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Contents

Distillers Grains Supplementation Strategy for Grazing Stocker Cattle

L.W. Lomas and J.L. Moyer

Summary
A total of 72 steers grazing smooth bromegrass pastures were used to evaluate the effects of distillers grains supplementation strategy on available forage, grazing gains, subsequent finishing gains, and carcass characteristics in 2008 and 2009. Supplementation treatments evaluated were no supplement, dried distillers grains (DDG) at 0.5% of body weight per head daily during the entire grazing phase, and no supplementation during the first 56 days and DDG at 0.5% of body weight per head daily during the remainder of the grazing phase. Supplementation with DDG during the entire grazing phase or only during the latter part of the grazing phase resulted in higher ($P<0.05$) grazing gains than feeding no supplement. Supplementation treatment had no effect ($P>0.05$) on available forage during the grazing phase. Grazing performance and supplement conversion efficiency were not different ($P>0.05$) However, compared with steers supplemented during the entire grazing phase, steers on the delayed supplementation treatment consumed 155 and 142 lb less DDG in 2008 and 2009, respectively, but had similar gains. Supplementation during the grazing phase had no effect ($P>0.05$) on finishing performance, carcass characteristics, or overall performance in 2008. In 2009, however, steers that received no supplementation during the grazing phase had greater ($P<0.05$) finishing gains than steers that were supplemented during the entire grazing phase and lower ($P<0.05$) feed:gain ratios than steers that were supplemented with DDG while grazing.

Introduction
Distillers grains are a by-product of the ethanol industry and have tremendous potential as an economical and nutritious supplement for grazing cattle. Because the coproducts generally have high concentrations of protein and phosphorus, their nutrient composition complements that of mature forages, which are typically deficient in these nutrients. Previous research at this location evaluating DDG supplementation of stocker cattle grazing smooth bromegrass has shown DDG at 0.5% of body weight per head daily to be the most efficacious level from both an animal performance and economics perspective. This research was conducted to evaluate DDG supplementation strategies that might increase the efficiency of supplement conversion by delaying supplementation until later in the grazing season, when forage quality starts to decline.

Experimental Procedures
Thirty-six steers of predominately Angus breeding were weighed on 2 consecutive days, stratified by weight, and randomly allotted to nine 5-acre smooth bromegrass pastures on Apr. 9, 2008 (450 lb) and Apr. 3, 2009 (467 lb). Three pastures of steers were randomly assigned to one of three supplementation treatments (three replicates per treatment) and were grazed for 196 days and 221 days in 2008 and 2009, respectively. Supplementation treatments were no DDG, DDG at 0.5% of body weight per head daily, and no DDG during the first 56 days of grazing then DDG at 0.5% of body

weight per head daily for the remainder of the grazing phase (140 days and 165 days in 2008 and 2009, respectively). Pastures were fertilized with 100 lb/a nitrogen on Feb. 29, 2008, and Feb. 10, 2009. Pastures were stocked with 0.8 steers per acre and grazed continuously until Oct. 22, 2008 and Nov. 10, 2009, when steers were weighed on 2 consecutive days and grazing was terminated.

Cattle in each pasture were group fed DDG in meal form on a daily basis in metal feed bunks, 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; quantity of distillers grain fed was 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.

Forage availability was measured approximately every 28 days with a disk meter calibrated for smooth bromegrass.

After the grazing period, cattle were shipped to a finishing facility, implanted with Synovex S, and fed a diet of 80% whole-shelled corn, 15% corn silage, and 5% supplement (dry matter basis) for 112 days in both years. All cattle were slaughtered in a commercial facility at the end of the finishing period, and carcass data were collected.

Results and Discussion

Average available forage for the smooth bromegrass pastures during the grazing phase and grazing and subsequent finishing performance of grazing steers are presented by supplementation treatment in Tables 1 and 2 for 2008 and 2009, respectively. Supplementation with DDG had no effect (P>0.05) on quantity of forage available for grazing in either year. However, average available forage for all treatments was higher in 2008 than in 2009.

Steers supplemented with 0.5% DDG during the entire grazing season or only during the latter part of the grazing season had 31% or 23% greater (P<0.05) weight gain, daily gain, and steer gain per acre in 2008 and 42 or 40% greater (P<0.05) weight gain, daily gain, and steer gain per acre in 2009, respectively, than those that received no supplement. Steers supplemented with 0.5% DDG throughout the grazing season or only during the latter part in 2008 had 100 or 75 lb greater (P<0.05) total weight gain, 0.51 or 0.38 lb greater (P<0.05) daily gain, and 80 or 60 lb greater (P<0.05) gain per acre, respectively, than those that received no supplementation. Steers supplemented with 0.5% DDG throughout the grazing season or only during the latter part in 2009 had 135 or 129 lb greater (P<0.05) total weight gain, 0.61 or 0.59 lb greater (P<0.05) daily gain, and 108 or 104 lb greater (P<0.05) gain per acre, respectively, than those that received no supplementation. Grazing weight gain, daily gain, and gain per acre were not different (P>0.05) between steers that were supplemented with 0.5% DDG during the entire grazing season or only during the latter part of the season. Steers supplemented with DDG at 0.5% of body weight per head daily during the entire grazing season consumed 155 and 142 lb more DDG in 2008 and 2009, respectively, than those that were supplemented only during the latter part of the grazing season. Steers supplemented with DDG during the entire grazing season or only during the latter part consumed 6.5 or 6.6 lb of DDG and 5.7 or 4.9 lb of DDG for each additional pound of body weight gained during the grazing phase above steers that received no supplement in 2008 and 2009, respectively.

In 2008, supplementation during the grazing phase had no effect (P>0.05) on finishing weight gain, feed intake, feed:gain, hot carcass weight, backfat, ribeye area, yield grade, or marbling score. Overall performance (grazing plus finishing) was not different (P>0.05) between supplementation treatments.

In 2009, steers that received no supplement during the grazing phase had greater (P<0.05) finishing gains than those that were supplemented with DDG during the entire grazing season; lower (P<0.05) final live weight, hot carcass weight, and overall gain than those that received DDG only during the latter part of the grazing season; and lower (P<0.05) feed:gain ratios, dressing percentage, and ribeye areas than steers that received either DDG supplementation treatment. Feed intake, backfat, yield grade, marbling score, and percentage of carcasses grading choice or higher were not different (P>0.05) between supplementation treatments.

Under the conditions of this study, supplementation of stocker cattle grazing smooth bromegrass pasture with DDG at 0.5% of body weight during the entire grazing season or only during the latter part of the grazing season would likely have been most profitable if the cattle had been marketed as feeder cattle at the end of the grazing phase. Delaying supplementation until early June reduced labor requirements for the first 56 days of the grazing phase, when cattle received no supplement, but resulted in similar grazing gains. In 2008, there was no advantage to DDG supplementation during the grazing phase if ownership of the cattle was retained through slaughter. In 2009, however, stocker cattle that were supplemented with DDG during the grazing phase maintained their weight advantage through slaughter.

Table 1. Effect of dried distillers grains (DDG) supplementation strategy on available smooth bromegrass forage and grazing and subsequent finishing performance of steers grazing smooth bromegrass pastures, Southeast Agricultural Research Center, 2008

	Level of DDG (% body weight/head per day)		
Item	0	0.5	0.5 delayed[1]
Grazing phase (196 days)			
No. of head	12	12	12
Initial weight, lb	450	450	450
Final weight, lb	772a	871b	846b
Gain, lb	321a	421b	396b
Daily gain, lb	1.64a	2.15b	2.02b
Gain/acre, lb	257a	337b	317b
Total DDG consumption, lb/head	0	651	496
Average DDG consumption, lb/head/day	0	3.3	3.5
DDG, lb/additional gain	---	6.5	6.6
Average available smooth bromegrass forage, lb of dry matter/acre	9,264	9,020	9,240
Finishing phase (112 days)			
Beginning weight, lb	772a	871b	846b
Ending weight, lb	1306	1369	1357
Gain, lb	535	498	511
Daily gain, lb	4.77	4.44	4.56
Daily dry matter intake, lb	26.0	25.8	25.7
Feed:Gain	5.46	5.83	5.64
Hot carcass weight, lb	764	821	813
Dressing percentage, %	58	60	60
Backfat, in.	0.43	0.45	0.41
Ribeye area, sq. in.	11.1	11.6	11.5
Yield grade	3.2	2.9	2.8
Marbling score[2]	675	645	640
Percentage choice, %	100	100	100
Overall performance (grazing plus finishing; 308 days)			
Gain, lb	856	918	907
Daily gain, lb	2.78	2.98	2.94

[1] Steers were supplemented with DDG only during the last 140 days of the grazing phase.
[2] 600 = modest, 700 = moderate.
Means within a row followed by the same letter are not significantly different ($P<0.05$).

Table 2. Effect of dried distillers grains (DDG) supplementation strategy on available smooth bromegrass forage and grazing and subsequent finishing performance of steers grazing smooth bromegrass pastures, Southeast Agricultural Research Center, 2009

	Level of DDG (% body weight/head per day)		
Item	0	0.5	0.5 delayed[1]
Grazing phase (221 days)			
No. of head	12	12	12
Initial weight, lb	467	467	467
Final weight, lb	792a	927b	922b
Gain, lb	325a	460b	454b
Daily gain, lb	1.47a	2.08b	2.06b
Gain/acre, lb	260a	368b	364b
Total DDG consumption, lb/head	0	773	631
Average DDG consumption, lb/head/day	0	3.5	2.9
DDG, lb/additional gain	---	5.7	4.9
Average available smooth bromegrass forage, lb of dry matter/acre	5,109	5,110	5,212
Finishing phase (112 days)			
Beginning weight, lb	792a	927b	922b
Ending weight, lb	1230a	1280ab	1304b
Gain, lb	438a	353b	383ab
Daily gain, lb	3.91a	3.15b	3.42ab
Daily dry matter intake, lb	23.9	23.7	24.7
Feed:Gain	6.13a	7.56b	7.25b
Hot carcass weight, lb	734a	781ab	799b
Dressing percentage, %	60a	61b	61b
Backfat, in.	0.36	0.36	0.41
Ribeye area, sq. in.	10.8a	11.9b	11.8b
Yield grade	2.8	2.7	2.9
Marbling score[2]	629	638	670
Percentage choice, %	92	92	100
Overall performance (grazing plus finishing; 333 days)			
Gain, lb	763a	813ab	838b
Daily gain, lb	2.29a	2.44ab	2.52b

[1] Steers were supplemented with DDG only during the last 165 days of the grazing phase.
[2] 600 = modest, 700 = moderate.
Means within a row followed by the same letter are not significantly different ($P<0.05$).

Effect of Cultivar and Distillers Grains Supplementation on Grazing and Subsequent Finishing Performance of Stocker Steers Grazing Tall Fescue Pasture

L.W. Lomas and J.L. Moyer

Summary

Seventy-two steers grazing tall fescue pastures were used to evaluate the effects of fescue cultivar and dried distillers grains (DDG) supplementation during the grazing phase on available forage, grazing gains, subsequent finishing gains, and carcass characteristics. Fescue cultivars evaluated were high-endophyte Kentucky 31, low-endophyte Kentucky 31, HM4, and MaxQ. Steers were either fed no supplement or supplemented with DDG at 1.0% body weight per head daily. Steers that grazed pastures of low-endophyte Kentucky 31, HM4, or MaxQ gained significantly more ($P<0.05$) and produced more ($P<0.05$) gain per acre than those that grazed high-endophyte Kentucky 31 pastures. Gains of cattle that grazed low-endophyte Kentucky 31, HM4, or MaxQ were similar ($P>0.05$). Subsequent finishing gains and feed efficiency were similar ($P>0.05$) among fescue cultivars. Steers that previously grazed low-endophyte Kentucky 31, HM4, or MaxQ maintained their weight advantage through the finishing phase and had greater ($P<0.05$) final finishing weights, hot carcass weights, overall gains, and overall daily gains than those that previously grazed high-endophyte Kentucky 31. Final finishing weights, hot carcass weights, overall gains, and overall daily gains were similar ($P>0.05$) between steers that previously grazed low-endophyte Kentucky 31, HM4, or MaxQ. Supplementation of grazing steers with DDG supported a higher stocking rate and resulted in greater ($P<0.05$) grazing gains, gain per acre, hot carcass weights, ribeye area, and overall gains and reduced the amount of fertilizer needed by providing approximately 60 lb/a of nitrogen from feces and urine of grazing cattle.

Introduction

Tall fescue, the most widely adapted cool-season perennial grass in the United States, 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, presence of a fungal endophyte results in poor performance of grazing livestock, especially during the summer. Until recently, producers with high-endophyte tall fescue pastures had two primary options for improving grazing livestock performance. One option was to destroy existing stands and replace them with endophyte-free fescue or other forages. Although it supports greater animal performance than endophyte-infected fescue, endophyte-free fescue has been shown to be less persistent under grazing and more susceptible to stand loss from drought stress. In locations where high-endophyte tall fescue must be grown, the other option was for producers to adopt management strategies that reduce the negative effects of the endophyte on grazing animals, such as diluting the effects of the endophyte by incorporating legumes into existing pastures or providing supplemental feeds. In recent years, new tall fescue cultivars have been developed with a "novel" endophyte that provides vigor to the fescue plant but does not have the negative effect on performance of grazing livestock.

Growth in the ethanol industry has resulted in increased availability of distillers grains, which, because of their high protein and phosphorus content, have been shown to be an excellent feedstuff for supplementing grazing cattle. Distillers grains contain approximately 4% to 5% N, and cattle consuming them excrete a high percentage of the nitrogen in their urine and feces. Therefore, feeding DDG to grazing cattle will provide nitrogen to the pastures. Objectives of this study were to (1) evaluate two of these new cultivars in terms of forage availability, stand persistence, and grazing and subsequent finishing performance of stocker steers and compare them with high- and low-endophyte Kentucky 31 tall fescue; (2) evaluate DDG supplementation of cattle grazing these pastures; and (3) determine the contribution of DDG as a nitrogen fertilizer source.

Experimental Procedures

Seventy-two mixed black steers (569 lb) were weighed on 2 consecutive days and allotted to 16 five-acre established pastures of high-endophyte Kentucky 31, low-endophyte Kentucky 31, HM4, or MaxQ tall fescue (four replications per cultivar) on Mar. 26, 2009. HM4 and MaxQ have the novel endophyte. Four steers were assigned to two pastures of each cultivar and received no supplementation, and five steers were assigned to two pastures of each cultivar and supplemented with DDG at 1.0% body weight per head daily during the grazing phase. All pastures were fertilized with 80 lb/a nitrogen and P_2O_5 and K_2O as required by soil test on Feb. 5, 2009. Pastures with steers that received no supplement were fertilized with 60 lb/a nitrogen on Sept. 16, 2009. This was approximately the same amount of nitrogen from DDG that was excreted on pastures by supplemented steers during the entire grazing season.

Cattle in each pasture were group fed DDG in meal form in bunks on a daily basis, and pasture was the experimental unit. No implants or feed additives were used. Weight gain was the primary measurement. Cattle were weighed every 28 days; quantity of DDG fed was adjusted at that time. Forage availability was measured approximately every 28 days with a disk meter calibrated for tall fescue. Cattle were treated for internal and external parasites before being turned out to pasture and later vaccinated for protection from pinkeye. Steers had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt. Two steers were removed from the study for reasons unrelated to experimental treatment. Pastures were grazed continuously until October 13 (201 days), when steers were weighed on 2 consecutive days and grazing was terminated.

After the grazing period, cattle were moved to a finishing facility, implanted with Synovex-S, and fed a diet of 80% whole-shelled corn, 15% corn silage, and 5% supplement (dry matter basis). Cattle that received no supplement or were supplemented with DDG while grazing were fed a finishing diet for 119 or 99 days, respectively. All steers were slaughtered in a commercial facility, and carcass data were collected.

