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2006 Agricultural Research




Southeast Agricultural Research Center

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service

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SOUTHEAST AGRICULTURAL RESEARCH CENTER KANSAS STATE UNIVERSITY

DISTILLERS GRAINS SUPPLEMENTATION FOR GRAZING STOCKER CATTLE

Lyle W. Lomas and Joseph L. Moyer

Summary

Thirty-six steers were used to evaluate the effects of supplementation with distillers dried grains (DDGS), at 0.5 or 1.0% of bodyweight while grazing smooth bromegrass, on available forage, grazing gains, subsequent finishing gains, and carcass characteristics. Supplementation treatment had no effect ($P>0.05$) on forage availability. Supplementation with DDGS resulted in significantly higher ($P<0.05$) grazing gains and gain/acre than feeding no supplement. Supplementation with 1.0% DDGS resulted in higher ($P<0.05$) grazing gains and gain/acre than supplementation with 0.5% DDGS. Supplementation during the grazing phase had no effect ($P>0.05$) on finishing gains. Steers that were fed supplement during the grazing phase had higher ($P<0.05$) slaughter weights and overall gains than those that received no DDGS while grazing.

Introduction

Distillers grains are a by-product of the ethanol industry. Ethanol production from feed grains is a rapidly growing industry that is making a major contribution to the American agricultural economy. Total ethanol production in the United States has more than doubled in the past 10 years and is expected to increase in the future. Kansas currently has seven dry-mill ethanol plants in operation, with a capacity of producing more than 170 million gallons of ethanol annually and additional potential plants are in various stages of planning. Current ethanol production in Kansas creates a market for more than 65 million bushels of corn and sorghum, and yields approximately 600 thousand tons of distillers dried grains annually. The availability of this co-product will likely increase and the cost decrease even more in the future with the growth of the ethanol industry; efficient, cost-effective uses of this feedstuff need to be identified. Conversely, the value of distillers grains as a supplement for grazing cattle also needs to be determined.

More than 80% of distillers grains are currently being fed to ruminants, but they are also being used in swine and poultry diets. Distillers grains are commonly included in diets of dairy and finishing cattle at 20 to 30% of diet dry matter. A limiting factor to feeding large amounts of distillers grains is the environmental impact of excess nitrogen and phosphorus. A South Dakota study revealed that protein was in excess of requirements when distillers grains were included at 30% of the diet dry matter in cows producing either 53 or 66 lb of milk per day. Care must also be taken in balancing diets containing distillers grains to avoid overfeeding of phosphorus.

Forage-based livestock production is a vital component of the Kansas economy. Kansas has nearly 18 million acres of pasture land, and ranks sixth in the United States in the number of beef cows, with more than 1.5 million head. Cash receipts from cattle production in Kansas exceeded $5.6 billion in 2003. Forages account for 80% of the feed units consumed by beef cattle and, therefore, represent an extremely

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important resource to the industry. Increasing the proportion of total cattle feed that is harvested directly by grazing cattle, and balancing their diets with low-cost supplements such as distillers grains, could improve the sustainability and profitability of the beef cattle industry in Kansas and also create additional demand for corn co-products.

Productivity of forage-livestock systems is limited by seasonality of forage growth. The energy value of cool-season grasses can decline as much as 30% from the vegetative stage to maturity. Livestock growth rates and reproductive performance generally decline in response to these changes in seasonal forage availability and quality unless their diets are supplemented with additional nutrients. Depending on price, use of supplemental feeds may be a cost-effective risk management strategy if the amounts and/or nutritional quality of forages are inadequate. Because of the expansion of the grain-processing industries, co-products like distillers grains or gluten feed may be purchased at a price that is competitive with corn on a net energy basis and, with further growth of the industry, will likely be less expensive in the future. Because the co-products generally have high concentrations of protein and phosphorus, their composition complements those of mature forages that are typically deficient in these nutrients.

Experimental Procedures

Thirty-six steers of predominately Angus breeding (437 lb) were weighed on two consecutive days, stratified by weight, and randomly allotted to nine 4-acre smooth bromegrass pastures on April 5, 2005. Three pastures of steers were randomly assigned to one of three supplementation treatments (3 replicates per treatment) and were grazed for 196 days. Supplementation treatments were 0, 0.5, or 1.0% bodyweight of corn distillers dried grain per head daily. Cattle in each pasture were group-fed distillers dried grains in meal form daily and pasture was the experimental unit. No implants or feed additives were used during the grazing phase. Weight gain was the primary measurement. Cattle were weighed every 28 days, and the quantity of distillers grain fed adjusted at that time.

Cattle were treated for internal and external parasites before being turned out to pasture, and later were vaccinated for protection from pinkeye. Cattle had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorous, and 12% salt. Pastures were previously fertilized with 100-40-40 lb/a of N-P_2O_5-K_2O_5 on March 5, 2005. Forage availability was measured approximately every 28 days with a disk meter calibrated for smooth bromegrass. One steer was removed from the study for reasons unrelated to experimental treatment.

Grazing was terminated and cattle were weighed off pasture on October 17 and 18, 2005. After the grazing period, cattle were shipped to a finishing facility, implanted with Synovex S®, and fed a diet of 80% ground milo, 15% corn silage, and 5% supplement (dry-matter basis) for 126 days. Cattle were slaughtered in a commercial facility at the end of the finishing period, and carcass data were collected.

Results and Discussion

Available forage during the grazing phase is presented by date and supplementation level in Table 1. Supplementation with distillers dried grains had no effect ($P>0.05$) on the quantity of forage available for grazing. The quantity of available forage did differ ($P<0.05$) by sampling date. Available forage was the least on April 6 (1,159 lb/a), increased with each successive sampling date to a high of 10,271 lb/a on June 28, and then gradually declined as the grazing season progressed.

Table 2 presents grazing and subsequent finishing performance of steers fed supplemental distillers dried grains while grazing smooth bromegrass. During the grazing phase, steers fed 0.5 or 1.0% DDGS had 37% or

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54% higher (P<0.05) weight gain, daily gain, and steer gain/a, respectively, than those that received no supplement. Steers fed 0.5 or 1.0% DDGS had 112 or 165 lb higher (P<0.05) total weight gain, 0.57 or 0.84 lb higher (P<0.05) daily gain, and 89 or 132 lb higher (P<0.05) gain/a, respectively, than those that received no supplementation. Grazing steers fed 1.0% DDGS had 13% higher (P<0.05) weight gain (53 lb), daily gain (0.27 lb), and gain/a (43 lb), than those fed 0.5% DDGS. Steers fed DDGS at 0.5 or 1.0% body weight per head daily consumed a total of 650 or 1308 lb of DDGS, respectively, during the 196-day grazing period. Average consumption of DDGS was 3.3 or 6.7 lb per head daily for steers receiving 0.5 or 1.0% DDGS per head daily, respectively.

Supplementation with distillers dried grains during the grazing phase had no effect (P>0.05) on subsequent finishing gain, but steers that received supplement during the grazing phase were heavier (P<0.05) at the end of the grazing phase, were heavier (P<0.05) at the end of the finishing phase, and had higher (P<0.05) hot carcass weights than those that received no supplement while grazing. Supplementation during the grazing phase had no effect (P>0.05) on feed intake, but steers that received no supplement while grazing required less (P<0.05) feed per lb of gain than those that were fed distillers grains at 1.0% of their bodyweight. Supplementation during the grazing phase had no effect (P>0.05) on dressing percentage, fat thickness, ribeye area, yield grade, marbling score, or percentage of cattle that graded choice. Overall gain (grazing + finishing) was higher (P<0.05) for cattle that received distillers dried grains during the grazing phase. Steers that received 0.5 or 1.0% DDGS had 89 or 148 lb higher (P<0.05) overall gain and 0.28 or 0.46 lb higher (P<0.05) daily gain, respectively, than those that received no supplement while grazing. Overall gains were similar (P>0.05) between steers receiving 0.5 or 1.0% distillers dried grains.

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Table 1. Effect of Supplementation with Distillers Dried Grains on Available Forage, Southeast Agricultural Research Center, 2005.

	Rate of Distillers Grains (%BW/hd/day)			
	0	0.5	1.0	
Date				Average
	- - - - - - - - - - - lb of dry matter/a- - - - - - - - - - - - -			
4/6/05	1602	1595	1480	1559[a]
5/3/05	4205	4040	4098	4114[b]
6/2/05	4241	4470	4470	4394[b]
6/28/05	9954	10107	10753	10271[c]
7/26/05	9680	9522	10349	9851[c]
8/23/05	7285	7378	7229	7297[d]
9/22/05	6844	6872	6983	6900[d,e]
10/17/05	6189	6315	6231	6245[e]
Season Average	6250	6287	6449	6329

[a,b,c,d,e] Means within a column with the same letter are not significantly different ($P<0.05$).

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Table 2. Effect of Supplemental Distillers Dried Grains on Grazing and Subsequent Finishing Performance of Steers Grazing Smooth Bromegrass Pastures, Southeast Agricultural Research Center, 2005.

	Rate of Distillers Grains (%BW/hd/day)		
Item	0	0.5	1.0
Grazing Phase (196 days)			
No. of head	11	12	12
Initial wt., lb	435	438	437
Final wt., lb	739[a]	853[b]	907[c]
Gain, lb	304[a]	416[b]	469[c]
Daily gain, lb	1.55[a]	2.12[b]	2.39[c]
Gain/acre, lb	243[a]	332[b]	375[c]
Total DDGS consumption, lb/head	0	650	1308
Average DDGS consumption, lb/head/day	0	3.3	6.7
Finishing Phase (126 days)			
Beginning wt., lb	739[a]	853[b]	907[c]
Ending wt., lb	1225[a]	1317[b]	1375[b]
Gain, lb	486	464	468
Daily gain, lb	3.85	3.68	3.72
Daily DM intake, lb	26.1	26.6	28.0
Feed/gain	6.78[a]	7.23[a,b]	7.52[b]
Hot carcass wt., lb	747[a]	805[b]	848[c]
Dressing %	61	61	62
Backfat, in	0.52	0.62	0.68
Ribeye area, in^2	13.2	13.4	13.5
Yield grade	2.8	3.2	3.5
Marbling score	SM^{38}	SM^{35}	SM^{69}
% Choice	83	83	83
Overall Performance (Grazing + Finishing) (322 days)			
Gain, lb	790[a]	879[b]	938[b]
Daily gain, lb	2.45[a]	2.73[b]	2.91[b]

[a,b,c] Means within a row with the same superscript are not significantly different ($P<0.05$).

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EVALUATION OF FORAGE PRODUCTION, STAND PERSISTENCE, AND GRAZING PERFORMANCE OF STEERS GRAZING TALL FESCUE CULTIVARS WITH THE NOVEL ENDOPHYTE

Lyle W. Lomas and Joseph L. Moyer

Summary

Sixty-four crossbred steers were used to evaluate the effect of tall fescue cultivar on grazing gains, forage production, and stand persistence in 2004 and 2005. Cultivars evaluated included high-endophyte Kentucky 31, low-endophyte Kentucky 31, ArkPlus, and MaxQ. Pastures with low-endophyte Kentucky 31, ArkPlus, or MaxQ produced higher ($P<0.05$) steer grazing gains and more ($P<0.05$) gain/acre than did high-endophyte Kentucky 31 during both years. Steer liveweight gain and gain/a were similar ($P>0.05$) between pastures with low-endophyte Kentucky 31, ArkPlus, and MaxQ in 2004 and 2005. Stand density and average available forage for the grazing season did not differ ($P>0.05$) between varieties.

Introduction

Tall fescue, the most widely adapted cool-season perennial grass in the USA, is grown on approximately 66 million acres. Although tall fescue is well-adapted in the eastern half of the country between the temperate North and mild South, the presence of a fungal endophyte results in poor performance by grazing livestock, especially during the summer.

Until recently, producers with high-endophyte tall fescue pastures had two primary options to improve grazing-livestock performance. One option was to destroy existing stands and replace them with endophyte-free fescue or other forages. Although it supports greater grazing-animal performance than endophyte-infected fescue does, endophyte-free fescue has proven to be less persistent under grazing and more susceptible to stand loss from drought stress. In situations in which high-endophyte tall fescue must be grown, the other option was for producers to adopt management strategies to reduce the negative effects of the endophyte on grazing animals, such as incorporation of legumes into existing pastures. Addition of legumes can improve nutritive quality of fescue pastures, increase gains of grazing livestock, and reduce N fertilizer rates.

During the past few years, new cultivars of tall fescue have been developed that have a so-called novel endophyte that provides vigor to the fescue plant, but does not have the traditional negative effect on performance of grazing livestock. The objective of this study was to evaluate grazing and subsequent finishing performance of stocker steers, forage availability, and stand persistence of two of these new cultivars and to compare them with high- and low-endophyte Kentucky 31 tall fescue.

Experimental Procedures

Sixty-four crossbred steers were weighed on consecutive days and allotted to 16 five-acre pastures of high-endophyte Kentucky 31, low-endophyte Kentucky 31, ArkPlus, or MaxQ tall fescue (4 replications/cultivar) on March 16, 2004 (513 lb) and March 24, 2005 (501 lb). All pastures were seeded in the fall of 2002 and had been harvested for hay in 2003. All pastures were fertilized on January 15, 2004, with 80 lb of N/a and P_2O_5 and K_2O as required by soil

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test; on February 2, 2005, with 80 lb of N/a; and on September 3, 2004, and September 13, 2005, with 40-40-30 lb of N-P_2O_5-K_2O/a.

Cattle were treated for internal and external parasites before being turned out to pasture and later were vaccinated for protection from pinkeye. Steers had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt.

Cattle were weighed every 28 days, and forage availability was measured approximately every 28 days with a disk meter calibrated for tall fescue. Pastures were grazed continuously until November 30, 2004 (257 days) and December 6, 2005 (257 days), when grazing was terminated and steers were weighed on consecutive days.

After the grazing period, cattle were shipped to a finishing facility, implanted with Synovex S®, and fed a diet of 80% ground milo, 15% corn silage, and 5% supplement (dry-matter basis). Cattle that were grazed during 2004 were fed a finishing diet for 112 days and then slaughtered in a commercial facility, and carcass data were collected. Steers grazed during 2005 are currently being finished for slaughter.

Results and Discussion

Grazing performance is presented by cultivar in Table 1 and Table 2 for 2004 and 2005, respectively. Steers that grazed pastures of low-endophyte Kentucky 31, MaxQ, or ArkPlus gained significantly more (P<0.05) and produced more (P<0.05) gain/acre than those that grazed high-endophyte Kentucky 31 pastures during both years. Gains of cattle that grazed low-endophyte Kentucky 31, ArkPlus, or MaxQ were similar (P>0.05) in 2004 and 2005. Steer daily gain from pastures with high-endophyte Kentucky 31, low-endophyte Kentucky 31, ArkPlus, and MaxQ were 0.94 and 1.17, 1.54 and 1.60, 1.55 and 1.53, and 1.47 and 1.65 lb per head daily, during 2004 and 2005, respectively. Gains per acre from pastures with high-endophyte Kentucky 31, low-endophyte Kentucky 31, ArkPlus, and MaxQ were 194 and 241, 317 and 329, 319 and 314, and 302 and 340 lb/a, during 2004 and 2005, respectively.

Finishing performance, carcass characteristics, and overall performance (grazing + finishing) for steers grazed in 2004 are presented in Table 1. Steers that had previously grazed high-endophyte Kentucky 31 had lower (P<0.05) final finishing weight and lower (P<0.05) hot carcass weight than those that grazed low-endophyte Kentucky 31 or ArkPlus. Final liveweight and hot carcass weights were similar (P>0.05) for steers that grazed high-endophyte Kentucky 31 or MaxQ, but steers that grazed high-endophyte Kentucky 31 or ArkPlus had higher (P<0.05) finishing daily gains than those that had grazed low-endophyte Kentucky 31 or MaxQ. Cattle that grazed high-endophyte Kentucky 31 required less (P<0.05) feed per lb of gain than those that had grazed low-endophyte Kentucky 31 or MaxQ, and had feed conversion similar (P>0.05) to steers that had grazed ArkPlus. Steers that grazed low endophyte Kentucky 31 had feed efficiency similar (P>0.05) to those that grazed ArkPlus or MaxQ. Steers that grazed ArkPlus required less (P<0.05) feed per lb of gain than those that grazed MaxQ.

Steers that grazed MaxQ had greater (P<0.05) external fat thickness than those that grazed high-endophyte Kentucky 31, low-endophyte Kentucky 31, or MaxQ, and had a higher (P<0.05) numerical yield grade than those that grazed MaxQ. There were no significant differences (P>0.05) between treatments in the percentage of cattle grading Choice or higher.

Cattle that grazed high-endophyte Kentucky 31 had lower (P<0.05) overall gains (grazing + finishing) than those that grazed low-endophyte Kentucky 31 or ArkPlus, and had overall gains similar (P>0.05) to those that grazed MaxQ.

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Overall gains of steers that grazed low-endophyte Kentucky 31 or ArkPlus were similar (P>0.05).

Available forage and stand density of each cultivar are presented in Table 3. Although there was no difference between cultivars for average available forage for the entire grazing season in 2004, available forage between cultivars did differ on three measurement dates toward the latter part of the grazing season. On September 1, low-endophyte Kentucky 31 pastures had less (P<0.05) available forage than did pastures with high-endophyte Kentucky 31, ArkPlus, or MaxQ. On September 29, low-endophyte Kentucky 31 pastures had less (P<0.05) available forage than did MaxQ pastures. On November 30, high-endophyte Kentucky 31 pastures had more (P<0.05) available forage than low-endophyte Kentucky 31 or ArkPlus pastures had.

In 2005, Kentucky 31 pastures had higher (P<0.05) average available forage than the other three varieties, MaxQ pastures had higher (P<0.05) available forage than did low-endophyte Kentucky 31 and ArkPlus, and average available forage for low-endophyte Kentucky 31 and ArkPlus pastures were similar (P>0.05). High-endophyte Kentucky 31 pastures had more (P<0.05) available forage than the other three varieties had on March 24 and September 8. On August 11, high-endophyte Kentucky 31 and MaxQ pastures had more (P<0.05) available forage than did low-endophyte Kentucky 31 and ArkPlus pastures. On November 11, MaxQ pastures had more (P<0.05) available forage than did low-endophyte Kentucky 31 pastures. On December 6, high-endophyte Kentucky 31 and low-endophyte Kentucky 31 pastures had more (P<0.05) available forage than did ArkPlus and MaxQ pastures.

In general, pastures with less available forage dry matter produced higher steer gains than those with greater available forage dry matter. This may indicate that reduced available dry matter may be the result of greater forage intake by grazing steers, which in turn results in higher gains and/or less vigor of the fescue cultivar. Stand density was similar between cultivars at both the beginning and end of each grazing season.

