



AGRICULTURAL RESEARCH CENTER - HAYS

ROUNDUP 2020

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Statement of Purpose

Roundup is the major beef cattle education and outreach event sponsored by the Agricultural Research Center - Hays. The 2020 program is the 106th staging of Roundup. The purpose is to communicate timely, applicable research information to producers and extension personnel.

The research program of the Agricultural Research Center - Hays is dedicated to serving the people of Kansas by developing new knowledge and technology to stabilize and sustain long-term production of food and fiber in a manner consistent with conservation of natural resources, protection of the environment, and assurance of food safety. Primary emphasis is on production efficiency through optimization of inputs in order to increase profit margins for producers in the long term.

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An Efficient Stocking Strategy for Grazing Replacement Heifers

Keith Harmony and John Jaeger

Introduction

Even though Kansas native rangelands often have steep slopes or shallow soils not conducive to many other uses other than livestock grazing, native rangeland and perennial grassland acres in Kansas have been declining. Cropland acreage over this same time frame has increased, and rangelands have also become more fragmented by small ranchettes and urbanization. Producers may be looking to increase production efficiency on a shrinking forage land base. The use of intensive early stocking (IES) is one of the most efficient stocking strategies to produce beef on rangeland acres. The IES strategy has been widely used in eastern Kansas and is capable of increasing beef production by 30–40% compared to continuous season long stocking (SLS). In western Kansas, IES and continuous SLS have resulted in similar beef production. However, a modified IES (MIES) system, which combines greater early season animal density on high-quality forage of IES and late season individual animal selectivity for a high-quality diet of SLS, has increased beef production by 26% compared to continuous SLS alone on western Kansas rangelands. Even with this significant increase in production efficiency, stocker production is largely overshadowed by cow/calf production in terms of acres grazed in western Kansas. The question then arises, can the efficiencies of greater beef stocker production from modified IES be utilized with reproductive animals of the cow/calf production system? The purpose of this study was to compare the use of continuous SLS and MIES in a replacement heifer system for western Kansas.

Experimental Procedures

A high percentage of Angus and Angus crossbred replacement heifers were either stocked at 1.6× the typical stocking density May through July and at 1× for the rest of the season in a modified IES system, or at 1× for the entire season in a continuous SLS system. Pastures averaged 35 acres in size and consisted mostly of limy upland ecological sites. Stocking consisted of 8 heifers or 13 heifers per pasture in the SLS and MIES pastures, respectively. Heifers were checked by transrectal ultrasonography between 30 and 35 days after fixed time artificial insemination (AI) to determine pregnancy and were checked again at the end of the grazing season to determine final pregnancy. One bull was placed in each pasture 10 days after timed AI and remained on pasture for 35 days. Heifers determined not pregnant by artificial insemination in the 1.6× IES system were removed in mid-July while all heifers, regardless of pregnancy status, remained on pasture in the 1× continuous system. In cases when not enough AI pregnant heifers in the 1.6× IES system could be retained to meet the late 1× stocking density, the oldest non-AI pregnant heifers remained on pasture while the youngest were removed. Heifer body weight and body condition scores (BCS) were collected each year in May at the start of the grazing season, in mid-July at mid-season, and again in October at the end of the grazing season. Standing available herbage biomass was also collected from pastures each year from 2015–2019 at the grazing season midpoint in July, and again at the end of the grazing season in October by sample measurements from a falling plate meter calibrated to clipped sample plots at each harvest. At midsea-

son, a modified step-point sampling method was also used to estimate ground cover and vegetative species composition in 2014 prior to grazing treatments, in 2017 at mid-experiment, and in 2019 the last year of the experiment.