Results and Discussion

Because there were no significant interactions (P>0.05) between cultivar and supplementation treatment, grazing and subsequent finishing performance are pooled across supplementation treatment and presented by tall fescue cultivar in Table 1 and by supplementation treatment in Table 2. Steers that grazed pastures of low-endophyte Kentucky 31, HM4, or MaxQ gained significantly more (P<0.05) and produced more (P<0.05) gain per acre than those that grazed high-endophyte Kentucky 31 pastures. Gains of cattle that grazed low-endophyte Kentucky 31, HM4, or MaxQ were similar (P>0.05). Daily gains of steers grazing pastures with high-endophyte Kentucky 31, low-endophyte Kentucky 31, HM4, or MaxQ were 1.70, 2.35, 2.25, and 2.33 lb/head, respectively. Gains per acre from pastures with high-endophyte Kentucky 31, low-endophyte Kentucky 31, HM4, and Max Q were 318, 438, 415, and 428 lb/a, respectively. Subsequent finishing gains and feed efficiency were similar (P>0.05) among fescue cultivars. However, steers that previously grazed low-endophyte Kentucky 31, HM4, or MaxQ maintained their weight advantage through the finishing phase and had greater (P<0.05) final finishing weights, hot carcass weights, overall gains, and overall daily gains than those that previously grazed high-endophyte Kentucky 31. Final finishing weights, hot carcass weights, overall gains, and overall daily gains were similar (P>0.05) among steers that previously grazed low-endophyte Kentucky 31, HM4, or MaxQ. Backfat thickness and percentage of carcasses grading Choice or higher were similar (P>0.05) among fescue cultivars.

Steers supplemented with DDG gained significantly more (P<0.05) and produced more (P<0.05) gain per acre than those that received no supplement while grazing (Table 2). Grazing gains and gain per acre of steers that received no supplement and those that were supplemented with DDG were 1.71 and 2.61 lb/head daily and 343 and 525 lb/a, respectively. Supplemented steers consumed an average of 7.8 lb of DDG/head daily during the grazing phase. Each additional pound of gain obtained from pastures with supplemented steers required 6.5 lb of DDG. Steers that were supplemented during the grazing phase had greater (P<0.05) final finishing weights, hot carcass weights, ribeye area, overall gain, and overall daily gain than those that received no supplement while grazing. Daily gain, feed efficiency, yield grade, marbling score, and percentage of carcasses grading Choice or higher were similar (P>0.05) between supplementation treatments.

Average available forage dry matter is presented for each fescue cultivar and supplementation treatment combination in Table 3. There was a significant interaction (P<0.05) between cultivar and supplementation treatment. Within each variety, there was no difference (P>0.05) in average available forage dry matter between pastures stocked with 0.8 steer per acre that received no supplement and those stocked with 1.0 steer per acre and supplemented with DDG at 1.0% body weight per head daily. Average available forage dry matter was similar (P>0.05) between supplementation treatments and pastures with supplemented steers were stocked at a heavier rate, which indicates that pastures were responding to the nitrogen that was being returned to the soil from steers consuming DDG, or cattle supplemented with DDG were consuming less forage, or both. High-endophyte Kentucky 31 pastures with or without DDG supplementation had greater (P<0.05) average available forage dry matter than MaxQ pastures without supplementation. No other differences in average available forage dry matter were observed.

Grazing gains and overall gains of steers that grazed low-endophyte Kentucky 31, HM4, or MaxQ were similar (P>0.05) and significantly greater (P<0.05) than those of steers that grazed high-endophyte Kentucky 31. Supplementation of grazing steers with DDG resulted in greater (P<0.05) grazing gains, supported a higher stocking rate, resulted in greater (P<0.05) gain per acre, and reduced the amount of fertilizer needed by providing approximately 60 lb of nitrogen per acre. Producers seeking to maximize production from fescue pastures should consider using one of the new fescue varieties with the novel endophyte in combination with DDG supplementation.

Table 1. Effect of cultivar on grazing and subsequent performance of steers grazing tall fescue pastures, Southeast Agricultural Research Center, 2009

	Tall fescue cultivar			
Item	High-endophyte Kentucky 31	Low-endophyte Kentucky 31	HM4	MaxQ
Grazing phase (201 days)				
No. of head	17	18	17	18
Initial weight, lb	571	569	566	569
Ending weight, lb	913a	1042b	1019b	1038b
Gain, lb	342a	473b	453b	468b
Daily gain, lb	1.70a	2.35b	2.25b	2.33b
Gain/acre, lb	318a	438b	415b	428b
Finishing phase (109 days)				
Beginning weight, lb	913a	1042b	1019b	1038b
Ending weight, lb	1285a	1381b	1366b	1376b
Gain, lb	372	339	347	338
Daily gain, lb	3.41	3.11	3.20	3.10
Daily dry matter intake, lb	24.4	24.1	24.1	24.9
Feed:Gain	7.18	7.81	7.57	8.11
Hot carcass weight, lb	759a	820b	810b	811b
Dressing percentage, %	59.1	59.4	59.3	58.9
Backfat, in.	0.43	0.43	0.44	0.47
Ribeye area, sq. in.	11.9a	11.9a	12.5b	11.7a
Yield grade[1]	2.6a	3.0b	2.8a	3.0b
Marbling score[2]	601a	646ab	672bc	717c
Percentage choice, %	95	100	95	100
Overall performance (grazing plus finishing) (310 days)				
Gain, lb	714a	812b	800b	807b
Daily gain, lb	2.31a	2.63b	2.59b	2.61b

[1] USDA (1987).
[2] 600 = modest, 700 = moderate, 800 = slightly abundant.
Means within a row followed by the same letter do not differ (P<0.05).

Table 2. Effect of dried distillers grains (DDG) supplementation on grazing and subsequent performance of steers grazing tall fescue pastures, Southeast Agricultural Research Center, 2009

	DDG level (% body weight/head per day)	
Item	0	1.0
Grazing phase (201 days)		
No. of head	30	40
Initial weight, lb	569	569
Ending weight, lb	911a	1095b
Gain, lb	343a	525b
Daily gain, lb	1.71a	2.61b
Gain/acre, lb	274a	525b
Total DDG consumption, lb/head	---	1628
Average DDG consumption, lb/head per day	---	7.8
DDG, lb/additional gain, lb	---	6.5
Finishing phase		
No. of days	119	99
Beginning weight, lb	911a	1095b
Ending weight, lb	1289a	1415b
Gain, lb	378a	320b
Daily gain, lb	3.17	3.23
Daily dry matter intake, lb	24.6	24.2
Feed:Gain	7.80	7.54
Hot carcass weight, lb	768a	832b
Dressing percentage, %	59.6	58.8
Backfat, in.	0.43	0.45
Ribeye area, sq. in.	11.7a	12.3b
Yield grade	2.8	2.9
Marbling score[1]	638	680
Percentage choice, %	100	95
Overall performance (grazing plus finishing)		
No. of days	320	300
Gain, lb	721a	846b
Daily gain, lb	2.25a	2.82b

[1] 600 = modest, 700 = moderate.
Means within a row followed by the same letter do not differ (P<0.05).

Table 3. Effect of tall fescue cultivar and dried distillers grains (DDG) supplementation on average available forage dry matter, Southeast Agricultural Research Center, 2009

	DDG level (% body weight/head per day)	
Tall fescue cultivar	0	1.0
	----------------lb/a----------------	
High-endophyte Kentucky 31	5593a	5564a
Low-endophyte Kentucky 3	5135ab	5052ab
HM4	5193ab	5146ab
MaxQ	4762b	5527ab

Means followed by the same letter do not differ ($P<0.05$).

Effect of Frequency of Dried Distillers Grains Supplementation on Gains of Heifers Grazing Smooth Bromegrass Pastures

L.W. Lomas and J.L. Moyer

Summary
Thirty heifer calves grazing smooth bromegrass pastures were used to compare daily supplementation of dried distillers grains (DDG) with supplementation with an equivalent amount of DDG 3 days per week (Monday, Wednesday, and Friday). The rate of DDG fed was based on the equivalent of 0.5% of body weight per head daily. Daily gains and DDG intake of heifers fed daily or 3 days per week were similar (P>0.05).

Introduction
Distillers grains, a by-product of the ethanol industry, have tremendous potential as an economical and nutritious supplement for grazing cattle. Distillers grains contain a high concentration of protein (25% to 30%) with more than two thirds escaping degradation in the rumen, which makes it an excellent supplement for younger cattle. Previous research at this location on DDG supplementation of stocker cattle grazing smooth bromegrass has shown DDG at 0.5% body weight per head daily to be the most efficacious level from the perspective of both animal performance and economics. However, many producers would prefer to not supplement their cattle on a daily basis to save labor and reduce costs. This research was conducted to compare daily supplementation of grazing stocker cattle with DDG at 0.5% body weight with an equivalent amount of DDG supplemented 3 days per week (Monday, Wednesday, and Friday).

Experimental Procedures
Thirty heifer calves (420 lb) were weighed on 2 consecutive days, stratified by weight, and randomly allotted to six 5-acre smooth bromegrass pastures on Apr. 7, 2009. Three pastures of heifers were randomly assigned to one of two supplementation treatments (three replicates per treatment) and grazed for 192 days. Supplementation treatments were DDG at 0.5% body weight per head daily or an equivalent amount of DDG fed 3 days per week (Monday, Wednesday, and Friday). Pastures were fertilized with 100 lb/a nitrogen and P_2O_5 and K_2O as required by soil test on Feb. 10, 2009. Pastures were stocked with 1 heifer per acre and grazed continuously until Oct. 16, 2009 (192 days), when heifers were weighed on 2 consecutive days and grazing was terminated.

Cattle in each pasture were group fed DDG in meal form in bunks on a daily basis, and pasture was the experimental unit. No implants or feed additives were used. Weight gain was the primary measurement. Cattle were weighed every 28 days; quantity of DDG fed was adjusted at that time. Cattle were treated for internal and external parasites before being turned out to pasture and later vaccinated for protection from pinkeye. Heifers had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt. One heifer was removed from the study for reasons unrelated to experimental treatment.

Results and Discussion

Cattle gains and DDG intake are presented in Table 1. Gains and DDG intake of heifers that were supplemented three times per week were similar ($P>0.05$) to those of heifers that were supplemented daily. Daily gain and gain per acre were 1.89 and 362 lb, respectively, for heifers supplemented daily and 1.87 and 359 lb, respectively, for heifers supplemented three times per week. Total DDG consumption and average daily DDG consumption were 561 and 2.9 lb, respectively, for heifers supplemented daily and 566 and 3.0 lb, respectively, for heifers supplemented three times per week. Heifers supplemented three times per week were fed an average of 6.9 lb per feeding.

Stocker cattle can be fed DDG three times per week rather than daily without any adverse effects on performance. However, caution should be used when feeding greater than the equivalent of 0.5% per head daily fewer than 7 days per week to avoid potential sulfur toxicity problems.

Table 1. Effect of frequency of dried distillers grains (DDG) supplementation on gains of heifer calves grazing smooth bromegrass pastures, Southeast Agricultural Research Center, 2009

	Supplementation frequency	
Item	Daily	Three times per week
No. of days	192	192
No. of head	15	15
Initial weight, lb	420	420
Final weight, lb	782	779
Gain, lb	362	359
Daily gain, lb	1.89	1.87
Gain/acre, lb	362	359
Total DDG consumption, lb/head	561	566
Average DDG consumption, lb/head/day	2.9	3.0

Effects of Various Grazing Systems on Grazing and Subsequent Finishing Performance

L.W. Lomas and J.L. Moyer

Summary
Twenty-eight mixed black steers (641 lb) were used to compare grazing and subsequent finishing performance from pastures with MaxQ tall fescue or a wheat-bermudagrass double-crop system. Steers that grazed the wheat-bermudagrass system had greater ($P<0.05$) daily gains during the grazing phase than those that grazed MaxQ tall fescue. However, total grazing gains were similar ($P>0.05$) because cattle grazed fescue pasture for more days. Grazing treatment had no effect on finishing gains or feed efficiency. Steers that grazed wheat-bermudagrass had greater ($P<0.05$) ribeye areas than those that grazed fescue. Overall gains were similar ($P>0.05$) for steers that grazed wheat-bermudagrass or tall fescue. However, steers that grazed wheat-bermudagrass had greater ($P<0.05$) overall daily gains than those that grazed fescue because the latter grazed for more days.

Introduction
MaxQ tall fescue and a wheat-bermudagrass double-crop system have been two of the most promising grazing systems evaluated at the Southeast Agricultural Research Center during the past 20 years. However, these systems have never been directly compared in the same study. The objective of this study was to compare grazing and subsequent finishing performance of stocker steers that grazed MaxQ tall fescue or a wheat-bermudagrass double-crop system.

Experimental Procedures
Twenty-eight mixed black steers (641 lb) were weighed on 2 consecutive days (Mar. 25-26, 2009) and allotted to three 4-acre pastures of Midland 99 bermudagrass that had previously been no-till seeded with approximately 100 lb/a of Overly hard red winter wheat on Oct. 3, 2008, and four 4-acre established pastures of MaxQ tall fescue (four steers/pasture). All pastures were fertilized with 80-40-40 lb/a of N-P_2O_5-K_2O on Feb. 5, 2009. Bermudagrass pastures received an additional 69 lb/a of N on May 26, 2009, and fescue pastures received an additional 46 lb/a of N on Aug. 26, 2009.

Pasture was the experimental unit. No implants or feed additives were used. Weight gain was the primary measurement. Cattle were weighed every 28 days, and forage availability was measured approximately every 28 days with a disk meter calibrated for bermudagrass or tall fescue. Cattle were treated for internal and external parasites before being turned out to pasture and later were vaccinated for protection from pink-eye. Steers had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt. Wheat-bermudagrass and fescue pastures were grazed continuously until Sept. 16, 2009 (175 days) and Oct. 16, 2009 (205 days), respectively, when steers were weighed on 2 consecutive days and grazing was terminated.

After the grazing period, cattle were moved to a finishing facility, implanted with Synovex-S, and fed a diet of 80% whole-shelled corn, 15% corn silage, and 5% supplement (dry matter basis). Finishing diets were fed for 111 (bermudagrass) or 115 days (fescue). All steers were slaughtered in a commercial facility, and carcass data were collected.

Results and Discussion

Grazing and subsequent finishing performance of steers that grazed MaxQ tall fescue or a wheat-bermudagrass system are presented in Table 1. Steers that grazed the wheat-bermudagrass system had greater ($P<0.05$) daily gains during the grazing phase than those that grazed MaxQ tall fescue. However, total grazing gains and gain per acre were similar ($P>0.05$) because cattle grazed fescue for more days. Total gain and daily gain for steers that grazed MaxQ tall fescue or wheat-bermudagrass were 373 lb and 1.82 lb/head daily and 416 lb and 2.37 lb/head daily, respectively. Gain per acre was 373 and 416 lb for steers that grazed MaxQ tall fescue and wheat-bermudagrass, respectively.

Average available forage dry matter was similar ($P>0.05$) between pastures. However, available forage was greater ($P<0.05$) during the early part of the grazing season for MaxQ and greater ($P<0.05$) during late summer for wheat-bermudagrass pastures.

Grazing treatment had no effect on finishing gains or feed efficiency. Steers that grazed wheat-bermudagrass had greater ($P<0.05$) ribeye areas than those that grazed fescue. Overall gains were similar ($P>0.05$) for steers that grazed either type of pasture. However, steers that grazed wheat-bermudagrass had greater ($P<0.05$) overall daily gains than those that grazed fescue because the latter grazed for more days.

