Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 8 *Southeast Agricultural Research Center Reports (2014 and earlier)*

Article 25

2013

2013 Agricultural Research Southeast Agricultural Research Center

Kansas State University. Agricultural Experiment Station and Cooperative Extension Service

SEARC

Agricultural Research 2013

Report of Progress 1087

K-STATE
Research and Extension

Kansas State University Agricultural Experiment Station and Cooperative Extension Service

LYLE LOMAS
Research Center Head and Animal Scientist

B.S., M.S., Animal Husbandry, University of Missouri
Ph.D., Animal Husbandry, Michigan State University

Lyle provides administrative and research leadership and directs beef cattle research at the Kansas State University Southeast Agricultural Research Center. Lyle joined the staff in 1979 as an animal scientist and became head in 1986. His research interests are beef cattle nutrition and forage utilization by grazing beef cattle.

JOE MOYER
Forage Agronomist

B.S., M.S., Ph.D., Agronomy, Kansas State University

Joe has been a staff member since 1978. His research evaluates forage grass and legume cultivars and management practices and forage utilization by grazing beef cattle.

DAN SWEENEY
Soil and Water Management Agronomist

B.S., Chemistry, Kentucky Wesleyan College
M.S., Agronomy, Purdue University
Ph.D., Soil Science, University of Florida

Dan joined the staff in 1983. His research focuses on soil fertility, tillage and compaction, water quality, and irrigation.

SEARC
Agricultural Research
2013

Contents

Research Center Personnel

Lyle Lomas, Research Center Head and Animal Scientist
- Larry Buffington, Custodial Specialist
- Jason Denton, Agricultural Technician Senior
- TaLana Erikson, Agricultural Technician Senior
- Terry Green, Agricultural Technician Senior
- Adam Harris, Agricultural Technician Senior
- Kelly Kusel, Research Assistant
- Morgan Pearman, Agricultural Technician
- Marla Sexton, Accountant I

Joseph Moyer, Forage Agronomist
- Mike Cramer, Agricultural Technician Senior
- Larry Sale, Agricultural Technician

Daniel Sweeney, Soil and Water Management Agronomist
- Michael Dean, Agricultural Technician Senior
- David Kerley, Agricultural Technician Senior

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

L.W. Lomas and J.L. Moyer

Summary
A total of 120 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 three days per week (Monday, Wednesday, and Friday) in 2009, 2010, 2011, and 2012. 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 three days per week were similar ($P > 0.05$) during all four years.

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 perspectives of both animal performance and economics. Many producers would prefer to not supplement their cattle on a daily basis, however, 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 three days per week (Monday, Wednesday, and Friday).

Experimental Procedures
Thirty heifer calves were weighed on two consecutive days each year, stratified by weight, and randomly allotted to six 5-acre smooth bromegrass pastures on April 7, 2009 (420 lb); March 30, 2010 (422 lb); April 5, 2011 (406 lb); and April 3, 2012 (447 lb). Three pastures of heifers were randomly assigned to one of two supplementation treatments (three replicates per treatment) and grazed for 192 days, 168 days, 169 days, and 127 days in 2009, 2010, 2011, and 2012, respectively. Supplementation treatments were DDG at 0.5% body weight per head daily or an equivalent amount of DDG fed three 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 February 10, 2009; February 19, 2010; April 6, 2011; and February 1, 2012. Pastures were stocked with 1 heifer/a and grazed continuously until October 16, 2009 (192 days); September 13, 2010 (168 days); September 21, 2011 (169 days); and August 8, 2012 (127 days) when heifers were weighed on two 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 in 2009, 2011, and 2012 for reasons unrelated to experimental treatment.

Results and Discussion

Cattle gains and DDG intake are presented in Tables 1, 2, 3, and 4 for 2009, 2010, 2011, and 2012, respectively. 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 all three years. In 2009, daily gain and gain/a 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.

In 2010, daily gain and gain/a were 1.75 and 294 lb, respectively, for heifers supplemented daily and 1.76 and 295 lb, respectively, for heifers supplemented three times per week. Total DDG consumption and average daily DDG consumption were 485 and 2.9 lb, respectively, for heifers supplemented daily and 478 and 2.8 lb, respectively, for heifers supplemented three times per week. Heifers supplemented three times per week were fed an average of 6.5 lb per feeding.

In 2011, daily gain and gain/a were 1.84 and 311 lb, respectively, for heifers supplemented daily and 1.82 and 307 lb, respectively, for heifers supplemented three times per week. Total DDG consumption and average daily DDG consumption were 477 and 2.8 lb, respectively, for heifers supplemented daily and 470 and 2.8 lb, respectively, for heifers supplemented three times per week. Heifers supplemented three times per week were fed an average of 6.5 lb per feeding.

In 2012, daily gain and gain/a were 1.86 and 237 lb, respectively, for heifers supplemented daily and 1.74 and 220 lb, respectively, for heifers supplemented three times per week. Total DDG consumption and average daily DDG consumption were 349 and 2.1 lb, respectively, for heifers supplemented daily and 351 and 2.1 lb, respectively, for heifers supplemented three times per week. Heifers supplemented three times per week were fed an average of 4.9 lb per feeding.

Stocker cattle can be fed DDG three times per week rather than daily without any adverse effects on performance. Caution should be used, however, when feeding greater than the equivalent of 0.5% per head daily fewer than seven 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	14	15
Initial weight, lb	420	420
Final weight, lb	782	779
Gain, lb	362	359
Daily gain, lb	1.89	1.87
Gain/a, lb	362	359
Total DDG consumption, lb/head	561	566
Average DDG consumption, lb/head per day	2.9	3.0

Table 2. Effect of frequency of dried distillers grains (DDG) supplementation on gains of heifer calves grazing smooth bromegrass pastures, Southeast Agricultural Research Center, 2010

	Supplementation frequency	
Item	Daily	Three times per week
No. of days	168	168
No. of head	15	15
Initial weight, lb	422	422
Final weight, lb	716	717
Gain, lb	294	295
Daily gain, lb	1.75	1.76
Gain/a, lb	294	295
Total DDG consumption, lb/head	485	478
Average DDG consumption, lb/head per day	2.9	2.8

Table 3. Effect of frequency of dried distillers grains (DDG) supplementation on gains of heifer calves grazing smooth bromegrass pastures, Southeast Agricultural Research Center, 2011

	Supplementation frequency	
Item	Daily	Three times per week
No. of days	169	169
No. of head	14	15
Initial weight, lb	409	403
Final weight, lb	720	710
Gain, lb	311	307
Daily gain, lb	1.84	1.82
Gain/a, lb	311	307
Total DDG consumption, lb/head	477	470
Average DDG consumption, lb/head per day	2.8	2.8

Table 4. Effect of frequency of dried distillers grains (DDG) supplementation on gains of heifer calves grazing smooth bromegrass pastures, Southeast Agricultural Research Center, 2012

	Supplementation frequency	
Item	Daily	Three times per week
No. of days	127	127
No. of head	14	15
Initial weight, lb	451	443
Final weight, lb	688	663
Gain, lb	237	220
Daily gain, lb	1.86	1.74
Gain/a, lb	237	220
Total DDG consumption, lb/head	349	351
Average DDG consumption, lb/head per day	2.1	2.1

Distillers Grains Supplementation Strategy for Grazing Stocker Cattle

L.W. Lomas and J.L. Moyer

Summary
A total of 180 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, 2009, 2010, 2011, and 2012. 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. Steers on the delayed supplementation treatment consumed 155, 142, 128, 132, and 151 lb less DDG in 2008, 2009, 2010, 2011, and 2012, respectively, but had gains ($P > 0.05$) similar to those supplemented during the entire grazing phase. Supplementation during the grazing phase had no effect ($P > 0.05$) on finishing performance in 2008, 2010, 2011, or 2012. In 2009, steers that received no supplementation during the grazing phase had greater ($P < 0.05$) finishing gains than those supplemented during the entire grazing phase and lower ($P < 0.05$) feed:gain ratios than steers that were supplemented with DDG while grazing. Steers supplemented with DDG in 2010 had greater ($P > 0.05$) overall gains than those that received no supplement during the grazing phase.

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 co-products 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 economic 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 two consecutive days, stratified by weight, and randomly allotted to nine 5-acre smooth bromegrass pastures on April 9, 2008 (450 lb); April 3, 2009 (467 lb); March 30, 2010 (448 lb); April 5, 2011 (468 lb); and April 3, 2012 (489 lb). Three pastures of steers were randomly assigned to 1 of 3 supplementation treatments (3 replicates per treatment)

and were grazed for 196 days, 221 days, 224 days, 199 days, and 142 days in 2008, 2009, 2010, 2011, and 2012, respectively. Supplementation treatments were no supplement, 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, 165 days, 168 days, 143 days, and 86 days in 2008, 2009, 2010, 2011, and 2012, respectively). Pastures were fertilized with 100 lb/a N on February 29, 2008; February 10, 2009; February 18, 2010; April 6, 2011, and February 1, 2012. Pastures were stocked with 0.8 steers/a and grazed continuously until October 22, 2008; November 10, 2009; November 9, 2010; October 21, 2011; and August 23, 2012, when steers were weighed on two 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 DDG 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 (Pfizer Animal Health, Madison, NJ), and fed a diet of 80% whole-shelled corn, 15% corn silage, and 5% supplement (dry matter basis) for 112 days in 2008 and 2009, for 100 days in 2010, for 110 days in 2011, and for 127 days in 2012. 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, 2, 3, 4, and 5 for 2008, 2009, 2010, 2011, and 2012, respectively. Supplementation with DDG had no effect ($P > 0.05$) on quantity of forage available for grazing in any year; however, average available forage for all treatments was higher in 2008 than in any of the other years.

Steers supplemented with 0.5% DDG during the entire grazing season or only during the latter part of the grazing season had greater ($P < 0.05$) weight gain, daily gain, and steer gain/a during each year than those that received no supplement. Supplementation with either system resulted in an average of 0.5 lb greater average daily gain over those that received no supplement. Grazing weight gain, daily gain, and gain/a 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, 142, 128, 132, and 151 lb more DDG in 2008, 2009, 2010, 2011, and 2012, respectively, than those that were supplemented only during the latter part of the grazing season. In general, steers supplemented with DDG only during the latter part of the grazing season consumed approximately 20% less DDG but had grazing gains similar to ($P > 0.05$) those supplemented during the entire grazing season.

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) did not differ ($P > 0.05$) 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 did not differ ($P > 0.05$) between supplementation treatments.

In 2010, supplementation during the grazing phase had no effect ($P > 0.05$) on finishing gains, dry matter intake, or feed:gain, but steers supplemented with DDG during the grazing phase had greater ($P < 0.05$) final live weight, hot carcass weight, and overall daily gain than those that received no supplement during the grazing phase.

In 2011, supplementation during the grazing phase had no effect ($P > 0.05$) on finishing gains, feed:gain, or carcass characteristics. Steers that received no supplementation during the grazing phase had lower ($P < 0.05$) final live weight, hot carcass weight, finishing feed intake, and overall live weight gain than those that were supplemented during the grazing phase.

In 2012, supplementation during the grazing phase had no effect ($P > 0.05$) on finishing gains or feed:gain. Steers that were supplemented during the entire grazing phase had greater ($P < 0.05$) ribeye area than those that received no supplement. No other differences in carcass characteristics were observed.