Results and Discussion

Heifer body weight and body condition scores were not different between the two stocking treatments at the beginning and the end of the grazing season (Table 1). However, heifers were slightly heavier in the continuously grazed pasture at midseason (Table 1), and early individual average daily gain (ADG) from May to July was slightly greater (1.63 vs. 1.49 lb/day) for the continuous SLS group compared to the MIES group (Table 2). This difference disappeared during the last half of the grazing season, and animals had similar ADG for the last half of the grazing season and the combined whole grazing season. Because animals were stocked at a greater density in the MIES pastures early in the season, the MIES treatment had greater total beef production during the first half of the growing season, and subsequently had 33% greater beef production per acre for the whole grazing season (Table 2). First service conception rate (FSCR) was not different between stocking treatments. Because heifers not pregnant to AI were removed from MIES pastures at mid-season, the MIES pastures had a higher percentage of AI-bred heifers remaining on pasture at the end of grazing (72% vs. 52% for the MIES and continuous heifers, respectively), forming a more uniform and synchronized group.

Available herbage dry matter at mid-season in July was greater for the continuous SLS pastures by 163 lb/acre, but available herbage dry matter was not statistically different between stocking systems in October at the end of the growing season (Table 3). Both stocking systems averaged just fewer or greater than 1900 lb/acre of residual available herbage at the end of five growing seasons. Litter cover (Table 4) and species composition of most dominant and subdominant grasses and forbs were not different between stocking systems before or after the initiation of experiment. However, buffalograss (*Bouteloua dactyloides*), sand dropseed (*Sporobolus cryptandrus*), and sedges (*Carex* sp.) did have significant composition changes after stocking treatments were imposed (Table 4). Composition of buffalograss increased to a greater extent in the MIES pastures, while sand dropseed and sedges decreased to a greater extent in the continuous SLS pastures and ended 2019 being equal to the MIES pastures (Table 4). Increased buffalograss composition in the MIES pastures could signal a future downward trend in yield at the end of the season that was not yet detected after 5 years. Dropseed and sedges comprise only a small percentage of total vegetative composition, so these differences may have only small or minimal biological impacts on a pasture system in western Kansas.

Implications

The MIES system appears to be ideally suited for the production of replacement heifers. The use of a synchronization protocol and early pregnancy detection with ultrasonography enables the removal of non-AI pregnant heifers at the grazing season mid-point. This creates a uniform group of heifers remaining on pasture at the end of the grazing season. Individual weight gain trends and gains per acre of the MIES system with replacement heifers closely resembles the improved production efficiency of MIES observed in long-term stocker steer grazing research. End of season pasture available

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dry matter has not been affected by increased early stocking rate of MIES, but increased buffalograss composition with MIES indicates that yields may eventually decline.

Table 1. Heifer body weights and condition scores (BCS) in early May at the start of the grazing season, at mid-July at mid-grazing season, and at the end of the grazing season in early October, averaged over 2015–2019

Heifer stocking treatment	May weight	May BCS	July weight	July BCS	October weight	October BCS	Heifer FSCR	Pasture AI remain
	lb		lb		lb		%	%
Continuous SLS	777	5.4	907*	5.5	968	5.3	53	52*
Modified IES	782	5.4	896*	5.5	970	5.4	47	72*

Heifer first service conception rate (FSCR) to timed AI and percent of heifers pregnant to AI left on pasture at the end of season is also included. *Indicates statistically different values at the $P \leq 0.05$ level.

Table 2. Early grazing season, late grazing season, and total season individual ADG and total beef produced per acre for replacement heifers stocked with a continuous SLS system or a 1.6×+1 modified IES system averaged over three years, 2015–2019

Heifer stocking treatment	May-July ADG	July-October ADG	Total ADG	May-July beef	July-October beef	Total beef
	lb/hd	lb/hd		lb/hd	lb/acre	
Continuous SLS	1.63*	0.72	1.20	32*	14	49*
Modified IES	1.49*	0.82	1.14	47*	16	65*

*Indicates statistically different values at the $P \leq 0.05$ level.

ADG = average daily gain. SLS = season long stocking. IES = intensive early stocking.

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Table 3. Pasture available herbage dry matter (DM) yield determined by falling plate meter readings correlated with clipped frame samples in July and October of 2014 prior to grazing treatments and in 2015–2019 at mid-season and after grazing

	Heifer stocking treatment			
	July		October	
	Continuous SLS	Modified IES	Continuous SLS	Modified IES
	Available DM (lb/acre)			
2014 pretrial	1310	1428	1568	1754
2015	1866	1909	1571	1559
2016	2482	2195	2429	2332
2017	2112	1919	1856	1710
2018	1703	1561	2025	1855
2019	2145	1910	1998	1893
Average 2015–2019	2062*	1899*	1976	1870

*Indicates statistically different values at the $P \leq 0.05$ level.
SLS = season long stocking. IES = intensive early stocking.