Grazing gains, finishing gains, and overall gains were similar ($P>0.05$) between MaxQ tall fescue pastures and a wheat-bermudagrass system. Average available forage dry matter also was similar ($P>0.05$) between pasture types, but forage availability varied during the grazing season.

Table 1. Effect of forage system on grazing and subsequent performance of stocker steers, Southeast Agricultural Research Center, 2009

	Forage system	
Item	MaxQ fescue	Wheat-Bermudagrass
Grazing phase		
No. of days	205	175
No. of head	16	12
Initial weight, lb	641	641
Ending weight, lb	1015	1057
Gain, lb	373	416
Daily gain, lb	1.82a	2.37b
Gain/acre, lb	373	416
Average available forage dry matter, lb/a	4931	5797
Finishing phase		
No. of days	115	111
Beginning weight, lb	1015	1057
Ending weight, lb	1368	1400
Gain, lb	353	343
Daily gain, lb	3.07	3.09
Daily dry matter intake, lb	24.9	25.8
Feed:Gain	8.15	8.39
Hot carcass weight, lb	805	842
Dressing percentage, %	58.8	60.1
Backfat, in.	0.40	0.48
Ribeye area, sq. in.	11.9a	12.7b
Yield grade	2.8	2.8
Marbling score[1]	652	674
Percentage choice, %	88	100
Overall performance (grazing plus finishing)		
No. of days	320	286
Gain, lb	726	758
Daily gain, lb	2.27a	2.65b

[1] 600 = modest, 700 = moderate.

Means within a row followed by the same letter do not differ ($P<0.05$).

Forage Production of Seeded Bermudagrass Cultivars

J.L. Moyer

Summary
Yields from three cuttings in 2009 were higher for 'Sungrazer' and 'SG 19' than for seven other entries. Three seeded types yielded more than 'Midland 99', a sprigged type included as a check cultivar.

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 produce more than common bermudagrasses. 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
Thirteen 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 June 21, 2005, and Midland 99 plugs were planted 2 weeks later. In 2009, plots were fertilized on May 18 with 150 lb/a of nitrogen as urea and on July 2 with 100 lb/a of nitrogen as ammonium nitrate.

Plots were cut June 30, August 4, and November 3, and subsamples were collected from the 20 × 3 ft strips harvested to determine moisture content of forage.

Results and Discussion
Rainfall each month of the 2009 growing season was greater than the 30-year average. From April through September, 41.67 in. was received, which is more than 90% of the average annual precipitation and 13.65 in. above average for the period.

First-cut yield was higher for Sungrazer and SG 19 than for any of the other 12 cultivars (Table 1). Seven cultivars produced significantly more forage than five lower-yielding cultivars.

Second-cut yield of Midland 99 was greater than that of all other cultivars except 'Jackpot' (Table 1), and second-cut yield of Sungrazer was greater than that of 'Riata' and 'KF 888'. Third-cut yields ranged from 1.16 to 2.15 ton/a. The high-yielding cultivar, KF 888, produced more than eight others.

Total seasonal yield for 2009 was higher for Sungrazer than for nine other entries. Sungrazer, SG 19, and 'Sungrazer I' yielded more than seven other cultivars including Midland 99, a sprigged type included as a check cultivar.

Annual yields were obtained for two other post-seeding years, 2006 and 2008. The 3-year total yields of SG 19 and Sungrazer were greater than those of 10 of the other 12 cultivars. Riata, 'CIS-CD-4', 'Cherokee', and 'Wrangler' produced less than 9 of the other 10 cultivars.

Table 1. Forage yields in 2009 and 3-year total yields (2006, 2008, and 2009) for bermudagrass seeded in 2005, Southeast Agricultural Research Center, Mound Valley Unit

		2009 forage yield				3-year
Source	Entry	6/30	8/4	11/3	Total	total
		-------------ton/a at 12% moisture-------------				
K-F Seeds	KF 888	2.86	1.82	2.15	6.84	17.29
K-F Seeds	KF 194	2.51	2.23	1.51	6.25	16.91
K-F Seeds	KF 111	2.62	2.02	1.70	6.34	18.43
K-F Seeds	KF 222	3.07	2.06	1.82	6.94	17.52
K-F Seeds	SG 19	3.70	2.21	1.30	7.21	19.61
Genetic Seed & Chemical	Sungrazer	3.77	2.25	1.55	7.57	19.60
Genetic Seed & Chemical	Sungrazer I	3.08	2.08	1.99	7.16	17.83
Genetic Seed & Chemical	Sungrazer Plus	2.35	1.97	1.59	5.91	16.29
Nixa Hardware & Seed	Cherokee	2.24	2.19	1.54	5.96	13.97
Genetic Seed & Chemical	Jackpot	1.38	2.50	1.64	5.52	15.26
Oklahoma State University	Wrangler	1.41	1.98	1.16	4.55	14.33
Oklahoma State University	Midland 99[1]	1.51	2.76	1.81	6.07	17.05
Johnston Seed	Riata	1.38	1.77	1.20	4.35	13.63
DLF International Seeds	CIS-CD 4	1.30	2.01	1.57	4.89	13.83
Average		2.37	2.13	1.60	6.11	16.54
LSD 0.05		0.59	0.29	0.46	0.85	1.77

[1] Sprigged cultivar.

Biomass Production of Switchgrass Lines

J.L. Moyer and C. Christensen[1]

Summary
Biomass production in 2009 was greater for 'Kanlow' than for five other entries. Five entries in the "high-yield" group produced more than 'Cave-in-Rock' and experimental line 58. In the past 2 years and averaged over 3 years, experimental line 58 and Cave-in-Rock produced less than the other entries.

Introduction
Switchgrass is a perennial grass that is native to the prairies of North America. It has been identified by the U.S. Department of Energy as a preferred dedicated energy crop. Because switchgrass has been subjected to less intense breeding efforts than most commodity crops, rapid and significant improvements can be made through advanced plant breeding and biotechnology. This study was established to compare standard cultivars with advanced lines for adaptation in eastern Kansas and test the biomass for suitability as a bioenergy crop.

Experimental Procedures
Ten switchgrass entries were seeded at 5 lb/a of pure live seed in 20-in. rows at the Mound Valley Unit of the Southeast Agricultural Research Center on May 21, 2007. Seed was planted no-till after a wheat-soybean double crop and then sprayed with 1 qt/a glyphosate (0.75 lb ai/gal). Plots (20 ft × 10 ft) were arranged in a randomized complete block with six replications. On June 21, stands were rated as good to excellent. Plots were sprayed on June 25, 2007, with 0.1 oz/a (60 DF) metsulfuron + 1 lb ai/a 2,4-D amine +1 lb ai/a atrazine.

Two rows (40 in. wide by 14 ft long) were harvested from each plot at a 2.5-in. height on Nov. 27, 2007, biomass was subsampled for moisture content and chemical constituents, and the residual was burned that winter. In 2008, plots were sprayed with 1 qt/a S-metolachlor (1.9 lb ai/gal) for weed control. Plots were fertilized on Apr. 15, 2008, with 50-40-60 lb/a of N-P_2O_5-K_2O and again on May 15, 2008, with 50 lb/a of nitrogen as ammonium nitrate. Plots were harvested on Nov. 25, 2008, from two 13-ft-long rows as described previously, and the residual was cut and removed.

Plots were fertilized on May 19, 2009, with 100 lb/a of nitrogen as ammonium nitrate. Plots were harvested on Dec. 1, 2009, from two 13-ft-long rows as described previously.

Results and Discussion
In the 2009 growing season, rainfall each month was greater than the 30-year average. From April through September, more than 41 in. was received, which is near the average annual precipitation and more than 13 in. above average for the period.

[1] Product Manager, Ceres, Inc., Thousand Oaks, CA.

First-year (2007) yield was higher ($P<0.05$) for experimental lines 56 and 60 than for the other eight cultivars (Table 1). Experimental line 58, Cave-in-Rock, and Kanlow produced less than the four highest-yielding entries.

In 2008, experimental line 59 produced more than five other entries (Table 1), and Cave-in-Rock and experimental line 58 produced less than the other eight entries. In 2009, Kanlow produced more than five other entries. Five cultivars in the "high-yield" group produced more than Cave-in-Rock and experimental line 58. In terms of average 3-year production, Cave-in-Rock and experimental line 58 produced less than the other cultivars, which had similar yields.

Biomass dry matter content for each year and the 3-year average are shown in Table 2. Cave-in-Rock and experimental line 58 consistently had biomass with the highest dry matter content (lowest moisture) in the test. Conversely, experimental lines 56, 60, and 57 and Alamo had the highest moisture. If moisture content is indicative of maturity, Cave-in-Rock and experimental line 58 are relatively early maturing, which might also be related to their tendency to produce lower yields. Relative greenup ratings in April 2009 (Table 3) indicate that experimental line 58 and Cave-in Rock, along with experimental line 55, begin growth relatively early in spring.

Stands have been excellent throughout the 3-year test (Table 3). A slightly lower stand of experimental line 60 in 2007 was not evident in fall 2009, so it may have been due to a small amount of dormant seed. A slight reduction in the stand of Cave-in-Rock could indicate it is less adapted than other cultivars, which is consistent with observations on its other traits.

Table 1. Biomass production in 2007, 2008, and 2009 for switchgrass seeded in 2007, Southeast Agricultural Research Center, Mound Valley Unit

Entry	Status	2007	2008	2009	3-year avg.
		---------------------lb/a dry matter---------------------			
54	Experimental	6,440	14,150	13,420	11,337
55	Experimental	6,930	13,760	13,470	11,384
56	Experimental	8,380	13,280	11,980	11,211
57	Experimental	6,400	13,820	10,590	10,271
58	Experimental	4,120	9,630	8,880	7,547
59	Experimental	6,310	15,760	12,260	11,444
60	Experimental	8,220	14,180	11,810	11,401
Cave-in-Rock	Variety	4,740	9,270	8,470	7,496
Alamo	Variety	6,950	14,455	12,350	11,251
Kanlow	Variety	5,660	14,540	14,250	11,483
Average		6,415	13,284	11,748	10,483
LSD (0.05)		1,240	1,690	1,846	1,185

Table 2. Dry matter content of biomass produced in 2007, 2008, and 2009 for switchgrass seeded in 2007, Southeast Agricultural Research Center, Mound Valley Unit

Entry	Status	2007	2008	2009	3-year avg.
		---------------------% dry matter---------------------			
54	Experimental	72	67	62	66.8
55	Experimental	73	71	64	69.3
56	Experimental	68	63	58	63.1
57	Experimental	68	64	58	63.5
58	Experimental	78	76	70	74.5
59	Experimental	69	71	61	66.8
60	Experimental	69	65	55	63.2
Cave-in-Rock	Variety	77	76	71	74.4
Alamo	Variety	69	64	60	64.4
Kanlow	Variety	72	73	66	70.3
Average		71.4	69.0	62.4	67.6
LSD (0.05)		2.9	4.8	2.9	2.2

Table 3. Stand and 2009 spring greenup rating (April 16) for switchgrass seeded in 2007, Southeast Agricultural Research Center, Mound Valley Unit

Entry	Status	June 2007	Nov. 2007	Dec. 2009	Greenup[1]
		-------------% of possible-------------			
54	Experimental	100	100	100	2.5
55	Experimental	100	100	100	3.2
56	Experimental	100	100	100	1.3
57	Experimental	100	100	100	2.2
58	Experimental	100	100	99	3.2
59	Experimental	100	99	100	2.3
60	Experimental	99	98	100	2.2
Cave-in-Rock	Variety	100	100	97	2.7
Alamo	Variety	100	100	100	2.2
Kanlow	Variety	100	100	100	2.7
Average		99.7	99.6	99.3	2.43
LSD (0.05)		NS	1.0	1.8	0.78

[1] Scale: 0 to 5, where 0 = no green shoots and 5 = all tillers with green shoots emerged.

Nitrogen Management for Crabgrass Hay Production

J.L. Moyer and D.W. Sweeney

Summary
Fertilizing crabgrass with 100 lb/a nitrogen (N) resulted in more forage than fertilizing with 50 lb/a N, but additional 50-lb increments did not result in further increases. Forage fertilized with more than 100 lb/a N generally had a higher N concentration than forage that received less N. Split application usually resulted in less forage with a lower N concentration in the first cutting but more in the second cutting than a single N application. Responses to N application as urea versus ammonium nitrate varied with cutting, N rate, and timing.

Introduction
Warm-season grass is needed to fill a production void left in forage systems by cool-season grasses. Crabgrass could fill this niche by providing high-quality forage in summer. Although crabgrass is an annual species, it is a warm-season grass that has the capacity to reseed itself. Crabgrass requires N for optimum production, but little is known about its needs or responses to different nitrogen management alternatives.

Experimental Procedures
The plot area at the Mound Valley Unit of the Southeast Agricultural Research Center was fertilized with 0-60-60 lb/a N-P_2O_5-K_2O beginning in May 2005. Shortly thereafter, the plot was seeded with 5 lb/a pure live seed of 'Red River' crabgrass [*Digitaria ciliaris* (Retz.) Koel.] with a Brillion seeder. In addition to natural reseeding, another 3 lb/a pure live seed was broadcast each spring thereafter, another 0-60-60 lb/a N-P_2O_5-K_2O was applied, and the plot area was rotary hoed.

The three N treatments (rates, sources, and timing) and a check were arranged in a 4 × 2 × 2 factorial design in four replications. Rates were 50, 100, 150, and 200 lb/a N per year, sources were urea and ammonium nitrate, and timing was either all N applied in a single application at the beginning of the growing season or split, with half applied initially and half in midsummer.

Nitrogen was applied for the initial spring applications on Apr. 12, 2006; May 22, 2007; and Apr. 15, 2008. Plots were harvested on June 26, 2006; June 21, 2007; and July 14, 2008. The split N applications were made on June 26, 2006; July 17, 2007; and July 15, 2008. The second cuttings were made on Sept. 18, 2006; Aug. 27, 2007; and Sept. 18, 2008. In 2007, some plots that emerged late because of uneven drainage from heavy rain were not harvested or sampled. Plots were harvested with a Carter flail cutter at a height of 2 to 3 in. The remainder of the area was clipped at each harvest to the same height. A forage subsample was taken from each plot for moisture determination and analysis of forage N.

Results and Discussion

Forage yields responded to N fertilizer treatments somewhat differently in the 3 years, so these results are shown by year (Table 1). Nitrogen rate significantly ($P<0.05$) affected first-cut and total yield in 2006 and all yields in 2007; the 50-lb rate yielded less than the higher rates (factorial means not shown). The split N application produced less forage in cut 1 of 2006 and 2008 but more in cut 2 of 2007and 2008 compared with a single application. The only effect of source in the first 2 years was in cut 2 of 2007, when urea resulted in more forage than ammonium nitrate.

In 2008, a significant N rate by N source interaction for first-cut and total yield resulted from the sources having similar yields for all except the 200 lb/a rate, for which urea produced more than ammonium nitrate (factorial means not shown). Further, yield with ammonium nitrate seemed to peak at the 150 lb/a rate because that treatment yielded as much as the 200 lb/a rate of urea. Otherwise, treatment with 50 lb/a N yielded significantly less first-cut and total forage than th e 100 and 150 lb/a N rates regardless of source. In the second cutting, yield from ammonium nitrate application increased between 50 and 100 lb/a N but declined at the 200 lb/a N rate, whereas urea application rates from 100 to 200 lb/a N were similar. Also, increasing N rate from 50 to 100 lb/a increased yield with ammonium nitrate, but urea required 150 lb/a N to increase yield above that of the 50 lb/a rate (Table 1).