Under the conditions of this study, supplementation of stocker cattle grazing smooth bromegrass pasture with DDG at 0.5% of body weight only during the latter part of the grazing season would likely have been the most profitable treatment 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 grazing gains similar to those supplemented during the entire grazing phase. In 2008 and 2012, DDG supplementation during the grazing phase carried no advantage if ownership of the cattle was retained through slaughter. In 2009, 2010, and 2011, however, stocker cattle that were supplemented with DDG during the grazing phase maintained their weight advantage through slaughter. Cattle grazed for a shorter duration in 2012 than in previous years due to forage availability being limited due to below normal precipitation; therefore, weight gain from grazing represented a smaller percentage and weight gain from finishing a greater percentage of overall gain than in previous years.

Table 1. Effects 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/a, lb	257a	337b	317b
Total DDG consumption, lb/head	0	651	496
Average DDG consumption, lb/head per day	0	3.3	3.5
DDG, lb/additional gain	---	6.5	6.6
Average available smooth bromegrass forage, lb of dry matter/a	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 USDA grade 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. Effects 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/a, lb	260a	368b	364b
Total DDG consumption, lb/head	0	773	631
Average DDG consumption, lb/head per day	0	3.5	2.9
DDG, lb/additional gain	---	5.7	4.9
Average available smooth bromegrass forage, lb of dry matter/a	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 USDA grade 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 ($P < 0.05$).

Table 3. Effects 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, 2010

	Level of DDG (% body weight/head per day)		
Item	0	0.5	0.5 delayed[1]
Grazing phase (224 days)			
No. of head	12	12	12
Initial weight, lb	448	448	448
Final weight, lb	791a	880b	894b
Gain, lb	343a	431b	446b
Daily gain, lb	1.53a	1.93b	1.99b
Gain/a, lb	275a	345b	357b
Total DDG consumption, lb/head	0	758	630
Average DDG consumption, lb/head per day	0	3.4	2.8
DDG, lb/additional gain	---	8.6	6.1
Average available smooth bromegrass forage, lb of dry matter/a	6,382	6,364	6,477
Finishing phase (100 days)			
Beginning weight, lb	791a	880b	894b
Ending weight, lb	1228a	1319b	1318b
Gain, lb	436	439	424
Daily gain, lb	4.36	4.39	4.24
Daily dry matter intake, lb	23.6	26.1	24.7
Feed:gain	5.41	5.94	5.82
Hot carcass weight, lb	725a	772b	779b
Dressing percentage	59.1	58.5	59.1
Backfat, in.	0.34	0.35	0.41
Ribeye area, sq. in.	11.0	11.3	11.7
Yield grade	2.7	2.8	2.9
Marbling score[2]	565	600	610
Percentage USDA grade choice	100	92	100
Overall performance (grazing plus finishing; 324 days)			
Gain, lb	780a	871b	870b
Daily gain, lb	2.41a	2.69b	2.69b

[1] Steers were supplemented with DDG only during the last 168 days of the grazing phase.
[2] 500 = small, 600 = modest, 700 = moderate.
Means within a row followed by the same letter are not significantly different ($P < 0.05$).

Table 4. Effects 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, 2011

	Level of DDG (% body weight/head per day)		
Item	0	0.5	0.5 delayed[1]
Grazing phase (199 days)			
No. of head	12	12	12
Initial weight, lb	468	468	468
Final weight, lb	725a	814b	833b
Gain, lb	257a	346b	365b
Daily gain, lb	1.29a	1.74b	1.83b
Gain/a, lb	206a	277b	292b
Total DDG consumption, lb/head	0	658	526
Average DDG consumption, lb/head per day	0	3.3	2.6
DDG, lb/additional gain	---	7.4	4.9
Average available smooth bromegrass forage, lb of dry matter/a	5,203	5,273	5,236
Finishing phase (110 days)			
Beginning weight, lb	725a	814b	833b
Ending weight, lb	1250a	1325b	1349b
Gain, lb	525	511	516
Daily gain, lb	4.77	4.64	4.69
Daily dry matter intake, lb	25.2a	26.7b	26.6b
Feed:gain	5.28	5.76	5.67
Hot carcass weight, lb	731a	780ab	788b
Dressing percentage	58.5	58.9	58.5
Backfat, in.	0.39	0.41	0.40
Ribeye area, sq. in.	11.6	11.7	12.4
Yield grade	2.8	2.8	2.5
Marbling score[2]	653	605	636
Percentage USDA grade choice	100	92	92
Overall performance (grazing plus finishing; 309 days)			
Gain, lb	782a	857ab	881b
Daily gain, lb	2.53a	2.77ab	2.85b

[1] Steers were supplemented with DDG only during the last 143 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 5. Effects 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, 2012

	Level of DDG (% body weight/head per day)		
Item	0	0.5	0.5 delayed[1]
Grazing phase (142 days)			
No. of head	12	12	12
Initial weight, lb	489	489	490
Final weight, lb	671a	753b	749b
Gain, lb	182a	264b	260b
Daily gain, lb	1.28a	1.86b	1.83b
Gain/a, lb	145a	211b	208b
Total DDG consumption, lb/head	0	441	290
Average DDG consumption, lb/head per day	0	3.1	2.0
DDG, lb/additional gain	---	5.4	3.7
Average available smooth bromegrass forage, lb of dry matter/a	6,437	6,575	6,519
Finishing phase (127 days)			
Beginning weight, lb	671a	753b	749b
Ending weight, lb	1217	1294	1291
Gain, lb	546	541	541
Daily gain, lb	4.30	4.26	4.26
Daily dry matter intake, lb	25.9	26.1	25.4
Feed:gain	6.03	6.14	5.95
Hot carcass weight, lb	755	802	800
Backfat, in.	0.38	0.40	0.42
Ribeye area, sq. in.	11.8a	12.6b	12.3ab
Yield grade	2.5	2.4	2.7
Marbling score[2]	537	582	553
Percentage USDA grade choice	83	69	92
Overall performance (grazing plus finishing; 269 days)			
Gain, lb	728	804	801
Daily gain, lb	2.71	2.99	2.98

[1] Steers were supplemented with DDG only during the last 86 days of the grazing phase.
[2] 500 = small, 600 = modest.
Means within a row followed by the same letter are not significantly different ($P < 0.05$).

Effects of Various Forage Systems on Grazing and Subsequent Finishing Performance

L.W. Lomas and J.L. Moyer

Summary
A total of 120 mixed black yearling steers were used to compare grazing and subsequent finishing performance from pastures with 'MaxQ' tall fescue, a wheat-bermudagrass double-crop system, or a wheat-crabgrass double-crop system in 2010, 2011, and 2012. Daily gains of steers that grazed 'MaxQ' tall fescue, wheat-bermudagrass, or wheat-crabgrass were similar ($P > 0.05$) in 2010, but daily gains of steers that grazed wheat-bermudagrass or wheat-crabgrass were greater ($P > 0.05$) than those that grazed 'MaxQ' tall fescue in 2011 and 2012. Finishing gains were similar ($P > 0.05$) among forage systems in 2010 and 2012. In 2011, finishing gains of steers that grazed 'MaxQ' tall fescue were greater ($P < 0.05$) than those that grazed wheat-bermudagrass.

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

Experimental Procedures
Forty mixed black yearling steers were weighed on two consecutive days each year and allotted on April 6, 2010 (633 lb); March 23, 2011 (607 lb); and March 22, 2012 (632 lb) to three four-acre pastures of 'Midland 99' bermudagrass and three 4-acre pastures of 'Red River' crabgrass that had previously been no-till seeded with approximately 120 lb/a of 'Fuller' hard red winter wheat on September 30, 2009, and September 22, 2010, and 130 lb/a of 'Everest" hard red winter wheat seeded on September 27, 2011, and four 4-acre established pastures of 'MaxQ' tall fescue (4 steers/pasture). All pastures were fertilized with 80-40-40 lb/a of N-P_2O_5-K_2O on March 3, 2010; January 27, 2011; and January 25, 2012. Bermudagrass and crabgrass pastures received an additional 46 lb/a of nitrogen (N) on May 28, 2010; June 10, 2011; and May 18, 2012. Fescue pastures received an additional 46 lb/a of N on August 31, 2010, and September 15, 2011. An additional 5 lb/a and 4 lb/a of crabgrass seed was broadcast on crabgrass pastures on April 8, 2011, and April 4, 2012, respectively.

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 wheat, bermudagrass, crabgrass, or tall fescue. Cattle were treated for internal and external parasites before being turned out to pasture and later were vaccinated for protection from pinkeye. Steers had free access to commercial mineral blocks that contained 12% calcium, 12% phosphorus, and 12% salt. Wheat-bermudagrass and wheat-crabgrass pastures were grazed continuously until September 14, 2010 (161 days), and September 7, 2011 (168 days), and fescue pastures were grazed continuously until November 9, 2010 (217 days), and October 21, 2011 (212 days). In 2012, all pastures were grazed continuously until August 23 (144 days), when grazing was on all pastures was terminated due to limited forage availability because of below-average precipitation. Steers were weighed on two consecutive days at the end of the grazing phase.

After the grazing period, cattle were moved to a finishing facility, implanted with Synovex-S (Pfizer Animal Health, Madison, NJ), and fed a diet of 80% whole-shelled corn, 15% corn silage, and 5% supplement (dry matter basis). Finishing diets were fed for 94 days (wheat-bermudagrass and wheat-crabgrass) or 100 days (fescue) in 2010, 98 days (wheat-bermudagrass and wheat-crabgrass) or 96 days (fescue) in 2011, and 105 days in 2012. 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, a wheat-bermudagrass double-crop system, or a wheat-crabgrass double-crop system are presented in Tables 1, 2, and 3 for 2010, 2011, and 2012, respectively. Daily gains of steers that grazed 'MaxQ' tall fescue, wheat-bermudagrass, or wheat-crabgrass were similar ($P > 0.05$) in 2010, but total grazing gain and gain/a were greater ($P < 0.05$) for 'MaxQ' tall fescue than wheat-bermudagrass or wheat-crabgrass because steers grazed 'MaxQ' tall fescue for more days. Gain/a for 'MaxQ' fescue, wheat-bermudagrss, and wheat-crabgrass were 362, 286, and 258 lb/a, respectively. 'MaxQ' tall fescue pastures had greater ($P < 0.05$) average available forage dry matter (DM) than wheat-bermudagrass or wheat-crabgrass. Grazing treatment in 2010 had no effect ($P > 0.05$) on subsequent finishing gains. Steers that grazed 'MaxQ' were heavier ($P < 0.05$) at the end of the grazing phase, maintained their weight advantage through the finishing phase, and had greater ($P < 0.05$) hot carcass weight than those that grazed wheat-bermudagrass or wheat-crabgrass pastures. Steers that previously grazed wheat-bermudagrass or wheat-crabgrass had lower ($P < 0.05$) feed:gain than those that had grazed 'MaxQ.'

In 2011, daily gains, total gain, and gain/a of steers that grazed wheat-bermudagrass or wheat-crabgrass were greater ($P < 0.05$) than 'MaxQ' fescue. Gain/a for 'MaxQ' fescue, wheat-bermudagrss, and wheat-crabgrass were 307, 347, and 376 lb/a, respectively. 'MaxQ' tall fescue pastures had greater ($P < 0.05$) average available forage DM than wheat-bermudagrass or wheat-crabgrass. Steers that grazed 'MaxQ' had greater ($P < 0.05$) finishing gain than those that grazed wheat-bermudagrass and lower ($P < 0.05$) feed:gain than those that grazed wheat-bermudagrass or wheat-crabgrass. Carcass weight was similar ($P > 0.05$) among treatments.