Cattle grazing ArkPlus or MaxQ tall fescue, new varieties with the novel endophyte, seem to have gains similar to those of cattle grazing low-endophyte Kentucky 31, and significantly higher gains than those of cattle grazing high-endophyte Kentucky 31 tall fescue. Persistence of these varieties under grazing will continue to be monitored. This study will be continued for at least three more years.

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Table 1. Effect of Cultivar on Grazing and Subsequent Performance of Steers Grazing Tall Fescue Pastures, Southeast Agricultural Research Center, 2004.

	Tall Fescue Cultivar			
Item	High-endophyte Kentucky 31	Low-endophyte Kentucky 31	ArkPlus	MaxQ
Grazing Phase (257 days)				
No. of head	16	16	16	16
Initial wt., lb	513	513	513	512
Ending wt., lb	756[a]	908[b]	911[b]	890[b]
Gain, lb	243[a]	396[b]	399[b]	377[b]
Daily gain, lb	0.94[a]	1.54[b]	1.55[b]	1.47[b]
Gain/acre, lb	194[a]	317[b]	319[b]	302[b]
Finishing Phase (112 days)				
Beginning wt., lb	756[a]	908[b]	911[b]	890[b]
Ending wt., lb	1252[a]	1341[b,c]	1388[b]	1285[a,c]
Gain, lb	497[a]	433[b,c]	477[a,c]	395[b]
Daily gain, lb	4.44[a]	3.86[b]	4.26[a]	3.53[b]
Daily DM intake, lb	27.2	28.1	28.6	27.1
Feed/gain	6.14[a]	7.36[b,c]	6.73[a,c]	7.68[b]
Hot carcass wt., lb	731[a]	786[b,c]	801[b]	754[a,c]
Dressing %	58	59	58	59
Backfat, in	0.38[a]	0.38[a]	0.49[b]	0.34[a]
Ribeye area, in^2	12.0	11.9	12.1	12.2
Yield grade	2.8[a,b]	3.1[a,b]	3.3[a]	2.7[b]
Marbling score	SM^{50}	SM^{63}	SM^{86}	SM^{24}
% Choice	69	75	94	69
Overall Performance (Grazing + Finishing) (369 days)				
Gain, lb	740[a]	828[b,c]	876[b]	772[a,c]
Daily gain, lb	2.00[a]	2.25[b,c]	2.37[b]	2.09[a,c]

[a,b,c] Means within a row with the same letter are not significantly different (P<0.05).

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Table 2. Effect of Cultivar on Grazing Performance of Steers Grazing Tall Fescue Pastures, Southeast Agricultural Research Center, 2005 (257 days).

	Tall Fescue Cultivar			
Item	High-endophyte Kentucky 31	Low-endophyte Kentucky 31	ArkPlus	MaxQ
No. of head	16	16	16	16
Initial wt., lb	501	501	501	501
Ending wt., lb	802[a]	912[b]	893[b]	926[b]
Gain, lb	302[a]	412[b]	392[b]	425[b]
Daily gain, lb	1.17[a]	1.60[b]	1.53[b]	1.65[b]
Gain/acre, lb	241[a]	329[b]	314[b]	340[b]

[a,b] Means within a row with the same letter are not significantly different ($P<0.05$).

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Table 3. Effect of Cultivar on Available Forage and Stand Density of Tall Fescue Pastures, Southeast Agricultural Research Center, 2004 and 2005.

	Tall Fescue Cultivar			
Date	High-endophyte Kentucky 31	Low-endophyte Kentucky 31	ArkPlus	MaxQ
Available Forage	lb of dry matter/a			
3/17/04	2611	2367	2276	2585
4/14/04	2890	2569	2576	2822
5/11/04	4652	4331	4258	4730
6/15/04	3816	3276	3632	3607
7/7/04	3179	3026	3252	3068
8/4/04	3038	2912	2975	3094
8/30/04	2610[a]	2392[b]	2630[a]	2824[a]
9/29/04	2192[a,b]	1879[b]	2056[a,b]	2246[a]
10/27/04	2042	1872	1764	2034
12/1/04	1653[a]	1366[b]	1342[b]	1488[a,b]
2004 Season Average	2868	2599	2676	2850
3/24/05	1883[a]	1394[b]	1404[b]	1498[b]
4/20/05	2760	2526	2516	2913
5/18/05	3431	3099	3331	3389
7/14/05	2972	2811	2749	2670
8/11/05	2401[a]	2080[b]	2148[b]	2472[a]
9/8/05	2558[a]	2262[b]	2331[b]	2309[b]
10/5/05	2301	2029	2142	1996
11/2/05	1451[a,b]	1354[b]	1568[a,b]	1791[a]
12/6/05	1950[a]	1643[a]	1096[b]	1270[b]
2005 Season Average	2412[a]	2133[c]	2132[c]	2257[b]
Stand Density	tillers/ft^2			
3/17/04	66	62	70	70
12/1/04	78	85	74	75
12/12/05	130	135	118	134

[a,b,c] Means within a row with the same letter are not significantly different (P<0.05).

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EFFECTS OF GRAIN SORGHUM SUPPLEMENTATION ON GRAZING AND SUBSEQUENT FINISHING PERFORMANCE OF STEERS AND HEIFERS GRAZING SMOOTH BROMEGRASS PASTURES

Lyle W. Lomas and Joseph L. Moyer

Summary

Twenty-four steer calves and 12 heifer calves in 2002 and 36 steer calves in 2003 and 2004 were used to evaluate the effect on grazing performance and subsequent finishing performance from grain sorghum supplementation for calves grazing smooth bromegrass pastures. In all three years, cattle fed 4 lb of supplemental grain sorghum per head daily had greater ($P<0.05$) grazing gain than did those that received no supplement. In 2002 and 2003, 2 lb of supplement per head daily resulted in no significant ($P>0.05$) improvement in grazing gain over the control. In 2004, however, steers fed 2 lb of supplemental grain sorghum per head daily gained more ($P<0.05$) than did those that received no supplement. Average forage availability was not affected ($P>0.05$) by supplementation in any of the three years, but was affected ($P<0.05$) on two sampling dates in 2003. Supplementation during the grazing phase had no effect ($P>0.05$) on finishing performance or overall cattle weight gain of cattle.

Introduction

Providing supplemental feed to grazing stocker cattle is an effective way to increase gains of cattle on pasture. The decision of whether or not to provide supplement to grazing cattle may depend on several factors, including pasture conditions, supplement cost, anticipated selling price, cattle weight, and expected selling date. Although supplementation will improve grazing gains in most instances, the effect of supplementation on available forage during the grazing phase and the effects on subsequent finishing performance and carcass characteristics are not clearly documented. The purpose of this study was to evaluate the effects of grain sorghum supplementation on forage availability, grazing performance, and subsequent finishing performance.

Experimental Procedures

Twenty-four steer calves and 12 heifer calves in 2002 and 36 steer calves in 2003 and 2004, with initial average weights of 552, 472, 569, and 469 lb, respectively, were weighed on consecutive days, stratified by weight within sex, and allotted randomly to nine 5-acre smooth bromegrass pastures on April 25, 2002, April 29, 2003, or April 9, 2004. All animals were of predominately Angus breeding. Two pastures of steers and one pasture of heifers were randomly assigned to one of three supplementation treatments and were grazed for 188 days in 2002. Three pastures of steers were randomly assigned to one of three supplementation treatments and were grazed for 199 and 235 days in 2003 and 2004, respectively. Supplementation treatments were 0, 2, or 4 lb of ground grain sorghum/head daily. Pastures were fertilized in late spring of each year with 100-40-40 lb of N-P_2O_5-K_2O/a.

Cattle were weighed and forage samples were collected every 28 days, and forage availability was measured approximately every 28 days with a disk meter calibrated for smooth bromegrass. Grazing was terminated and cattle

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were weighed on October 29 and 30, November 12 and 13, and November 29 and 30 in 2002, 2003,and 2004, respectively.

Cattle were treated for internal and external parasites before being turned out to pasture, and later were vaccinated for protection from pinkeye. Cattle had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt.

After the grazing period, cattle were shipped to a finishing facility and fed a diet of 80% ground milo, 15% corn silage, and 5% supplement (dry-matter basis) for 112, 99, and 126 days in 2002, 2003,and 2004, respectively. In 2002, steers were implanted with Synovex S® and heifers were implanted with Ralgro® on days 0 and 84 of the finishing period, respectively. In 2003 and 2004, steers were implanted with Synovex S® on day 0. Cattle were slaughtered in a commercial facility at the end of the finishing period, and carcass data were collected.

Results and Discussion

Forage availability and crude protein content of pastures during the grazing phase are presented in Tables 1, 2, and 3 for 2002, 2003, and 2004, respectively. In 2002, there were no significant (P>0.05) differencesin pasture forage availability as a result of supplementation treatment or gender on any of the evaluation dates. In 2003, forage availability was greater (P<0.05) on May 28 in pastures with cattle fed 4 lb of supplemental grain sorghum per head daily and on November 13 in pastures with cattle fed 2 lb of supplemental grain sorghum per head daily. Average forage availability over the entire grazing season was not affected (P>0.05) by supplementation in 2002, 2003, or 2004. In 2002, forage availability peaked on May 29 and was least on October 29. In 2003, forage availability peaked on May 28 and was least on November 13. In 2004, forage availability peaked on May 1 and was least on November 29.

Although average forage crude protein values ranged from 11.4% in 2002 to 12.2% in both 2003 and 2004, there was considerable variation in forage protein content during the grazing season. Forage protein content tended to be the greatest in April of each year, ranging from 17.9% in 2003 to 21.1 % in 2002, and tended to be the least in late June or early July, ranging from 7.2% in 2002 to 7.6% in 2004. Forage protein content tended to decline from April to late June and then gradually increase toward fall. The dramatic decrease in protein content observed from April to early July was likely caused, at least in part, by increased plant maturity and the presence of seed heads in the July samples.

Cattle performance is presented in Tables 4, 5, and 6, for 2002, 2003, and 2004, respectively. One steer was removed from the 2-lb supplementation group near the end of the grazing phase in 2003 for reasons unrelated to experimental treatment. In 2002, 2003, and 2004, respectively, cattle fed 4 lb of grain sorghum per head daily gained 0.30, 0.25, and 0.41 lb more (P<0.05) per day and produced 45, 40, and 79 lb more (P<0.05) grazing gain per acre than did those that received no supplement. Supplementation with 2 lb of grain sorghum per head daily resulted in no significant (P<0.05) improvement in grazing performance over the control in 2002 and 2003. In 2004, however, steers fed 2 lb of supplemental grain sorghum per head daily gained 0.22 lb more (P<0.05) weight per head daily and produced 42 lb more (P<0.05) grazing gain per acre than did those that received no supplement.

Supplementation during the grazing phase had no effect (P>0.05) on finishing gain or overall gain in either 2002, 2003, or 2004. Cattle fed 4 lb of supplemental grain sorghum per head daily during the grazing phase in 2002 were heavier at the end of the finishing phase than were those receiving 0 or 2 lb per head daily, although this difference was not significant (P>0.05). Cattle that received no supplement during the grazing phase seemingly made some compensatory gain in the feedlot.

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Cattle fed 4 lb of supplemental grain sorghum per head daily during the grazing phase had higher (P<0.05) marbling scores than those that received 0 or 2 lb of supplement. Marbling score was lower (P<0.05) for cattle fed 2 lb of supplement than for those fed 0 or 4 lb per head daily.

In 2003, steers receiving 2 lb of supplement during the grazing phase were heavier (P<0.05) at the end of the finishing phase and had heavier (P<0.05) hot-carcass weights than did those that received no supplement while grazing. No other differences (P>0.05) in finishing or overall performance were observed in steers grazed in 2003.

In 2004, steers fed 2 or 4 lb of supplemental grain sorghum during the grazing phase were heaver (P<0.05) at the beginning of the finishing phase. Cattle that received no supplement during the grazing phase made compensatory gains during the finishing phase, however, and as a result, ending weights and hot carcass weights were similar (P>0.05) between treatments. Steers that received 2 lb of supplement during the grazing phase had a higher (P<0.05) dressing percentage than those that received no supplement.

Although the steers were heavier (P<0.05) than the heifers in 2002 at both the beginning and end of the grazing phase, grazing gains of steers and heifers were similar (P<0.05). During the finishing phase, steers had greater (P<0.05) gains, consumed more (P<0.05) feed, had smaller (P<0.05) feed/gain, had heavier (P<0.05) carcasses, and had greater (P<0.05) overall gains than heifers. Heifers had a larger (P<0.05) dressing percentage and higher (P<0.05) marbling scores than steers did.

In summary, supplementation with 4 lb of grain sorghum/head/day improved (P<0.05) performance during the grazing phase, but had no effect (P>0.05) on finishing or overall performance. Supplementation with 2 lb of grain sorghum per head daily resulted in performance similar (P>0.05) to feeding no supplement in 2002 and 2003, but improved (P<0.05) grazing gain in 2004.

On the basis of these data, a producer planning to background cattle and sell them at the end of the grazing period might want to consider supplementation with 4 lb of grain sorghum per head daily. If ownership of the cattle were to be retained through slaughter, there would be little or no advantage to supplementation with grain sorghum during the backgrounding phase.

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Table 1. Effect of Supplemental Grain Sorghum on Forage Availability for Steers and Heifers Grazing Smooth Bromegrass Pastures, Southeast Agricultural Research Center, 2002.

	Forage Availability (lb/a)				
	Grain Sorghum (lb/head/day)				
Date	0	2	4	Average	Crude Protein (%)
April 25	3109	3546	3309	3321	21.1
May 29	4234	4266	4251	4250	8.8
June 27	2936	2798	2963	2899	8.9
July 24	2292	2307	2460	2353	7.2
August 27	1830	1699	1762	1764	8.5
September 26	1502	1497	1614	1538	16.0
October 29	1145	1055	987	1062	9.4
Average	2436	2452	2478	2455	11.4

Table 2. Effect of Supplemental Grain Sorghum on Forage Availability for Steers Grazing Smooth Bromegrass Pastures, Southeast Agricultural Research Center, 2003.

	Forage Availability (lb/a)				
	Grain Sorghum (lb/head/day)				
Date	0	2	4	Average	Crude Protein (%)
April 30	5409	4835	5623	5289	17.9
May 28	4757[a]	5169[a]	6721[b]	5549	9.5
June 25	3581	3866	3451	3633	7.4
July 22	2751	2609	2845	2735	11.0
August 19	2162	2220	2382	2254	10.8
September 15	2048	2278	2162	2163	12.5
October 15	1562	1637	1633	1611	15.5
November 13	1202[a]	1371[b]	1151[a]	1241	13.1
Average	2934	2998	3246	3059	12.2

[a,b] Means within a row with the same letter are not significantly different (P<0.05).

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Table 3. Effect of Supplemental Grain Sorghum on Forage Availability for Steers Grazing Smooth Bromegrass Pastures, Southeast Agricultural Research Center, 2004.

	Forage Availability (lb/a)				
	Grain Sorghum (lb/head/day)				
Date	0	2	4	Average	Crude Protein (%)
April 8	1640	1954	1844	1813	20.2
May 11	5804	6271	6164	6080	12.9
June 11	4502	4031	4190	4241	8.5
July 7	3396	3445	3685	3509	7.6
August 4	2534	2982	2891	2802	9.8
September 2	2697	2249	2551	2499	9.3
September 30	2032	1928	1909	1956	8.7
October 28	1373	1381	1428	1394	8.4
November 29	1157	1134	1112	1134	18.3
Average	2793	2819	2864	2825	12.2

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Table 4. Effect of Supplemental Grain Sorghum on Grazing and Subsequent Finishing Performance of Steers and Heifers Grazing Smooth Bromegrass Pastures, Southeast Agricultural Research Center, 2002.

	Grain Sorghum (lb/head/day)			Sex	
Item	0	2	4	Steers	Heifers
Grazing Phase (188 days)					
No. of head	12	12	12	24	12
Initial wt., lb	512	512	512	552[a]	472[b]
Ending wt., lb	822[c]	844[c,d]	879[d]	897[a]	800[b]
Gain, lb	310[c]	332	366[d]	345	328
Daily gain, lb	1.65[c]	1.77[c,d]	1.95[d]	1.83	1.74
Gain/acre, lb	248[c]	266[c,d]	293[d]	276	262
Finishing Phase (112 days)					
Initial wt., lb	822[c]	844[c,d]	879[d]	897[a]	800[b]
Ending wt., lb	1214	1217	1254	1320[a]	1136[b]
Gain, lb	392	373	375	424[a]	336[b]
Daily gain, lb	3.50	3.33	3.35	3.78[a]	3.00[b]
Daily DM intake, lb	25.8	25.6	25.2	26.9[a]	24.2[b]
Feed/gain	7.46	7.76	7.57	7.12[a]	8.07[b]
Hot carcass wt., lb	720	746	749	780[a]	696[b]
Dressing %	59.4	61.4	59.8	59.0[a]	61.3[b]
Backfat, in	0.39	0.47	0.45	0.41	0.46
Ribeye area, in^2	12.1	11.9	12.4	12.3	11.9
Yield grade	2.7	3.1	3.0	2.9	2.9
Marbling score	SM[51c]	SM[28d]	SM[74e]	SM[28a]	SM[74b]
% Choice	94	69	94	71	100
Overall Performance (Grazing + Finishing) (300 days)					
Gain, lb	702	705	741	768[a]	664[b]
Daily gain, lb	2.34	2.35	2.47	2.56[a]	2.21[b]

[a,b] Gender means within a row with the same letter are not significantly different (P<0.05).

[c,d,e] Supplementation-rate means within a row with the same letter are not significantly different (P<0.05).

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Table 5. Effect of Supplemental Grain Sorghum on Grazing and Subsequent Finishing Performance of Steers Grazing Smooth Bromegrass Pastures, Southeast Agricultural Research Center, 2003.

	Grain Sorghum (lb/head/day)		
Item	0	2	4
Grazing Phase (198 days)			
No. of head	12	11	12
Initial wt., lb	569	582	569
Ending wt., lb	919	969	968
Gain, lb	350[a]	387[a,b]	400[b]
Daily gain, lb	1.77[a]	1.96[a,b]	2.02[b]
Gain/acre, lb	280[a]	310[a,b]	320[b]
Finishing Phase (99 days)			
Initial wt., lb	919	969	968
Ending wt., lb	1307[a]	1355[b]	1326[a,b]
Gain, lb	388	385	357
Daily gain, lb	3.92	3.89	3.61
Daily DM intake, lb	29.0	28.0	28.0
Feed/gain	7.40	7.22	7.77
Hot carcass wt., lb	752[a]	795[b]	775[a,b]
Dressing %	57.5	58.7	58.4
Backfat, in	0.43	0.47	0.49
Ribeye area, in^2	12.8	13.3	13.3
Yield grade	2.7	2.8	2.8
Marbling score	SM^{04}	SM^{27}	SM^{45}
% Choice	58	75	75
Overall Performance (Grazing + Finishing) (297 days)			
Gain, lb	738	773	757
Daily gain, lb	2.48	2.60	2.55

[a,b] Means within a row with the same letter are not significantly different ($P<0.05$).