Forage N concentrations responded to N fertilizer treatments somewhat differently in the 2 years that subsamples were assayed, so these results are shown by year (Table 2). Nitrogen rate significantly ($P<0.05$) affected forage N concentration but interacted with application timing in cut 2 of 2008 (factorial means not shown). Increasing the N rate from 50 to 100 lb/a resulted in an increase of forage N concentration in 2006 but not in 2008. In 2006, forage N concentration of cut 1increased as application rate increased from 100 to 150 lb/a N but not with the addition of another 50-lb increment. In cut 2, N concentration was similar with 100 and 150 lb/a N applied, and 200 lb/a N provided a further increase. In both cuttings of 2008, average forage N concentration increased as N rate increased from 100 to 150 lb/a and increased again as N rate increased to 200 lb/a.

The single N application increased forage N concentration in cut 1 of both years, but there was an interaction of timing and N rate in 2008 because the difference occurred only at the two higher N rates. In cut 2, an effect of N timing appeared only in 2006 as an interaction with N rate, wherein split applications resulted in an increase of N concentration only at the 200 lb/a N rate (Table 2). Use of ammonium nitrate as an N source increased forage N concentration in 2008 but not in 2006.

Table 1. Forage yields of crabgrass in response to nitrogen management, Southeast Agricultural Research Center, Mound Valley Unit

Year	N Rate	N Source	N Timing	Cut 1	Cut 2	Total
				---------------ton/a---------------		
2006	0	---	---	0.90	0.89	1.79
	50	Urea	1X	1.23	0.93	2.16
			2X	1.16	1.16	2.32
		NH_4NO_3	1X	1.29	0.92	2.22
			2X	0.80	1.06	1.86
	100	Urea	1X	1.90	0.91	2.81
			2X	1.28	1.26	2.53
		NH_4NO_3	1X	1.95	0.92	2.87
			2X	1.50	1.20	2.70
	150	Urea	1X	2.04	0.90	2.95
			2X	1.85	1.16	3.01
		NH_4NO_3	1X	1.91	0.98	2.89
			2X	1.65	1.07	2.72
	200	Urea	1X	1.64	1.13	2.77
			2X	1.79	0.88	2.66
		NH_4NO_3	1X	1.72	1.06	2.77
			2X	1.80	0.96	2.75
			LSD	0.52	NS	0.47
2007	0	---	---	0.24	1.96	2.16
	50	Urea	1X	0.87	2.50	3.37
			2X	0.27	2.96	3.33
		NH_4NO_3	1X	0.86	2.28	3.14
			2X	0.37	2.41	2.77
	100	Urea	1X	1.40	3.20	4.58
			2X	0.40	3.92	4.32
		NH_4NO_3	1X	1.80	2.49	4.29
			2X	1.26	3.60	5.08
	150	Urea	1X	1.87	2.52	4.39
			2X	1.49	3.92	5.41
		NH_4NO_3	1X	1.75	2.98	4.73
			2X	1.48	3.44	4.85
	200	Urea	1X	1.21	3.03	4.24
			2X	1.97	3.28	4.80
		NH_4NO_3	1X	2.05	2.80	4.66
			2X	2.03	2.75	4.63
			LSD	0.79	0.52	0.64

continued

Table 1. Forage yields of crabgrass in response to nitrogen management, Southeast Agricultural Research Center, Mound Valley Unit

Year	N Rate	N Source	N Timing	Cut 1	Cut 2	Total
				---------------ton/a---------------		
2008	0	---	---	1.51	1.20	2.71
	50	Urea	1X	2.97	1.23	4.20
			2X	2.37	1.82	4.19
		NH_4NO_3	1X	3.24	1.50	4.74
			2X	2.10	2.22	4.32
	100	Urea	1X	4.10	1.65	5.75
			2X	3.56	1.91	5.48
		NH_4NO_3	1X	3.79	1.90	5.69
			2X	3.82	2.46	6.28
	150	Urea	1X	3.99	1.55	5.54
			2X	3.67	2.47	6.13
		NH_4NO_3	1X	4.00	1.79	5.79
			2X	4.00	2.26	6.26
	200	Urea	1X	4.28	1.74	6.02
			2X	4.32	2.28	6.60
		NH_4NO_3	1X	3.98	1.44	5.42
			2X	3.52	2.00	5.52
LSD				0.50	0.44	0.63

Table 2. Forage nitrogen concentration of crabgrass in response to nitrogen management, Southeast Agricultural Research Center, Mound Valley Unit

Year	N Rate	N Source	N Timing	Cut 1	Cut 2
				----------%----------	
2006	0	---	---	1.66	1.41
	50	Urea	1X	1.99	1.71
			2X	1.73	1.74
		NH_4NO_3	1X	2.26	1.76
			2X	1.65	1.67
	100	Urea	1X	2.14	1.91
			2X	2.19	1.84
		NH_4NO_3	1X	2.35	1.83
			2X	2.15	1.76
	150	Urea	1X	2.55	1.87
			2X	2.53	1.93
		NH_4NO_3	1X	2.52	1.88
			2X	2.36	1.95
	200	Urea	1X	2.60	1.95
			2X	2.44	2.11
		NH_4NO_3	1X	2.68	1.91
			2X	2.50	2.06
			LSD	0.35	0.15
2008	0	---	---	1.21	1.15
	50	Urea	1X	1.06	0.99
			2X	1.09	1.04
		NH_4NO_3	1X	1.07	1.08
			2X	1.33	1.07
	100	Urea	1X	1.02	0.96
			2X	1.03	1.19
		NH_4NO_3	1X	1.31	1.05
			2X	0.93	1.30
	150	Urea	1X	1.61	1.49
			2X	1.29	1.36
		NH_4NO_3	1X	1.75	1.47
			2X	1.32	1.63
	200	Urea	1X	1.79	1.51
			2X	1.28	1.68
		NH_4NO_3	1X	1.95	1.79
			2X	1.77	1.80
			LSD	0.28	0.30

Forage Yield and Quality of Soybean Cultivars

J.L. Moyer and J.H. Long

Summary
Forage yields at the latest growth stage (R6-R7) ranged in average from 1.85 ton/a in a droughty year to 4.66 ton/a (12% moisture). The forage-type cultivars produced more forage than 'Hutcheson' in 2 of the 3 years at that growth stage but had no advantage at the R5 stage. In terms of forage crude protein and fiber contents, 'Donegal' typically had better forage quality than 'Tyrone'.

Introduction
Soybean was originally promoted in the United States as a forage crop, but by the late 1940s, it was being produced primarily for grain. Its recent use as forage in southeastern Kansas has occurred primarily when drought has limited the potential for grain production. This study was conducted to determine the relative forage potential of grain versus forage cultivars from different maturity groups harvested at different growth stages.

Experimental Procedures
The four cultivars selected for testing included three forage types and Hutcheson, a grain type. Hutcheson and Donegal are classified as Group V cultivars, 'Derry' is in Group VI, and Tyrone is a Group VII cultivar.

The 2001 trial was seeded at the Columbus Unit of the Southeast Agricultural Research Center in 7-in. rows, and the 2002 and 2003 trials were seeded at the Mound Valley Unit in 10-in. rows, both on Parsons silt loam soil. Plots were 30 ft × 7 or 8 ft and arranged in four randomized complete blocks with cultivar as the main plot and growth stage at harvest as subplots. Plots were seeded with 150,000 seeds/a on May 15, 2001, May 22, 2002, and June 10, 2003.

Fertilizer containing 20-50-50, 26-67-87, and 18-46-200 lb/a of N-P_2O_5-K_2O was supplied preplant to all plots in 2001, 2002, and 2003, respectively. Herbicides (0.75 lb ai/a pendimethalin and 0.125 lb ai/a imazaquin) were applied preemergence to the crop.

A strip 3 ft wide and 20 to 25 ft long was harvested from each plot at its designated growth stage (Table 1) at a 3-in. height with a flail-type cutter and weighed. A subsample was collected and dried at 140°F to determine moisture and forage nitrogen, phosphorus, acid and neutral detergent fiber (ADF and NDF), and acid detergent lignin (ADL) concentrations. Forage crude protein concentration was obtained by multiplying nitrogen concentration by a factor of 6.25.

Results and Discussion
Forage yield of cultivars generally increased at each successive growth stage (Table 2, means not shown), except in 2003, when forage yield at R2-R3 was higher ($P<0.05$) than that at later stages. This may have been related to extreme weather variations that occurred between early to mid-August and early September (i.e., from dry and hot to

wet, cool, and stormy with perhaps some leaf loss before R5; Table 1). Droughty conditions in late July and most of August also account for the lower yields in 2003 compared with earlier years.

Forage yields at the R2-R3 growth stage were higher for Derry and Tyrone than for Donegal and Hutcheson in 2001 (Table 2). In 2002, Tyrone had higher yield at R2-R3 than Derry, and Donegal and Hutcheson were intermediate. Yields were similarly low at R2-R3 under the droughty conditions in 2003. Yields were similar at R5 in all 3 years, though yield of Tyrone was lowest in 2001. At R6-R7, Donegal yielded more than Hutcheson in all 3 years, whereas Derry and Tyrone yielded less than Hutcheson in 2001 but more than Hutcheson and similarly to Donegal in 2002 and 2003. Overall, Donegal generally seemed to have a yield advantage, except at the R5 maturity, when Tyrone yielded more (Table 2).

Dry matter content at harvest was highly variable, perhaps because it depends on growing conditions prior to harvest more than other characteristics do (Table 3). Plant height was less for Hutcheson than for Tyrone and Donegal and for Derry at later stages of 2001. Donegal was significantly taller than Derry on half of the occasions that measurements were recorded and Tyrone on one occasion (Table 3).

Crude protein concentration at R2-R3 was greater for Donegal than for Derry and Tyrone in 2001 and 2002 (Table 4) but did not differ among cultivars in the dry year of 2003. At R5, crude protein concentration was greater for Hutcheson than for the other cultivars in 2001, similar for all cultivars in 2002, and greater in Derry than Tyrone with the other cultivars intermediate in 2003. At R6-R7, relative responses were the same as those at R5 in 2001 and 2002. In 2003, crude protein concentration of Derry was greater than that of Hutcheson and Tyrone. Over all cultivars, crude protein concentration was greater at the earlier stages than at R6-R7 in 2003.

Phosphorus concentration at R2-R3 was greater for Hutcheson and Donegal than for Derry and Tyrone in 2001 and 2002 but did not differ among cultivars in the dry year of 2003 (Table 4). At R5, phosphorus concentration was again greater for Hutcheson and Donegal than for the other cultivars in 2001 and 2003. In 2002, however, phosphorus concentration was greater in Hutcheson than in Derry and Tyrone, and Donegal's phosphorus concentration was greater than only that of Derry. At R6-R7, phosphorus concentration of Hutcheson was greater than that of Derry and Tyrone in 2001 and 2002, and Donegal was intermediate. Over all cultivars, phosphorus concentration at the R2-R3 growth stage was greater than that at the later stages in 2001 and 2002. Over all growth stages, phosphorus concentration was greater for Hutcheson and Donegal than for the other cultivars in 2001 and 2002. There was no difference in overall phosphorus concentration of cultivars or growth stages in 2003.

At the R2-R3 growth stage, NDF concentration was less for Derry than for the other cultivars in 2001, less for Hutcheson than for the other cultivars in 2002, and did not differ among cultivars in 2003 (Table 5). The ADF concentration at R2-R3 was less for Derry and Donegal than for the other cultivars in 2001 but did not differ among cultivars in 2002 or 2003. The ADL concentration at R2-R3 was less for Derry than for Hutcheson and less for Donegal than for both Hutcheson and Tyrone in 2001. In 2002, ADL concentration of Donegal was less than that of Hutcheson and Derry, but there was no difference among cultivars in 2003. Thus, at R2-R3, fiber components (i.e., NDF, ADF, and ADL) were often lower for Derry and higher for Tyrone and Hutcheson compared with the other cultivars.

At the R5 growth stage, NDF concentration was less for Derry than for Hutcheson in 2002, less for Donegal and Derry than for the other cultivars in 2003, and did not differ among cultivars in 2001 (Table 5). The ADF concentration at R5 was less for Hutcheson than for Tyrone and Derry in 2001 and 2002 and less for Donegal than for Tyrone in 2001, but there was no difference in ADF concentration among cultivars in 2003. The ADL concentration at R5 in 2001 was less for Derry than for Donegal and Tyrone and less for Hutcheson and Tyrone than for Donegal. In 2003, Hutcheson had more ADL than the other cultivars, but there was no difference in ADL concentration among cultivars in 2002. Thus, at R5, fiber components were often higher for Tyrone and lower for Hutcheson compared with the other cultivars.

At the R6-R7 growth stage, NDF concentration was less for Hutcheson than for Tyrone and Derry and less for Donegal than for Tyrone in 2001 but less for Tyrone than for Hutcheson in 2002 (Table 5). In 2003, NDF concentration was least for Derry and greatest for Hutcheson. The ADF concentration at R6-R7 was less for Donegal and Hutcheson than for Tyrone and Derry in 2001, but Tyrone's ADF concentration was less than that for Hutcheson and Derry in 2002. In 2003, ADF concentration was least for Derry and greatest for Hutcheson. The ADL concentration at R6-R7 was less for Donegal than for Tyrone in 2001, greatest for Tyrone in 2003, and did not differ among cultivars in 2002. Thus, at R6-R7, relative concentrations of fiber components varied by year but were often lower for Donegal and higher for Tyrone (particularly lignin concentration) compared with other cultivars.

Over all growth stages, Donegal generally had lower concentrations of fiber components than Tyrone (Table 5).

Table 1. Harvest dates of soybean cultivars at different growth stages, Southeast Agricultural Research Center, Columbus Unit (2001) and Mound Valley Unit (2002 and 2003)

		Growth stage		
Cultivar	Year	R2-R3	R5	R6-R7
		------------------------ Harvest date ------------------------		
Hutcheson	2001	July 26	August 30	September 25
Donegal		July 17	August 30	September 25
Derry		August 7	September 14	October 9
Tyrone		August 7	September 14	October 9
Hutcheson	2002	August 7	August 22	September 27
Donegal		August 12	August 30	October 10
Derry		August 7	August 30	October 10
Tyrone		August 16	September 5	October 18
Hutcheson	2003	August 19	September 10	October 8
Donegal		August 19	September 10	October 8
Derry		August 19	September 10	October 8
Tyrone		August 19	September 25	October 21

Table 2. Forage yields of soybean cultivars at different growth stages, Southeast Agricultural Research Center, Columbus Unit (2001) and Mound Valley Unit (2002 and 2003)

		Forage yield		
Cultivar	Growth stage	2001	2002	2003
		--------------- ton/a at 12% moisture ---------------		
Hutcheson	R2-R3	2.92b[1]	3.05ab	2.21a
Donegal		2.77b	3.51ab	2.28a
Derry		3.91a	2.59b	2.41a
Tyrone		3.78a	3.81a	2.23a
Hutcheson	R5	4.52a	3.74a	1.31a
Donegal		4.71a	3.47a	1.67a
Derry		4.39a	3.59a	1.42a
Tyrone		2.96a	3.40a	1.62a
Hutcheson	R6-R7	4.91b	2.70b	1.17b
Donegal		6.11a	3.97a	1.95a
Derry		3.84c	3.81a	2.00a
Tyrone		3.79c	4.59a	2.30a
LSD (0.05)		0.86	1.02	0.62

[1] Cultivar means within a growth stage and year followed by the same letter are not significantly different ($P<0.05$) according to single-comparison *t*-tests.