Table 4. Pasture ground cover and species composition in 2019. Significant changes in composition occurred for buffalo-grass (BUDA), sand dropseed (SPCR), and sedges (CARX) from 2014, prior to grazing treatments, to 2019 after grazing treatments

	Litter cover 2019	2014–2019 Change	BUDA 2019	2014–2019 Change	SPCR 2019	2014–2019 Change	CARX 2019	2014–2019 Change
	----- % -----							
Continuous SLS	87	18	27	8*	1	-4*	5	-5*
Modified IES	83	17	29	15*	1	-1*	5	-1*

*Indicates statistically different values between stocking treatments at the $P \leq 0.10$ level.
SLS = season long stocking. IES = intensive early stocking.

Using Modified Intensive Early Stocking for Cow/Calf Production

Keith Harmony and John Jaeger

Introduction

Intensive early stocking (IES) was introduced nearly a half century ago in eastern Kansas and has since been adopted as a major management tool to increase animal production, efficiency of production, and economic return on tallgrass rangelands. These increases have come almost exclusively by using IES with young stocker animals. Intensive early stocking and its gains have been proven effective repeatedly in published research. A similar modified IES (MIES) system has increased production efficiency of stocker animals on western Kansas rangelands. Perennial grassland acres for cattle production, as well as cattle numbers, are declining. Using management practices that mimic the MIES system to increase beef cattle stocking density for breeding herds may allow producers to maintain or increase cow numbers for beef production on fewer perennial grassland resources. The objective of this project is to compare cow and calf growth and performance in traditional continuous season-long stocking (SLS) and MIES beef production systems.

Experimental Procedures

On native mixed-grass rangelands, 211–225 total cow/calf pairs at two locations were stocked at either 1.45× the typical stocking density May through November, or at a typical 1× density during the growing seasons of 2015–2019. The grazing study occurred at the Saline Experimental Range in northeast Ellis County, and the HB Ranch in southern Trego County. Both stocking treatments were implemented at both locations. Calves from 1.45× cows were weaned mid-growing season in late July and were backgrounded in a feedlot, thus reducing pasture stocking rate and density for the last portion of the grazing season. Calves from 1× cows were weaned in October. Cow body weights and body condition scores (BCS) were measured each year at the start of grazing in May, at the grazing mid-point in late July, and at the end of the grazing season in October. Calf weights were also recorded at these times. Additional calf weights were measured at approximately 4 and 8 weeks after weaning time periods. Cows were synchronized for artificial insemination (AI), and pregnancy was determined 30–35 days following AI and at the end of the grazing season by using transrectal ultrasonography. All pastures were monitored for plant species composition, ground cover, and biomass along transects at representative ecological sites to compare rangeland health between MIES and continuous stocking systems. Available herbage dry matter (DM) availability was measured through a double sampling protocol of clipped sample plots calibrated to readings from a falling plate meter, while ground cover and species composition were estimated with a modified step-point technique along the same transects. Cows were intermingled during the winter, managed together, and had access to the same stockpiled winter rangeland and short-term feed resources until being sorted into their respective stocking treatments at grazing turnout in May.

Results and Discussion

Cow body weight and BCS were similar between grazing treatments at the start of the experiment in May 2015, but cow weight and BCS in May were greater for the MIES treatment after five years (Table 1). Cow BCS was similar for both grazing treatments each year at the midpoint of the grazing season, at the end of July (Table 1). Cows in the MIES treatment had greater cow body weight and BCS in October each year. Even though MIES cows were stocked at a greater density, early-weaning calves in late July allowed the MIES cows to gain weight and condition each fall. The MIES cows retained some of this greater body condition through the winter and subsequently had greater body weight and condition to start the grazing season in May. Cow grazing treatment did not affect cow first service conception rate (FSCR), but final conception rate was greater for the MIES grazing treatment (Table 1). Greater average cow BCS to start the grazing season in the MIES cow group may have benefitted final pregnancy rate. Averaged over all five years, calf body weight was not different for the two grazing treatments at any time during the growing season.