In 2012, daily gains, total gain, and gain/a of steers that grazed wheat-bermudagrass or wheat-crabgrass were greater ($P < 0.05$) than 'MaxQ'fescue. Gain/a for 'MaxQ' fescue, wheat-bermudagrss, and wheat-crabgrass were 226, 325, and 313 lb/a, respectively. 'MaxQ' tall fescue pastures had greater ($P < 0.05$) average available forage DM than wheat-bermudagrass or wheat-crabgrass. Grazing treatment had no effect ($P > 0.05$) on subsequent finishing performance or carcass characteristics.

Hotter, drier weather during the summer of 2011 and 2012 likely provided more favorable growing conditions for bermudagrass and crabgrass than for fescue, which was reflected in greater ($P < 0.05$) gains by cattle grazing those pastures. Lack of precipitation also reduced the length of the grazing season for 'MaxQ' fescue pastures in 2011 and 2012, which resulted in less fall grazing and lower gain/a than was observed for those pastures in 2010.

Table 1. Effects of forage system on grazing and subsequent performance of stocker steers, Southeast Agricultural Research Center, 2010

	Forage system		
Item	'MaxQ' fescue	Wheat-bermudagrass	Wheat-crabgrass
Grazing phase			
No. of days	217	161	161
No. of head	16	12	12
Initial weight, lb	633	633	633
Ending weight, lb	995a	919b	891b
Gain, lb	362a	286b	258b
Daily gain, lb	1.67	1.78	1.60
Gain/a, lb	362a	286b	258b
Average available forage dry matter, lb/a	6214a	3497b	3174c
Finishing phase			
No. of days	100	94	94
Beginning weight, lb	995a	919b	891b
Ending weight, lb	1367a	1281b	1273b
Gain, lb	372	361	382
Daily gain, lb	3.72	3.84	4.07
Daily dry matter intake, lb	27.3a	24.6b	25.2b
Feed:gain	7.35a	6.42b	6.22b
Hot carcass weight, lb	847a	794b	790b
Backfat, in.	0.43	0.38	0.35
Ribeye area, sq. in.	12.5	12.5	12.2
Yield grade	2.8	2.5	2.5
Marbling score[1]	649	590	592
Percentage USDA choice grade	100	92	83
Overall performance (grazing plus finishing)			
No. of days	317	255	255
Gain, lb	734a	648b	640b
Daily gain, lb	2.32a	2.54b	2.51ab

[1] 500 = small, 600 = modest, 700 = moderate.

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

Table 2. Effects of forage system on grazing and subsequent performance of stocker steers, Southeast Agricultural Research Center, 2011

	Forage system		
Item	'MaxQ' fescue	Wheat-bermudagrass	Wheat-crabgrass
Grazing phase			
No. of days	212	168	168
No. of head	16	12	12
Initial weight, lb	607	607	607
Ending weight, lb	914a	954b	982b
Gain, lb	307a	347b	376b
Daily gain, lb	1.45a	2.07b	2.24b
Gain/a, lb	307a	347b	376b
Average available forage dry matter, lb/a	5983a	4172b	3904c
Finishing phase			
No. of days	96	98	98
Beginning weight, lb	914a	954b	982b
Ending weight, lb	1355	1344	1385
Gain, lb	442a	389b	403ab
Daily gain, lb	4.60a	3.97b	4.11ab
Daily dry matter intake, lb	27.9	28.0	29.3
Feed:gain	6.09a	7.07b	7.13b
Hot carcass weight, lb	841	833	859
Backfat, in.	0.41	041	0.44
Ribeye area, sq. in.	12.9	13.0	13.3
Yield grade	2.6	2.7	2.8
Marbling score[1]	619	640	612
Percentage USDA choice grade	100	92	92
Overall performance (grazing plus finishing)			
No. of days	308	266	266
Gain, lb	749	737	779
Daily gain, lb	2.43a	2.77b	2.93b

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

Table 3. Effects of forage system on grazing and subsequent performance of stocker steers, Southeast Agricultural Research Center, 2012

	Forage system		
Item	'MaxQ' fescue	Wheat-bermudagrass	Wheat-crabgrass
Grazing phase			
No. of days	144	144	144
No. of head	16	12	12
Initial weight, lb	632	632	632
Ending weight, lb	858a	957b	945b
Gain, lb	226a	325b	313b
Daily gain, lb	1.57a	2.26b	2.17b
Gain/a, lb	226a	325b	313b
Average available forage dry matter, lb/a	5983a	4172b	3904c
Finishing phase			
No. of days	105	105	105
Beginning weight, lb	858a	957b	945b
Ending weight, lb	1355	1409	1431
Gain, lb	497	451	486
Daily gain, lb	4.73	4.30	4.63
Daily dry matter intake, lb	30.7	28.3	29.1
Feed:gain	6.53	6.61	6.28
Hot carcass weight, lb	840	873	887
Backfat, in.	0.44	0.38	0.45
Ribeye area, sq. in.	12.6	12.8	13.3
Yield grade	2.8	2.7	2.8
Marbling score[1]	625	591	603
Percentage USDA choice grade	100	83	92
Overall performance (grazing plus finishing)			
No. of days	249	249	249
Gain, lb	722	776	799
Daily gain, lb	2.90	3.12	3.21

[1] 500 = small, 600 = modest, 700 = moderate.
Means within a row followed by the same letter do not differ ($P < 0.05$).

Effects 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

Two hundred eighty-eight yearling 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' and low-endophyte 'Kentucky 31,' 'HM4,' and 'MaxQ.' Steers were either fed no supplement or were supplemented with DDG at 1.0% body weight per head daily in 2009 or 0.75% of body weight per head daily in 2010, 2011, and 2012 while grazing. 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/a 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 were similar ($P > 0.05$) among fescue cultivars in 2009 and 2012; however, steers that previously grazed high-endophyte 'Kentucky 31' had greater ($P > 0.05$) finishing gains that those that had grazed 'HM4' or 'MaxQ' in 2010 and greater ($P < 0.05$) finishing gains than those that grazed low-endophyte 'Kentucky 31' or 'HM4' in 2011. Supplementation of grazing steers with DDG supported a higher stocking rate and resulted in greater ($P < 0.05$) grazing gain, gain/a, hot carcass weight, ribeye area, and overall gain and reduced the amount of fertilizer needed by providing approximately 60 lb/a, 50 lb/a, 50 lb/a, and 30 lb/a of nitrogen (N) in 2009, 2010, 2011, and 2012, respectively, primarily from 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 pressure 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 feed. In recent years, new tall fescue cultivars have been developed with a non-toxic endophyte that provides vigor to the fescue plant without negatively affecting performance of grazing livestock.

Growth in the ethanol industry has resulted in increased availability of distillers grains, which have been shown to be an excellent feedstuff for supplementing grazing cattle because of their high protein and phosphorus content. Distillers grains contain approximately 4% to 5% N, and cattle consuming them excrete a high percentage of this N in their urine and feces; therefore, feeding DDG to grazing cattle will provide N 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 yearling steers were weighed on two consecutive days and allotted to 16 5-acre established pastures of high-endophyte 'Kentucky 31' or low-endophyte 'Kentucky 31,' 'HM4,' or 'MaxQ' tall fescue (4 replications per cultivar) on March 26, 2009 (569 lb); March 24, 2010 (550 lb); March 23, 2011 (536 lb); and March 22, 2012 (550 lb). 'HM4' and 'MaxQ' are cultivars that have a non-toxic 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% or 0.75% body weight per head daily during the grazing phase in 2009 or 2010, 2011, and 2012, respectively. All pastures were fertilized with 80 lb/a N and P_2O_5 and K_2O as required by soil test on February 5, 2009; February 10, 2010; and January 27, 2011; and with 90 lb/a N on January 25, 2012. Pastures with steers that received no supplement were fertilized with 60 lb/a N on September 16, 2009; 46 lb/a N on August 30, 2011 and September 15, 2011; and 30 lb/a N on August 10, 2012. This was calculated to be approximately the same amount of N 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 in 2009 and one steer in 2012 were removed from the study for reasons unrelated to experimental treatment. Pastures were grazed continuously until October 13, 2009 (201 days); November 3, 2010 (224 days); October 19, 2011 (210 days); and August 21, 2012 (152 days), when steers were weighed on two consecutive days and grazing was terminated.

After the grazing period, cattle were moved to a finishing facility, implanted with Synovex-S (Pfizer Animal Health, Madison, NJ), 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 and for 112 or 98 days, respectively, in 2009 and 2011, for 106 days in 2010, and for 113 days in 2012. All steers were slaughtered in a commercial facility, and carcass data were collected.

Results and Discussion

Because no significant interactions occurred ($P > 0.05$) between cultivar and supplementation treatment, grazing and subsequent finishing performance are pooled across supplementation treatment and presented by tall fescue cultivar in Tables 1, 2, 3, and 4 for 2009, 2010, 2011, and 2012, respectively, and by supplementation treatment in Tables 5, 6, 7, and 8 for 2009, 2010, 2011, and 2012, respectively.

During all four years, 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/a than those that grazed high-endophyte 'Kentucky 31' pastures (Tables 1, 2, 3, and 4). 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, in 2009; 1.56, 1.91, 1.97, and 2.04 lb/head, respectively, in 2010; 1.47, 2.00, 1.96, and 1.95 lb/head, respectively, in 2011; and 1.00, 1.93, 2.06, and 2.04 lb/head, respectively, in 2012. Gain/a from pastures with high-endophyte 'Kentucky 31,' low-endophyte 'Kentucky 31,' 'HM4,' and 'MaxQ' were 318, 438, 415, and 428 lb/a, respectively, in 2009; 322, 390, 400, and 416 lb/a, respectively, in 2010; 288, 385, 377, and 378 lb/a, respectively, in 2011; and 145, 271, 288, and 286 lb/a, respectively, in 2012.

In 2009, subsequent finishing gains and feed efficiency were similar ($P > 0.05$) among fescue cultivars (Table 1). 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 graded choice or higher were similar ($P > 0.05$) among fescue cultivars.

In 2010, steers that previously grazed high-endophyte 'Kentucky 31' had greater ($P < 0.05$) finishing gains than those that had grazed 'HM4' or 'MaxQ,' finishing gains similar ($P > 0.05$) to those that grazed low-endophyte 'Kentucky 31,' lower ($P < 0.05$) hot carcass weight than those that grazed 'MaxQ,' hot carcass weight similar ($P > 0.05$) to those that grazed low-endophyte 'Kentucky 31' or 'HM4,' and less ($P < 0.05$) fat thickness than those that grazed low-endophyte 'Kentucky 31,' 'HM4,' or 'MaxQ' (Table 2). Feed:gain and percentage of carcasses grading choice or higher were similar ($P > 0.05$) among fescue cultivars. Overall gain of steers that grazed high-endophyte 'Kentucky 31' was greater ($P < 0.05$) than that of steers that grazed low-endophyte 'Kentucky 31' or 'MaxQ' and similar ($P > 0.05$) to that of steers that grazed 'HM4.'