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Table 6. Effect of Supplemental Grain Sorghum on Grazing and Subsequent Finishing Performance of Steers Grazing Smooth Bromegrass Pastures, Southeast Agricultural Research Center, 2004.

Item	Grain Sorghum (lb/head/day) 0	2	4
Grazing Phase (235 days)			
No. of head	12	12	12
Initial wt., lb	469	468	469
Ending wt., lb	806[a]	859[b]	904[b]
Gain, lb	338[a]	390[b]	436[b]
Daily gain, lb	1.44[a]	1.66[b]	1.85[b]
Gain/acre, lb	270[a]	312[b]	349[b]
Finishing Phase (126 days)			
Initial wt., lb	806[a]	859[b]	904[b]
Ending wt., lb	1280	1273	1345
Gain, lb	473	414	441
Daily gain, lb	3.76	3.28	3.50
Daily DM intake, lb	27.6	26.3	29.2
Feed/gain	7.39	8.02	8.37
Hot carcass wt., lb	755	777	800
Dressing %	59.0[a]	61.0[b]	59.4[a,b]
Backfat, in	0.40	0.41	0.44
Ribeye area, in^2	13.2	13.0	13.1
Yield grade	2.6	2.8	2.9
Marbling score	SM^{25}	SM^{57}	SM^{42}
% Choice	83	92	92
Overall Performance (Grazing + Finishing) (361 days)			
Gain, lb	811	804	877
Daily gain, lb	2.25	2.23	2.43

[a,b] Means within a row with the same letter are not significantly different ($P<0.05$).

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SOUTHEAST AGRICULTURAL RESEARCH CENTER KANSAS STATE UNIVERSITY

HEIFER PERFORMANCE AND SUPPLEMENTAL HAY PRODUCTION FROM THREE BERMUDAGRASS CULTIVARS

Joseph L. Moyer and Lyle W. Lomas

Summary

Bermudagrass paddocks with ‘Midland 99’, ‘Midland’, and an experimental cultivar, ‘LCB84x16-66’ were grazed for two years. Heifer gains were similar for the three cultivars, but Midland 99 produced more forage, the excess of which was harvested for hay.

Introduction

Bermudagrass can be a high-producing, warm-season perennial pasture for eastern Kansas. Bermudagrass cultivars are typically tested for forage yield, but the ultimate test is in a grazing situation. There, animal performance and cultivar tolerance to grazing can be tested. Three cultivars, the original Midland variety; a recent release, Midland 99; and an experimental line, LCB84x16-66, were tested at Mound Valley under pasture conditions.

Experimental Procedures

Six 2.5-acre paddocks were sprigged in 2000. Three cultivars were used, each in two replicated paddocks: the original Midland variety; the recently released Midland 99; and an experimental cultivar, LCB84x16-66. The paddocks were fertilized, weeds were controlled, and the paddocks were clipped or hayed for the next three years.

In 2004, paddocks were fertilized on May 18 with 123-50-60 lb/a of N-P_2O_5-K_2O, and on July 23 with 50 lb of N/a as ammonium nitrate. In 2005, paddocks were fertilized on May 19 with 100-40-30, and on July 5 with 50 lb of N/a.

On June 8, 2004, heifers averaging 503.5 lb were weighed on consecutive days, stratified by weight, and allotted to paddocks at the rate of 0.8 head/a. Heifers were treated for internal and external parasites before being turned onto pasture, and had free access to commercial mineral supplement while on pasture. Heifers were weighed at about 4-week intervals and were removed from the paddocks at the end of 98 days (September 14), after double-weighing.

Excess forage was cut July 21 and removed as hay. Bale counts from each paddock and average weight/bale were used to determine excess forage production. Forage remaining on September 17 was estimated with a falling disk meter.

On June 8, 2005, heifers averaging 557.5 lb were allotted to the paddocks at the rate of 1.2 head/a. Handling procedures were the same as those used in 2004, and heifers were removed after 91 days, on September 7. Excess forage was cut June 24 and removed as hay after taking bale counts and average weight. Remaining forage was cut on August 31 and also removed. Available forage during and after the season was estimated with a falling disk meter on July 19 and August 31.

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Results and Discussion

In 2004, average daily gains were not significantly ($P<0.10$) different for the cultivars, although they ranged from 1.48 for Midland 99 to 1.79 for LCB84x16-66 (Table 1). Amount of hay removed on July 21 was also similar, averaging 2.28 tons/a. But Midland 99 had about 4.3 tons/a of residual forage in September, which was 95% more ($P<0.01$) than the amount remaining in paddocks of the other two cultivars.

In 2005, average daily gains were not significantly ($P<0.10$) different for the cultivars, although they ranged from 0.94 for Midland 99 to 1.18 for LCB84x16-66 (Table 2).

Excess forage removed on June 24 was similar for the cultivars ($P=0.12$), but forage remaining at the end of the season, and total forage removed, were greater for Midland 99 than for the other two cultivars (Table 2). Available forage measured with the disk meter at the end of the season gave the same relative results as that actually harvested, although it underestimated the actual yield of Midland 99. Earlier in the growing season (July 19), Midland 99 was estimated to have more available forage than LCB84x16-66 had, with Midland intermediate.

Table 1. Pasture Performance of Heifers (0.8 head per acre) that Grazed Different Cultivars of Bermudagrass, and the Amount of Excess Forage Produced, 2004.

	Bermudagrass Cultivar		
Item	Midland 99	Midland	LCB84x16-66[1]
Pasture performance			
No. of head	4	4	4
Initial wt., lb	501	501	503
End wt., lb	646	663	684
Gain, lb	145	162	181
Daily gain (98 days), lb	1.48	1.64	1.79
Excess Forage Production			
Hay removed (July 21), tons/a [2]	2.85	2.03	1.96
Residual forage (September 17), tons/a [2]	4.26[a]	2.00[b]	2.38[b]

[1]Stand fair, with some weedy grasses.
[2]Based on 12% moisture.
[a,b]Means within a row with different superscripts are significantly different ($P<0.01$).

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Table 2. Pasture Performance of Heifers (1.2 head per acre) that Grazed Different Cultivars of Bermudagrass, and the Amount of Forage Produced, 2005.

	Bermudagrass Cultivar		
Item	Midland 99	Midland	LCB84x16-66
Pasture performance			
No. of head	6	6	6
Initial wt., lb	557	556	557
Gain, lb	660	643	664
	103	97	107
Daily gain (91 days), lb	1.13	0.95	1.18
Excess Forage Production			
Hay removed (June 24), tons/a [1]	2.73	1.24	2.15
Hay removed (August 31), tons/a [1]	4.62[a]	1.35[b]	1.76[b]
Total hay removed, tons/acre	7.35[a]	2.59[b]	3.91[b]
Available dry matter (July 19), lb/a [2]	3244[a]	2923[a,b]	2480[a]
Available dry matter (August 31), lb/a [2]	4496[a]	2819[b]	2807[b]

[1]Based on 12% moisture.
[2]Calculated from disk meter readings.
[a,b]Means within a row with different superscripts are significantly different (P<0.01).

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ALFALFA VARIETY PERFORMANCE IN SOUTHEASTERN KANSAS

Joseph L. Moyer

Summary

A 13-line alfalfa test seeded in 2005 was cut four times. Yields were greater ($P<0.05$) from ‘FSG5’ than from ‘Integrity’, ‘AA108E’, and ‘6420’.

Introduction

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

Experimental Procedures

A 13-line alfalfa test was seeded (15 lb/a) on April 14, 2005, at the Mound Valley Unit (Parsons silt loam) after preplant fertilization with 20-50-200 lb/a of N-P_2O_5-K_2O. Plots were treated for weed control with 1.5 pt/a of Treflan® preplant incorporated.

Results and Discussion

Yields of the first cutting in 2005 were significantly ($P<0.05$) greater for FSG505 than for 6420 and Integrity (Table 1). Second-cut yields were similar for the cultivars. Third-cut yields were greater from FSG505 and ‘Kanza’ than from Integrity. In the last cutting, yields were greater for FSG505 and ‘WL 357HQ’ than for Integrity and AA108E. Total 2005 yields were greater from FSG505 than from Integrity, AA108E, and 6420 (Table 1).

Statewide alfalfa performance test results can be found at http://www.ksu.edu/kscpt/.

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Table 1. Forage Yields (tons/a @ 12% moisture) for the 2005 Alfalfa Variety Test, Mound Valley Unit, Southeast Agricultural Research Center.

Source	Entry	6/20	7/26	8/31	10/26	2005 Total
AgriPro Biosciences, Inc	AA112E	1.82[a,b]	1.04[a]	0.84[a,b]	1.03[a,b]	4.74[a,b]
AgriPro Biosciences, Inc	AA108E	1.76[a,b]	1.08[a]	0.66[a,b]	0.84[b]	4.35[b]
AgriPro Biosciences, Inc	Integrity	1.73[b]	0.92[a]	0.58[b]	0.84[b]	4.08[b]
Allied	FSG505	2.23[a]	1.11[a]	0.90[a]	1.18[a]	5.42[a]
Allied	FSG408DP	1.84[a,b]	0.98[a]	0.81[a,b]	1.02[a,b]	4.66[a,b]
Cal/West	CW 15030	1.76[a,b]	1.01[a]	0.79[a,b]	0.98[a,b]	4.54[a,b]
Cimarron USA	Cimarron VL400	1.99[a,b]	0.92[a]	0.84[a,b]	1.07[a,b]	4.82[a,b]
Garst Seed	6420	1.71[b]	0.95[a]	0.73[a,b]	0.98[a,b]	4.37[b]
Garst Seed	6530	2.00[a,b]	0.97[a]	0.79[a,b]	1.04[a,b]	4.81[a,b]
Johnston Seed Co.	Good asGold II	1.86[a,b]	1.02[a]	0.83[a,b]	1.08[a,b]	4.79[a,b]
W-L Research	WL 357 HQ	1.94[a,b]	1.12[a]	0.82[a,b]	1.13[a]	5.01[a,b]
Kansas AES & USDA	Kanza	1.91[a,b]	1.00[a]	0.88[a]	1.07[a,b]	4.87[a,b]
Nebraska AES & USDA	Perry	1.87[a,b]	1.16[a]	0.81[a,b]	1.05[a,b]	4.90[a,b]
Average		1.88	1.02	0.79	1.03	4.72

[a,b] Means within a column followed by the same letter are not significantly ($P<0.05$) different, according to Duncan's test.

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EVALUATION OF TALL FESCUE CULTIVARS

Joseph L. Moyer

Summary

Heading dates of tall fescue trials seeded in fall 1999, 2001, and 2003 were earliest for 'AU Triumph', except for the first year of the 2001test. 'Fuego' and 'Seine' were latest-heading in the 1999 test, but the 2001 test was more variable. Yields of the 2003 trial were obtained from spring and fall harvests. 'FTF-24' produced more in 2005 than 'Montendre' and 'Enhance' did.

Introduction

Tall fescue (*Festuca arundinacea* Schreb.) is the most widely grown forage grass in southeastern Kansas. The abundance of this cool-season perennial grass is due largely to its vigor and tolerance to the extremes in climate and soils of the region. Tolerance of the grass to stresses and heavy use is partly attributable to its association with a fungal endophyte, *Neotyphodium coenophialum* (Morgan-Jones and Gams) Glenn, Bacon, and Hanlin, but most ubiquitous endophytes are also responsible for the production of substances toxic to some herbivores, including cattle, sheep, and horses.

Recent research efforts have identified endophytes that purportedly lack toxins but augment plant vigor. Such endophytes have been inserted into tall fescue cultivars adapted to the United States and are represented in this test. Other cultivars are either fungus-free or contain a ubiquitous form of the endophyte. Such combinations need to be tested in this western fringe of the United States' tall fescue belt.

Heading date indicates relative maturity of the cultivars. Because reproductive growth is largely stem production, early heading should generally indicate an earlier decline in forage quality.

Experimental Procedures

All trials were seeded at the Mound Valley Unit, Southeast Agricultural Research Center, with a cone planter in 10-inch rows on Parsons silt loam soil (Mollic albaqualf). Plots were 30 ft x 5 ft, arranged in four randomized complete blocks. The tests were seeded with 19 lb/a of pure, live seed in September each year, on the 9th in 1999, the 25th in 2001, and the 17th in 2003.

Fertilizer to supply 150-50-60 lb/a of N-P_2O_5-K_2O was applied to all plots on March 10, 2005, and another 50 lb/a of N as ammonium nitrate was added on August 19. Harvests were performed for a strip 3-ft wide and 15-20 ft long from each plot, cut to a 3-in. height with a flail-type harvester. The 2003 test was cut for yield determination, once after all plots were headed and again when fall growth slowed. Contamination in the older plots prevented accurate measurement of fescue yield. A forage subsample was collected and dried at 140F for moisture determination, and forage was removed from the rest of the plot at the same height.

Results and Discussion

Heading date in the 1999 trial was earlier ($P<0.05$) for AU Triumph than for all other

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cultivars in each of the 4 years that data were collected (Table 1). ‘FA 102’ was earlier than the remaining cultivars in 2004 and 2005, and was earlier than all except ‘Ga-5’ in 2002. The latter cultivar was earlier than eight other cultivars in 2000 and 2002, three in 2004, and seven in 2005. Conversely, Fuego and Seine headed later than all except for ‘Ky 31 EF’ in all years except 2002, and except for FA 102 in 2000.

Heading date in the 2001 trial was earlier (P<0.05) for AU Triumph than for all other cultivars in 2004, and tied for earliest in 2005 with ‘Q 4508’, which was next-earliest in 2004 (Table 2). In the first year of production, 2002, all heading dates were much later than in the 1999 test, and do not seem representative. ‘FTF-1’ and ‘FTF-2’ were later than the remaining cultivars in 2004, and were later than all except ‘ArkPlus’ in 2005.

Heading date in the 2003 trial was earlier (P<0.05) for AU Triumph than for all other cultivars in 2004 (Table 3). FTF-24 was earlier than all remaining cultivars, except for ‘FA 117’ and ‘FA 120’, whereas ‘FA 111’, ‘Ky 31 LE’, Montendre, and ‘Enhance’ were later than 16 other cultivars.

Spring 2005 forage yield of entries in the 2003 trial was greater (P<0.05) for FA 117, FA 120, and ‘FA 121’ than for FA 111, AU Triumph, ‘Select’, and Ky 31 LE (Table 3). Fall production of FTF-24 and FTF-25 was greater than that of any of fifteen other entries, including ‘Ky 31 HE’. Select, ‘FA 2845’, and ‘FA2846’ had lower yield than that of any of the five highest-producing entries.

Total 2005 yield of the 2003 trial was greater (P<0.05) for FTF-24 than for any of 11 other cultivars (Table 3). Select and FA 111 yields were lower than that of the seven highest-yielding entries. Total 2-year production for 2004-2005 for FTF-24 was greater than for any of 11 other cultivars. Select had lower yield than that of any of the six highest-producing entries.

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Table 1. Heading Date By Year of Tall Fescue Cultivars Seeded in 1999, Mound Valley Unit, Southeast Agricultural Research Center.

	Year			
Cultivar	2000	2002	2004	2005
	- - - - - - - - Heading Date, Julian - - - - - - - -			
FA 102 EF [1]	128	127	119	113
Jesup NETF [2]	124	128	123	125
Ga-5 NETF [2]	122	126	122	122
AU Triumph	109	123	110	111
Fuego LE [3]	130	131	129	130
Seine EF	129	131	128	130
Select EF	126	129	124	125
Ky 31 EF	128	129	126	129
Ky 31 HE [3]	126	128	123	126
MV 99 EF	127	129	124	127
Average	125	128	123	124
LSD (0.05)	2	1	3	3

[1]EF=Endophyte-free.
[2]Contains proprietary novel endophyte.
[3]LE= Low-endophyte seed (0-2% infected); HE=High-endophyte seed (80% infected).

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Table 2. Heading Date By Year of Tall Fescue Cultivars Seeded in 2001, Mound Valley Unit, Southeast Agricultural Research Center.

	Year		
Cultivar	2002[1]	2004[2]	2005[1]
	- - - - - - - - - - - - Heading Date, Julian - -	- - - - - - - - - -	
FTF-1	139	125	130
FTF-2	135	126	129
AU Triumph	142	111	111
Martin 2	136	120	123
Cajun 2	136	122	124
HiMag EF [3]	141	122	127
ArkPlus [4]	136	124	129
Q 4508	144	113	111
R 4663	144	123	127
Ky 31 HE [5]	134	124	127
Ky 31 LE [5]	141	123	127
Average	139	121	124
LSD (0.05)	3	2	2

[1]Day when 50% of plants were headed; Day 122=May 1.
[2]Day when 50% of plants were headed; Day 123=May 1.
[3]EF=Endophyte-free.
[4]Contains proprietary novel endophyte.
[5]LE= Low-endophyte seed (0-2% infected); HE=High-endophyte seed (80% infected).

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Table 3. Forage Yield and Heading Date of Tall Fescue Cultivars Seeded in 2003, Mound Valley Unit, Southeast Agricultural Research Center, 2005.

Cultivar	Heading Date[1]	Forage Yield 5/31	11/30	2005	2-Yr
	Julian Day	- - - - - - - - tons/a@12% moisture - - - - - - - -			
FTF-24	116	2.28	2.36	4.63	9.74
FTF-25	124	2.24	2.37	4.61	9.42
AU Triumph	111	1.97	2.22	4.20	8.35
Stockman	124	2.23	2.06	4.28	9.14
Tuscany II	128	2.27	2.14	4.41	8.98
Montendre	131	2.10	2.10	4.20	8.33
ArkPlus [2]	128	2.30	1.84	4.13	8.96
Jesup MaxQ [2]	126	2.38	1.80	4.18	8.98
Select	129	2.00	1.72	3.72	8.06
Enhance	131	2.10	2.00	4.10	8.28
FA 111	132	1.90	1.94	3.84	8.20
FA 117	118	2.48	1.91	4.39	9.33
FA 120	118	2.46	1.83	4.29	8.77
FA 121	120	2.40	2.02	4.43	9.28
FA 2845	124	2.20	1.72	3.92	8.22
FA 2846	126	2.21	1.74	3.94	8.39
FA 2847	125	2.33	2.03	4.36	9.11
FA 2848	123	2.34	1.98	4.32	8.77
FA 2849	126	2.17	1.78	3.94	8.40
FA 2850	127	2.28	2.00	4.28	8.92
FA 2860	129	2.16	1.90	4.05	8.66
FA 2861	130	2.19	1.88	4.08	8.99
Ky 31 HE [3]	129	2.18	1.92	4.10	8.72
Ky 31 LE [3]	131	2.01	2.03	4.04	8.43
Average	125	2.22	1.97	4.18	8.77
LSD (0.05)	3	0.32	0.30	0.47	1.01

[1]Day when 50% of plants were headed; Day 125=May 5.
[2]Contains proprietary novel endophyte.
[3]LE= Low-endophyte seed (0-2% infected); HE=High-endophyte seed (80% infected).