Table 3. Forage dry matter and height of soybean cultivars at different growth stages, Southeast Agricultural Research Center, Columbus Unit (2001) and Mound Valley Unit (2002 and 2003)

Cultivar	Growth stage	Forage dry matter			Plant height		
		2001	2002	2003	2001	2002	2003
		---------------- % ----------------			---------------- in. ----------------		
Hutcheson	R2-R3	21.7d[1]	31.6b	41.7a	26.7b	27.0c	14.7b
Donegal		24.7c	35.6a	38.5a	34.3a	38.3a	20.0a
Derry		36.6a	31.2b	39.7a	31.0ab	27.7c	18.0ab
Tyrone		34.5b	38.2a	40.3a	34.0a	33.3b	17.7ab
Hutcheson	R5	28.9c	37.7a	38.0a	30.0c	---	17.7c
Donegal		29.2c	34.2a	38.8a	42.3a	---	23.7ab
Derry		37.0a	34.5a	39.7a	36.3b	---	20.0bc
Tyrone		35.2b	34.7a	35.3a	42.7a	---	27.3a
Hutcheson	R6-R7	28.0c	40.2b	37.9a	28.0c	---	---
Donegal		28.7c	46.9a	36.9a	41.3a	---	---
Derry		33.4a	43.4ab	36.5a	34.7b	---	---
Tyrone		31.1b	46.0a	41.6a	44.0a	---	---
LSD (0.05)		1.2	3.7	NS	4.7	3.3	4.6

[1] Cultivar means within a growth stage and year followed by the same letter are not significantly different (P<0.05) according to single-comparison *t*-tests.

Table 4. Forage crude protein and phosphorus content of soybean cultivars at different growth stages, Southeast Agricultural Research Center, Columbus Unit (2001) and Mound Valley Unit (2002 and 2003)

Cultivar	Growth stage	Crude protein			Phosphorus		
		2001	2002	2003	2001	2002	2003
		---------------- % ----------------			---------------- % ----------------		
Hutcheson	R2-R3	14.8ab[1]	14.4ab	13.4a	0.211a	0.209a	0.170a
Donegal		15.4a	15.4a	12.4a	0.222a	0.221a	0.153a
Derry		13.9b	13.8b	13.3a	0.177b	0.176b	0.153a
Tyrone		12.3c	11.9c	13.0a	0.161b	0.159b	0.145a
Hutcheson	R5	13.6a	13.6a	13.0ab	0.198a	0.195a	0.180a
Donegal		11.9b	12.0a	13.1ab	0.184a	0.183ab	0.153a
Derry		11.3b	13.8a	14.3a	0.151b	0.151c	0.148b
Tyrone		11.2b	11.1a	11.8b	0.159b	0.162bc	0.132b
Hutcheson	R6-R7	12.6a	12.1a	11.4b	0.185a	0.182a	0.166a
Donegal		11.0b	10.7b	11.8ab	0.171ab	0.168ab	0.166a
Derry		10.4b	10.4b	13.3a	0.154b	0.157b	0.148a
Tyrone		11.0b	10.4b	10.4b	0.161b	0.156b	0.153a
LSD (0.05)		1.1	1.2	2.5[2]	0.022	0.022	NS

[1] Cultivar means within a growth stage and year followed by the same letter are not significantly different (P<0.05) according to single-comparison *t*-tests.
[2] Growth stage was the only overall main effect that was significant (P<0.05) in 2003.

Table 5. Forage neutral detergent fiber, acid detergent fiber, and acid detergent lignin of soybean cultivars at different growth stages, Southeast Agricultural Research Center, Columbus Unit (2001) and Mound Valley Unit (2002 and 2003)

		Neutral detergent fiber			Acid detergent fiber			Acid detergent lignin		
Cultivar	Growth stage	2001	2002	2003	2001	2002	2003	2001	2002	2003
Hutcheson	R2-R3	51.9	52.4	45.2	34.3	38.2	31.9	12.1	6.7	5.0
Donegal		50.7	55.9	45.3	32.1	41.5	31.2	7.1	5.3	5.7
Derry		46.9	56.2	46.2	32.1	42.1	31.4	8.6	7.8	5.8
Tyrone		51.4	55.7	45.0	34.8	42.0	31.3	10.9	6.5	5.9
Hutcheson	R5	49.9	50.5	49.5	31.6	35.7	32.3	10.4	7.2	9.4
Donegal		48.9	51.3	46.8	32.8	36.4	31.5	15.0	8.2	7.5
Derry		48.7	54.0	45.3	33.8	38.9	30.2	7.9	7.0	6.3
Tyrone		50.6	52.7	50.0	35.0	38.8	32.5	11.6	7.8	7.1
Hutcheson	R6-R7	48.1	58.9	55.2	31.1	43.3	36.3	7.1	8.3	7.5
Donegal		49.4	56.4	49.2	32.0	41.2	32.4	7.0	7.4	8.0
Derry		51.9	56.8	46.1	36.0	42.6	29.9	9.0	7.4	6.9
Tyrone		54.3	54.6	51.7	37.1	40.0	33.6	9.8	7.7	9.7
LSD (0.05)		2.5	3.2	2.6	2.0	2.6	2.4	2.7	1.3	1.7

Tillage and Nitrogen Placement Effects on Yields in a Short-Season Corn/Wheat/Double-Crop Soybean Rotation

D.W. Sweeney and K.W. Kelley

Summary
In 2009, overall corn yields were greater with conventional and reduced tillage than with no-till. Adding nitrogen (N) fertilizer greatly increased yields. The effect of N placement on yield was nonsignificant in conventional and reduced tillage, but knife N application resulted in greater yields than dribble application in no-till.

Introduction
Many crop rotation systems are used in southeastern Kansas. This experiment is designed to determine the long-term effect of selected tillage and N fertilizer placement options on yields of short-season corn, wheat, and double-crop 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. In 2005, the rotation was changed to begin a short-season corn/wheat/double-crop soybean sequence. Use of three tillage systems (conventional, reduced, and no-till) continues in the same areas used during the previous 22 years. The conventional system consists of chiseling, disking, and field cultivation. Chiseling occurs in the fall preceding corn or wheat crops. The reduced-tillage system consists of disking and field cultivation prior to planting. Glyphosate (Roundup) is applied to the no-till areas. The four N treatments for the crop are: no N (control), broadcast urea-ammonium nitrate (UAN; 28% N) solution, dribble UAN solution, and knife UAN solution at 4 in. deep. The N rate for the corn crop grown in odd years is 125 lb/a. Planting was delayed until May 22, 2009, because of wet weather.

Results and Discussion
In 2009, adding fertilizer N, in general, greatly increased corn yields compared with the no-N controls (Figure 1). Overall yield was greater with knifed application than with dribble application, and broadcast application gave intermediate yields. An interaction between tillage and N treatment significantly affected yield (P=0.10). This interaction occurred because yield differences among N placements in conventional and reduced tillage were not significant but dribble application resulted in lower yield than knifing in no-till.

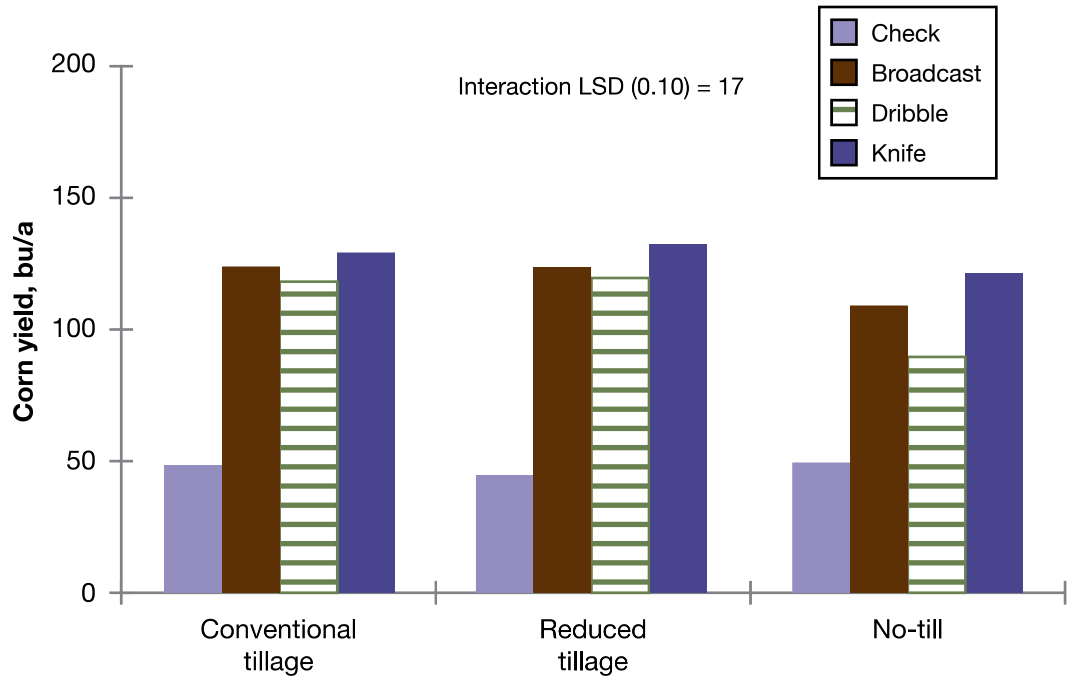

Figure 1. Effect of tillage and nitrogen placement on short-season corn yield in 2009.

Seeding Rates and Fertilizer Placement to Improve Strip-Till and No-Till Corn[1]

D.W. Sweeney and K.W. Kelley

Summary
Weather conditions adversely affected corn stand and yield in 2009. Producers who use these systems to grow corn in southeastern Kansas should note that these responses are not expected to be typical.

Introduction
Use of conservation tillage systems is promoted because of environmental concerns. In the claypan soils of southeastern Kansas, crops grown with no-till may yield less than crops grown in systems involving some tillage operation, often because of reduced plant emergence. Strip tillage provides a tilled seedbed zone where early spring soil temperatures might be greater than those in no-till soils. But like no-till, strip tillage leaves residues intact between the rows as a conservation measure. Optimizing seeding rates for different tillage systems should improve corn stands and yields.

Experimental Procedures
This experiment was established in spring 2009 at the Mound Valley Unit of the Southeast Agricultural Research Center. The experimental design was a split-plot arrangement of a randomized complete block with three replications. The whole plots were three tillage systems: conventional tillage, strip tillage, and no-till. Conventional tillage consisted of chisel and disk operations in the spring. Strip tillage was done with a Redball strip-till unit in the spring prior to planting. The subplots were a 5 × 2 factorial combination of five seed planting rates (18,000, 22,000, 26,000, 30,000, and 34,000 seeds/a) and two nitrogen-phosphorus (N-P) fertilizer placement methods: surface band (dribble) on 30-in. centers near the row and subsurface band (knife) at 4 in. deep. The N and P nutrients were supplied as 28% urea ammonium nitrate and ammonium polyphosphate (10-34-0) applied at 125 lb/a N and 40 lb/a P_2O_5. Wet weather delayed planting until May 21, 2009.

Results and Discussion
An interaction between tillage and N-P placement affected yield and plant stands. This interaction primarily resulted from reduced stands for the knife application, especially in no-till (Figure 1). After fertilizer application on May 20 and planting on May 21, rainfall was sparse for the next 3 weeks, and soil drying in knifed bands near the seed resulted in reduced emergence. This effect is not expected to be typical, especially if the corn is planted earlier. Even so, the effect on total yield in 2009 was not as dramatic as the effect on stand because corn yield was reduced by knife applications only in no-till (Figure 2). Seeding rate did not interact with tillage system on corn yield as anticipated. Seeding rate produced maximum yields at about 26,000 seeds/a when N-P fertilizer was dribble applied, but yield linearly increased as seeding rate increased to 34,000 seeds/a

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

when N-P fertilizer was knifed (Figure 3), a likely artifact of the reduced stands in the knife application treatments.

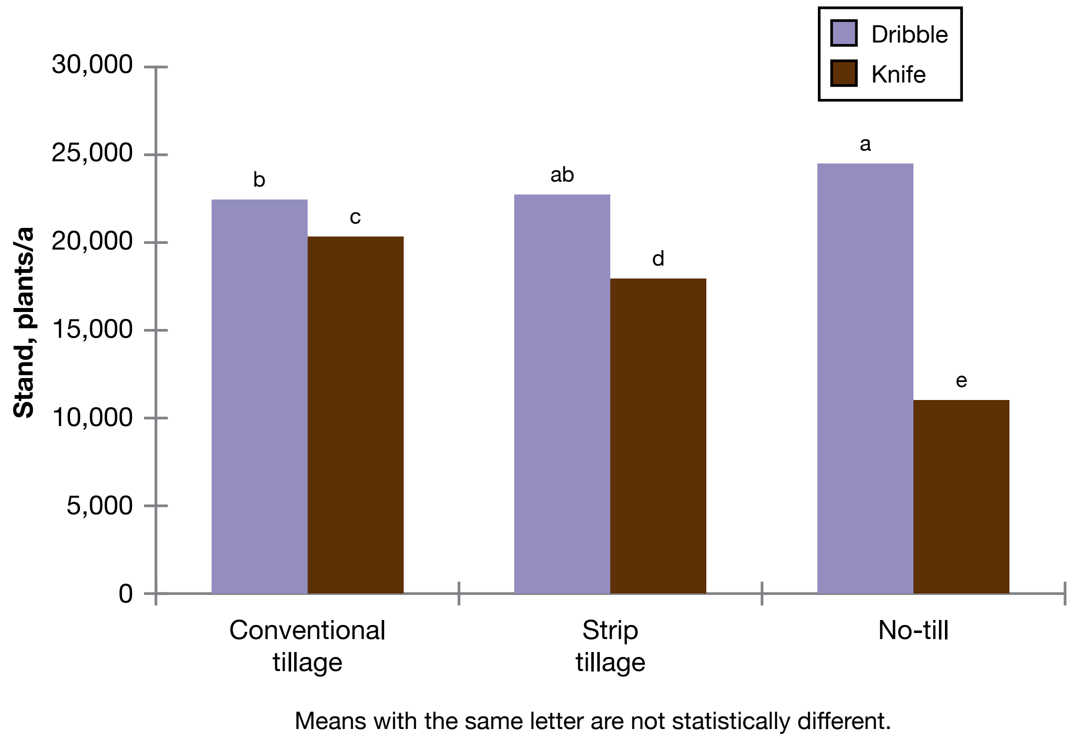

Figure 1. Effect of tillage system and N-P fertilizer placement on short-season corn stand in 2009.

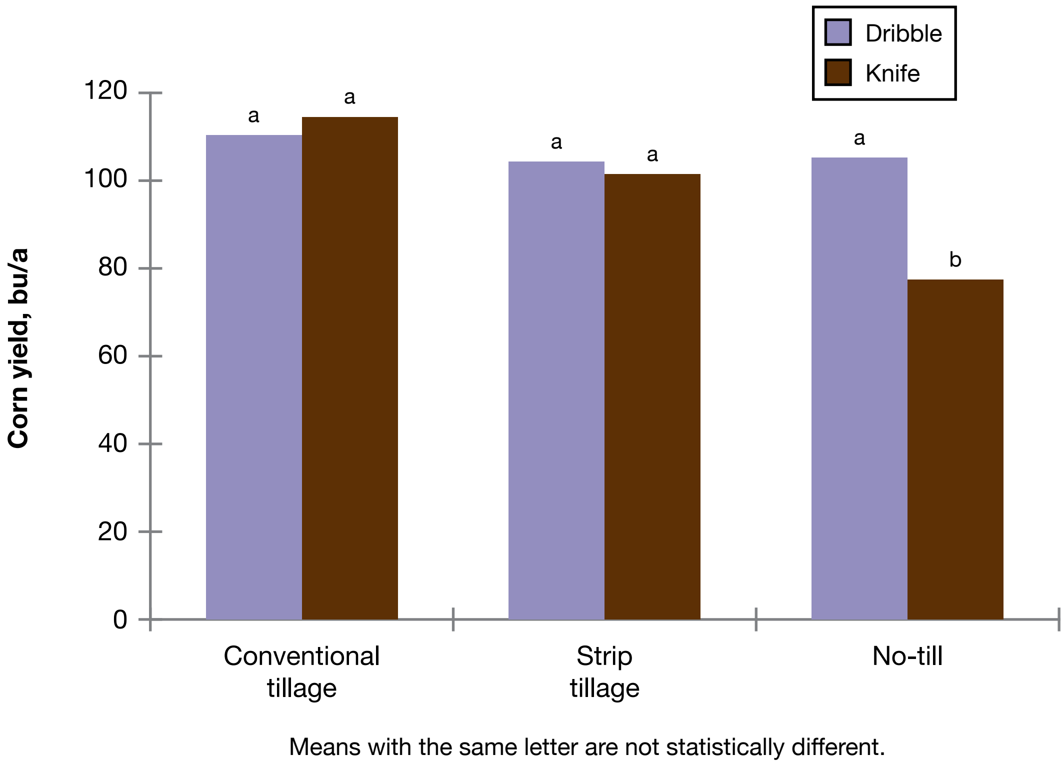

Figure 2. Effect of tillage system and N-P fertilizer placement on short-season corn yield in 2009.