In 2011, steers that previously grazed high-endophyte 'Kentucky 31' had greater ($P < 0.05$) finishing gains and lower ($P < 0.05$) feed:gain than those that had grazed low-endophyte 'Kentucky 31' or 'HM4' and lower ($P < 0.05$) hot carcass weight and smaller ($P < 0.05$) ribeye area than those that grazed 'MaxQ' (Table 3). Hot carcass weight, ribeye area, and overall gain and daily gain were similar ($P < 0.05$) between steers that grazed low-endophyte 'Kentucky 31,' 'HM4,' or 'MaxQ.' Steers that previously grazed high-endophyte 'Kentucky 31' had lower ($P < 0.05$) overall gain and daily gain than steers that grazed 'HM4' or 'MaxQ.'

In 2012, subsequent finishing gains were similar ($P > 0.05$) among fescue cultivars (Table 4), but steers that previously grazed high-endophyte 'Kentucky 31' had lower ($P < 0.05$) feed intake, lower ($P < 0.05$) feed:gain, lower ($P < 0.05$) hot carcass weight, lower ($P < 0.05$) overall gain, and lower ($P < 0.05$) overall daily gain than those that had grazed low-endophyte 'Kentucky 31,' 'HM4,' or 'MaxQ' (Table 4).

Steers supplemented with DDG gained significantly more ($P < 0.05$) and produced more ($P < 0.05$) gain/a than those that received no supplement while grazing (Tables 5, 6, 7, and 8). Grazing gains and gain/a 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, in 2009; 1.62 and 2.12 lb/head daily and 363 and 475 lb/a, respectively, in 2010; 1.46 and 2.23 lb/head daily and 246 and 469 lb/a, respectively, in 2011; and 1.31 and 2.20 lb/head daily and 160 and 334 lb/a, respectively, in 2012. Supplemented steers consumed an average of 7.8, 6.0, 5.9, and 5.5 lb of DDG/head daily during the grazing phase in 2009, 2010, 2011, and 2012, respectively. Each additional pound of gain obtained from pastures with supplemented steers required 6.5, 7.2, 5.6, and 4.8 lb of DDG in 2009, 2010, 2011, and 2012, respectively. Steers that were supplemented during the grazing phase had greater ($P < 0.05$) final finishing weights, hot carcass weights, overall gain, and overall daily gain than those that received no supplement while grazing during all four years. Daily gain, feed efficiency, yield grade, marbling score, and percentage of carcasses grading choice or higher were similar ($P > 0.05$) between supplementation treatments in 2009; however, in 2010, 2011, and 2012, steers supplemented with DDG while grazing had lower ($P < 0.05$) finishing gains than those that received no supplement while grazing.

Average available forage dry matter (DM) is presented for each fescue cultivar and supplementation treatment combination for 2009, 2010, 2011, and 2012 in Tables 9, 10, 11, and 12, respectively. A significant interaction occurred ($P < 0.05$) between cultivar and supplementation treatment during all four years. Within each variety, there was no difference ($P > 0.05$) in average available forage DM between pastures stocked with 0.8 steer/a that received no supplement and those stocked with 1.0 steer/a and supplemented with DDG at 1.0% body weight per head daily in 2009 (Table 9). Average available forage DM was similar ($P > 0.05$) between supplementation treatments and pastures with supplemented steers stocked at a heavier rate, which indicates that pastures were responding to the N 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 DM than 'MaxQ' pastures without supplementation. No other differences in average available forage DM were observed.

In 2010, no difference occurred ($P > 0.05$) in average available forage DM within variety for high-endophyte 'Kentucky 31,' low-endophyte 'Kentucky 31,' or 'HM4' pastures stocked with 0.8 steer/a that received no supplement and those stocked with 1.0 steer/a and supplemented with DDG at 0.75% body weight per head daily (Table 10); however, 'MaxQ' pastures that were stocked at the heavier rate and grazed by steers supplemented with DDG had greater ($P < 0.05$) average available forage DM than those stocked at a lighter rate and grazed by steers that received no supplement. High-endophyte 'Kentucky 31' pastures had greater ($P < 0.05$) average available DM than low-endophyte 'Kentucky 31,' 'HM4,' or 'MaxQ' pastures stocked with 0.8 steer/a that received no supplement.

In 2011, no difference occurred ($P > 0.05$) in average available forage DM within variety for low-endophyte 'Kentucky 31' or 'HM4' pastures stocked with 0.8 steer/a that received no supplement and those stocked with 1.0 steer/a and supplemented with DDG at 0.75% body weight per head daily (Table 11), but 'MaxQ' pastures that were stocked at the heavier rate and grazed by steers supplemented with DDG had greater ($P < 0.05$) average available forage DM than those stocked at a lighter rate and grazed by steers that received no supplement. High-endophyte 'Kentucky 31' pastures that were stocked at the heavier rate and grazed by steers supplemented with DDG had lower ($P < 0.05$) average available forage DM than those stocked at a lighter rate. High-endophyte 'Kentucky 31' pastures had greater ($P < 0.05$) average available DM than low-endophyte 'Kentucky 31,' 'HM4,' or 'MaxQ' pastures stocked with 0.8 steer/a that received no supplement.

In 2012, a cultivar × date interaction occurred, with similar peak available DM on April 18 ($P > 0.05$) but lower available DM for 'MaxQ' and 'HM4' ($P < 0.05$) at the end of the grazing phase on August 17. No difference occurred ($P > 0.05$) in average available forage DM within variety for low-endophyte 'Kentucky 31,' 'HM4,' or 'MaxQ' pastures stocked with 0.8 steer/a that received no supplement and those stocked with 1.0 steer/a and supplemented with DDG at 0.75% body weight per head daily (Table 12); however, high-endophyte 'Kentucky 31' pastures that were stocked at the heavier rate and grazed by steers supplemented with DDG had lower ($P < 0.05$) average available forage DM than those stocked at a lighter rate in both 2011 and 2012. This result suggests that supplementation with DDG increased forage intake and utilization by cattle grazing these pastures. High-endophyte 'Kentucky 31' pastures had greater ($P < 0.05$) average available DM than low-endophyte 'Kentucky 31,' 'HM4,' or 'MaxQ' pastures within each stocking rate and supplementation level in 2012.

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/a, and reduced the amount of fertilizer needed by providing approximately 30 to 60 lb of N/a. Producers seeking to maximize production from fescue pastures should consider using one of the new fescue varieties with the non-toxic endophyte in combination with DDG supplementation.

Table 1. Effects 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/a, 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
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 USDA grade 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. Effects of cultivar on grazing and subsequent performance of steers grazing tall fescue pastures, Southeast Agricultural Research Center, 2010

	Tall fescue cultivar			
Item	High-endophyte Kentucky 31	Low-endophyte Kentucky 31	HM4	MaxQ
Grazing phase (224 days)				
No. of head	18	18	18	18
Initial weight, lb	550	550	550	550
Ending weight, lb	899a	978b	990b	1007b
Gain, lb	349a	428b	441b	457b
Daily gain, lb	1.56a	1.91b	1.97b	2.04b
Gain/a, lb	322a	390b	400b	416b
Finishing phase (106 days)				
Beginning weight, lb	899a	978b	990b	1007b
Ending weight, lb	1386a	1432b	1419b	1449b
Gain, lb	486a	454ab	429b	442b
Daily gain, lb	4.59a	4.28ab	4.04b	4.17b
Daily dry matter intake, lb	25.8	26.0	25.7	26.0
Feed:gain	5.63	6.10	6.37	6.24
Hot carcass weight, lb	812a	849ab	840ab	861b
Dressing percentage	58.6	59.3	59.2	59.4
Backfat, in.	0.37a	0.48b	0.44b	0.45b
Ribeye area, sq. in.	12.0	12.2	12.2	12.4
Yield grade[1]	2.7	2.9	2.8	2.8
Marbling score[2]	660ab	676a	630b	648ab
Percentage USDA grade choice	100	94	94	100
Overall performance (grazing plus finishing) (330 days)				
Gain, lb	836a	882b	869ab	899b
Daily gain, lb	2.53a	2.67b	2.63ab	2.72b

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

Table 3. Effects of cultivar on grazing and subsequent performance of steers grazing tall fescue pastures, Southeast Agricultural Research Center, 2011

	Tall fescue cultivar			
Item	High-endophyte Kentucky 31	Low-endophyte Kentucky 31	HM4	MaxQ
Grazing phase (210 days)				
No. of head	18	18	18	18
Initial weight, lb	536	536	536	536
Ending weight, lb	845a	956b	947b	946b
Gain, lb	310a	420b	411b	410b
Daily gain, lb	1.47a	2.00b	1.96b	1.95b
Gain/a, lb	288a	385b	377b	378b
Finishing phase (105 days)				
Beginning weight, lb	845a	956b	947b	946b
Ending weight, lb	1310a	1369ab	1374ab	1401b
Gain, lb	465a	412b	427bc	455ac
Daily gain, lb	4.42a	3.93b	4.05bc	4.33ac
Daily dry matter intake, lb	27.0ab	27.2ab	26.7a	27.8b
Feed:gain	6.12a	6.94b	6.62bc	6.43ac
Hot carcass weight, lb	812a	849ab	852ab	869b
Dressing percentage	59.9ab	59.5b	60.4a	60.5a
Backfat, in.	0.39a	0.46ab	0.45ab	0.50b
Ribeye area, sq. in.	12.7a	13.0ab	13.1ab	13.3b
Yield grade[1]	2.5	2.8	2.8	2.8
Marbling score[2]	646ab	620a	687b	654ab
Percentage USDA grade choice	100	100	100	100
Overall performance (grazing plus finishing) (315 days)				
Gain, lb	774a	833ab	839b	865b
Daily gain, lb	2.46a	2.65ab	2.66b	2.75b

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

Table 4. Effects of cultivar on grazing and subsequent performance of steers grazing tall fescue pastures, Southeast Agricultural Research Center, 2012

	Tall fescue cultivar			
Item	High-endophyte Kentucky 31	Low-endophyte Kentucky 31	HM4	MaxQ
Grazing phase (152 days)				
No. of head	18	18	17	18
Initial weight, lb	550	550	548	550
Ending weight, lb	702a	843b	861b	859b
Gain, lb	152a	293b	313b	310b
Daily gain, lb	1.00a	1.93b	2.06b	2.04b
Gain/a, lb	145a	271b	288b	286b
Finishing phase (113 days)				
Beginning weight, lb	702a	843b	861b	859b
Ending weight, lb	1249a	1384b	1408b	1415b
Gain, lb	547	541	547	556
Daily gain, lb	4.84	4.79	4.84	4.92
Daily dry matter intake, lb	24.8a	27.2b	28.0b	28.6b
Feed:gain	5.13a	5.67b	5.79b	5.85b
Hot carcass weight, lb	774a	858b	873b	877b
Backfat, in.	0.45a	0.52b	0.49ab	0.48ab
Ribeye area, sq. in.	12.2a	12.9ab	13.4b	13.1b
Yield grade[1]	2.7	3.0	2.8	2.9
Marbling score[2]	577a	591a	657b	619ab
Percentage USDA grade choice	95	88	100	100
Overall performance (grazing plus finishing) (265 days)				
Gain, lb	699a	835b	860b	865b
Daily gain, lb	2.64a	3.15b	3.25b	3.27b

[1] USDA (1987).

[2] 500 = small, 600 = modest, 700 = moderate.