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FORAGE PRODUCTION OF SEEDED BERMUDAGRASS CULTIVARS

Joseph L. Moyer and Charles M. Taliaferro[1]

Summary

Forage yield of bermudagrass plots seeded in 2002 for 2005 and for the 4-year total was higher for ‘Cheyenne’ than for any of the other cultivars.

Introduction

Bermudagrass can be a high-producing, warm-season perennial forage for eastern Kansas when not affected by winterkill. Producers in southeastern Kansas have profited from the use of more winter-hardy varieties that produced more than common bermudas. Seeded types may offer cost savings or other advantages in marginal areas. Further developments in bermudagrass breeding should be monitored to speed adoption of improved, cold-hardy types.

Experimental Procedures

Five bermudagrass entries were seeded at 8 lb/a of pure, live seed for hulled seed or 5 lb/a of hulless seed at the Mound Valley Unit of the Southeast Agricultural Research Center on May 7, 2002. In 2005, plots were fertilized on May 18 with 123-50-60 lb/a of N-P_2O_5-K_2O, and on August 19 with 50 lb of N/a as ammonium nitrate.

Plots were cut when seedheads had emerged on one or more cultivars. This resulted in two harvests in 2002, three in 2003, and four in 2004. Subsamples were collected from the 20 x 3 ft strips taken for yield to determine moisture content of forage.

Results and Discussion

Forage production in 2005 was greater ($P< 0.05$) by June 2 for Cheyenne than for the other cultivars, except for ‘Guymon’ (Table 1). The latter cultivar produced more in the first cutting than ‘Johnston’s Gold’. Differences between the cultivars were not significant for the next two cuttings, partly because of drought and perhaps low N availability. Total 2005 yield and total production for the 4-year period was higher for Cheyenne than for any of the other cultivars (Table 1).

[1]Southeast Agricultural Research Center, and Plant and Soil Sciences Department, Oklahoma State University, Stillwater, respectively.

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Table 1. Forage Yield in 2005 and for Four Years, for Bermudagrass Seeded in 2002, Mound Valley Unit, Southeast Agricultural Research Center.

Entry	6/2	8/5	8/31	Total	4-Yr Total
	- - - - - - - - - - - - - tons/a @ 12% moisture - - - - - - - - - - - - -				
Cherokee	1.35	0.46	0.75	2.55	13.60
Guymon	1.57	0.48	0.73	2.77	13.51
Wrangler	1.35	0.44	0.73	2.53	12.80
Johnston's Gold	1.18	0.59	0.74	2.51	13.06
Cheyenne	1.75	0.51	0.85	3.12	17.43
Average	1.44	0.50	0.76	2.69	14.08
LSD (0.05)	0.24	NS	NS	0.33	1.47

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PERFORMANCE OF WARM-SEASON PERENNIAL FORAGE GRASSES

Joseph L. Moyer and Kenneth W. Kelley

Summary

Twelve warm-season perennial grasses seeded in spring 2001 were harvested for forage production on July 11, 2005. After application of 60 lb/a of nitrogen, production averaged 2.28 tons/a. 'Kaw' big bluestem produced 2.82 tons/a of forage, which was more ($P<0.05$) than five other entries.

Introduction

Warm-season perennial grasses can fill a production void left in forage systems by cool-season grasses. Reseeding improved varieties of certain native species, such as big bluestem and indiangrass, could help fill that summer production "gap." Other warm-season grasses, such as sand bluestem (*Andropogon hallii* Hack.), are used in other areas, and may have potential for certain sites in southeastern Kansas.

Experimental Procedures

Warm-season grass plots (30 ft x 5 ft) were seeded with a cone planter in 10-inch rows on May 10, 2001, at the Columbus Unit, Southeast Agricultural Research Center. Fifty lb/a of diammonium phosphate (18-46-0) were applied with the seed material to facilitate movement through the planter. Big bluestem and sand bluestem entries were seeded at 10 lb/a pure, live seed (PLS). Indiangrasses were seeded at 8 lb PLS/a. Entries were obtained from the USDA-NRCS Plant Materials Center in Manhattan; the USDA-ARS Southern Plains Research Station, Woodward, Oklahoma; and the USDA-ARS Forage Research Unit, Lincoln, Nebraska. Plots were sprayed with 2,4-D to control weeds in 2001. In 2002, plots were burned in spring and clipped in summer. Plots were burned in spring 2003, 2004, and 2005. Fifty lb/a of nitrogen as urea was applied to all plots on April 20, 2005. A 20 ft x 3 ft area was harvested in 2003, 2004, and on July 11, 2005, with a Carter flail harvester at a height of 2 to 3 inches. The remainder of the area was clipped to the same height.

Results and Discussion

Forage yields from the warm-season cultivar test after nitrogen fertilization are shown in Table 1. Stands were better in 2005 than in 2004, and yields averaged 2.28 tons/a. Kaw big bluestem yielded more ($P<0.05$) forage than two of the indiangrass entries, two sand bluestems, and 'TS Early' big bluestem. The 'Kaw C3 Syn 2' entry produced more forage than TS Early, 'Oto C3 Syn 2' indiangrass, and 'AB Medium' sand bluestem.

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Table 1. Forage Yields of Warm-season Grass Cultivars, Columbus Unit, Southeast Agricultural Research Center, 2005.

Species	Cultivar	Forage Yield
		- tons/a @ 12% moisture -
Big bluestem	Kaw	2.82
	Pawnee C3 Syn. 2	2.44
	Kaw C3 Syn. 2	2.62
	TS Intermediate	2.36
	TS Early	1.82[1]
Sand bluestem	WW (Woodward)	2.42
	AB Medium	1.94
	CD Tall	1.98
Indiangrass	Oto C3 Syn. 2	1.88
	Holt x Oto Late C3 Syn. 2	2.13
	NE 54 C2	2.40
	Osage	2.52
LSD (0.05)		0.66

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

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GROWING ANNUAL CROPS FOR SUMMER FORAGE

Joseph L. Moyer and Kenneth J. Moore[1]

Summary

Forage yield of corn at the vegetative stage was higher ($P<0.05$) than that of other species, followed by crabgrass, then oat. Yield at the reproductive stage was highest for pearl millet, then corn, sudangrass, and soybean. Regrowth after cutting at the vegetative stage was greater for crabgrass and millet than for sudangrass, and nil for the other species. Only sudangrass produced forage after cutting at the reproductive stage. Total forage production from vegetative harvests was greater for crabgrass and millet than for other species, whereas sudangrass produced more forage from harvests at the reproductive stage.

Introduction

Pastures in eastern Kansas consist mainly of cool-season grasses that produce mostly in the spring and early summer, but nutritional needs of stockers and cow-calf pairs generally increase throughout the season. Typical management undergrazes early growth of cool-season pastures for use when production declines and demand increases. The problem with this approach is that as ungrazed forage matures, its quality declines. A complementary system that uses annuals for summer grazing would provide high-quality forage when quality of cool-season grasses is lowest. To design such a system, basic information relating growth and development of annual species in each area is needed. The objective of this research is to evaluate the adaptability, yield, and quality of summer annual forages at specific sites on a regional basis for use in complementary forage systems.

Experimental Procedures

Oat, Italian ryegrass, berseem clover, corn, and forage rape were planted in blocks with four replications at designated rates when soil temperature reached about 50F on April 5, 2005. Sudangrass, pearl millet, soybean, and crabgrass were planted when soil temperature reached ca. 59F on May 12. Fertilizer (100-50-60 lb/a of N-P_2O_5-K_2O) was applied preplant. Separate portions of the plots were harvested initially at one of two growth stages: mid-vegetative and early reproductive (Table 1). Regrowth was harvested from previously harvested strips if sufficient forage was produced. Subsamples were used for moisture determination, then ground for analysis.

Results and Discussion

When cut at the mid-vegetative stage, before reproductive growth had begun, corn produced more forage than any other species (Table 2). Crabgrass produced more ($P<0.05$) forage than oat and four of the other species. Pearl millet, soybean, and sudangrass produced more than rape, ryegrass, and berseem clover at that stage.

At the reproductive stage, when seed was being formed, millet produced more forage

[1]Southeast Agricultural Research Center, and Department of Agronomy, Iowa State University, Ames, respectively.

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(P<0.05) than any other species. Corn and sudangrass produced more than all other species except for soybean, which, in turn yielded more than ryegrass, rape, and berseem clover. Oat and crabgrass produced more forage than ryegrass.

Regrowth after mid-July harvests was limited by drought. Similar harvestable amounts of regrowth were produced after the previous vegetative cutting by crabgrass and millet, with less (P<0.05) produced by sudangrass. After cutting at the reproductive stage, sufficient regrowth for harvest was produced only by sudangrass.

Total forage production from cutting at the vegetative stage was greater (P<0.05) for crabgrass than for all other species except millet (Table 2). Millet and corn, in turn, produced more total forage at that stage than all other species. Total yield of sudangrass and soybean were greater than yield of rape, ryegrass, and berseem clover, with sudangrass also producing more than oat.

After cutting at the reproductive stage, total forage production was greatest for sudangrass (P<0.05, Table 2). Millet, corn, and soybean each, in turn, produced more than all remaining species. Conversely, total production of ryegrass after cutting at the reproductive stage was less than production of all other species except rape. Yields of oat, crabgrass, and berseem clover were intermediate.

Table 1. Harvest Dates for Crops at Vegetative and Reproductive Stages.

Species	Vegetative	Reproductive
Oat	5/31	6/20
Ryegrass	5/31	6/20
Clover	5/31	6/30
Forage rape	5/31	6/30
Sudangrass	6/30, 7/13	7/13, 9/21
Millet	6/20, 7/26	7/26
Soybean	7/11	9/14
Corn	7/13	8/4
Crabgrass	7/13, 9/14	7/26

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Table 2. Yield of Forage in Summer 2005, from Nine Annual Species, Mound Valley Unit, Southeast Agricultural Research Center.

		Cut at Vegetative Stage			Cut at Reproductive Stage		
Species	Cultivar	First Growth	Re-growth	Total	First Growth	Re-growth	Total
		- - - - - - - - - - tons/a @ 12% moisture - - - - - - - - - -					
Oat	Striker	1.16	- -	1.16	3.17	- -	3.17
Ryegrass	Feast II	0.28	- -	0.28	2.06	- -	2.06
Berseem clover	Joe Burton	0.32	- -	0.32	2.81	- -	2.81
Forage rape	Bonar	0.18	- -	0.18	2.51	- -	2.51
Sudangrass	Trudan 8	1.41	0.69	2.10	4.64	6.36	11.00
Pearl millet	Tifleaf III	1.63	2.00	3.63	6.66	- -	6.66
Soybean	Derry	1.50	- -	1.50	3.93	- -	3.93
Corn	Garst 8315IT	3.18	- -	3.18	4.92	- -	4.92
Crabgrass	Red River	2.07	2.02	4.09	3.14	- -	3.14
	Average	1.30	0.52	1.83	3.76	0.71	4.46
	LSD (0.05)	0.70	0.58	0.77	0.83	0.33	0.70

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DRY MATTER OF STOCKPILED FORAGES

Joseph L. Moyer and E. Charles Brummer[1]

Summary

Tall fescue cultivars generally yielded the most stockpile forage during November to January, largely because of more fall regrowth. Forage durability, as indicated by January to December yield ratios, were not significantly different, averaging 0.72.

Introduction

Stockpiling forages during late summer and fall for use as pasture during winter is common in Kansas' native pastures, but the practice is less common for introduced or "tame" pastures. Tall fescue is generally resistant to weathering, but no comparison is available for other species, or even for cultivars of tall fescue with different endophyte status.

Experimental Procedures

Eleven perennial cool-season grasses and seven perennial cool-season legumes (Table 1) were seeded in 5 x 25 ft plots in four blocks at designated rates on September 11, 2002. Growth was removed May 12 and July 24, 2003, and May 10 and July 20, 2004. Grasses were fertilized with 50 lb/a of nitrogen as NH_4NO_3 on July 25, 2003, and July 26, 2004, and were stockpiled the rest of the season. Forage was harvested from separate 36 x 40-inch areas in each plot, beginning when fall growth slowed. Harvest dates were October 8, November 12, December 22, and January 30 in 2003-2004, and November 5, December 14, and January 18 in 2004-2005. Forage was weighed, and subsamples were collected and dried at 122 F for moisture determination, then ground for analysis.

Results and Discussion

'Rhizo' kura clover failed to make a stand. Stands of 'Marathon' red clover and '54H91' alfalfa were reduced in fall 2003, and stands of 'Oahe' intermediate wheatgrass later declined, allowing excessive weed encroachment, so data were not collected for those cultivars.

Dry matter of all cultivars increased between October and November 2003 (data not shown). Also, killing frost did not occur either year until November, so 2-year average yields are shown for November, December, and January (Fig. 1). Although yields of stockpile forage were higher in the second than the first year of the study, relative yields were similar for the two years (no year x cultivar interactions; data not shown) in November and December. In January, yields of 'Ky 31' and 'MaxQ' showed much less increase between 2004 and 2005, compared with other cultivars. 'Alice' white clover and 'Palaton' reed canarygrass had the greatest relative increase in January yields between the two years.

[1]Southeast Agricultural Research Center, and Department of Agronomy, Iowa State University, Ames, respectively.

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Tall fescue cultivars generally yielded the most stockpile forage throughout the off-season (Fig. 1). This was largely due to more fall regrowth inasmuch as forage durability, as indicated by January to December yield ratios, did not significantly ($P>0.20$) differ among cultivars, averaging 0.72.

Table 1. Cultivars of the Different Species and Seeding Rates Used.

Species	Cultivar	Rate
		lb/a
Tall fescue	MaxQ	20
	Jesup E+	20
	Jesup E-	20
	Kentucky 31	20
Reed canarygrass	Palaton	25
Orchardgrass	Haymate	20
	Potomac	20
Perennial ryegrass	BG 34	20
Smooth bromegrass	Rebound	15
Timothy	Climax	12
Inter. wheatgrass	Oahe	20
Alfalfa	Samurai	15
	34H35	15
Birdsfoot trefoil	Norcen	8
	Steadfast	8
Red clover	Marathon	15
Kura clover	Rhizo	15
White clover	Alice	5

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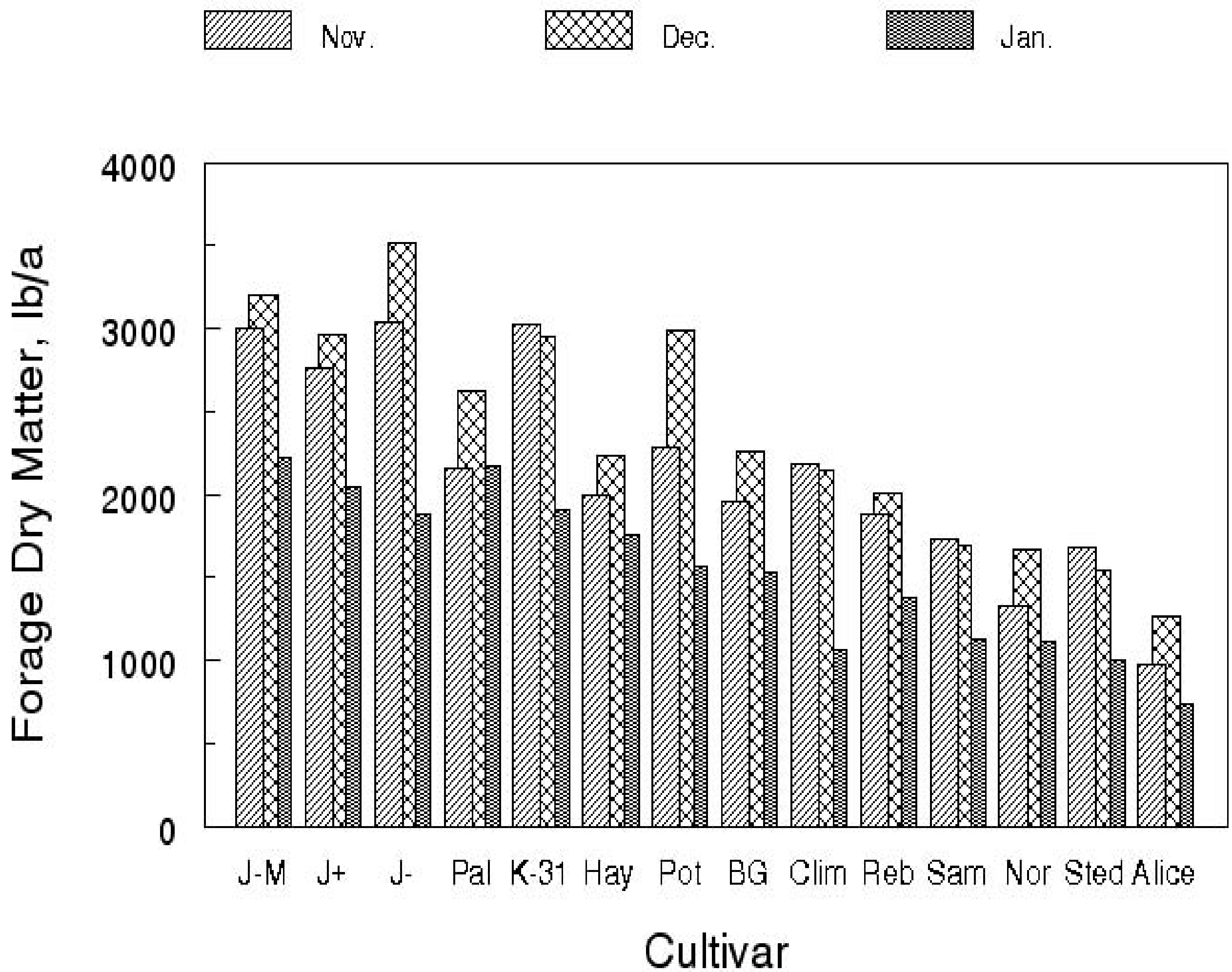

Figure 1. Winter Stockpile Dry Matter of Forages at Each of Three Dates. LSD(0.05)=558, 778, and 459 lb/a for November, December, and January harvests, respectively. J-M, Jesup MaxQ; J+, Jesup endophyte-infected; J-, Jesup endophyte-free; Pal, Palaton; K-31, Ky 31 endophyte-infected; Hay, Haymate; Pot, Potomac; BG, BG-34; Clim, Climax; Sam, Samurai; Nor, Norcen; Sted, Steadfast.

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NITROGEN MANAGEMENT FOR SEED AND RESIDUAL FORAGE PRODUCTION OF ENDOPHYTE-FREE AND ENDOPHYTE-INFECTED TALL FESCUE

Daniel W. Sweeney and Joseph L. Moyer

Summary

Clean-seed yield of endophyte-free tall fescue was greater with late fall N application than with late winter application and increased with N rates up to 100 lb/a. Forage aftermath was increased with increasing N rates up to 200 lb/a and when all N was applied in late winter. Endophyte infection had no effect on yields of clean seed or aftermath forage.