Total available herbage dry matter was similar between grazing treatments in the year prior to the study and was also similar between grazing treatments at the midpoint in late July and the end of grazing in October for each of the five study years (Table 2). However, in 2019, July and October available standing dry matter between the two stocking treatments was separated by 200 and 300 lb/acre, respectively. This separation was almost two times greater than any other year, but was still not detected as being statistically different. This separation does indicate that a downward trend in pasture yield may have started in the MIES treatment, and yields in the following years should be monitored and observed closely for a continued downward trend. Initial composition was slightly different between pasture treatments. The MIES pastures started with a greater composition of little bluestem (*Schizachyrium scoparium*) than the continuous SLS pastures, but no other major grass or forb species was statistically different between treatments in 2015. After five years, continuous SLS pastures had greater Japanese brome (*Bromus arvensis*) and western ragweed (*Ambrosia psilostachya*) composition, while MIES treatment pastures had greater sideoats grama (*Bouteloua curtipendula*) and continued to have greater little bluestem composition than continuous SLS pastures. The direction of composition trends was unexpected based on the observed separation in available dry matter at the end of the growing season between treatments.

Implications

The use of an MIES system appears to be a suitable stocking strategy to increase cow/calf units while maintaining rangeland productivity. Cows in the MIES system with early weaning had similar or improved values for most production characteristics, including beginning and end of season BCS and final pregnancy rate. These characteristics may result in long-term greater pasture production trends, such as more beef lb/acre. However, the separation in pasture yield that developed at the end of five years may be an indicator that the upward limit on stocking has been reached in the MIES pastures, and future yield trends need to be monitored closely.

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Table 1. Cow body weights and body condition scores (BCS), and calf body weights at the start of the grazing season, at the end of July at mid-grazing season, and at the end of the grazing season from 2015–2019

	Stocking treatment	
	Continuous SLS	Modified IES
Cow May weight, lb	1136*	1182*
Cow May BCS	4.94*	5.18*
Calf May weight, lb	185	187
Cow July weight, lb	1261*	1280*
Cow July BCS	5.28	5.34
Calf July weight, lb	382	383
Cow October weight, lb	1287*	1383*
Cow October BCS	5.18*	5.72*
Calf October weight, lb	570	575
Cow FSCR, %	47.8	51.7
Cow final conception rate, %	87.0*	91.2*

*Indicates statistically different values between treatments at the $P \leq 0.05$ level.

Cow first service conception rate (FSCR) to timed AI and final conception rate is also included.

SLS = season long stocking. IES = intensive early stocking.

Table 2. Pasture available herbage dry matter yield determined by falling plate meter readings calibrated with clipped frame samples in the fall of 2014 prior to grazing treatments, and in 2015–2019 at mid-season in July and after the growing season in October

Year	Cow stocking treatment			
	July		October	
	Continuous SLS	Modified IES	Continuous SLS	Modified IES
	Available dry matter (lb/acre)			
2014			1831	1861
2015	2298	2260	1997	1980
2016	2655	2526	2365	2279
2017	1970	2026	1579	1584
2018	1944	2042	2232 ^a	2436 ^a
2019	2066	1861	2276	1983
Average 2015–2019	2187	2143	2074	2010

^aData from one location only. Heavy snowfall occurred and matted the vegetation before standing available dry matter was clipped at the second location.

SLS = season long stocking. IES = intensive early stocking.

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Table 3. Plant species composition of continuous SLS and MIES pastures at the onset of grazing treatments in 2015 and at the end of five years of grazing in 2019

Species ^a	Cow stocking treatment			
	2015		2019	
	Continuous SLS	Modified IES	Continuous SLS	Modified IES
	Composition (%)			
Big bluestem	8.2	6.3	8.7	10.1
Little bluestem	12.3*	18.8*	13.9*	18.8*
Indiangrass	2.1	0.2	2.3	0.3
Sideoats grama	20.2	26.0	15.1*	24.2*
Blue grama	19.9	17.5	13.4	12.0
Buffalograss	8.0	8.1	8.7	9.0
Western wheatgrass	9.5	0.9	4.2	1.6
Japanese brome	0.0	0.0	8.1*	4.8*
Sedges	4.6	1.1	5.7	2.7
Western ragweed	2.7	4.9	3.6*	2.4*

^aBig bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), blue grama (*Bouteloua gracilis*), buffalograss (*Bouteloua dactyloides*), western wheatgrass (*Pascopyrum smithii*), and sedges (*Carex spp.*).