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

Table 5. Effects 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/a, 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 USDA grade 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 6. Effects of dried distillers grains (DDG) supplementation on grazing and subsequent performance of steers grazing tall fescue pastures, Southeast Agricultural Research Center, 2010

	DDG level (% body weight/head per day)	
Item	0	0.75
Grazing phase (224 days)		
No. of head	32	40
Initial weight, lb	550	550
Ending weight, lb	912a	1025b
Gain, lb	363a	475b
Daily gain, lb	1.62a	2.12b
Gain/a, lb	290a	475b
Total DDG consumption, lb/head	---	1335
Average DDG consumption, lb/head per day	---	6.0
DDG, lb/additional gain, lb	---	7.2
Finishing phase (106 days)		
Beginning weight, lb	912a	1025b
Ending weight, lb	1378a	1464b
Gain, lb	466a	439b
Daily gain, lb	4.40a	4.15b
Daily dry matter intake, lb	26.2	25.6
Feed:gain	5.99	6.18
Hot carcass weight, lb	806a	875b
Dressing percentage	58.5a	59.7b
Backfat, in.	0.39a	0.47b
Ribeye area, sq. in.	12.1	12.2
Yield grade	2.6	3.0
Marbling score[1]	638a	669b
Percentage USDA grade choice	94	100
Overall performance (grazing plus finishing) (330 days)		
Gain, lb	829a	914b
Daily gain, lb	2.51a	2.77b

[1] 600 = modest, 700 = moderate.

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

Table 7. Effects of dried distillers grains (DDG) supplementation on grazing and subsequent performance of steers grazing tall fescue pastures, Southeast Agricultural Research Center, 2011

	DDG level (% body weight/head per day)	
Item	0	0.75
Grazing phase (210 days)		
No. of head	32	40
Initial weight, lb	536	536
Ending weight, lb	843a	1005b
Gain, lb	307a	469b
Daily gain, lb	1.46a	2.23b
Gain/a, lb	246a	469b
Total DDG consumption, lb/head	---	1240
Average DDG consumption, lb/head per day	---	5.9
DDG, lb/additional gain, lb	---	5.6
Finishing phase		
No. of days	112	98
Beginning weight, lb	943a	1005b
Ending weight, lb	1324a	1403b
Gain, lb	481a	498b
Daily gain, lb	4.30a	4.07b
Daily dry matter intake, lb	27.3	27.1
Feed:gain	6.38	6.68
Hot carcass weight, lb	821a	870b
Backfat, in.	0.46	0.44
Ribeye area, sq. in.	12.7a	13.3b
Yield grade	2.8	2.6
Marbling score[1]	644	659
Percentage USDA grade choice	100	100
Overall performance (grazing plus finishing)		
No. of days	322	308
Gain, lb	788a	867b
Daily gain, lb	2.45a	2.82b

[1] 600 = modest, 700 = moderate.

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

Table 8. Effects of dried distillers grains (DDG) supplementation on grazing and subsequent performance of steers grazing tall fescue pastures, Southeast Agricultural Research Center, 2012

	DDG level (% body weight/head per day)	
Item	0	0.75
Grazing phase (152 days)		
No. of head	31	40
Initial weight, lb	549	550
Ending weight, lb	748a	884b
Gain, lb	200a	334b
Daily gain, lb	1.31a	2.20b
Gain/a, lb	160a	334b
Total DDG consumption, lb/head	---	829
Average DDG consumption, lb/head per day	---	5.5
DDG, lb/additional gain, lb	---	4.8
Finishing phase (113 days)		
Beginning weight, lb	748a	884b
Ending weight, lb	1314a	1414b
Gain, lb	566a	530b
Daily gain, lb	5.01a	4.69b
Daily dry matter intake, lb	26.8	27.5
Feed:gain	5.35a	5.87b
Hot carcass weight, lb	815a	877b
Backfat, in.	0.44a	0.53b
Ribeye area, sq. in.	12.6	13.2
Yield grade	2.7	3.0
Marbling score[1]	605	616
Percentage USDA grade choice	94	98
Overall performance (grazing plus finishing) (265 days)		
Gain, lb	765a	864b
Daily gain, lb	2.89a	3.26b

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

Table 9. Effects 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	5,593a	5,564a
Low-endophyte Kentucky 31	5,135ab	5,052ab
HM4	5,193ab	5,146ab
MaxQ	4,762b	5,527ab

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

Table 10. Effects of tall fescue cultivar and dried distillers grains (DDG) supplementation on average available forage dry matter, Southeast Agricultural Research Center, 2010

	DDG level (% body weight/head per day)	
Tall fescue cultivar	0	0.75
	------------------------ lb/a ------------------------	
High-endophyte Kentucky 31	6,553a	6,253ab
Low-endophyte Kentucky 31	5,791cd	5,675cd
HM4	5,884cd	5,617d
MaxQ	5,668d	5,984bc

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

Table 11. Effects of tall fescue cultivar and dried distillers grains (DDG) supplementation on average available forage dry matter, Southeast Agricultural Research Center, 2011

	DDG level (% body weight/head per day)	
Tall fescue cultivar	0	0.75
	------------------------ lb/a ------------------------	
High-endophyte Kentucky 31	5,313a	4,861b
Low-endophyte Kentucky 31	4,426c	4,439c
HM4	4,535c	4,468c
MaxQ	4,486c	4,939b

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

Table 12. Effects of tall fescue cultivar and dried distillers grains (DDG) supplementation on average available forage dry matter, Southeast Agricultural Research Center, 2012

	DDG level (% body weight/head per day)	
Tall fescue cultivar	0	0.75
	------------------------ lb/a ------------------------	
High-endophyte Kentucky 31	6,203a	5,784d
Low-endophyte Kentucky 31	5,993bcd	6,024abc
HM4	5,837cd	6,004abc
MaxQ	5,837cd	6,004abc

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

Using Legumes In Wheat-Bermudagrass Pastures

J.L. Moyer and L.W. Lomas

Summary
Use of legumes in lieu of 100 lb/a of nitrogen (N) for wheat-bermudagrass pastures have previously maintained spring and summer cow gains. A winter legume could further increase N available for summer bermudagrass production, so Austrian winter fieldpea as well as wheat were interseeded in fall to supplement summer clover production in bermudagrass. Forage production and estimated forage crude protein were increased in the legume pasture. Otherwise, cow performance was similar between the two treatments.

Introduction
Bermudagrass is a productive forage species when intensively managed, but it has periods of dormancy and requires proper management to maintain forage quality. Bermudagrass also requires adequate N fertilizer to optimize forage yield and quality. Interseeding wheat or other small grains can lengthen the grazing season, but this approach requires additional N fertilization. Legumes in the bermudagrass sward could improve forage quality and reduce fertilizer usage, but legumes are difficult to establish and maintain with the competitive grass. Clovers can maintain summer survival once established in bermudagrass sod and may be productive enough to substitute for some N fertilization. Including a winter annual legume with wheat could produce more N and forage crude protein. This study was designed to compare dry cow performance on a wheat-bermudagrass pasture system including spring and summer legume with a single 50 lb/a N application (Legumes) vs. wheat-bermudagrass with additional N application of 100 lb/a and no legumes (Nitrogen).

Experimental Procedures
Eight 5-acre 'Hardie' bermudagrass pastures that were interseeded with wheat at the Mound Valley Unit of the Southeast Agricultural Research Center (Parsons silt loam soil) were assigned to Legume or Nitrogen treatments in a completely randomized design with four replications.

All pastures were interseeded (no-till) with 'Everest' wheat (90 lb/a) into the bermudagrass sod on September 21–22, 2011, and the four designated pastures were interseeded with Austrian winter fieldpeas (35 lb/a) on September 23. Legume pastures received additional red clover (8 lb/a) and ladino clover (3 lb/a) by broadcast on March 1. Pastures that received no legumes (Nitrogen) were fertilized with 50 lb/a N as urea each on January 24 and May 6, 2012. All pastures received 50-30-30 of N-P_2O_5-K_2O on July 6.

Thirty-two pregnant fall-calving cows of predominantly Angus breeding were weighed on consecutive days and assigned randomly by weight to pastures on March 29. On August 17, cows were weighed again on consecutive days and removed from the pastures.

Available forage and forage crude protein (CP), as estimated by the normalized difference vegetation index (NDVI), were monitored monthly during grazing with an automated rising plate meter and Greenseeker (Trimble, Sunnyvale, CA) instrument, respectively.

Results and Discussion

Available forage is plotted by date (Figure 1); available forage was similar ($P > 0.10$) for the Legume and the Nitrogen systems overall as well as at each sampling time. The greatest amount of forage (primarily wheat) occurred in April, then declined significantly ($P < 0.05$) at each succeeding sampling date, largely due to summer drought.

Estimated crude protein concentration was higher in pastures with Legume vs. Nitrogen treatments in April, but the reverse was true on day 86 (Figure 1). The forage on both of those dates consisted primarily of wheat. On all subsequent dates, the treatments were similar, declining from May to June and from July to August.

Data for cow performance are in Table 1. Gains during the season were similar for the Legume and Nitrogen systems ($P > 0.10$), averaging 2.07 lb/head per day.

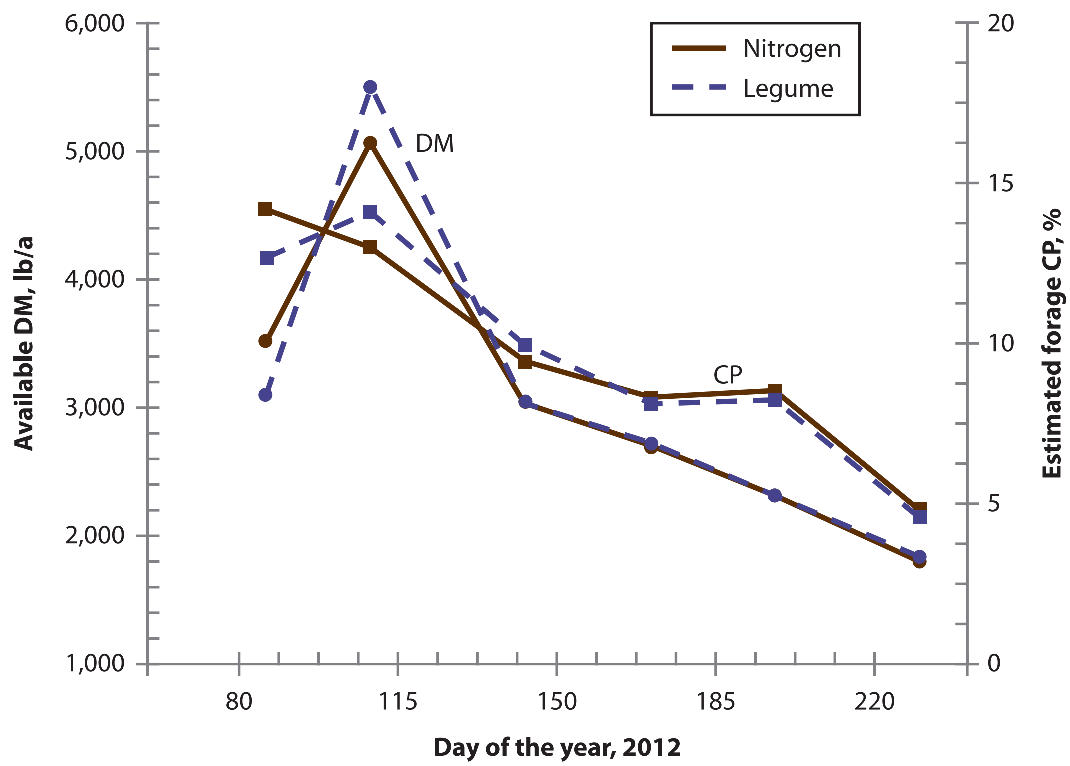


Figure 1. Available forage dry matter (DM) and estimated crude protein (CP) concentration during the grazing season in wheat-bermudagrass pastures fertilized with nitrogen or interseeded with legumes, Mound Valley Unit, Southeast Agricultural Research Center, 2012.