Introduction

Nitrogen fertilization is important for fescue and other cool-season grasses, but management of nitrogen (N) for seed production is less defined. Endophyte-free tall fescue may need better management than infected stands. Nitrogen fertilization has been shown to affect forage yields, but data are lacking regarding the yield and quality of the aftermath remaining after seed harvest. The objective of this study was to determine the effects of timing and rate of N applied to endophyte-free and endophyte-infected tall fescue for seed and aftermath forage production.

Experimental Procedures

The experiment was established as a split-plot arrangement of a completely randomized block design with three replications. Whole plots were endophyte-free and endophyte-infected tall fescue. The subplots were a 3 × 5 factorial arrangement of fertilizer N timing and N rate. The three N timings were 100% in late fall (Dec. 1, 2003, and Dec. 17, 2004), 100% in late winter (Feb. 26, 2004, and Mar. 7, 2005), and 50% of N in late fall and 50% in late winter. The five N rates were 0, 50, 100, 150, and 200 lb/a. In all treatments, N fertilizer was broadcast applied as UAN (urea ammonium-nitrate) solution. Each fall, all plots received broadcast applications of 40 lb P_2O_5/a and 70 lb K_2O/a. Seed harvest was on June 7, 2004, and June 15, 2005, and forage aftermath was harvested on June 14, 2004, and June 20, 2005.

Results and Discussion

Averaged across years and endophyte-infected stands, application of all fertilizer N in late fall resulted in more than 15% greater clean-seed yield, compared with all N applied in late winter, with the split (50% late fall - 50% late winter) application being intermediate (Figure 1). Clean-seed yield increased with increasing rates to 100 lb N/a, but did not seem to benefit from higher N rates. Endophyte infection had no effect on clean-seed yield.

Averaged across years and endophyte-infected stands, yield of the forage aftermath left after seed harvest was increased by applying N fertilizer in late winter, compared with late fall, with the split application being intermediate (Figure 2). Increasing N rates up to 200 lb/a increased forage yield, but the amount of increase diminished with each additional N increment. Endophyte infection had no effect on yield of aftermath forage.

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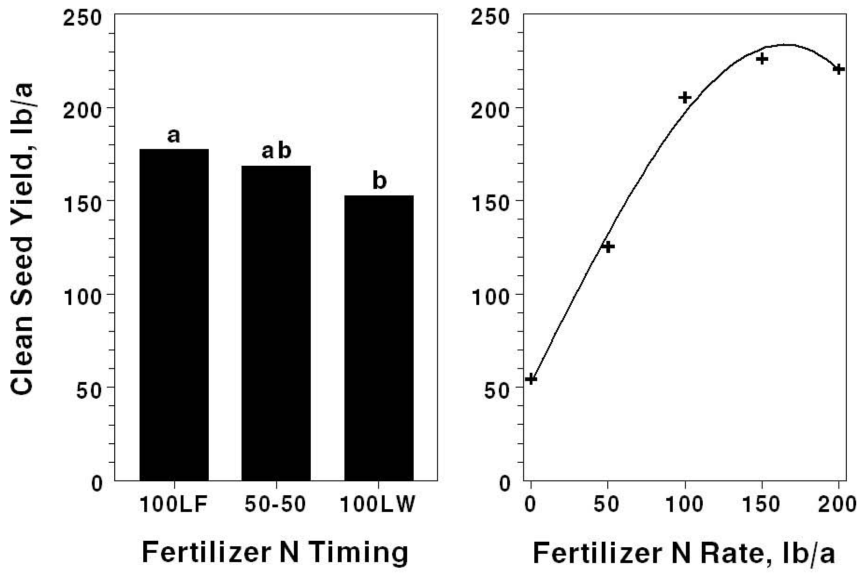

Figure 1. **Effects of Nitrogen Timing and Rate on Clean-seed Yield Averaged Across Years (2004-2005) and Stands (Endophyte-free and Endophyte-infected) of Tall Fescue, Southeast Agricultural Research Center. (100LF=100% of fertilizer N applied in late fall; 100LW=100% of fertilizer N applied in late winter; 50-50=50% of fertilizer N applied in late fall and 50% applied in late winter)**

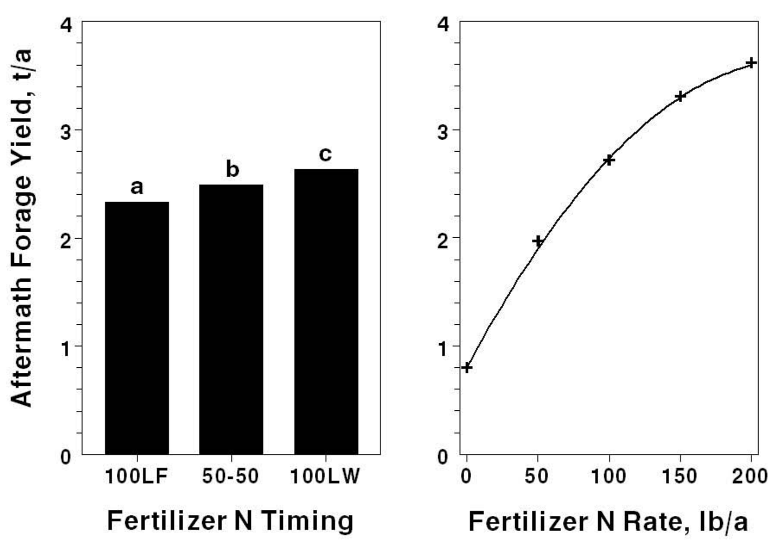

Figure 2. **Effects of Nitrogen Timing and Rate on Aftermath-forage Yield Averaged Across Years (2004-2005) and Stands (Endophyte-free and Endophyte-infected) of Tall Fescue, Southeast Agricultural Research Center. (100LF=100% of fertilizer N applied in late fall; 100LW=100% of fertilizer N applied in late winter; 50-50=50% of fertilizer N applied in late fall and 50% applied in late winter)**

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EFFECTS OF POPULATION, PLANTING DATE, AND TIMING OF SUPPLEMENTAL IRRIGATION ON SWEET CORN

Daniel W. Sweeney and M.B. Kirkham

Summary

In 2005, irrigation applied at both the VT and R2 growth stages increased the total number of ears and total fresh weight, but not the individual ear weight. Earlier planting increased total ears, total fresh weight, and individual ear weight. Increasing plant population increased total ears, but reduced individual ear weight.

Introduction

Field corn responds to irrigation, and timing of water deficits can affect yield components. Sweet corn is considered as a possible value-added, alternative crop for producers. Even though large irrigation sources, such as aquifers, are lacking in southeastern Kansas, supplemental irrigation could be supplied from the substantial number of small lakes and ponds in the area. Information is lacking on effects of irrigation management, plant population, and planting date on the performance of sweet corn.

Experimental Procedures

The experiment was established on a Parsons silt loam in spring 2002 as a split-plot arrangement of a randomized complete block with three replications. The whole plots included four irrigation schemes: 1) no irrigation, 2) 1.5 in. at VT (tassel), 3) 1.5 in. at R2 (blister), and 4) 1.5 in. at both VT and R2; and two planting dates (targets of late April and mid-May). The subplots were three plant populations of 15,000, 22,500, and 30,000 plants/a. Sweet corn was planted on April 21 and May 17, 2005. Sweet corn from the first planting date was picked on July 11 and 14, and corn from the second planting date was picked on July 22 and 26, 2005.

Results and Discussion

The total number of ears was 50% greater from sweet corn planted in late April than from sweet corn planted in mid-May (Table 1), with a similar difference in total fresh weight. Individual ear weight also was greater when sweet corn was planted at the earlier date. Limited irrigation applied at both the VT and R2 growth stages resulted in more than 10% greater total number of ears and total fresh weight than no irrigation or irrigation at only one growth stage. Irrigations did not result in greater individual ear weight. The maximum number of total ears was greatest at the 22,500 plant population, but even at that population, there were stalks with nonmarketable ears. Total fresh weight was reduced only by the 30,000 plant population. Interactions between planting date and plant population showed that any decline in total ears and total fresh weight with the highest population was more pronounced at the latter planting date (interaction data not shown). Individual ear weight declined with increasing plant population.

Southeast Agricultural Research Center and Department of Agronomy, respectively.

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Table 1. Effects of Planting Date, Irrigation Scheme, and Plant Population on Sweet Corn, Southeast Agricultural Research Center, 2005.

Treatment	Total Ears	Total Fresh Weight	Individual Ear Weight
	ears/a	ton/a	g/ear
Planting Date (D)			
Date 1	20500	7.22	322
Date 2	13600	4.30	286
LSD (0.05)	1400	0.47	11
Irrigation Scheme (I)			
None	16700	5.47	296
VT (1.5 in.)	16700	5.58	301
R2 (1.5 in.)	16100	5.52	307
VT-R2 (1.5 in. at each)	18700	6.46	312
LSD (0.10)	1700	0.54	NS
Population (P), plants/a			
15000	16400	6.06	335
22500	18100	6.06	302
30000	16700	5.15	275
LSD (0.05)	1100	0.32	12
Interactions	D×P	D×P	NS

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USE OF STRIP TILLAGE FOR CORN PRODUCTION IN A CLAYPAN SOIL[1]

Daniel W. Sweeney, Ray Lamond, and Gary Kilgore[2]

Summary

Corn yield response to tillage selection varied with year. In the second and third years, reduced tillage resulted in greater yields than with no-till and usually with either strip-tillage system. Across years, early spring fertilization and knife (subsurface band) applications of N and P solutions resulted in greater yield than did N-P fertilizer application in late fall or dribble application.

Introduction

The use of conservation tillage systems is promoted to reduce the potential for sediment and nutrient losses. In the claypan soils of southeastern Kansas, crops grown with no tillage may yield less than in systems involving some tillage operation. But strip tillage provides a tilled seed-bed zone where early spring soil temperatures might be greater, while leaving residues intact between the rows as a conservation measure similar to no-till.

Experimental Procedures

The experiment was established on a Parsons silt loam in late fall 2002. The experimental design was a split-plot arrangement of a randomized complete block with three replications. The four tillage systems constituting the whole plots were: 1) strip tillage in late fall, 2) strip tillage in early spring, 3) reduced tillage (1 pass with tandem disk in late fall and 1 pass in early spring), and 4) no tillage. The subplots were a 2×2 factorial arrangement of fertilizer timing and fertilizer placement. Fertilizer application timing was targeted for late fall or early spring. Fertilizer placement was dribble [surface band] or knife [subsurface band at 4 in-depth]. Fertilizer rates of 120 lb N/a and 40 lb P_2O_5/a were applied in each fluid fertilizer scheme. Fertilization was done on Dec. 17, 2002, and on April 1, 2003. Short-season corn was planted on April 3, 2003, and harvested on Aug. 25, 2003. For the second year, fertilization was done on Dec. 2, 2003, and on April 5, 2004. Short-season corn was planted on April 6, 2004, and harvested on Sept. 3, 2004. For the third year, fertilization was done on Dec. 29, 2004, and on March 31, 2005. Short-season corn was planted on March 31, 2005, and harvested on Aug. 29, 2005.

Results and Discussion

Short-season corn yields were affected by a year × tillage interaction. In 2003, there were no differences in short-season corn yields as affected by tillage (Figure 1). In 2004, however, reduced tillage resulted in greater yield than with no-till or with strip tillage done in the spring. By 2005,

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

[2]Southeast Agricultural Research Center, Department of Agronomy, and Southeast Area Extension Office, Chanute, respectively.

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reduced tillage resulted in 50% greater yield than with no-till or either strip-tillage system. Averaged across years, knife (subsurface band) applications resulted in nearly 11% greater yield than dribble (surface band) applications did (Figure 2). Fertilization done in early spring resulted in significantly greater corn yields (118 bu/a) than with late fall fertilization (107 bu/a).

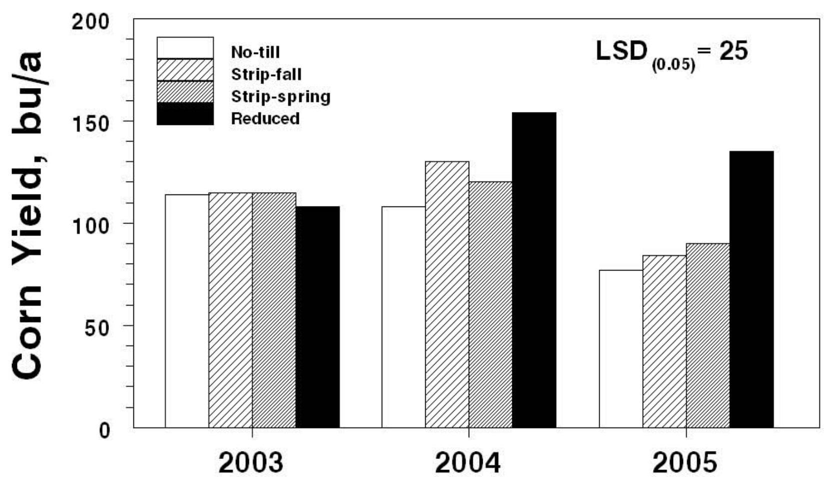

Figure 1. Effect of Tillage Systems on Short-season Corn Yield During 2003, 2004, and 2005, Southeast Agricultural Research Center.

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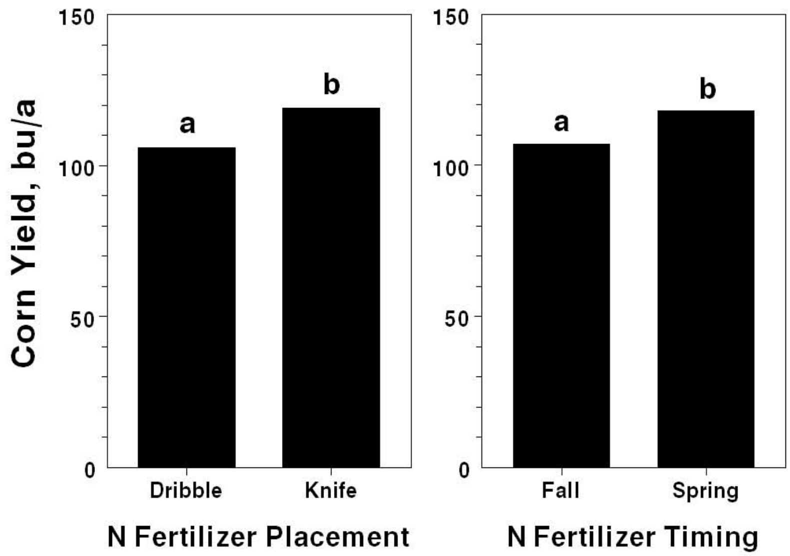

Figure 2. Effects of N Fertilizer Placement and Timing on Short-season Corn Yield Averaged Across Years (2003, 2004, and 2005), Southeast Agricultural Research Center. (Bars with different letters are statistically different at $p<0.05$ according to the LSD test.)

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SOUTHEAST AGRICULTURAL RESEARCH CENTER
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TILLAGE AND NITROGEN PLACEMENT EFFECTS ON YIELDS IN A SHORT-SEASON CORN - WHEAT - DOUBLECROP SOYBEAN ROTATION

Daniel W. Sweeney and Kenneth W. Kelley

Summary

In 2005, corn yields were lower with no tillage, likely due to reduced plant stand. There were no yield differences due to N fertilizer placement in the conventional or reduced-tillage systems, but knifed fertilizer N increased yields, compared with broadcast and dribble application methods in no-till.

Introduction

Many rotational systems are employed in southeastern Kansas. This experiment was designed to determine the long-term effect of selected tillage and nitrogen (N) fertilizer placement options on the yields of short-season corn, wheat, and doublecrop soybean in rotation.

Experimental Procedures

A split-plot design with four replications was initiated in 1983, with tillage system as the whole plot and N treatment as the subplot. After 22 years, the rotation was changed in 2005 to begin a short-season corn - wheat - doublecrop soybean sequence. The three tillage systems were conventional, reduced, and no tillage and were continued in the same areas as during the previous 22 years. The conventional system consisted of chiseling, disking, and field cultivation. The reduced-tillage system consisted of disking and field cultivation. Glyphosate (Roundup®) was applied to the no-till areas. The four N treatments for the crop were: a) no N (check), b) broadcast urea-ammonium nitrate (UAN - 28% N) solution, c) dribble UAN solution, and d) knife UAN solution at 4 inches deep. The N rate for the corn crop was 125 lb/a.

Results and Discussion

In 2005, adding fertilizer N, in general, nearly doubled yields, compared with yields in the no-N control (Figure 1). There were no differences in yield due to placement method in the conventional and reduced-tillage systems. In the no-till system, however, knife applications resulted in about 40 bu/a greater yield than with broadcast or dribble applications. The overall lower corn yields with no-till were likely because of lower plant stands than in conventional or reduced-tillage systems.

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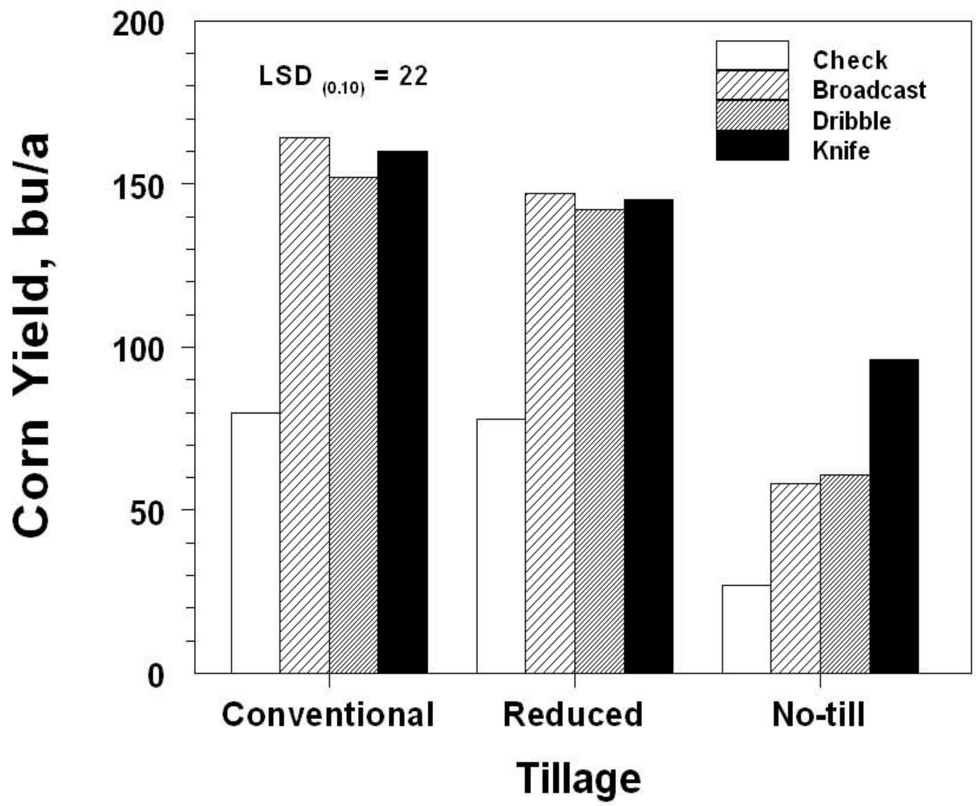

Figure 1. Effect of Tillage and N Placement on Short-season Corn Yield in 2005, Southeast Agricultural Research Center.