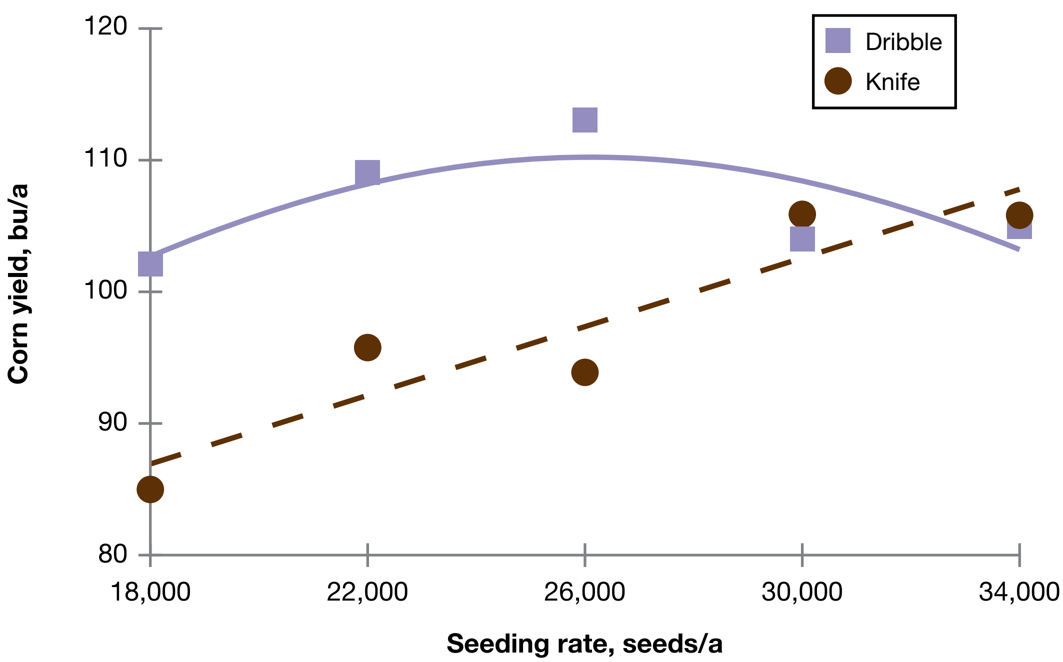

Figure 3. Effect of seeding rate and N-P fertilizer placement on short-season corn yield in 2009.

Effect of Planting Date, Nitrogen Placement, and Timing of Supplemental Irrigation on Sweet Corn

D.W. Sweeney and M.B. Kirkham[1]

Summary
In 2009, wet conditions resulted in poor emergence of and no data from sweet corn planted on the first date in late April. Sweet corn planted in mid-May was little affected by irrigation or nitrogen (N) treatments.

Introduction
Sweet corn is a possible value-added, alternative crop for producers in southeastern Kansas. Corn responds to irrigation, and timing of water deficits can affect yield components. 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. However, there is a lack of information on effects of irrigation management, N placement, and planting date on performance of sweet corn, which may hinder producers' adoption of this crop.

Experimental Procedures
The experiment was established on a Parsons silt loam in spring 2008 as a split-plot arrangement of a randomized complete block with three replications. The whole plots were two planting dates (targets of late April and mid-May) and 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. Subplots were three N treatments consisting of no N and 100 lb/a N applied broadcast or as a subsurface band (knife) at 4 in. Sweet corn was planted on Apr. 24 and May 19, 2009. Wet weather resulted in poor emergence (<15%) of sweet corn planted on April 24, and this resulted in no data from the first planting date. Corn from the second planting date was picked on July 30 and Aug. 4, 2009.

Results and Discussion
In 2009, irrigation had no effect on total ears, total fresh weight, or individual ear weight of sweet corn planted in mid-May (Table 1). Total fresh weight was greater with N application than with no N but was unaffected by N placement. The N treatments had no effect on number of ears or individual ear weight for corn planted in mid-May.

[1] Kansas State University Department of Agronomy, Manhattan.

Table 1. Effect of irrigation scheme and nitrogen placement on sweet corn planted in mid-May, Southeast Agricultural Research Center, 2009

Treatment	Total ears	Total fresh weight	Individual ear weight
	ears/a	ton/a	g/ear
Irrigation scheme			
None	19,500	5.81	270
VT (1.5 in.)	19,800	5.94	272
R2 (1.5 in.)	19,000	5.45	260
VT-R2 (1.5 in. at each)	17,900	5.45	275
LSD (0.10)	NS	NS	NS
N Placement			
None	18,400	5.14	255
Broadcast	19,200	5.77	273
Knife	19,600	6.07	281
LSD (0.05)	NS	0.51	NS
Interaction	NS	NS	NS

NS, Not significant.

Effect of Previous Crop, Nitrogen Placement Method, and Time of Nitrogen Application on No-Till Wheat Yield

K.W. Kelley and D.W. Sweeney

Summary
Previous crop, fertilizer nitrogen (N) method, and time of N application significantly influenced no-till wheat yields. In 2009, yields were significantly greater for wheat following soybean than for wheat following corn or grain sorghum. Yield responses to N method and time of N application varied with previous crop. Yield potential was reduced because of excessive rainfall in April and May, which also resulted in severe scab disease infection after heading.

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 crop residues near the soil surface, however, affects fertilizer N management for no-till wheat.

Experimental Procedures
The experiment was a split-plot design, in which main plots were previous crops (corn, grain sorghum, and soybean) and subplots were three fertilizer N methods and three N application times. Application methods were: (1) subsurface knife of 28% N (coulter-knife on 15-in. spacing at a depth of nearly 4 in.), (2) surface strip-band of 28% N (15-in. strip bands on soil surface), (3) surface broadcast of 28% N using TeeJet streamer nozzles, and (4) surface broadcast of urea (46% N). The N application times were: (1) ⅓ of the N in fall followed by ⅔ in late winter, (2) ⅔ of the N in fall followed by ⅓ in late winter, and (3) all N applied in fall. All plots also received 100 lb/a of 18-46-0 and 100 lb/a of 0-0-60. Wheat was planted on October 21 with a no-till drill in 7.5-in. spacing at a seeding rate of 100 lb/a.

Results and Discussion
In 2009, wheat yields were reduced because of excessive rainfall in April and May, which resulted in a severe scab disease infection after wheat heading. Wheat yields were highest following soybean, and yields generally were similar following either corn or grain sorghum (Table 1). However, fertilizer N responses varied with previous crop. When wheat followed grain sorghum, N application method and time of N application resulted in more significant yield responses compared with wheat following soybean or corn.

Table 1. Effect of previous crop, nitrogen application method, and time of nitrogen application on no-till wheat yield, Southeast Agricultural Research Center, Parsons Unit, 2009

	Time of N application		Wheat yield following		
Fertilizer N application method and N source	Fall	Late winter	Corn	Grain sorghum	Soybean
	-------- lb/a --------		--------------- bu/a ----------------		
Subsurface knife	33	67	45.4	52.4	59.8
(28% liquid N)	67	33	44.5	49.4	58.8
	100	0	46.6	44.5	58.7
Surface strip-band	33	67	44.8	46.0	57.2
(28% liquid N)	67	33	46.3	46.6	59.5
	100	0	42.9	40.1	55.2
Surface broadcast	33	67	44.9	45.2	54.8
(28% liquid N)	67	33	46.6	46.1	58.6
	100	0	41.7	41.2	54.2
Surface broadcast	33	67	45.2	48.5	59.0
(46% urea)	67	33	46.1	45.1	59.0
	100	0	45.5	41.1	56.7
Control			14.3	16.8	33.5
Means (without control)			Avg. yield		
Corn			45.0		
Grain sorghum			45.5		
Soybean			57.6		
LSD (0.05)			2.5		
Subsurface-knife	28% N		51.1		
Surface strip-band	28% N		48.7		
Surface broadcast	28% N		48.1		
	Urea		49.6		
LSD (0.05)			1.5		
Fall (⅓) – Late winter (⅔)			50.3		
Fall (⅔) – Late winter (⅓)			50.5		
Fall (all)			47.3		
LSD (0.05)			1.3		

Comparison of Fertilizer Nitrogen Sources Applied in Late Winter for No-Till Winter Wheat

K.W. Kelley

Summary
This study compared the effects of various fertilizer nitrogen (N) sources applied in late winter to no-till wheat following corn. Although grain yields were reduced because of moderate scab disease infection after heading, yields were still significantly affected by fertilizer N source and method of application. Including a urease inhibitor with 28% N solution resulted in greater yield compared with surface-applied urea.

Introduction
More producers are planting winter wheat no-till into previous crop residues as a means of reducing labor and tillage costs. However, the large amount of crop residue left on the soil surface in no-till systems can make N management difficult. Loss of N as ammonia (NH_3) is a concern in no-till crop production when urea-containing fertilizers are applied to the soil surface. The use of urease inhibitors, such as Agrotain and Nutrisphere, applied with urea-containing fertilizers has been shown to reduce ammonia volatilization losses. In addition, a slow-release polymer-coated urea (ESN) has become available as an N management product. Ammonium thiosulfate (ATS) also has the ability to slow soil urease activity and delay urea hydrolysis. This study compared the effects of various fertilizer N sources and urease inhibitors applied in late winter to no-till wheat following corn.

Experimental Procedures
Winter wheat was planted in mid-October 2008 following corn harvest at the Parsons Unit of the Southeast Agricultural Research Center. Wheat was planted no-till in 7.5-in. spacing at a seeding rate of 100 lb/a. All plots received a preplant broadcast application of 100 lb/a of 18-46-0. Various fertilizer N sources were applied in late February at a rate of 75 lb/a N. Fertilizer N treatments were ESN, Nutrisphere-N + urea-ammonium nitrate solution (UAN; 28%N), Agrotain + UAN, UAN + ATS, UAN alone, urea, and ammonium nitrate. Liquid UAN treated with urease inhibitors was broadcast on the soil surface using TeeJet nozzle streamers. In addition, effects of UAN as a broadcast application on the soil surface and as a subsurface treatment applied on 15-in. centers with a coulter-shank applicator were compared.

Results and Discussion
Grain yields were reduced because of excessive rainfall in April and May, which resulted in moderate scab disease infection after wheat headed. However, wheat yields were significantly affected by fertilizer N source. Applying a urease inhibitor with UAN generally increased wheat yield compared with UAN alone and surface-applied urea. Additional research conducted under various environmental conditions is needed to evaluate the effectiveness of urease inhibitors with urea-containing N fertilizer sources.

Table 1. Comparison of fertilizer nitrogen sources applied in late winter to no-till winter wheat, Southeast Agricultural Research Center, Parsons Unit, 2009

Fertilizer N source[1]	N rate	N application method	Yield
	lb/a		bu/a
UAN (28% N)	75	Broadcast	42.1
UAN + Nutrisphere	75	Broadcast	45.8
UAN + Agrotain	75	Broadcast	44.2
UAN + ATS	75	Broadcast	41.6
UAN	75	Subsurface-knife	41.8
UAN	75	Surface-band	41.0
ESN-polymer	75	Broadcast	39.4
Urea	75	Broadcast	37.8
Ammonium nitrate	75	Broadcast	44.5
Control	0		13.5
LSD (0.05)			4.8

[1] UAN, urea-ammonium nitrate solution (28% N); Nutrisphere and Agrotain are urease inhibitors; ATS, ammonium thiosulfate (12% N); ESN-polymer, environmentally smart nitrogen (43% N) with a polymer coating; Urea, 46% N; ammonium nitrate, 34% N.
All plots also received 100 lb/a of 18-0-46 as a preplant application.
Late-winter N treatments were applied on Feb. 24, 2009.
Previous crop was corn.

Wheat Foliar Fungicide Trial

K.W. Kelley

Summary
Eight foliar fungicide treatments were applied to winter wheat in late April at the Parsons Unit to evaluate effects on grain yield and grain quality. Scab infection was moderate in 2009 because of excessive spring rainfall near wheat flowering. Foliar fungicide treatments had little effect on controlling scab infection. Thus, fungicide-treated wheat and the control treatment had similar wheat grain yield and quality.

Introduction
In southeastern Kansas, winter wheat is often infected with various foliar diseases in late spring, which has the potential to reduce grain yield and quality. Foliar fungicides are a management tool for reducing foliar disease infection. However, effectiveness of fungicides is dependent on several factors, such as disease, level of infection, fungicide mode of action, time of application, and variety disease resistance.

Experimental Procedures
Winter wheat variety Santa Fe was planted no-till into previous corn stalk residues at the Parsons Unit. Eight foliar fungicides were applied April 22. Treatments were replicated four times and applied with a 10-ft-wide boom sprayer using a 20 gal/a spray volume. Wheat flag leaves had emerged at the time of fungicide application.

Results and Discussion
In 2009, rainfall was above normal before and after wheat flowering, which resulted in a moderate to severe Fusarium head blight (scab) infection. Leaf rust infection also occurred after mid-May, when foliar fungicide residual effectiveness likely was reduced. Thus, foliar fungicide treatments did not significantly affect grain yield or test weight (Table 1). Scab disease in wheat is difficult to control because few fungicides are labeled for this specific disease. In addition, fungicides labeled for scab infection need to be applied near wheat flowering time for optimal disease control.

Table 1. Foliar fungicide effects on wheat grain yields, Parsons Unit, 2009

Foliar fungicide treatment	Application rate	Grain yield	Test weight
	oz/a	bu/a	lb/bu
Folicur	4	37.4	54.2
Headline	9	38.6	54.1
Proline	5	37.9	54.9
Prosaro	8	37.6	55.6
Quadris	10	38.5	55.1
Quilt	14	38.0	54.5
Stratego	10	37.8	55.1
Tilt	4	37.3	55.1
Control	---	38.1	54.9
LSD (0.05)		NS	

Effects of Phosphorus and Potassium Fertilizer Rate and Time of Application in a Wheat Double-Cropping System

K.W. Kelley

Summary
Neither rate nor timing of fertilizer phosphorus (P) and potassium (K) application significantly affected grain yields of grain sorghum, wheat, and double-crop soybean during the first two cropping cycles of this long-term study.