Table 1. Performance of cows grazing wheat-bermudagrass pastures interseeded with wheat and fertilized with nitrogen or interseeded with legumes, Mound Valley Unit, Southeast Agricultural Research Center, 2012

	Management system[1]	
Item	Nitrogen[2]	Legumes
No. of cows	16	16
No. of days	141	141
Stocking rate, cows/a	0.8	0.8
Cow initial weight, lb	1215	1230
Cow final weight, lb	1515	1513
Cow gain, lb	300	283
Cow daily gain, lb	2.13	2.01
Cow gain, lb/a	240	226

[1] None of the means within a row were significantly different at $P < 0.05$.

[2] Fertilized with 50 lb/a of nitrogen (N) in February and May; both treatments received 50 lb N/a, along with phosphorus (P) and potassium (K), on July 1.

Alfalfa Variety Performance in Southeastern Kansas[1]

J.L. Moyer

Summary
A 16-line alfalfa test was seeded in 2010 and cut four times in 2012. Total 2012 yields from 'Ameristand 407TQ' and 'FSG408DP' were greater ($P < 0.05$) than yields from three other cultivars. Three-year production from 'FSG639ST' and 'Ameristand 407TQ' was greater than five other entries.

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

Experimental Procedures
A 16-line alfalfa test with four replications was seeded (15 lb/a) on April 12, 2010, at the Mound Valley Unit of the Southeast Agricultural Research Center (Parsons silt loam). Plots were fertilized with 20-50-200 lb/a N-P_2O_5-K_2O each year. Plots were sprayed with Velpar AlfaMax herbicide (DuPont, Wilmington, DE) January 4 at 2.5 lb/a. Some weevil damage occurred, so plots were sprayed with 1.5 pt/a of Lorsban (Dow AgroSciences, Indianapolis, IN) on March 28. The second cutting was damaged by a storm with hail on May 19 and by a blister beetle swarm that went across almost the whole plot just before the second cutting. Drought prevented much regrowth until rain was received in late August. Harvests were taken on April 25, May 31, June 28, and October 9.

Results and Discussion
First-cut yields (at 10% bloom) were significantly greater ($P < 0.05$) for 'FSG408DP' and 'Perry' than for six other entries (Table 1). Second-cut yields were greater for 'FSG408DP' than for four other entries. Although third-cut yields were small because of drought, yield of 'FSG639ST' was greater than yields of two other entries. 'Kanza' and 'Perry' yielded more in the fall (fourth) cutting than six other entries.

Total 2012 yield for 'Ameristand 407TQ' and 'FSG408DP' were greater than yields from 'Archer III,' 'DG 4210,' and 'FSG528 SF.' Total yield for three years was higher for 'FSG639ST' and 'Ameristand 407TQ' than for five other entries.

[1] Statewide alfalfa performance tests results can be found at http://www.agronomy.ksu.edu/extension/p.aspx?tabid=91.

Table 1. Forage yields (tons/a at 12% moisture) for 2012, and 3-year total for the alfalfa variety test, Mound Valley Unit

		2012					3-yr.
Source	Entry	April 29	May 31	June 28	Oct. 9	Total	total
		------------------------ Tons/a, 12% moisture ------------------------					
America's Alfalfa	AmeriStand 403T+	2.74	1.77	0.42	0.73	5.65	13.78
America's Alfalfa	AmeriStand 407TQ	2.58	1.77	0.50	0.74	5.58	13.96
America's Alfalfa	Archer III	2.31	1.61	0.45	0.67	5.03	12.50
Allied	FSG505 Bt	2.56	1.72	0.50	0.74	5.52	13.53
Allied	FSG408DP Bt	2.55	1.66	0.45	0.64	5.29	13.81
Allied	FSG639ST Bt	2.58	1.86	0.57	0.67	5.67	14.23
CPS	DG 4210	2.14	1.71	0.47	0.67	5.00	12.29
Farm Science Genetics	FSG 528SF	2.57	1.67	0.52	0.73	5.48	13.01
Garst Seed	6552	2.23	1.61	0.45	0.71	5.00	12.56
Monsanto Seed	DKA50-18	2.18	1.60	0.45	0.67	4.90	12.23
Syngenta	6422Q	2.21	1.83	0.50	0.69	5.24	12.94
W-L Research	WL 343 HQ	2.38	1.67	0.51	0.69	5.25	12.64
W-L Research	WL 363 HQ	2.23	1.68	0.50	0.72	5.13	13.28
Kansas AES[1] and USDA	Kanza	2.48	1.74	0.55	0.74	5.50	13.68
Nebraska AES and USDA	Perry	2.83	1.62	0.34	0.72	5.50	13.89
Wisconsin AES and USDA	Vernal	2.78	1.68	0.47	0.71	5.63	13.71
Average		2.46	1.70	0.48	0.70	5.33	13.25
LSD (0.05)		0.30	0.16	0.08	NS	0.49	1.09

[1] Agricultural Experiment Station.

Evaluation of Tall Fescue Cultivars

J.L. Moyer

Summary
Spring 2012 hay yields for the 2010 trial were higher for 'PennTF01' and 'Martin 2–647' than for eight of the 18 other entries. Fall production was greater for 'Drover' and 'AGRFA-179' than for nine other entries. Total 2012 hay production was higher for 'PennTF01' and 'Martin 2–647' than for 6 other entries. Total clipped forage removed was greater for 'PennTF01' than for 'BAR FA80DH' and for 'BarOptima Plus E34.'

Introduction
Tall fescue (*Lolium arundinacium* Schreb.) is the most widely grown forage grass in southeastern Kansas. Its tolerance to extremes in climate and soils of the region is partly attributable to its association with a fungal endophyte, *Neotyphodium coenophialum*; however, most ubiquitous endophytes are also responsible for production of substances toxic to some herbivores, including cattle, sheep, and horses. Endophytes that purportedly lack toxins but augment plant vigor have been identified and inserted into tall fescue cultivars adapted to the United States. These cultivars, and others that are fungus-free or contain a ubiquitous endophyte, are included in this test.

Experimental Procedures
The trial was seeded at the Mound Valley Unit of the Southeast Agricultural Research Center in 10-in. rows on Parsons silt loam soil. Plots were 50 ft × 5 ft and were arranged in four randomized complete blocks. They were fertilized preplant with 20-50-60 lb/a of N-P_2O_5-K_2O and seeded with 20 lb/a of pure, live seed on September 22, 2010. Spring nitrogen (N) (60 lb/a) was applied on March 17, 2011. Fall growth was supplemented with 50 lb/a N on August 31.

To simulate grazing, half of each 50-ft plot was clipped to ≤2 in. on March 19, April 9, April 26, September 11, October 24, and December 13 with a rotary mower after some growth (>4 in.) was attained. The other half was left to harvest for hay yield. Prior to clipping, we estimated the amount removed from two plate meter readings per plot.

Harvest was performed on a 3-ft-wide and 15- to 20-ft-long strip from the remainder of each plot. A flail-type harvester was used to cut a 3-in. height after most plots had bloomed (April 26, 2012). Regrowth that occurred primarily in fall was harvested on December 13, 2012. After each harvest, forage was removed from the rest of the plot at the same height. A forage subsample was collected from each plot and dried at 140°F for moisture determination, then ground to pass a 1-mm screen for forage analysis.

Visual stand assessments were made after greenup on March 15. A scale of 0 to 5 was used, where 5 was a solid stand with no dead plants.

Results and Discussion

After two summers of below-average precipitation and above-average temperatures, some thinning of the tall fescue cultivars has occurred. Visual stand ratings were better ($P < 0.05$) for 'AU Triumph,' 'PennTF01,' 'Martin 2–647,' and 'Drover' than for 'Bariane,' 'AGRFA-179,' 'BarOptima Plus E34,' 'BAR FA 80DH,' and 'Bar Elite' (Table 1).

Spring 2012 forage yield of entries was greater ($P < 0.05$) for 'PennTF01' and 'Martin 2–647' than for eight of the 18 entries (Table 1). 'Jesup MaxQ' yielded more than five of the other entries, whereas 'Bariane' and 'AGRFA-179' produced less forage than seven higher-yielding entries.

Forage production during the rest of the season (April 26 through December 13), primarily fall production, was greater for 'Drover' and 'AGRFA-179' than for nine other entries. Fall production of 'BAR FA70DH,' 'DuraMax GOLD,' and 'Ky 31' LE was less than for seven other entries.

Total 2012 harvested (cut 1 + cut 2) production was higher for 'PennTF01' and 'Martin 2–647' than for 6 of the other entries, five of which were the same as for spring yields (Table 1). 'AU Triumph,' 'Jesup MaxQ,' and 'Drover' also yielded more than 'Bariane,' 'BarOptima Plus E34,' and 'AGRFA-179.' Total clipped forage removed in 2012 was greater for 'PennTF01' than for 'BARFA80DH' and 'BarOptima Plus E34.'

Total 2-year production was higher for 'Martin 2–647' and 'PennTF01' than for 9 of the other entries (Table 1). 'Jesup MaxQ,' 'DuraMax GOLD,' and 'AU Triumph' also yielded more than 'Bariane'and 'AGRFA-111.'

Heading dates averaged about two weeks earlier in 2012 than in 2011. 'Bariane' and 'AGRFA-179' headed later ($P < 0.05$) than all the other entries, which did not differ among themselves. Similar to last year, 'AU Triumph' and 'Drover' tended to be earlier than other entries. Again this year, we found no correlation between heading date and any yield parameters (data not shown); however, we found a negative correlation ($P > 0.01$) between heading date and stand rating in this test, indicating that earlier cultivars tended to have better survival, perhaps related to drought avoidance.