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EFFECT OF PREVIOUS CROP, NITROGEN AND PHOSPHORUS PLACEMENT METHOD, AND TIME OF NITROGEN APPLICATION ON WHEAT YIELD WHEN PLANTED NO-TILL

Kenneth W. Kelley and Daniel W. Sweeney

Summary

No-till wheat yields were influenced significantly by previous crop, fertilizer nitrogen (N) and phosphorus (P) placement method, and timing of N. Grain yields averaged 70 bu/a following soybean, 65 bu/a following corn, and 57 bu/a following grain sorghum. Subsurface placement of fertilizer N (28% N) and P (10 - 34 - 0) resulted in greater wheat yields than did surface strip-band or surface broadcast applications, regardless of previous crop. In 2005, wheat yields were significantly greater when most of the fertilizer N was applied in late winter, especially when fertilizer N was surface-applied. But results also indicate that where fertilizer N was subsurface-applied (coulter-chisel in fall and/or spoke-wheel in late winter), wheat yields following corn or soybean were influenced very little by timing of N application.

Introduction

In southeastern Kansas, wheat is commonly planted after a summer crop, such as corn, grain sorghum, or soybean, to diversify crop rotation. Improved equipment technology has made no-till planting of wheat more feasible in high-residue conditions. The benefits of planting wheat no-till are reduced labor and tillage costs and less soil erosion. Leaving previous crop residues near the soil surface, however, affects fertilizer N and P management for no-till wheat. The objectives of this research were to evaluate the effects of previous crop, N and P placement method, and time of N application on wheat grain yield when planted no-till.

Experimental Procedures

The experiment was a split-plot design, in which the main plots were previous crops (corn, grain sorghum, and soybean) and subplots consisted of a factorial arrangement of two fertilizer-management schemes (three placement methods of N and P and four different times of N application). The application methods of liquid N (28% N) and P (10 - 34 - 0) consisted of: 1) subsurface [coulter-knife in fall on 15-in. spacing and spoke-wheel in late winter on 10-in. spacing], 2) surface-applied in 15-in. strip bands, and 3) broadcast on soil surface. The times of N application were: 1) all in the fall, 2) 1/4 fall + 3/4 late winter, 1/2 fall + 1/2 in late winter, and 3/4 fall + 1/4 late winter. Liquid N (120 lb N/a) and P (68 lb P_2O_5/a) rates were constant over all plots, except for control plots. Phosphorus fertilizer was fall-applied in combination with the different N application methods. All plots also received 120 lb K_2O/a as a preplant broadcast application. Wheat was planted with a no-till drill in 7.5 in. spacing at a seeding rate of 100 lb/a.

Results and Discussion

Wheat yields were influenced significantly by previous crop, N-P application method, and timing of N fertilizer (Table 1). Grain yields averaged 70 bu/a following soybean, 65 bu/a following corn, and 57 bu/a following grain sorghum. Above-normal rainfall in November (6.4 in.) and January (4.3 in.) also influenced wheat yield responses to fertilizer N.

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Grain yields for the different fertilizer N - P placement methods, when averaged over previous crops and fertilizer N schemes, were 75 bu/a for subsurface, 60 bu/a for surface strip-band, and 57 bu/a for surface broadcast. Results indicate that subsurface placement of fertilizer N and P significantly increases fertilizer nutrient efficiency, compared with surface applications. In addition, wheat yields often were greater for surface strip-banding of N and P than for surface broadcast applications.

Timing of fertilizer N also influenced wheat yields. Because of the greater than normal rainfall during late fall of 2004 and early winter of 2005, significant N losses likely occurred when N was applied before planting; but yield differences between timings of N application were greater for surface-applied N than for subsurface treatments. Grain yields were greatest for surface-band and surface-broadcast treatments when most of the fertilizer N was top-dressed in late winter, regardless of previous crop. When wheat followed corn or soybean and fertilizer N was subsurface applied, timing of N had only a slight affect on yield. Nitrogen losses from denitrification or immobilization evidently were greatly reduced with subsurface placement.

Although subsurface placement of fertilizer N and P often results in greater wheat yield, compared with surface applications, producers will have to determine whether the additional cost of equipment and labor can be justified. In addition, wheat planted no-till following corn or soybean often has a greater yield potential than does wheat following grain sorghum, especially where fertilizer is surface-applied. Results also indicate that timing of fertilizer N for no-till wheat is critical for optimum yield potential and depends upon both rainfall patterns and placement method.

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Table 1. Effect of Previous Crop, Nitrogen and Phosphorus Placement Method, and Time of N Application on No-till Wheat Yield, Southeast Agricultural Research Center, Parsons Unit, 2005.

Fertilizer	Time of Nitrogen		Wheat Yield Following		
N and P[1] Placement Method	Fall	Late Winter	Corn	Grain Sorghum	Soybean
	----- lb/a -----		------------------- bu/a -------------------		
Surface strip-band	30	90	68.1	61.2	72.8
	60	60	61.1	58.8	69.5
	90	30	59.9	51.0	64.6
	120	0	54.3	46.7	56.6
Surface broadcast	30	90	65.6	55.4	71.1
	60	60	61.9	50.6	70.4
	90	30	55.4	46.2	58.6
	120	0	52.1	38.9	55.0
Subsurface	30	90	73.1	71.9	82.6
(knife + spoke)[2]	60	60	73.5	73.0	82.4
	90	30	75.1	67.9	81.3
	120	0	73.5	63.6	79.4
AVG			(64.5)	(57.1)	(70.3)
Knife control			32.4	19.0	31.3
Control			32.8	19.5	30.9
LSD (0.05)					
Same PC				3.7	
Different PC				4.7	

[1] Phosphorus (68 lb P_20_5/a as liquid 10-34-0) applied with N placement treatments.
[2] Coulter-knifed applicator in fall and spoke-wheel applicator in late winter.
Potash (120 lb K_20/a as muriate of potash) broadcast applied before planting.
N source = liquid 28 % N.
Variety: Overley; seeding rate of 100 lb/a. Planting date: Oct. 21, 2004.

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EFFECTS OF CROPPING SYSTEMS ON WINTER WHEAT AND DOUBLE-CROP SOYBEAN YIELD[1]

Kenneth W. Kelley and Daniel W. Sweeney

Summary

Over a 9-yr period, wheat yields averaged 55 bu/a following soybeans, 53 bu/a following corn, and 52 bu/a following grain sorghum where liquid N and P fertilizer were knifed below crop residues. But wheat yields were affected very little by tillage method (no-till vs. disk). Previous crop before wheat also significantly influenced double-crop soybean yields in all years. Soybean yields were greatest when corn and grain sorghum preceded wheat and least when soybeans preceded wheat.

Introduction

Winter wheat is often rotated with other crops, such as soybean, grain sorghum, and corn, to diversify cropping systems in southeastern Kansas. Wheat typically is planted with reduced tillage, although the acreage of wheat planted with no-till has increased significantly in recent years. In extreme southeastern Kansas, double-crop soybean traditionally is planted after wheat harvest. Like wheat, more double-crop acreage is being planted with conservation-tillage methods. This research investigates the combined effects of crop rotation and tillage on yields of winter wheat and double-crop soybean in a 2-yr crop rotation.

Experimental Procedures

In 1996, a 2-yr crop rotation study consisting of corn, grain sorghum, or soybean in rotation with wheat and double-crop soybean, was started at the Columbus Unit on two adjacent sites. Tillage treatments were: 1) plant all crops with conventional tillage and 2) plant all crops with no tillage. Fertilizer N (120 lb N/a as liquid 28 % N) and P (68 lb P_2O_5/a as liquid 10 - 34 - 0) were applied preplant at a depth of 4 to 6 in. with a coulter-knife applicator. Potassium fertilizer (120 lb K_2O/a) was broadcast applied. In conventional tillage systems for wheat, disk tillage was performed before fertilizer application and planting. Wheat was planted with a no-till drill in 7.5-in. rows at a seeding rate of 90 to 120 lb/a, depending on date of planting. In the no-till system, weeds that emerged before planting were controlled with a preplant application of glyphosate. In early spring, wheat was sprayed with a postemergence herbicide when needed to control broadleaf weeds.

Double-crop soybean (MG IV) was planted in late June or early July after wheat harvest. Row spacing for double-crop soybean differed over years. During the first 3 years of the study, soybean was planted in 30-in. rows; in the last 6 years, row spacing has been 7.5 in.

Tillage method for double-crop soybean also has differed over years. From 1997 to 2002, two tillage methods were evaluated (no-till and disk tillage). Since 2003, all double-crop plots have been planted no-till. Weeds were effectively controlled with herbicides.

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

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Results and Discussion

Wheat Results (Table 1)

In this 2-yr rotation, previous crop (corn, grain sorghum, or soybean) has had a smaller effect on wheat yield, compared with previous fertilizer research trials, mainly because fertilizer N and P were knifed below crop residues in all rotations and tillage systems before planting. In addition, the rate of N applied (120 lb/a) has been high enough for the yields produced. For the 9-yr period, wheat yields averaged 55 bu/a following soybean, 53 bu/a following corn, and 52 bu/a following grain sorghum.

Wheat yields also were affected very little by tillage method. When wheat was planted during the optimum planting window of October, grain yields were relatively good, regardless of tillage system. Results indicate that wheat planted no-till into previous summer crop residues will yield similarly to wheat planted with reduced-tillage methods, provided that good management practices are used, such as sub-surface placement of fertilizer N and P.

Double-crop Soybean Results (Table 1)

Previous crop before wheat significantly influenced double-crop soybean yields in nearly all years. Soybean yields were greatest when corn and grain sorghum preceded wheat and were least when soybean preceded wheat. Nutrient analyses of double-crop soybean plants have shown very little difference in nutrient uptake between previous crops (data not shown). More research is needed to determine why the observed yield response occurs.

In the initial years of the study, double-crop soybean yields were similar between reduced and no-till methods. In the last few years, however, double-crop soybean yields have been significantly greater when planted no-till. There initially was concern that soybean root growth would be reduced in no-till systems, but recent data suggest that double-crop soybean planted no-till is better able to withstand drought stress conditions. Additional research is planned to further evaluate the effects of conservation management practices on soil quality characteristics, such as quantities of soil carbon and organic matter.

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Table 1. Effects of Previous Crop and Tillage on Wheat and Double-crop Soybean Yield, Columbus Unit, Southeast Agricultural Research Center, 1997 - 2005.

Previous Crop before Wheat	Tillage	Average Grain Yield: Wheat	Average Grain Yield: Double-crop Soybean
		---------- bu/a ----------	
Corn	NT	52.5	33.3
Corn	RT	53.7	31.7
Grain sorghum	NT	50.6	33.7
Grain sorghum	RT	52.8	31.7
Soybean	NT	56.0	28.8
Soybean	RT	54.6	26.3
Means:			
Corn		53.2	32.5
Grain sorghum		51.7	32.7
Soybean		55.3	27.6
LSD (0.05)		1.3	2.0
No-till		53.0	31.9
Reduced tillage		53.7	29.9
LSD (0.05)		NS	1.6

Since 2003, all double-crop soybean has been planted with no-till (NT).
Reduced tillage (RT) consisted of disking before wheat planting.

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EFFECT OF SOIL pH ON CROP YIELD

Kenneth W. Kelley

Summary

Grain yields of grain sorghum, soybean, and wheat increased as soil acidity decreased with lime application. Yields were greatest, however, when pH was near the neutral range of 7.0.

Introduction

In southeastern Kansas, nearly all topsoils are naturally acidic (pH less than 7.0). Agricultural limestone is applied to correct soil acidity and to improve nutrient availability. But applying too much lime can result in alkaline soil conditions (pH greater than 7.0), which also reduces nutrient availability and increases persistence of some herbicides. This research evaluated crop yield responses to different levels of soil pH.

Experimental Procedures

Beginning in 1989, five soil pH levels, ranging from 5.5 to 7.5, were established on a native grass site at the Parsons Unit in a 3-yr crop rotation consisting of [wheat - double-cropped soybean] - grain sorghum - soybean. Crops are grown with conventional tillage.

Results and Discussion

Grain yield responses for the various soil pH treatments over several years are shown in Table 1. Yields of all crops increased as soil acidity decreased. Yields generally were greatest, however, when soil pH was near the neutral range of 7.0. Plant nutrient availability (nitrogen and phosphorus) also increased as soil acidity decreased (data not shown).

Table 1. Effects of Soil pH on Crop Yields, Parsons Unit, Southeast Ag Research Center.

	Grain Yield			
	Grain Sorghum	Full-season Soybean	Double-crop Soybean	Wheat
Soil pH[1]	(4-yr avg)	(4-yr avg)	(4-yr avg)	(4-yr avg)
(0 - 6 in.)	bu/a			
5.3	83.8	28.2	18.9	43.0
5.6	89.9	30.3	21.8	44.0
6.3	96.3	33.6	23.3	45.1
6.8	99.3	34.2	25.0	46.6
7.2	99.0	35.0	24.0	45.8
LSD (0.05)	4.2	1.9	1.3	2.3

[1] Average pH from 2001 to 2005.

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EFFECTS OF TILLAGE ON FULL-SEASON SOYBEAN YIELD

Kenneth W. Kelley and Daniel W. Sweeney

Summary

Full-season soybean yields have differed over time with tillage method at two different sites. In general, when drier-than-normal conditions occur, soybean yields have been greater when soybean was planted no-till following corn or grain sorghum; when summer rainfall is above normal, however, tillage has had less effect on full-season soybean yield.

Introduction

In southeastern Kansas, full-season soybean often is rotated with other crops, such as corn and grain sorghum, to diversify cropping systems. Soybean previously has been planted with conventional tillage (chisel - disk - field cultivate) following corn or grain sorghum, but improved equipment technology has made no-till planting more feasible. Thus, this research evaluates the long-term effects of tillage method on full-season soybean yield.

Experimental Procedures

From 1995 through 2002, a 3-yr crop rotation was evaluated at both the Columbus and Parsons Units. The rotation consisted of [corn or grain sorghum] - soybean - [wheat and double-crop soybean], and tillage effects on full-season soybean yields were evaluated every 3 yrs. Tillage treatments were: 1) plant all crops with conventional tillage (CT); 2) plant all crops with no tillage (NT); and 3) alternate CT and NT systems. Beginning in 2003, the 3-yr rotation was changed to a 2-yr rotation, which consisted of soybeans following grain sorghum. Tillage effects on soybean yield were evaluated each year at both the Columbus and Parsons Units.

Results and Discussion

Effects of tillage method on full-season soybean yields are shown in Table 1. At the Columbus Unit, soybean yields were greater with CT than with NT during the first two cropping cycles. In recent years, however, soybean yields with continuous NT have been equal to or greater than with CT. But soybean yields for NT following CT have been significantly lower than those for continuous NT or continuous CT. At the Parsons Unit, tillage system had no significant effect on soybean yields in 1996, 1999, and 2004. But in 2002 and 2003, soybean yields were often greater for NT than for CT.

Results suggest that the effects of tillage on soybean yields have changed over time. Additional research is needed to evaluate long-term effects of no-till and continuous tillage on soybean yield and on changes in soil properties, such as soil carbon and nitrogen.

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Table 1. Effects of Tillage Systems on Full-season Soybean Yield, Southeast Agricultural Research Center, 1996 - 2005.

Tillage System[1]	Full-season Soybean Yield						
	1996[2]	1999[2]	2002[2]	2003	2004	2005	6-yr avg.
	---------- bu/a ----------						
				Columbus Unit			
NT only	48.4	18.1	27.0	35.7	46.1	30.8	34.4
NT following CT	46.0	14.2	26.0	29.3	38.4	23.7	29.6
CT only	53.9	20.3	23.4	35.8	43.2	29.3	34.3
CT following NT	54.4	20.0	26.5	36.9	40.3	25.9	34.0
LSD (0.05)	4.9	1.3	1.4	2.0	3.7	1.7	
				Parsons Unit			
NT only	45.3	15.8	32.4	34.9	42.4	30.8	33.6
NT following CT	43.7	14.9	32.1	33.5	42.2	27.1	32.2
CT only	45.2	15.5	27.9	30.8	45.1	29.4	32.3
CT following NT	45.8	16.0	29.6	35.1	43.8	29.4	33.3
LSD (0.05)	NS	NS	3.9	2.8	NS	1.9	

[1] NT = no tillage; CT = conventional tillage (disk - chisel - disk - field cultivate).
[2] Effects of previous crop (corn and grain sorghum) on soybean yield were non-significant (NS) for the first phase of the study from 1996 through 2002; thus, yields were averaged over both previous crops. From 2003 to 2006, previous crop before soybean was grain sorghum.

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EFFECTS OF NITROGEN AND PREVIOUS DOUBLE-CROPPING OPTIONS ON SUBSEQUENT CORN YIELD

Kenneth W. Kelley and Joseph L. Moyer

Summary

Corn yields were greatest following wheat - double-crop soybean and least following wheat - double-crop grain sorghum. Corn yield response to fertilizer N differed with previous wheat - double-crop option.

Introduction

In southeastern Kansas, producers typically double-crop soybean after wheat. But other double-crop options are suitable for the growing conditions of this region. Grain sorghum can be successfully grown as a double-crop option if planted by early July. If wet conditions follow wheat harvest, double-crop sunflower can be planted as late as mid- to late-July. Small-seeded legumes, such as lespedeza or sweet clover, typically are seeded into wheat in late winter. Lespedeza is commonly grown for seed or cut for hay, whereas sweet clover is planted primarily for soil amendment purposes. Other producers may summer fallow the land after wheat harvest. In fallow situations, weeds are often controlled with a summer application of herbicide, such as glyphosate.

Previous wheat and double-crop options likely affect growth of subsequent crops, such as corn. In addition, fertilizer N requirements for corn may need to be adjusted, depending upon previous wheat - double-crop option.

Experimental Procedures

The study was conducted at the Parsons Unit, and the experimental design was a split-plot arrangement with three replications. Main plots consisted of six different wheat - double-crop options that were grown in 2004: 1) wheat - double-crop soybean, 2) wheat - double-crop grain sorghum, 3) wheat - double-crop sunflower, 4) wheat - sweet clover, 5) wheat - lespedeza, and 6) wheat - chemical fallow. Double-crop grain sorghum and sunflower plots each received 75 lb N/a as ammonium nitrate. Subplots consisted of six preplant fertilizer N rates (0, 30, 60, 90, 120, and 150 lb N/a) for corn following wheat - double-crop options. Corn yield and leaf N concentration at R3 (milk stage after silking) were measured.