*Indicates statistically different values between treatments at the $P \leq 0.10$ level.

SLS = season long stocking. IES = intensive early stocking.

Effect of Exercise on Health and Performance by Long-Haul, High-Stress Steers During the Receiving Period

John R. Jaeger, Justin W. Waggoner, Keith R. Harmoney, and Quentin Rupp¹

Introduction

Morbidity and mortality associated with the bovine respiratory disease (BRD) complex continue to be a significant challenge to the United States beef industry. Stress associated with maternal separation, environment change, transportation, diet changes, and commingling are common to beef industry marketing channels and have been linked to depressed growth and health of recently weaned calves. Cattle originating from the Southeastern U.S. tend to exhibit high rates of BRD after transportation to Great Plains feedlots.

Previous research has utilized exercise one time per day or three times per week for the receiving period. In those studies, health performance of cattle was not different from non-exercised cattle and differences in gain performance were minimal. The objective of this research was to examine the effect of exercise four times daily for the first 14 days after arrival on incidence of BRD and animal growth and performance.

Experimental Procedures

Receiving protocol and treatments: 275 crossbred steers (average purchase weight = 496 lb) were purchased through an order buyer from multiple sale barns in Mississippi and Alabama and were transported (approximately 17 hours) to the Kansas State University Agricultural Research Center Feedlot in Hays, KS (KSU-ARCH). Upon arrival, cattle were individually tagged and weighed. Cattle were penned by truck and allowed free choice access to water and grass hay (13.7% CP, 13.7% ADF; DM basis). Cattle were stratified by truck and arrival weight, and assigned randomly to 1 of 2 receiving treatments with 5 pen replicates per treatment (10 pens, 27 or 28 head per pen). Treatments: 1) Steers were fed the facility's standard receiving ration and observed twice daily for symptoms of BRD (CON); 2) Steers were fed the facility's standard receiving ration, observed twice daily for symptoms of BRD, and exercised within their pen for 20 minutes every 6 hours for the first 14 days of the 60 d receiving period (EX).

Processing and management: At processing, cattle were weighed, vaccinated for clostridial disease (Ultrabac 7, Zoetis, Parsippany, NJ), respiratory disease (Bovi-Shield Gold, Zoetis, Parsippany, NJ), and administered an anti-microbial (Zuprevo, Merck, Madison, NJ). Steers also received a growth promoting implant (Component, Elanco Animal Health, Greenfield, IN). Steers were maintained in 11,120 ft² earth-floor pens with 9.5 inches of linear bunk space per head for the duration of the study. Cattle were fed once daily, using a slick-bunk management method and feed calls were made each morning at 0700 before feed delivery. Cattle were evaluated twice daily for 21 d and

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daily thereafter by KSU-ARCH feedlot personnel for clinical signs of morbidity. Cattle exhibiting clinical signs of morbidity were removed from their home pen for treatment and immediately returned. Medical treatments were administered according to the normal protocol for this facility (Table 1).

Data collection: Steers were individually weighed on d 0, 15, 29, and 57.

Results and Discussion

Exercise had no effect on body weight or average daily gain (ADG) compared to control steers during the receiving period (Table 2). Although not statistically different, numerically, there were 7.7% more CON steers treated for BRD by day 14, compared to EX steers (Table 3). Likewise, numerically there was a 2.67% greater death loss for CON by day 14 compared to EX steers (Table 3). By day 28 of the receiving period, the death loss difference was 2.10% greater for CON steers than for EX steers. Although not statistically different, economically (purchase price of \$814.68/head) this equates to \$4,704.78 greater loss for CON-treated steers than for EX-treated steers.