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

Experimental Procedures
This study was established in 2004 at the Columbus Unit of the Southeast Agricultural Research Center. The crop rotation consists of grain sorghum/(wheat/double-crop soybean), giving three crops in a 2-year period. Grain sorghum is planted with conventional tillage, and wheat and double-crop soybean are planted no-till. Different fertilizer P and K rates are applied preplant to the grain sorghum crop only or to both the grain sorghum and wheat crops. 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 various fertilizer P and K treatments on grain sorghum, wheat, and double-crop soybean yields are shown in Table 1. Fertilizer treatment has affected grain yields very little during first two cropping cycles. The nonsignificant yield response to fertilizer P and K was not unexpected because initial soil test values indicated that soil values of P and K were sufficient for the expected yield goals. Results of soil analyses after two complete cropping cycles are shown in Table 2. Soil P and K levels are beginning to change from initial values. Soil sampling will continue over time to monitor changes in soil nutrient levels.

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/a P205 and 72 lb/a K20. Thus, this study will continue for several cropping cycles to monitor 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.

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

Fertilizer rate						Average grain yield		
Grain sorghum			Wheat					
N	P_2O_5	K_2O	N	P2O5	K_2O	Grain sorghum	Wheat	Soybean
--------------------------------lb/a--------------------------------						---------------bu/a---------------		
120	0	0	120	0	0	90	42	32
120	45	45	120	45	45	92	46	34
120	90	90	120	0	0	95	44	33
120	60	60	120	60	60	93	46	33
120	120	120	120	0	0	95	46	33
120	75	75	120	75	75	94	46	33
LSD (0.05)						NS	NS	NS

2-year crop rotation: grain sorghum/(wheat/double-crop soybean).
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.
Grain yield averages: Grain sorghum = 6 years (2004–2009); Wheat = 3 years (2005, 2006, and 2008); No wheat data in 2007 because of freeze damage or in 2009 because of severe scab disease infection; Double-crop soybean = 5 years (2005–2009).

Table 2. Effects of phosphorus and potassium fertilizer rate and time of application on soil phosphorus and potassium in a double-cropping system, Southeast Agricultural Research Center, Columbus Unit

Fertilizer rate						Soil test values			
Grain sorghum			Wheat			Site 1		Site 2	
N	P_2O_5	K_2O	N	P_2O_5	K_2O	P	K	P	K
-----------------------------------lb/a-----------------------------------						---------- ppm ----------			
120	0	0	120	0	0	13	94	12	83
120	45	45	120	45	45	23	123	22	107
120	90	90	120	0	0	22	119	20	96
120	60	60	120	60	60	27	128	24	105
120	120	120	120	0	0	26	124	22	101
120	75	75	120	75	75	32	147	31	123

2-year crop rotation: grain sorghum/(wheat/double-crop soybean).
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.
Soil test values after two complete cropping cycles.

Effects of Nitrogen Fertilizer and Previous Double-Cropping Systems on Subsequent Corn Yield

K.W. Kelley and J.L. Moyer

Summary
In 2009, corn yields were highest following double-crop soybean, double-crop sunflower, chemical fallow, or summer fallow interseeded with sweet clover. Corn yields were lowest following double-crop grain sorghum. Corn yield response to nitrogen (N) fertilizer differed among previous wheat/double-crop systems, but yields increased with increasing N rate.

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 grown successfully 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 commonly is grown for seed or cut for hay, and sweet clover is planted primarily for soil amendment purposes. Fewer producers summer fallow land after wheat harvest. Previous wheat and double-crop systems likely affect growth of subsequent crops, such as corn. In addition, N fertilizer requirements for corn might need to be adjusted depending on the previous wheat and double-crop system used.

Experimental Procedures
The study was conducted at the Parsons Unit of the Southeast Agricultural Research Center. The experimental design was a split-plot arrangement with three replications. Main plots consisted of six different systems: (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/a N. Subplots consisted of six preplant fertilizer N rates (0, 30, 60, 90, 120, and 150 lb/a) for corn following wheat/double-crop options. The nitrogen source was 28% N solution preplant applied with a coulter-knife applicator. Because residual soil test values were relatively high, neither phosphorus nor potassium fertilizer was applied. Corn was planted with conventional tillage.

Results and Discussion
Corn yields in 2009 were highest following wheat/double-crop soybean, wheat/double-crop sunflower, chemical summer fallow, or summer fallow interseeded with sweet clover (Table 1). Corn yields were lowest following wheat/double-crop grain sorghum. Similar corn yield trends in response to wheat/double-crop options are shown in the

3-year averages (Table 1). The higher N fertilizer requirement following wheat/double-crop grain sorghum likely is the result of greater immobilization of N fertilizer following the high-residue sorghum crop. In addition, sweet clover growth was reduced in 2 of the 3 years because of dry soil conditions during midsummer, which likely affected subsequent corn yield responses.

Table 1. Effects of nitrogen and previous wheat/double-crop options on subsequent corn production, Parsons Unit, Southeast Agricultural Research Center

Previous wheat/double-crop system	N rate	Corn yield 2009	Corn yield 3-year avg.
	lb/a	---------------bu/a---------------	
Chemical fallow	0	57.0	57.8
	30	83.0	86.2
	60	93.5	119.3
	90	107.5	128.4
	120	113.6	144.2
	150	123.6	153.7
Soybean	0	62.6	79.0
	30	75.9	101.2
	60	88.5	116.3
	90	105.3	132.4
	120	109.7	140.9
	150	133.4	153.0
Grain sorghum	0	49.1	40.5
	30	51.7	61.9
	60	65.5	80.1
	90	78.3	100.9
	120	82.3	119.8
	150	106.6	131.2
Sunflower	0	47.9	57.4
	30	76.6	82.5
	60	98.0	122.0
	90	113.2	134.0
	120	117.7	144.0
	150	126.8	154.4
Sweet clover	0	57.7	61.4
	30	66.2	74.8
	60	89.0	111.0
	90	107.0	126.6
	120	121.3	143.7
	150	123.6	146.3

continued

Table 1. Effects of nitrogen and previous wheat/double-crop options on subsequent corn production, Parsons Unit, Southeast Agricultural Research Center

Previous wheat/double-crop system	N rate	Corn yield 2009	Corn yield 3-year avg.
		---------------bu/a ---------------	
Lespedeza	0	50.0	61.3
	30	55.8	74.5
	60	66.5	98.6
	90	99.4	125.0
	120	120.6	139.7
	150	125.7	145.4
LSD (0.05)			
Same cropping system		6.8	5.6
Different system		7.3	7.1
Mean values:			
Chemical fallow		96.4	115.0
Soybean		95.9	120.5
Grain sorghum		72.2	89.1
Sunflower		96.7	115.7
Sweet clover		94.1	110.7
Lespedeza		86.3	107.4
LSD (0.05)		4.4	5.3

Effects of Fertilizer Nitrogen Rate and Time of Application on Corn and Grain Sorghum Yields

K.W. Kelley and D.W. Sweeney

Summary
Effects of various rates of fertilizer nitrogen (N) applied preplant or side-dressed have been evaluated with corn and grain sorghum in southeastern Kansas since 2005. However, the yield differences between preplant N and side-dress N have been small. Grain yields have been influenced more by fertilizer N rate than time of N application.

Introduction
Because of recent increases in fertilizer 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 conducted at the Columbus Unit of the Southeast Agricultural Research Center from 2005 through 2009 to evaluate the effects of time and rate of fertilizer N application for both corn and grain sorghum. Fertilizer N (28% liquid N) treatments consisted of different N rates applied 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 during the early growing season. All plots received 30 lb/a N preplant as 18-46-0. The previous crop was double-crop soybean.

Results and Discussion
Wet soil conditions in early spring prevented corn from being planted in 2009. Corn yields for 2008 and 3-year averages are shown in Table 1. Grain sorghum yield results for 2009 and 4-year averages also are included in Table 1. In this study, both corn and grain sorghum yields responded more to rate than time of fertilizer N application. Even though soil moisture was excessive during early spring in several years, denitrification loses evidently were small at this silt loam site, where water did not pond on the soil surface.

Table 1. Effects of fertilizer nitrogen rate and time of application on corn and grain sorghum yields, Southeast Agricultural Research Center, Columbus Unit, 2006 to 2009

Rate of fertilizer N[1]		Grain yield			
		Corn		Grain sorghum	
Preplant	Side-dress	2008	3-year avg.	2009	4-year avg.
------------lb N/a ------------		------------------------------bu/a ------------------------------			
30	0	77.2	77.8	106.1	92.8
60	0	89.6	92.0	129.3	113.9
90	0	111.8	111.1	138.0	123.1
120	0	129.6	122.0	142.4	133.3
150	0	130.4	128.5	148.2	136.0
30	30	84.2	89.1	126.3	113.7
30	60	103.3	107.3	138.6	125.6
30	90	116.7	118.7	147.3	136.3
30	120	113.4	126.6	151.4	139.1
LSD (0.05)		6.4	6.1	6.7	3.4

[1] 30 lb N/a applied preplant as 18-46-0 to all treatments.

Effects of Tillage on Full-Season Soybean Yield

K.W. Kelley and D.W. Sweeney

Summary
Long-term effects of tillage method (conventional and no-till) on full-season soybean yield are being evaluated at the Parsons and Columbus units. Soybean yields have been more affected by tillage at the Columbus Unit, which has a longer cropping history than the Parsons Unit.

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

Experimental Procedures
From 1995 through 2002, a 3-year crop rotation was evaluated at both the Columbus and Parsons units. The rotation consisted of (corn and grain sorghum)/soybean/(wheat and double-crop soybean), and tillage effects on full-season soybean yield were evaluated every 3 years. Tillage treatments were: (1) all crops planted with conventional tillage, (2) all crops planted with no-till, and (3) alternate conventional tillage and no-till systems. Beginning in 2003, the 3-year rotation was changed to a 2-year rotation that consisted of soybean following grain sorghum. Since then, tillage effects on soybean yield have been evaluated each year at both the Columbus and Parsons units.

Results and Discussion
Effects of tillage method on full-season soybean yield are shown in Table 1. At the Columbus Unit, soybean yields were greater with conventional tillage than with no-till during the first two cropping cycles. In recent years, however, soybean yields with continuous no-till have been equal to or greater than yields with conventional tillage. But soybean yields for no-till following conventional tillage have been significantly lower than yields for continuous no-till or continuous conventional tillage. Tillage has had less effect on soybean yields at the Parsons Unit than at the Columbus Unit, except for the last two cropping years. The Columbus Unit has a significantly longer cropping history than the Parsons Unit, which may be affecting tillage responses.

Table 1. Effects of tillage systems on full-season soybean yield, Southeast Agricultural Research Center, 1996 to 2009

	Full-season soybean yield										
Tillage system[1]	1996	1999	2002	2003	2004	2005	2006	2007	2008	2009	avg.
Columbus Unit	-------------------------------------- bu/a --------------------------------------										
NT only	48.4	18.1	27.0	35.7	46.1	30.8	35.8	50.1	54.7	49.4	39.6
NT following CT	46.0	14.2	26.0	29.3	38.4	23.7	29.8	43.3	50.1	41.0	34.2
CT only	53.9	20.3	23.4	35.8	43.2	29.3	27.9	45.4	51.4	45.2	37.6
CT following NT	54.4	20.0	26.5	36.9	40.3	25.9	28.3	44.3	49.1	46.1	37.2
LSD (0.05)	4.9	1.3	1.4	2.0	3.7	1.7	2.3	2.8	3.2	3.3	
Parsons Unit											
NT only	45.3	15.8	32.4	34.9	42.4	30.8	---	35.0	46.9	39.6	35.9
NT following CT	43.7	14.9	32.1	33.5	42.2	27.1	---	32.0	47.1	36.3	34.3
CT only	45.2	15.5	27.9	30.8	45.1	29.4	---	32.2	45.8	38.8	34.5
CT following NT	45.8	16.0	29.6	35.1	43.8	29.4	---	33.6	46.6	39.7	35.5
LSD (0.05)	NS	NS	3.9	2.8	NS	1.9	---	2.1	NS	NS	

[1] NT, no-till; CT, conventional tillage (disk-chisel-disk-field cultivate).

Effects of previous crop (corn and grain sorghum) on soybean yield were nonsignificant (NS) for the first phase of the study from 1996 through 2002; thus, yields were averaged over both previous crops. From 2003 to 2009, the previous crop before soybean was grain sorghum. Drought conditions in 2006 prevented any meaningful yield data at the Parsons Unit.

Soybean Foliar Fungicide Trial

J.H. Long, D. Jardine[1], and E. DeWolf[1]

Summary
Nine fungicide treatments were applied at the Parsons unit on full-season soybean to evaluate their control of soybean rust (*Phakopsora pachyrhizi*) and other foliar diseases. These plots were evaluated for grain yield and other agronomic characteristics throughout summer 2009. Soybean rust did not infect plants during 2009, but other diseases, including Septoria brown spot, did. These diseases had strong visual effects on plants and affected grain yields. Grain yields ranged from 42 to 46 bu/a for all treatments, and the untreated check averaged 43 bu/a.

Introduction
Soybean rust is a new disease that is capable of causing severe grain yield loss. It can completely defoliate a soybean plant in just a few weeks. This disease spread from South America to the United States in 2004 and has infected most major soybean-producing areas in the United States. There are no known resistant varieties, so disease management through fungicide application is the only reliable remedy for this disease. Many fungicide treatments are available to manage soybean rust, but little is known regarding their effectiveness in Kansas. Treatments were determined by contacting retail outlets that sell soybean fungicides and determining treatments available to the farming public. This study established best management practices for control of this quick-acting disease and other foliar diseases and determined if fungicides should be applied at predetermined growth stages to protect the crop.

Experimental Procedures
Soybean variety NK S49Q9 was planted into good moisture at the Parsons Unit of the Southeast Agricultural Research Center. The soil is a Parsons silt loam. Soil was conventionally tilled, and soybean was planted with John Deere 7000 planter units on July 6, 2009, at 10 seeds per foot of row. Dual II Magnum herbicide was applied preemergence at the rate of 1 pint/a. Roundup WeatherMax at 22 oz/a was sprayed after planting to control weeds. Fungicide applications were then applied at three growth stages with a 10-ft-wide boom sprayer using a 20 gal/a mixture. Harvest occurred Nov. 25, 2009.

Results and Discussion
Most foliar fungicide treatments were applied at the R3 growth stage of soybean (beginning to pod), which is early in the reproductive stages of the soybean plant. One treatment was applied very early at R1 (first bloom), and another was applied late at R5 (pod fill). All treatments were compared with a nontreated control. Soybean rust was not present in these plots in 2009, yet several diseases occurred late in the season. Grain yield of the untreated check was equal to that of some fungicide treatments (Table 1). However, R3 applications of Quilt fungicide increased grain yield in 2009.

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[1] Kansas State University Department of Plant Pathology, Manhattan.

Table 1. Foliar fungicide effects on soybean grain yields, Parsons, 2009

Treatment	Rate	Soybean growth stage at application	Grain yield
	oz/a		bu/a
Headline	12	R3 – small pods	45.0
Quilt	14	R1 – first bloom	42.4
Quilt	14	R3 – small pods	46.3
Quilt	14	R5 – pods filling	42.9
Check - None	---	---	43.2
LSD (0.05)			2.7

Planting Date, Plant Population, and Fungicide/ Insecticide Effects on Late-Planted Sunflower in Southeastern Kansas

J.H. Long

Summary
Sunflower was planted at five populations on three dates during July and August 2009. In a separate trial on the same plants, three insecticide and fungicide treatments were sprayed to prevent damage to the plants. Grain yield and other agronomic characteristics were collected during summer 2009. Results indicate that July-planted sunflower gave greatest yields and that final plant stands of 15,000 and 20,000 plants were best. Fungicide treatments had the greatest effect on yield, and using insecticide alone did not increase yields.