Results and Discussion

In 2005, corn yields and leaf N concentration, averaged over all N rates, were greatest following wheat - double-crop soybean and lowest following wheat - double-crop grain sorghum (Table 1). At the higher N rates, differences in corn yield between previous double-crop systems were less pronounced than at lower N rates. In 2004, sweet clover growth was reduced because of dry soil conditions, which likely affected subsequent corn yield responses.

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Table 1. Effects of Nitrogen and Previous Wheat - Double-crop Options on Subsequent Corn Production, Parsons Unit, Southeast Agricultural Research Center, 2005.

Previous Wheat and Double-crop System	N Rate	Corn	
		Yield	Leaf N
	lb/a	bu/a	%
Chemical fallow	0	50.6	1.14
	30	75.5	1.35
	60	117.6	1.84
	90	137.9	2.10
	120	149.9	2.36
	150	158.7	2.65
Soybean	0	69.1	1.34
	30	90.3	1.66
	60	108.4	2.12
	90	135.6	2.51
	120	154.7	2.49
	150	157.2	2.70
Grain sorghum	0	28.8	1.14
	30	58.7	1.35
	60	78.7	1.52
	90	101.4	1.79
	120	128.0	2.27
	150	139.3	2.40
Sunflower	0	44.0	1.15
	30	70.8	1.47
	60	117.6	1.88
	90	129.7	2.18
	120	144.5	2.31
	150	158.0	2.64

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Table 1. (Continued).

Previous Wheat and Double-crop System	N Rate	Yield	Leaf N
	lb/a	bu/a	%
Sweet clover	0	59.6	1.38
	30	86.3	1.50
	60	119.6	2.00
	90	134.5	2.11
	120	148.1	2.51
	150	152.5	2.44
Lespedeza	0	49.2	1.26
	30	68.7	1.34
	60	103.8	1.81
	90	127.6	2.06
	120	142.5	2.31
	150	142.1	2.58
LSD (0.05)			
Same cropping system		7.8	0.20
Different system		8.8	0.25
Mean values:			
Chemical fallow		115.0	1.91
Soybean		119.2	2.14
Grain sorghum		89.2	1.74
Sunflower		110.8	1.94
Sweet clover		116.8	1.99
Lespedeza		105.6	1.89
LSD (0.05)		5.7	0.18

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EFFECTS OF PHOSPHORUS AND POTASSIUM FERTILIZER RATE AND TIME OF APPLICATION IN A WHEAT AND DOUBLE-CROPPING SYSTEM

Kenneth W. Kelley

Summary

Grain yields of grain sorghum, wheat, and double-crop soybean were not significantly affected by fertilizer P and K rates or time of application in the first cropping cycle where initial soil test values were in the medium range.

Introduction

Timing of fertilizer phosphorus (P) and potassium (K), as well as rate of application, are important management decisions in crop production. In southeastern Kansas, producers often plant wheat following the harvest of a feed-grain crop, such as grain sorghum or corn, and then plant double-crop soybean after wheat, giving 3 crops in 2 years. In these multi-cropping systems, producers typically apply fertilizer P and K to the feed-grain and wheat crops only. Because of increasing fertilizer cost, this research seeks to determine the direct and residual effects of P and K fertilizer, as well as rates of application, on grain yields in a double-cropping system.

Experimental Procedures

The study was established in 2004 at the Columbus Unit. Crop rotation consists of grain sorghum / [wheat - double-crop soybean], giving 3 crops in a 2-yr period. Both grain sorghum and wheat are planted with conventional tillage, and double-cropped soybean are planted no-till. Different rates of fertilizer P and K are applied preplant, to the grain sorghum crop only or to both the grain sorghum and wheat crops. Fertilizer is incorporated with tillage. The initial soil test values before study establishment were 23 ppm Bray-1 P and 160 ppm exchangeable K for the 0- to 6-in. soil depth.

Results and Discussion

Effects of the various fertilizer P and K treatments on grain sorghum, wheat, and double-crop soybean yields are shown in Table 1. For the initial cropping phase of this study, grain yields were not significantly affected by any of the fertilizer P and K treatments. The non-significant yield response to fertilizer P and K for the first year of the study was not unexpected because initial soil tests indicated that soil values of P and K were sufficient for the expected yield goals. Initial results confirm that current K-State soil test recommendations are an accurate management tool for making fertilizer recommendations.

The amount of nutrient removal in harvested grain for 100 bu/a grain sorghum, 50 bu/a wheat, and 25 bu/a double-crop soybean is 87 lb P_2O_5/a and 72 lb K_2O/a. Thus, this study will continue for several cropping cycles to monitor the residual effects of fertilizer P and K treatments on grain yields and soil nutrient concentrations of P and K. Additional treatments, such as starter fertilizer effects, likely will be imposed in the study as soil test values change with time.

With fertilizer cost increasing, it is important that producers take soil tests at periodic intervals to monitor soil concentrations of P and K, which likely will result in greater fertilizer use efficiency and higher net returns.

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Table 1. Effects of Phosphorus and Potassium Fertilizer Rate and Time of Application on Grain Yield in a Double-cropping System, Southeast Agricultural Research Center, Columbus Unit, 2005 - 2006.

Fertilizer Rate Applied to						Grain Yield		
Grain Sorghum			Wheat			Grain Sorghum	Wheat	DC Soybean
N	P_2O_5	K_2O	N	P_2O_5	K_2O			
lb/a						bu/a		
120	0	0	120	0	0	115	51	28
120	40	40	120	40	40	113	51	28
120	80	80	120	0	0	117	55	28
120	60	60	120	60	60	118	52	26
120	120	120	120	0	0	119	55	26
120	80	80	120	80	80	120	51	27
LSD (0.05)						NS	NS	NS

The initial soil test values before study establishment were 23 ppm Bray-1 P and 160 ppm exchangeable K for the 0- to 6-in. soil depth.

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EFFECTS OF FERTILIZER NITROGEN RATE AND TIME OF APPLICATION ON GRAIN SORGHUM PRODUCTION

Kenneth W. Kelley

Summary

In 2005, grain sorghum yields and leaf N concentrations were significantly influenced by fertilizer N rate but not by time of N application. This study will be continued for several more years to evaluate treatment effects over various rainfall conditions.

Introduction

Because of recent increases in fertilizer nitrogen (N) prices, producers are looking for ways to reduce production costs for feed-grain crops, such as corn and grain sorghum. One method that has gained renewed interest is applying some of the fertilizer N requirement after the crop has emerged, referred to as "side-dressing". Some research has shown that a subsurface application of banded N after the crop has emerged results in more efficient N use and often increases net return. In southeastern Kansas, excessive spring rainfall also increases the potential for greater N loss where fertilizer N is applied preplant.

Experimental Procedures

Studies were established at the Columbus Unit in 2005 to evaluate the effects of time and rate of fertilizer N application for both grain sorghum and corn. Fertilizer N (28 % liquid N) treatments consisted of different N rates applied either preplant or side-dressed. Preplant fertilizer N was subsurface applied in mid-March on 15-in. centers at a depth of 4 to 6 in. Side-dress N also was subsurface applied between 30-in. rows at a depth of 4 to 6 in. when crop was approximately 12-in. tall. All plots received 30 lb N/a preplant as 18 - 46 - 0. The previous crop before grain sorghum was full-season soybean.

Results and Discussion

A hail storm in early July resulted in moderate plant damage to the corn study; thus, only the grain sorghum results are shown (Table 1). In 2005, grain sorghum yields and leaf N concentrations were significantly influenced by fertilizer N rate but not by time of N application. This study will be continued for several more years to evaluate N treatment effects over various rainfall conditions.

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Table 1. Effects of Fertilizer N Rate and Time of Application on Grain Sorghum Yield and Leaf N Concentration, Columbus Unit, 2005.

Rate of Fertilizer N Applied[1]		Grain Sorghum	
Preplant	Side-dress	Yield	Leaf N
------------ lb/a ------------		bu/a	%
30	0	101.1	1.91
60	0	121.9	2.46
90	0	133.9	2.85
120	0	143.6	2.90
150	0	140.8	3.07
30	30	118.7	2.49
30	60	130.2	2.68
30	90	141.7	2.84
30	120	143.7	2.94
LSD (0.05)		10.0	0.24

[1] 30 lb N/a was applied preplant as 18 - 46 - 0 to all treatments. Liquid 28 % N was the fertilizer source for the additional N applied either preplant or side-dressed.

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PERFORMANCE TEST OF DOUBLE-CROPPED SOYBEAN VARIETIES

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

Summary

Seventeen double-cropped soybean varieties were planted following winter wheat at the Columbus unit and evaluated for yield and other agronomic characteristics throughout the summer of 2005. Overall, grain yields were average, with a normal frost occurring, and variety differences were seen. Yields ranged from 18.1 bu/a to 29.5 bu/a. Grain yields were strongly related to maturity, with the top varieties all being late Maturity Group (MG) IV or later. Tobacco Ringspot Virus (TRV) caused some varieties to mature very late and have green, flat pods at first frost.

Introduction

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

Experimental Procedures

Soybean varieties were planted into good moisture following winter wheat harvest at the Southeast Agricultural Research Center at Columbus. The soil is a Parsons silt loam. The wheat stubble was disked under, the soil was field cultivated and soybean was then planted with John Deere 7000 planter units. Glyphosate-tolerant varieties were used. Soybean were planted on June 23, 2005, at 10 seed per ft of row. When appropriate, 22 oz of Roundup Weathermax® +.25 oz Classic® was sprayed after planting. Harvest occurred October 28, 2005.

Results and Discussion

Soils were moist after rains throughout May, June, and early July, and plant stands were excellent. Excellent growing conditions prevailed early, but drought occurred in August, September, and October. Even so, timely rains in August and September provided for average yields of 25 bu/a in some varieties. Yields ranged from 18.1 bu/a to 29.5 bu/a (Table 1). Several varieties yielded more than 25 bu/a, and could be considered good yielders in 2005. The timely rains in September had an effect in determining top yields by improving pod set and retention of later-maturity varieties. Overall plant heights were good, reflecting the moist early conditions (Table 1). Tobacco Ringspot Virus damage was severe in 2005; one-third of varieties showed 20 to 40% infection. Grain yield of some varieties was affected (Table 1). This disease is not present every year; when it is severe, however, areas of

[1]Southeast Agricultural Research Center and Southeast Area Extension Office, respectively.

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a soybean field appear green while the majority of the field is mature. Soybean plants in these immature areas have green leaves, stems, and some flat pods that hang on until frost kills the plant.

Table 1. Yields from 2002 through 2005 for a Variety Test of Double-cropped Soybean at Columbus and Parsons.

Source	Variety	TRV Rating Tobacco Ringspot Virus disease	Height	Grain Yield 2002	2003	2004	2005
		-% plants- infected	-in-	bu/a			
Asgrow	AG4903	37.5 ab	28.0	--	--	--	22.2
Asgrow	AG5605	0.0 d	31.0	--	--	--	29.5
Garst	4512RR/N	12.5 bcd	27.3	--	--	--	18.5
Garst	D484RR/N	2.5 d	30.5	--	--	--	21.5
Midland	9A545NRS	42.5 a	31.5	--	--	28.7	23.5
Midland	9A494XRR	22.5 abcd	25.0	--	--	--	18.1
Mycogen	5B482NRR	12.5 bcd	26.0	--	--	--	18.5
Mycogen	5N501RR	2.5 d	29.3	--	--	--	22.7
NK	S57-P1	32.5 abc	34.0	20.1	32.0	26.8	27.8
NK	S49-Q9	10.0 cd	28.8	--	--	35.2	26.8
Pioneer	94M90	0.0 d	29.8	--	--	27.4	24.0
Pioneer	95M50	20.0 abcd	32.0	--	--	--	23.5
Prairie Brand	PB-4583NRRSTS	2.5 d	22.5	--	--	--	19.7
Prairie Brand	PB-5083NRR	12.5 bcd	29.3	--	--	--	20.2
Public	K4602RR	30.0 abc	28.3	--	--	--	19.9
Public	K5502RR	12.5 bcd	28.3	--	--	--	27.6
Public	K1463RR	0.0 d	34.5	--	--	--	27.4
Average		14.9	29.2	19.1	26.6	28.9	23.0
LSD (0.05)		26.0	2.9	2.7	4.4	4.0	5.3

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PERFORMANCE TEST OF RIVER-BOTTOM SOYBEAN VARIETIES

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

Summary

Eighteen soybean varieties typically grown on deep river-bottom soils were planted at Erie, Kansas, and evaluated for yield and other agronomic characteristics throughout the summer of 2005. Soybean received heavy hail soon after emergence but recovered. Plants were later maturing than normal. Grain yields were below average, yet variety differences were seen with this very productive soil. Yields ranged from 27.6 to 38.7 bu/a. The shorter-season Maturity Group (MG) III and IV varieties yield as well as, or better than, MG V varieties when grown on deep soils. Most soybean plants were short this year, and there was little lodging.

Introduction

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

Experimental Procedures

Eighteen soybean varieties were grown after corn in 2004. The farmer/cooperator was Joe Harris. The soil is a Lanton deep silt loam on the Neosho River flood plain approximately 1750 feet from the river channel. The soil was chiseled and disked, and the soil was field cultivated before planting. Dual II® Magnum herbicide was applied pre-emergent at the rate of 1 pint/a + .6 oz/a First Rate®. Soybean was planted on June 22, 2005, at 10 seeds/ft of row. Plants emerged to form an excellent stand. All varieties were glyphosate tolerant, and 22 oz/a of Roundup Weathermax® + .25 oz Classic® herbicide was applied postemergent, 33 days after planting. The soybean was harvested on October 24, 2005.

Results and Discussion

Warmer-than-normal conditions persisted throughout the summer, with periods of rainfall that kept the soybean growing. A severe hail storm on July 4 wreaked havoc on corn and early-planted soybean in the area, yet the performance test was planted late enough that it was able to recover from this damage. Plant growth was slower, however, and the test was not harvested until late October.

Yields ranged from 27.6 bu/a to 38.7 bu/a (Table 1). Many varieties yielded more than 33 bu/a for the 2005 growing season. Although consideration should be given to plant height and its effect on lodging on these productive soils, most plants were less than 3 feet tall in 2005. Overall plant height ranged from 28.5 in to 36.8 in. Lodging was not a problem during the 2005 growing season.

[1] Southeastern Agricultural Research Center and Southeast Area Extension Office, respectively.

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Table 1. Yields from 2002 through 2005 for a Variety Test of River-bottom Soybean at Erie, Kansas.

Source	Variety	Maturity	Height	Grain Yield			
				2002	2003	2004	2005
		Julian day[1]	-in-	---------------bu/a---------------			
Asgrow	AG4404	286	33.3	--	--	--	35.8
Asgrow	AG4703	290	30.0	--	--	--	38.7
Garst	4512RR/N	288	30.3	--	--	--	35.0
Garst	D484RR/N	290	36.8	--	--	--	38.1
Midland	9A442NRR	289	30.8	40.3	41.0	46.8	37.5
Midland	9A432NRS	288	30.3	--	--	--	37.5
Mycogen	5B482NRR	287	29.0	--	--	--	35.5
Mycogen	5N501RR	290	31.0	--	--	--	38.2
Pioneer	93M92	286	28.5	--	--	--	27.6
Pioneer	94M30	289	30.5	--	--	--	35.5
Pioneer	94B73	289	30.8	--	38.7	50.7	30.8
Prairie Brand	PB-4023NRR	289	32.8	--	--	--	38.5
Prairie Brand	PB-4583NRRSTS	289	31.0	--	--	--	36.2
Public	K1623RR	282	28.5	--	--	--	31.5
Public	K1630RR	285	28.5	--	--	--	34.6
Public	K1631RR	286	32.5	--	--	--	36.6
Public	K4202RR	283	32.8	--	--	--	34.9
Public	K4602RR	286	33.3	--	--	--	36.2
Average		----	----	40.9	38.5	44.5	35.5
LSD (0.05)		1	3.9	4.9	2.5	3.9	5.8

[1]Julian Day number 270 = September 27, 280=October 7, and 290=October 17.

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PERFORMANCE TEST OF COTTON VARIETIES

James H. Long, Gary Kilgore, Scott Staggenborg,
Chris Pachta, and Stewart Duncan[1]

Summary

Fifteen cotton varieties and one seed treatment were planted at Parsons, Kansas, and were evaluated for yield and other agronomic characteristics throughout the summer of 2005. Lint yields were above average at 705 lb/a, and variety differences were seen. Yields ranged from 551 lb/a to 885 lb/a of lint. Quality is reported on the individual varieties. Quality should be strongly considered because it will affect the final price of the crop.

Introduction

Cotton is a new crop for southeastern Kansas but is already grown on over 100,000 acres in the state. The crop is somewhat drought tolerant. Many of the varieties tested are grown on the high plains of Texas and in Oklahoma. Some factors that may influence the amount of cotton grown in this region are potential insect problems, local ginning capacity, and the management decisions associated with cotton, such as having an early harvest before fall rains arrive.

Experimental Procedures

Fifteen cotton varieties were grown following grain sorghum in 2004. The soil at the Parsons unit of the Southeast Agricultural Research Center is a Parsons silt loam. The soil was disked and field cultivated just before planting. Cotton was planted on May 19, 2005. Dual II Magnum® and Staple® herbicides were applied pre-emergent to help control weeds. Plants emerged to form an adequate stand. Target population was 68,000 plants/acre. Cotton lint was harvested on October 10, 2005. The cotton was ginned at Manhattan, and lint quality was then determined by HVI (high volume instrumentation) testing.

Results and Discussion

The summer of 2005 started warmer than normal but ended cooler than normal. There was very little sustained heat from mid-June until mid-September. There was less precipitation than normal during the summer, although significant rainfall events started and then sustained the crop throughout the season. Yields ranged from 551 lb/a to 885 lb/a (Table 1). DP&L DP444 BG/RR had the greatest lint yield. DP444 BG/RR also had the greatest 2-yr average at 923 lb/a, whereas DP&L 2145RR yielded 770 lb/a lint for the 3-yr average and should be considered a top yielder. Several varieties have above-average yields from 2005 and over the 3-yr period. Quality characteristics indicate differences between varieties that may affect the price at the gin (Table 2). Turnout was high again this year due to a burr extractor on the production cotton stripper used for harvest.

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[1] Southeastern Agricultural Research Center, Southeast Area Extension, State Extension, State Extension, and Northeast Area Extension, respectively.

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Table 1. Average Lint Yield (lb/a) of Cotton Varieties from 2003 through 2005 at the Parsons Unit of the Southeast Agricultural Research Center.