Table 1. Stand estimate, forage yield, and heading date of tall fescue cultivars seeded in 2010, Mound Valley Unit, 2012

Cultivar	Stand estimate[1]	Forage yield: April 28	Dec. 8	2012 total	2-yr. total	Clipped[2]	Heading date[3]
	--- 0-5 ---	Tons/a, 12% moisture					(Julian)
BarOptima PLUS E34	3.0	3.36	0.44	3.80	8.13	2.29	117
Bar Elite	3.3	3.51	0.43	3.93	8.01	2.61	119
Bardurum	3.5	3.60	0.39	3.99	8.25	2.71	117
Drover	4.3	3.87	0.65	4.52	8.64	2.70	102
BAR FA 70DH	3.6	3.93	0.27	4.20	8.59	2.68	109
BAR FA 80DH	3.2	3.83	0.40	4.22	8.45	2.20	111
Bariane	2.5	3.18	0.52	3.70	7.67	2.43	119
DuraMax GOLD	3.8	3.89	0.33	4.22	8.91	2.66	107
Martin 2 647	4.3	4.27	0.37	4.64	9.50	2.88	107
AGRFA 111	3.8	3.45	0.51	3.95	7.86	2.46	115
AGRFA 177	3.5	3.77	0.52	4.29	8.71	2.62	114
AGRFA 178	3.5	3.60	0.52	4.12	8.45	2.51	117
AGRFA 179	3.0	3.26	0.58	3.83	8.01	2.42	119
Jesup MaxQ	4.1	4.15	0.38	4.53	9.09	2.73	105
PennTF01	4.5	4.31	0.36	4.66	9.45	2.94	108
AU Triumph	4.5	4.02	0.53	4.54	8.81	2.46	100
Ky 31 HE	3.8	3.59	0.42	4.01	8.75	2.91	115
Ky 31 LE	4.0	3.73	0.34	4.07	8.44	2.58	113
Average	3.6	3.74	0.44	4.18	8.54	2.60	112
LSD (0.05)	0.8	0.52	0.13	0.54	0.90	0.54	2.5

[1] Visual estimate on March 15, where 0 = none, and 5 = solid stand.
[2] Sum of six clippings during the season, with yield estimated from disk meter readings.
[3] Average bloom date, Julian day 112, was April 21.

Adaptability of Sorghum Cultivars for Biomass Production

J.L. Moyer

Summary
Initial production of forage suitable for biomass was similarly ($P > 0.10$) low for the five sorghum entries in 2012 because of drought. Lodging was greater ($P < 0.05$) for 'SS2' than for 'Atlas,' but fall regrowth was greater for it and 'SG1' than for the other entries.

Introduction
Sorghums are an efficient genus of warm-season grasses, largely produced as annuals in North America. Because of their growth potential and stalk properties, they have been identified by the U.S. Department of Energy as a possible dedicated energy crop. This study was established to compare cultivars for adaptation in eastern Kansas, and to produce biomass to test for suitability as a bioenergy crop.

Experimental Procedures
Four sorghum hybrids entered by Chromatin, Inc., and a check cultivar, 'Atlas,' were planted at 100,000 seeds/a in 30-in. rows on May 14, 2012 at the Mound Valley Unit of the Southeast Agricultural Research Center. Plots were 30 ft × 10 ft, arranged in a randomized, complete block with four replications. The area was fertilized preplant with 150 lb nitrogen (N)/a as urea, and sprayed preemergence with 1 qt/a of atrazine 4L and 1.5 lb a.i./a of S-metolachlor. Plants were thinned to 35,000 plants/a on May 31.

Measurements of height to flag leaf, population, tillers per plant, and lodging were taken prior to the initial harvest. Two rows were harvested on August 27 for a length of 20 ft per plot at 2.5-in height, and biomass was subsampled, dried at 140°F for moisture content, and sent to the sponsor for analysis of biomass characteristics. Regrowth after fall moisture was harvested on October 24 as before and subsampled for moisture content.

Results and Discussion
Initial dry weight of sorghums was similarly low for all entries (Table 1), primarily because rainfall for June through August was only 49% of the 30-year average. Height of initial growth was greater ($P < 0.05$) for 'FS4' than the other entries, least for 'SG1' and 'FS9,' and intermediate for 'Atlas' and 'SS2.' Lodging was greater for 'SS2' than for 'Atlas' (Table 1).

The number of tillers produced per plant was significantly ($P < 0.05$) different for each entry. 'SS2' had the greatest number of tillers, 'FS4' the least, and the others ranged between, with 'SG1' > 'Atlas' > 'FS9' (Table 1).

Regrowth was promoted by some late-summer and fall moisture. Fall regrowth was greater ($P < 0.05$) for 'SS2' and 'SG1' than for the other cultivars.

Table 1. Agronomic traits, initial dry weight, and fall regrowth in 2012 for sorghum, Mound Valley Unit, Southeast Agricultural Research Center

Cultivar	Plant height	Tillering	Lodging	Initial dry wt.	Regrowth
	in.	no./plant	%	------------ lb/a	------------
FS4	64	1.1	3.6	7,298	1,819
FS9	44	1.5	4.1	7,070	1,977
SG1	39	2.5	1.2	6,547	2,375
SS2	50	3.1	5.0	6,755	2,524
Atlas	56	1.8	0.9	7,740	1,886
Average	50	2.0	2.9	7,082	2,116
LSD 0.05		0.3	3.8	NS	315

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

D.W. Sweeney

Summary
Overall in 2012, adding nitrogen (N) doubled average wheat yields, but the advantage of knifing compared with broadcast and dribble placement was apparent only in no-till. Double-crop soybean yields were greatest following wheat unfertilized with N and for those grown with no tillage.

Introduction
Many crop rotation systems are used in southeastern Kansas. This experiment is designed to determine the long-term effects 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 as 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-numbered years is 125 lb/a. The N rate of 120 lb/a for wheat is split as 60 lb/a applied preplant as broadcast, dribble, or knifed UAN. All plots except the controls are top-dressed in the spring with broadcast UAN at 60 lb/a N.

Results and Discussion
In 2012, wheat yields were excellent, with N fertilization approximately doubling the average yields obtained with no fertilization (Figure 1). Wheat yield was not affected by tillage alone but was affected by a tillage × N fertilization interaction. Across tillage systems, there was little yield difference when the preplant N was subsurface (knife)-applied; however, surface applications (broadcast or dribble) yielded lower in the conventional tillage system than with no-till, although the reason for this was not apparent.

Although not measured, the potentially greater soil moisture levels in the control plots where wheat yield was less than in the N-fertilized plots likely accounted for the subsequent greater double-crop soybean yields (Figure 2). Overall, double-crop soybean yields were about 10 bu/a greater with no-till than with conventional or reduced tillage. Soybean yield was lower following wheat fertilized by knifing N in the conventional tillage system but was not significantly lower in the reduced or no-till systems.

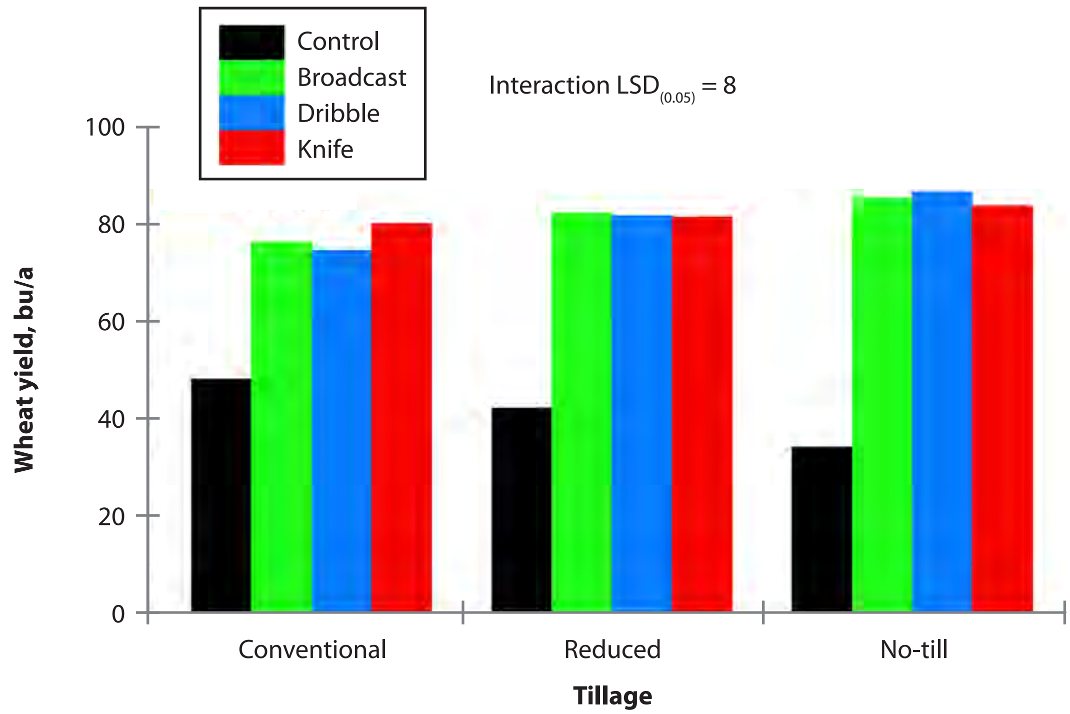


Figure 1. Effects of tillage and nitrogen placement on wheat yield, Southeast Agricultural Research Center, 2012.

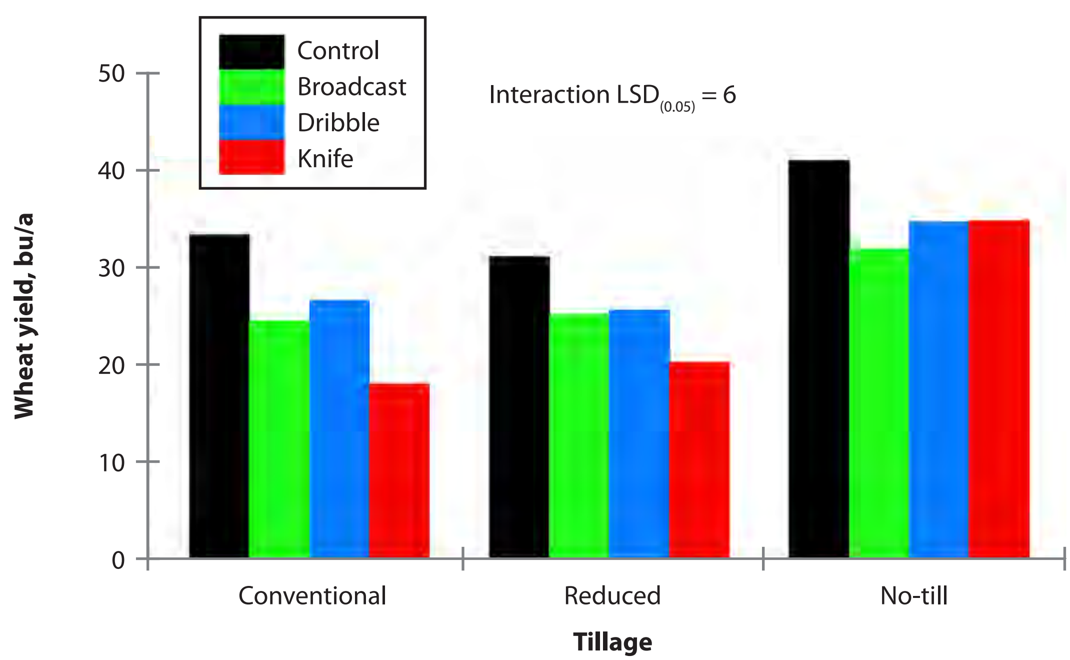


Figure 2. Effect of tillage and residual nitrogen placement on soybean yield planted as a double-crop after wheat, Southeast Agricultural Research Center, 2012.

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

D.W. Sweeney

Summary
In 2012, hot and dry conditions again resulted in low corn yields. Under these stressful environmental conditions, corn yields at two sites were unaffected by tillage, seeding rate, or fertilizer placement.