Introduction
Sunflower has been grown as a catch crop in eastern Kansas for many years. It has never been grown on more than a few thousand acres per county in this part of the state, but sunflower has great potential as a crop if management practices can be developed to enable greater grain yield. Little is known about the effect of late planting dates (following wheat harvest) and plant populations needed in southeastern Kansas, so a study was conducted to determine optimum conditions for these important practices. A concurrent study was conducted to determine the effects of fungicide and insecticide on sunflower yield.

Experimental Procedures
Sunflower hybrid Triumph S671 was planted into good moisture at the Parsons Unit of the Southeast Agricultural Research Center. The soil is a Parsons silt loam. Because of very high rainfall, soil was conventionally tilled to dry the ground before planting. Sunflower rates were planted with John Deere planter units on July 1, July 14, and July 31, 2009, according to planting populations needed. Each population was overplanted and then thinned to a final stand of 15,000, 20,000, 25,000, 30,000, or 35,000 plants/a. Trifluralin herbicide was applied preemergence at the rate of 1 pint/a. Harvest occurred October 28 for the July 1 planting, November 12 for the July 14 planting, and December 11 for the July 31, planting. The fungicide and insecticide study was planted July 6 and harvested October 21.

Results and Discussion
Planting date and plant population affected grain yields. The July 1 and July 14 plantings both had seed yields greater than 2,700 lb/a (Figure 1). The July 31 planting yielded much less than other plantings but still gave 1,160 lb/a. Grain yields were greatly reduced in the latest planting because of a lack of pollination of the flowers. It was not known if an early freeze killed insect pollinators or actually killed floral parts of the plant; however, a lack of seed fill caused the reduced yields (Figure 2). Yield decreased as population increased beyond 20,000 plants/a (Figure 3). Yield reductions were caused

by a decrease in both seed number and test weight in the higher-density plantings. The insecticide (Mustang Max at 3 oz/a) treatment alone was no more effective than the no-treatment check in preserving yield, but both treatments with fungicide (Headline at 9 oz/a) had greater yield than the no-treatment check and insecticide alone (Figure 4).

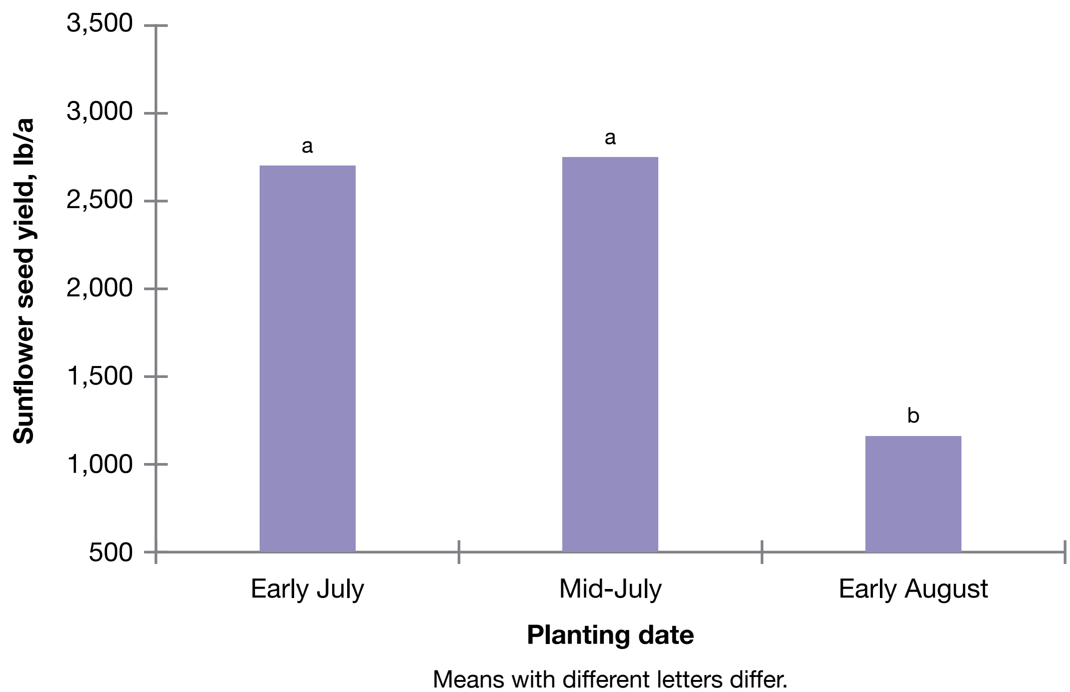


Figure 1. Effect of planting date on sunflower seed yield, Parsons, 2009.

Figure 2. Effect of early freeze on sunflower seed set, Parsons, 2009.
Normal development (left). Late-planted, not pollinated (right).

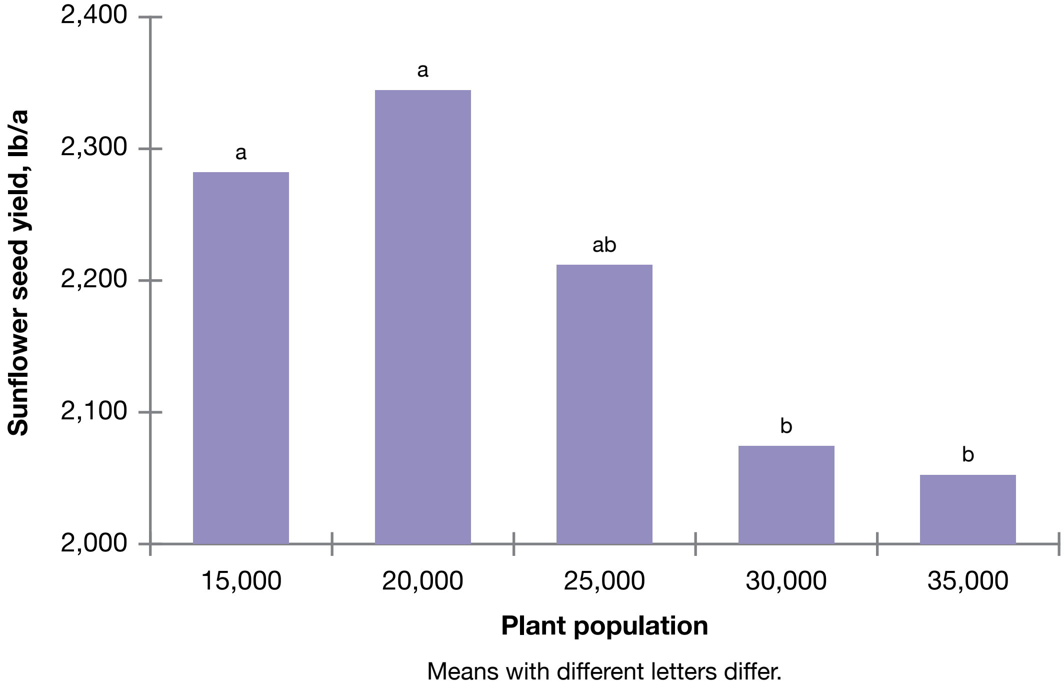


Figure 3. Effect of population on sunflower seed yield, Parsons, 2009.

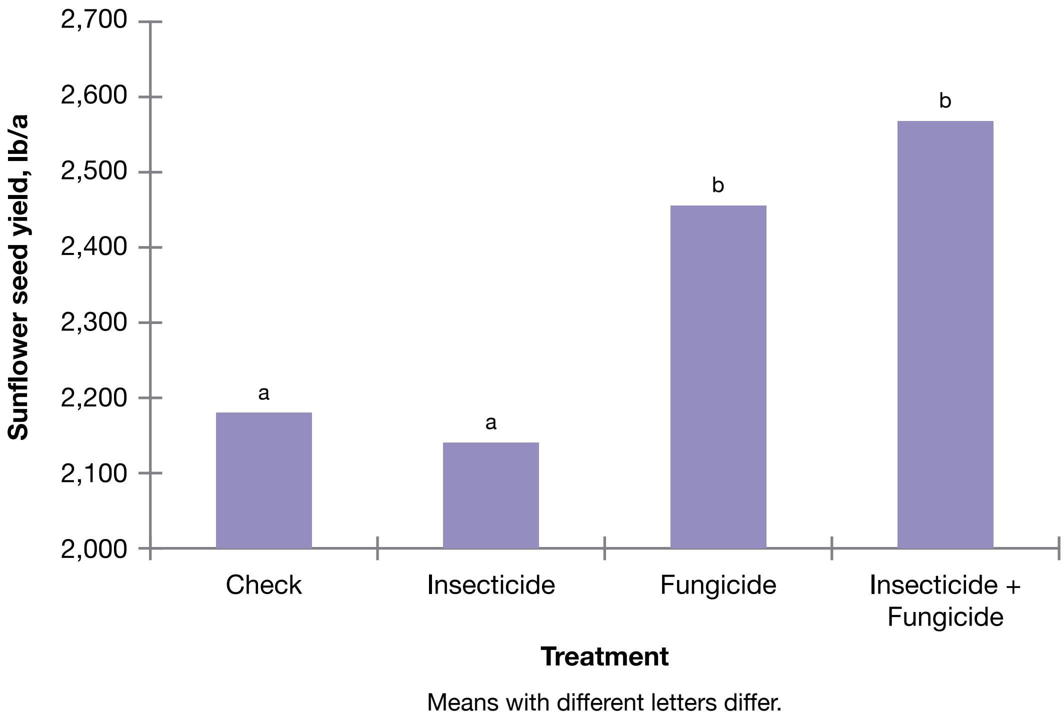


Figure 4. Effect of fungicide and insecticide on sunflower seed yield, Parsons, 2009.

Annual Summary of Weather Data for Parsons, KS

M. Knapp[1]

2009 Data

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Avg. max	41.5	55.0	58.4	64.4	73.3	87.6	86.4	85.1	76.0	60.3	60.7	39.8	65.7
Avg. min	18.4	28.8	35.1	41.8	54.2	67.3	64.6	63.7	57.5	42.3	40.1	21.0	44.6
Avg. mean	29.9	41.9	46.7	53.1	63.7	77.5	75.5	74.4	66.8	51.3	50.4	30.4	55.1
Precip.	0.13	1.7	4.10	10.0	6.17	4.67	7.36	5.30	12.61	7.45	2.3	2.31	64.05
Snow	0.5	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0	5.3	8.8
Heat DD[1]	1087	648	567	380	104	4	0	3	46	426	438	1072	4774
Cool DD[1]	0	0	0	23	65	378	326	295	100	1	0	0	1185
Rain days	2	3	10	12	11	11	9	7	11	12	5	7	100
Min <10	4	0	0	0	0	0	0	0	0	0	0	2	6
Min <32	31	18	9	5	0	0	0	0	0	1	5	26	95
Max >90	0	0	0	0	0	10	6	7	0	0	0	0	23

Normal values (1971-2000)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	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[1]	1079	800	590	295	95	6	0	3	51	229	594	942	4684
Cool DD[1]	0	0	0	13	101	283	456	406	187	24	0	0	1470

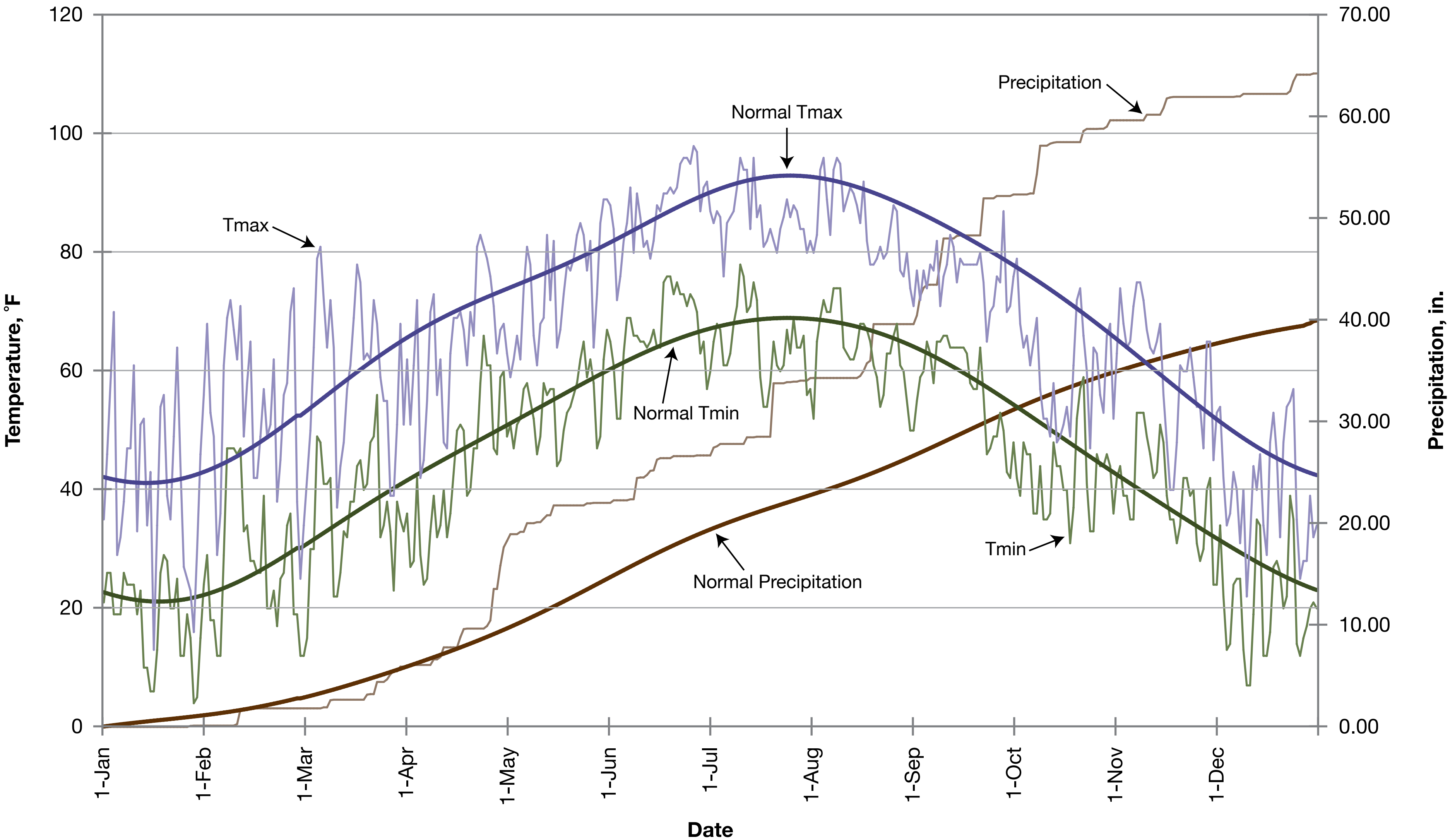
Departure from normal

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Avg. max	1.3	7.8	1.2	-2.7	-2.7	2.6	-4.7	-4.9	-5.0	-10.2	5.2	-4.6	-1.4
Avg. min	-1.8	3.2	0.3	-2.3	-0.2	3.9	-3.7	-2.3	-0.5	-4.0	5.2	-3.8	-0.5
Avg. mean	-0.3	5.5	0.7	-2.5	-1.5	3.3	-4.2	-3.6	-2.7	-7.1	5.2	-4.2	-0.9
Precip.	-1.24	-0.08	0.73	6.13	0.78	-0.15	3.53	1.88	7.68	3.41	-0.99	0.28	21.96
Snow	-1.5	-3.0	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-2	5.3	0.3
Heat DD[1]	8	-153	-23	85	9	-2	0	0	-5	197	-156	130	90
Cool DD[1]	0	0	0	10	-37	95	-131	-112	-88	-24	0	0	-285

[1] 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] Kansas State Climatologist, Kansas State University Department of Agronomy, Manhattan.

Weather Summary for Parsons, KS — 2009



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