		Lint Yield, lb/a				
					2yr	3yr
Source	**Variety**	**2005**	**2004**	**2003**	**Avg**	**Avg**
All-Tex	Excess RR	636	578	--	607	--
All-Tex	Xpress RR	551	470	--	511	--
Croplan Genetics	CG 3020B2RF	738	--	--	--	--
Croplan Genetics	CG 4020B2RF	721	--	--	--	--
Croplan Genetics	CG 3520B2RF	723	--	--	--	--
DP&L	2145 RR	659	733	918	696	770
DP&L	DP 434 RR	801	525	--	663	--
DP&L	DP 444 BG/RR	885	961	--	923	--
DP&L	DP 444 BG/RR untreated seed	832	--	--	--	--
DP&L	DPLX 04V405DF	647	--	--	--	--
DP&L	PM 2140 B2RF	567	--	--	--	--
DP&L	DP 117 B2RF	701	--	--	--	--
Stoneville	NG 1553R	683	536	771	609	663
Stoneville	ST 4554B2RF	687	--	--	--	--
Stoneville	ST 4664RF	706	--	--	--	--
Stoneville	NG 3550RF	738	--	--	--	--
Average		705	594	739	650	680
CV (%)		11	10.9	13	11	12
LSD (0.05)		76	76	109	76	87

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Table 2. Lint Quality Characteristics of Cotton Varieties from 2005 at the Parsons Unit of the Southeast Agricultural Research Center.

		Turnout %			Length	Unif.	Strength	Color	Grade
Source	Variety	Lint	Seed	Mic	in	%	g/tex		
All-Tex	Excess RR	0.33	0.42	5.4	1.00	81.0	28.6	62	1
All-Tex	Xpress RR	0.33	0.47	5.1	0.99	80.9	28.6	62	1
Croplan Genetics	CG 3020B2RF	0.35	0.41	5.5	1.02	81.5	25.9	62	1
Croplan Genetics	CG 4020B2RF	0.33	0.38	5.6	1.10	79.3	26.1	63	1
Croplan Genetics	CG 3520B2RF	0.35	0.39	5.5	1.06	80.5	26.9	63	2
DP&L	2145 RR	0.37	0.44	5.8	0.92	79.9	27.3	62	1
DP&L	DP 434 RR	0.37	0.41	5.6	1.04	80.4	26.5	52	2
DP&L	DP 444 BG/RR	0.38	0.40	5.5	1.01	80.5	26.5	62	1
DP&L	DP 444 BG/RR untreated seed	0.38	0.39	5.3	1.00	81.8	26.1	62	1
DP&L	DPLX 04V405DF	0.37	0.27	4.9	0.99	80.3	25.7	63	1
DP&L	PM 2140 B2RF	0.38	0.42	4.8	0.98	79.2	26.5	62	2
DP&L	DP 117 B2RF	0.37	0.39	5.7	1.02	79.5	28.2	83	1
Stoneville	NG 1553R	0.35	0.44	4.5	1.02	81.9	28.8	52	2
Stoneville	ST 4554B2RF	0.35	0.42	5.5	1.00	80.4	28.9	63	2
Stoneville	ST 4664RF	0.37	0.38	5.7	1.02	80.1	29.6	63	2
Stoneville	NG 3550RF	0.36	0.42	5.5	1.02	81.3	28.6	82	1
Average		0.36	0.40	5.4	1.01	80.7	27.6	--	--
CV (%)		5	18	6	3	1	2	--	--
LSD (0.05)		0.04	0.15	0.6	0.07	1.9	10.6	--	--

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THE USE OF NOVEL PLANT-DERIVED COMPOUNDS TO CONTROL DISEASE IN SOYBEAN

James H. Long, Nancy L. Brooker, and Kate Walker[1]

Summary

Work was conducted for three years at Columbus, Kansas, to compare two naturally occurring compounds with industry standard treatments and an untreated control. Seed treatment effects on initial plant stand were seen in all three years. The terpenoid compound performed as well as Allegiance® in two of three years and was equal to Rival® across the study. The terpenoid compound applied at the R1 growth stage also increased grain yield over the control in one year of three. Applying the two naturally occurring compounds at R4 tended to decrease grain yield.

Introduction

The use of chemical seed and foliar fungicides to control disease in soybean is an accepted practice, but little is known about the use of naturally occurring compounds to control seedling blights and seasonal soybean diseases. Naturally occurring compounds may offer advantages of being readily available, as well as being environmentally acceptable alternatives to standard fungicide treatments. A preliminary study to determine the compounds' effects on grain yield was begun in 2003 and continued until 2005. Pittsburg State University personnel prepared seed treatments and foliar sprays, and K-State personnel conducted the field operations on research center grounds of the Southeastern Agricultural Research Center – Columbus unit.

Experimental Procedures

Lab studies determined naturally occurring compounds with fungicidal activity. Five treatments were compared for their effect on initial stand 21 days after planting and grain yield of a mid MG IV soybean. Standards of no treatment, Rival® (120ml/45kg seed) and Allegiance FL® (6 ml/45 kg seed) were compared with sesamol (1 g L^{-1}) and a terpenoid compound (1 g L^{-1}). All treatments received Magnacoat® coating in a slurry. The foliar treatments were sesamol (185 g ha^{-1}) and a terpenoid compound (185 g ha^{-1}), applied at the R1 or R4 growth stages. All treatments were compared with a standard – no treatment. Grain yields of both studies were collected with an MF 8 plot combine and corrected to 13% moisture. The Parsons silt loam is a fine mixed, thermic Mollic Albaqualf.

Results and Discussion

Allegiance®, Rival®, and the terpenoid compound increased initial plant stand by 10.5, 11.9, and 15.5 %, respectively, in 2003 (Fig. 1). In 2004 Allegiance® increased stand by 8% and in 2005 Allegiance® and the terpenoid compound increased plant stand by 8.4 and 10.4%, respectively. Sesamol had little effect on initial plant stand. As so often happens with seed

[1]Southeast Agricultural Research Center, Pittsburg State University, and Pittsburg State University, respectively.

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treatments, there was little effect at the end of the season on grain yield (Fig. 2). The terpenoid applied at the R1 growth stage increased grain yield over the control in 2005 (Fig. 3). The naturally occurring compounds, when applied at the R4 growth stage, tended to decrease grain yields.

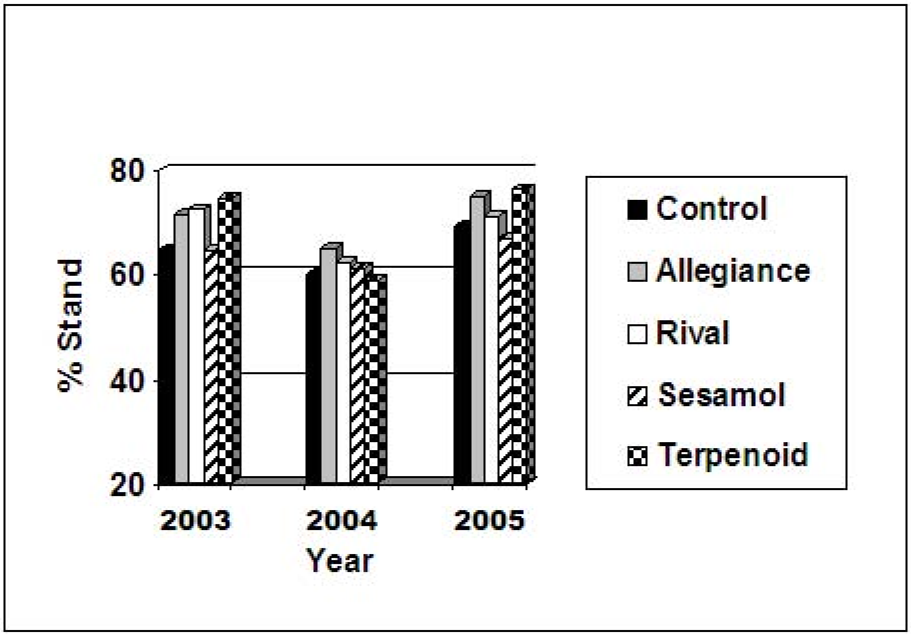

Figure 1. Effect of Seed Treatment on Initial Stand of Soybean at Columbus, Kansas.

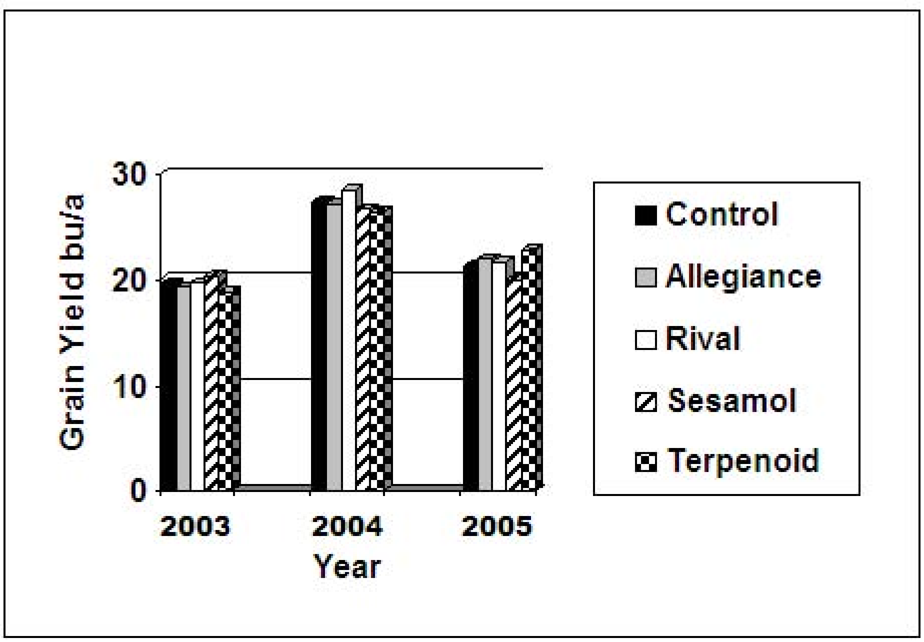

Figure 2. Effect of Seed Treatment on Grain Yield of Soybean at Columbus, Kansas.

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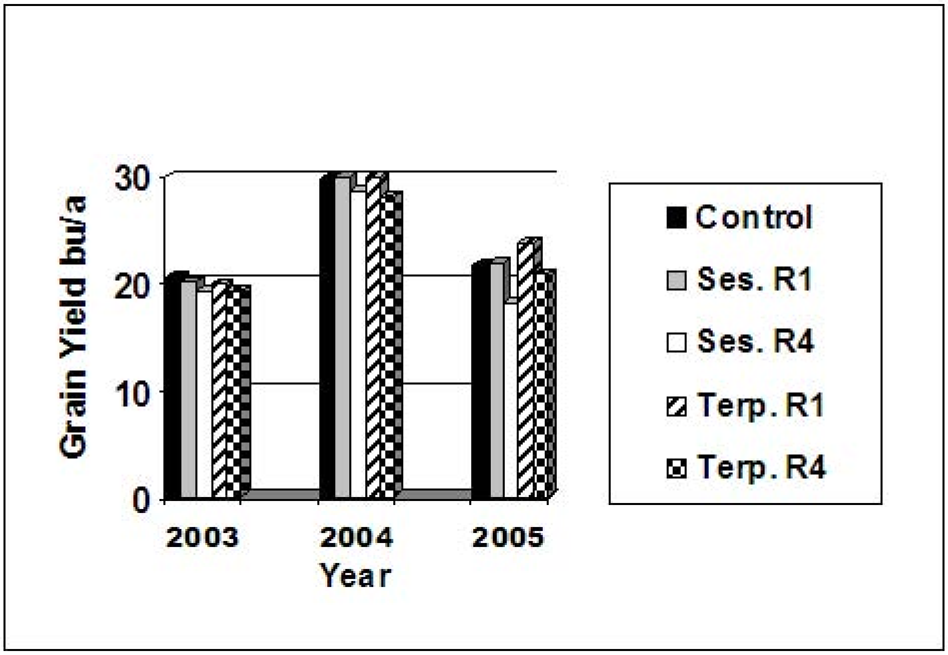

Figure 3. Effect of Foliar Treatment on Grain Yield of Soybean at Columbus, Kansas.

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ANNUAL SUMMARY OF WEATHER DATA FOR PARSONS, KANSAS - 2005

Mary Knapp[1]

2005 Data

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg. Max	42.4	51.6	58.5	67.4	77.5	86.4	90.2	90.0	86.2	71.2	60.6	44.1	68.8
Avg. Min	25.7	29.0	34.1	46.2	55.8	65.2	67.8	68.4	61.5	44.5	34.1	20.4	46.1
Avg. Mean	34.0	40.3	46.3	56.8	66.6	75.8	79.0	79.2	73.8	57.9	47.4	32.3	57.4
Precip	4.01	1.73	1.46	2.0	4.11	8.13	1.62	4.53	2.10	2.40	0.26	0.13	32.43
Snow	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	2.3	4.8
Heat DD*	960	692	581	259	79	0	0	0	18	282	533	1015	4418
Cool DD*	0	0	1	13	130	324	435	440	283	61	3.5	0	1688
Rain Days	9	8	4	9	9	10	3	7	5	4	2	3	73
Min < 10	3	0	0	0	0	0	0	0	0	0	0	6	9
Min < 32	23	17	13	1	0	0	0	0	0	4	14	27	99
Max > 90	0	0	0	0	0	6	13	15	9	0	0	0	43

NORMAL VALUES (1971-2000)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg. Max	40.2	47.2	57.2	67.1	76.0	85.0	91.1	90.0	81.0	70.5	55.5	44.4	67.1
Avg. Min	20.2	25.6	34.8	44.1	54.4	63.4	68.3	66.0	58.0	46.3	34.9	24.8	45.1
Avg. Mean	30.2	36.4	46.0	55.6	65.2	74.2	79.7	78.0	69.5	58.4	45.2	34.6	56.1
Precip	1.37	1.78	3.37	3.82	5.39	4.82	3.83	3.42	4.93	4.04	3.29	2.03	42.09
Snow	2.0	3.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2	0.0	8.5
Heat DD	1079	800	590	295	95	6	0	3	51	229	594	942	4684
Cool DD	0	0	0	13	101	283	456	406	187	24	0	0	1470

DEPARTURE FROM NORMAL

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Avg. Max	2.2	4.4	1.3	0.3	1.5	1.4	-0.9	0.0	5.2	0.7	5.1	-0.3	1.7
Avg. Min	5.5	3.4	-0.7	2.1	1.4	1.8	-0.5	2.4	3.5	-1.8	-0.8	-4.4	1.0
Avg. Mean	3.8	3.9	0.3	1.2	1.4	1.6	-0.7	1.2	4.3	-0.5	2.2	-2.3	1.4
Precip	2.64	-0.05	-1.91	-1.87	-1.28	3.31	-2.21	1.11	-2.83	-1.64	-3.03	-1.9	-9.66
Snow	0.5	-3.0	-1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2	2.3	-3.7
Heat DD	-120	-108	-9	-37	-16	-6	0	-3	-34	53	-61	73	-267
Cool DD	0	0	1	-1	29	41	-21	34	96	37	3.5	0	218

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

[1]Assistant Specialist, Weather Data Library, Kansas State University.

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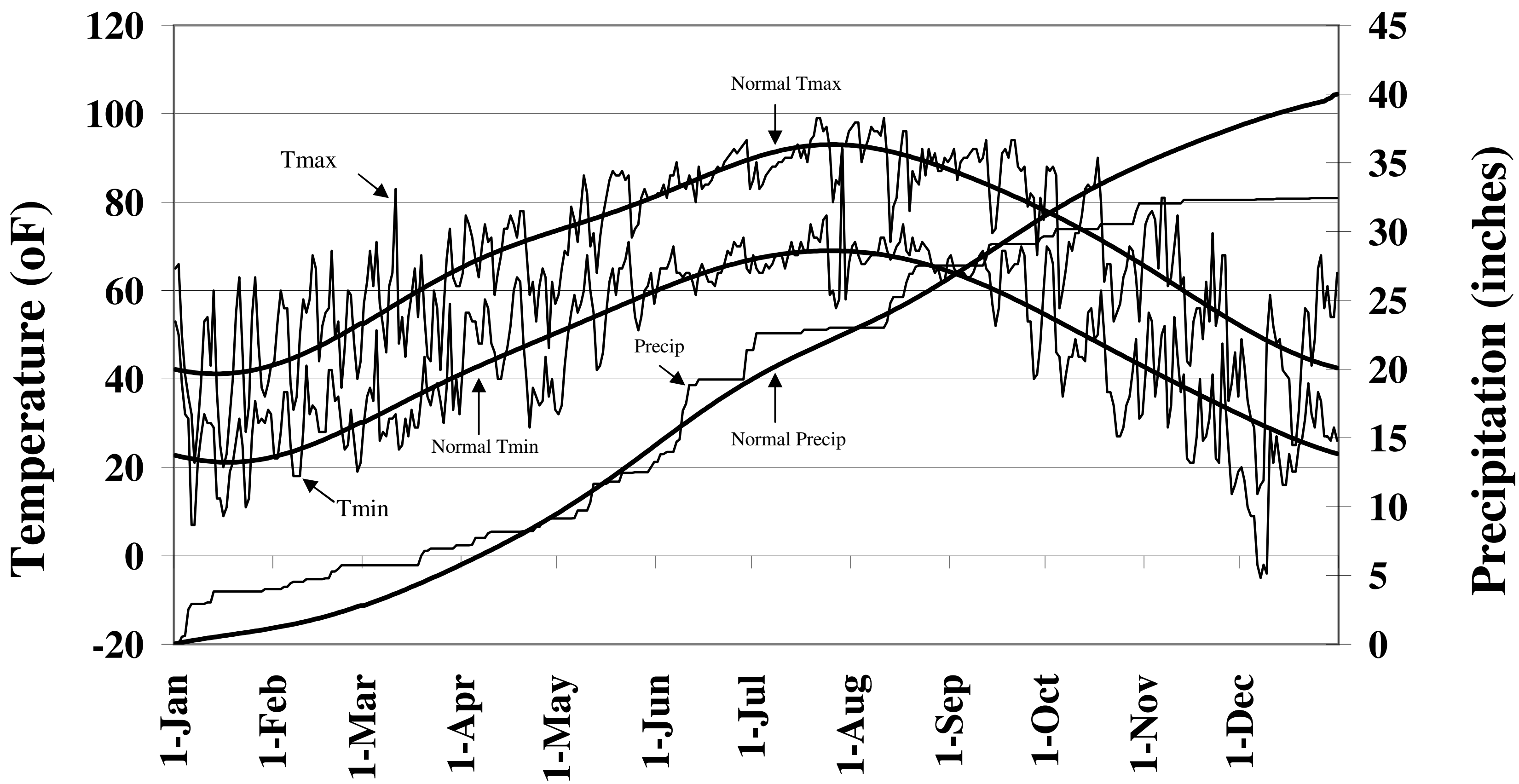
Weather Summary for Parsons -- 2005



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