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 seed-bed 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
In 2012, the experiment was conducted at the Mound Valley Unit (Site 1) and the Parsons Unit (Site 2) 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, 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 fertilizer placement methods: surface band (dribble) on 30-in. centers near the row and subsurface band (knife) at 4 in. deep. At the Mound Valley site, 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. Based on initial soil tests, at the Parsons site only N was applied by the two placement methods. Corn was planted at both sites on April 6, 2012.

Results and Discussion
In 2012, hot and dry conditions resulted in low overall corn yields averaging less than 60 bu/a at both locations. Stressful environmental conditions resulted in no effect on yield by tillage, seeding rate, fertilizer placement, or their interactions (data not shown).

[1] This research was partly funded by the Kansas Corn Commission and the Kansas Fertilizer Research Fund.

Performance Test of Sesame Varieties

K.R. Kusel

Summary
Twelve sesame varieties were planted at the Columbus unit of the Southeast Agricultural Research Center in 2012. This was the first time sesame has been grown and tested at the Southeast Agricultural Research Center. Seed yields were extremely low, likely resulting from delayed planting and an early frost.

Introduction
Throughout history, sesame has been a crop that uses limited water supplies efficiently during growth. Nearly all sesame grown today has to be hand-harvested because the seed capsules are fragile and will shatter and lose seed prior to and during harvest. Recent breeding efforts have resulted in sesame varieties that resist shattering and are able to dry in the field and be harvested mechanically. The objective of this test was to evaluate mechanically harvested sesame varieties as a potential new crop for southeastern Kansas.

Experimental Procedures
Twelve sesame varieties were planted June 26, 2012, following a 2011 grain sorghum crop. The soil at the Columbus Unit of the Southeast Agricultural Research Center is a Parsons silt loam. Prior to planting, the soil was chiseled in the spring followed by disking, fertilization, and field cultivation. Fertilizer was applied at 60-30-30 on June 11, 2012. The seeding rate was 5 lb/a. S-metolachlor was applied immediately following planting at 1.4 lb a.i./a. Fifty percent emergence was achieved on June 29, 2012. Seed was harvested on November 7, 2012.

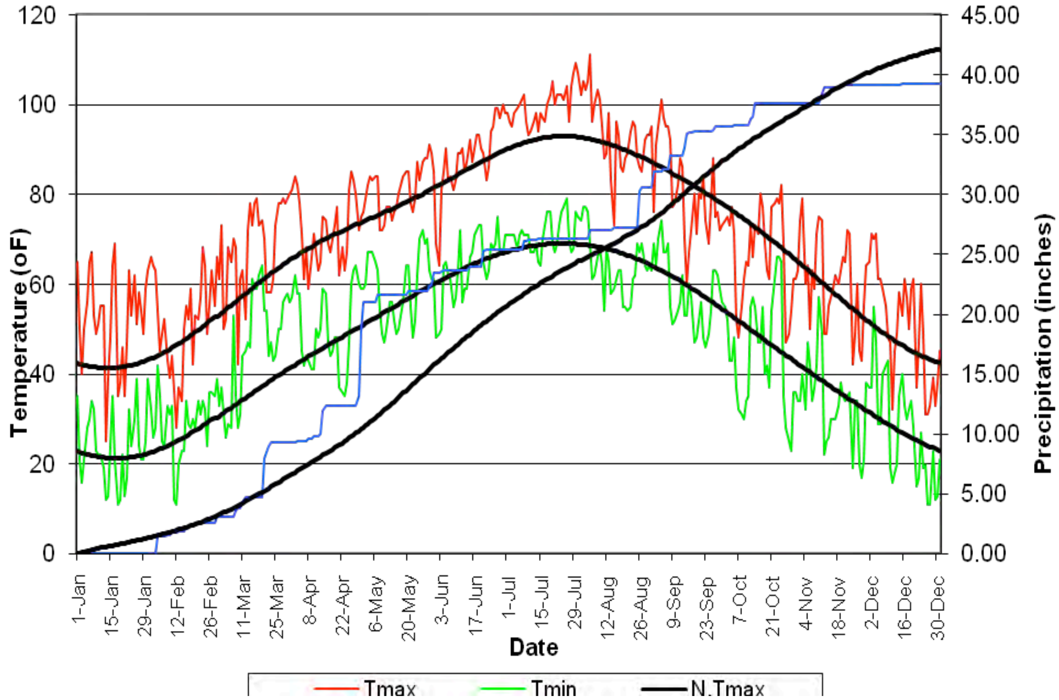
Results and Discussion
The summer of 2012 was very hot and dry. Thus, the planting date was delayed a week until after rainfall, but subsequent emergence and growth did not appear to be influenced by moisture stress. Because seed was immature, killing frost in early October greatly reduced yield to below 100 lb/a (Table 1). This was well below anticipated yields of 800 lb/a or more. Additional research is needed to define the potential of sesame in southeastern Kansas.

Table 1. Yield of sesame varieties at the Columbus Unit, Southeast Agricultural Research Center, 2012

Brand	Variety	Yield
		lb/a
Sesaco	S30-426	99
Sesaco	S33-001	67
Sesaco	X891	60
Sesaco	X864	55
Sesaco	X860	54
Sesaco	S70-002	52
Sesaco	S35-201	49
Sesaco	S34-101	35
Sesaco	S36-301	25
Sesaco	X980	24
Sesaco	S26-408	17
Sesaco	X974	17
	Mean	44
	CV (%)	25
	LSD 0.05	17

Annual Summary of Weather Data for Parsons

M. Knapp[1]



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

2012 data

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Avg. max	52.1	51.5	67.8	71.9	81.2	88.2	99.7	93.7	80.7	67.2	60.6	50.8	72.1
Avg. min	23.8	29.2	46.2	49.6	59.1	63.9	71.0	64.1	57.9	44.2	33.5	27.5	47.5
Avg. mean	37.9	40.4	57.0	60.7	70.1	76.0	85.4	78.9	69.3	55.7	47.1	39.2	59.8
Precip	0	3.04	6.23	9.2	4.96	1.89	0.9	4.26	5.09	2.02	1.43	0.15	39.21
Snow	0.3	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3
Heat DD*	839	714	276	177	19	15	0	0	34	318	540	801	3731
Cool DD*	0	0	28	49	178	346	632	431	162	29	1	0	1855
Rain days	0	8	9	10	7	5	3	6	9	5	3	4	69
Min < 10	0	0	0	0	0	0	0	0	0	0	0	0	0
Min < 32	24	16	6	0	0	0	0	0	0	5	10	19	80
Max > 90	0	0	0	0	1	10	31	20	7	0	0	0	69

Normal values (1981–2010)

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Avg. max	42.0	47.6	57.1	67.1	75.7	84.4	90.0	90.3	81.3	69.6	56.6	44.2	67.2
Avg. min	21.8	26.0	35.0	44.5	55.0	64.1	68.5	66.6	57.6	45.5	35.3	24.6	45.5
Avg. mean	31.9	36.8	46.1	55.8	65.3	74.2	79.3	78.5	69.4	57.6	46.0	34.4	56.4
Precip	1.41	1.77	3.19	4.38	5.93	5.53	3.92	3.29	4.69	3.86	2.94	2.06	42.97
Snow	2.8	1.7	1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.7	8.7
Heat DD	1026	790	590	299	85	8	1	1	52	260	574	948	4632
Cool DD	0	0	2	23	96	285	442	418	186	29	2	0	1483

Departure from normal

	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Avg. max	10.1	3.9	10.7	4.8	5.5	3.8	9.7	3.4	-0.6	-2.4	4.0	6.6	5.0
Avg. min	2.0	3.2	11.2	5.1	4.1	-0.2	2.5	-2.5	0.3	-1.3	-1.8	2.9	2.1
Avg. mean	6.0	3.6	10.9	4.9	4.8	1.8	6.1	0.4	-0.1	-1.9	1.1	4.8	3.5
Precip	-1.41	1.27	3.04	4.86	-0.97	-3.64	-3.02	0.97	0.4	-1.84	-1.51	-1.91	-3.76
Snow	-2.5	-0.7	-1.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3	-2.7	-7.4
Heat DD	-187	-76	-314	-123	-66	7	-1	-1	-19	58	-35	-148	-903
Cool DD	0	0	26	26	82	61	190	13	-24	0	-1	0	372

* 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 (DD).

Acknowledgments

We thank the following individuals, organizations, and firms that contributed to this year's research programs through financial support, product donations, or services.

America's Alfalfa, Nam

ADM Alliance Nutrition, Quincy, IL

AgChoice, Parsons, KS

Ag Research USA Ltd., Asheville, NC

AgriPro/Syngenta, Berthoud, CO

AGSECO, Girard, KS

Barenbrug USA, Tangent, OR

Bartlett Coop Association

Beachner Grain, St. Paul, KS

Casey Ag Solutions, St. Paul, KS

Chromatin Inc., Chicago, IL

Coffeyville Feed & Farm Supply, Coffeyville, KS

Coffeyville Livestock Market, Coffeyville, KS

Community National Bank & Trust

Larry Cook, Parsons, KS

DeLange Seed Co., Girard, KS

Dow AgroSciences LLC, Indianapolis, IN

DLF International, Tangent, OR

Ernie and Sharon Draeger, Columbus, KS

East Kansas Agri Energy, Garnett, KS

Elanco Animal Health, Greenfield, IN

Frontier Farm Credit, Parsons, KS

Greenbush Southeast Kansas Education Service Center, Girard, KS

Joe Harris, St. Paul, KS

Kansas Corn Commission, Garnett, KS

Kansas Crop Improvement Assn., Manhattan, KS

Kansas Fertilizer Research Fund, Topeka, KS

Kansas Forage and Grassland Council, Chanute, KS

Kansas Soybean Commission, Topeka, KS

Koch Agronomic Services LLC, Wichita, KS

Kansas Alliance for Biorefining and Bioenergy, Wichita, KS

Denver Lawson, Pittsburg, KS

Lima Grain Cereal Seeds, Ft. Collins, CO

Merck Animal Health, Summit, NJ

MFA Incorporated, Columbia, MO

Parsons Livestock Market, Parsons, KS

Pennington Seed, Inc., Madison, GA

Pioneer Hi-Bred International, Johnston, IA

Producers Coop, Girard, KS

R & F Farm Supply, Erie, KS

Sesaco, Idalou, TX

South Coffeyville Stockyards, South Coffeyville, OK

Star Seed Co., Osborne, KS

Ray Stice, Cherryvale, KS

Stockade Brands Inc., Pittsburg, KS

Strickland Brothers Inc., Oswego, KS

Emmet and Virginia Terril, Catoosa, OK

Marvin Wahl, Oswego, KS

Westbred LLC, Bozeman, MT

SEARC
Agricultural Research
2013

Chemical Disclaimer
Brand names appearing in this publication are for product identification purposes only. No endorsement is intended, nor is criticism implied of similar products not mentioned. Experiments with pesticides on nonlabeled crops or target species do not imply endorsement or recommendation of nonlabeled use of pesticides by Kansas State University. All pesticides must be used consistent with current label directions. Current information on weed control in Kansas is available in *2013 Chemical Weed Control for Field Crops, Pastures, Rangeland, and Noncropland*, Report of Progress 1081, available from the Distribution Center, Umberger Hall, Kansas State University, or at: ***www.ksre.ksu.edu/library*** (type Chemical Weed Control in search box).

Publications from Kansas State University are available at: ***www.ksre.ksu.edu***

Kansas State University Agricultural Experiment Station
and Cooperative Extension Service

SRP1087 April 2013