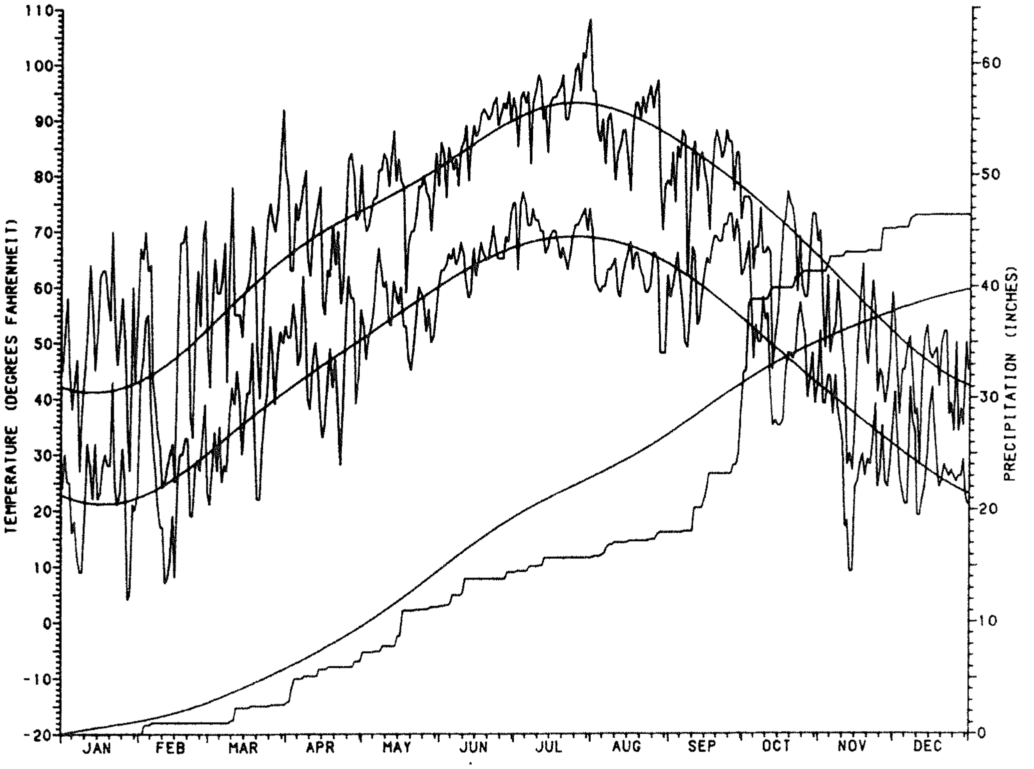
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVG MAX TEMPERATURE	42.8	49.3	58.6	70.8	78.8	87.2	93.1	92.2	84.0	73.6	57.9	47.3	69.6
AVG MIN TEMPERATURE	22.6	27.6	35.5	47.2	56.5	64.9	69.5	67.6	60.3	49.0	36.8	27.8	47.1
AVG MEAN TEMPERATURE	32.7	38.5	47.1	59.0	67.7	76.1	81.3	79.9	72.1	61.3	47.4	37.6	58.4
TOTAL PRECIPITATION	1.22	1.34	2.98	3.72	5.18	4.80	3.65	3.43	4.53	3.47	2.54	1.65	38.51
TOTAL SNOWFALL	3.1	2.9	2	.3	0	0	0	0	0	.1	.7	2.1	11.2
HEATING DEGREE DAYS	1001	742	565	209	59	6	0	0	24	173	528	849	4156
COOLING DEGREE DAYS	0	0	10	29	143	339	505	462	237	58	0	0	1783

1986 DEPARTURES FROM NORMAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
AVG MAX TEMPERATURE	7.3	.2	4.5	-.4	-2.2	.5	1.5	-4.6	-2.7	-6.6	-8.8	-3.1	-1.1
AVG MIN TEMPERATURE	-.4	.0	1.8	-.4	-1.0	.8	.3	-6.2	3.4	-.5	-6.2	.2	-.6
AVG MEAN TEMPERATURE	3.5	.1	3.1	-.4	-1.6	.6	.9	-5.4	.4	-3.5	-7.6	-1.5	-.9
TOTAL PRECIPITATION	-1.22	.00	-1.37	.17	-.31	-1.69	-2.41	-.16	6.64	8.68	1.28	-.38	9.23
TOTAL SNOWFALL	-3.1	1.1	-2.0	-.3	.0	.0	.0	.0	.0	-.1	-.7	-2.1	-7.2
HEATING DEGREE DAYS	-116	-8	-103	5	-11	-6	0	9	-14	64	292	47	159
COOLING DEGREE DAYS	0	0	0	1	-56	20	37	-151	7	-38	0	0	-180



GRAPHICAL WEATHER SUMMARY FOR PARSONS 1985



GRAPHICAL WEATHER SUMMARY FOR PARSONS 1986

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