Bovine respiratory disease complex treatment cost was greater for EX steers on day 14 than for CON steers (Table 4). During this period, numerically more EX steers were treated twice for BRD than were CON steers (Table 3). However, death loss (and associated economic loss) was greater for CON steers than the increase in drug treatment cost for EX steers. It is likely that exercise of steers (20 minutes every 6 hours) allowed more mildly moribund steers to be identified and retreated than for CON steers.

Average dry matter (DM) delivered daily to EX and CON steers was not different during any period throughout the 57-day study (Table 5). However, DM intake/hd/d was greater for CON steers for each period of the study (days 0–15, 16–29, and 30–57) compared to EX steers (Table 5). However, the EX steers were also more efficient (lb of feed/lb of gain, F:G) during the first 15 days with a F:G of 3.02 compared to the CON steers with a F:G of 3.36 (coinciding with the period they were exercised 4 times per day, Table 5). Likewise, although DM intake was lower for EX steers during the first (days 0–15) and second period (days 12–29), numerically, EX steers displayed a 0.2 lb/hd/d greater ADG than did CON steers but this was not statistically different. Numerically, total gain per treatment for each period was also greater for EX steers compared to CON steers (Table 5). Perhaps, exercise and encouraging steers to get up and move resulted in improved efficiency. Improved performance may be the result of earlier identification and treatment of moribund steers by prompt detection of steers requiring a second or third treatment for BRD. Other measures of efficiency (period gain and F:G) were not different between treatment groups for any other time point.

Implications

Although these data do not fully support frequent exercise of newly received long-haul, high-stress cattle, they do suggest that exercise can be utilized to reduce death loss and it may also improve feed efficiency and animal performance.

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Table 1. Treatment schedule used to treat steers diagnosed with bovine respiratory disease complex

Treatment	Drug	Dose	Route of injection	Hours to retreat
1st	Baytril 100 (enrofloxacin)	5 mL/cwt	Subcutaneous	48
2nd	Nuflor (florfenicol)	3 mL/cwt	Intramuscular	48
3rd	LA300 (oxytetracycline)	3 mL/cwt	Subcutaneous	48

Table 2. Long-haul, high-stress steer body weight and average daily gain during the receiving period for steers exposed to normal management or exercise for 14 days

Variable	Management treatment		P-value
	Control	Exercise*	
Steer body weight, lb			
Day 0	497	495	0.96
Day 15	535	535	0.98
Day 29	580	583	0.98
Day 57	681	688	0.99
Average daily gain, lb			
Days 0–15	2.46	2.61	0.65
Days 16–29	3.21	3.44	0.36
Days 20–57	3.56	3.57	0.92

*Steers were exercised within their pen for 20 minutes every 6 hours for the first 14 days after receiving.

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Table 3. Proportion of long-haul, high-stress steers exhibiting and treated for bovine respiratory disease, number of times treated for bovine respiratory disease, and associated death loss during the receiving period of those exposed to normal management or exercise for 14 days

Variable	Management treatment		<i>P</i> -value
	Control	Exercise*	
Pulled and treated, %			
Day 7	0.73	2.19	0.33
Day 14	9.18	1.43	0.23
Day 21	16.67	16.79	0.98
Day 28	17.39	16.79	0.89
Day 35	21.26	19.91	0.82
Pull rate, %			
Treated 1 time	2.13	1.99	0.82
Treated 2 times	7.25	8.03	0.81
Treated 3 times	0.72	1.46	0.57
Death loss, %			
Day 14	6.78	4.11	0.37
Day 21	6.78	4.11	0.37
Day 28	7.13	5.03	0.48
Day 60	7.97	6.57	0.66

*Steers were exercised within their pen for 20 minutes every 6 hours for the first 14 days after receiving.

Table 4. Treatment costs for long-haul, high-stress steers exhibiting and treated for bovine respiratory disease during the receiving period and exposed to normal management or exercise for 14 days

Drug treatment cost/head, \$	Management treatment		<i>P</i> -value
	Control	Exercise*	
Day 7	0.13	0.38	0.31
Day 14	1.62	2.93	0.09
Day 21	3.44	4.02	0.59
Day 28	3.67	4.02	0.75
Day 35	4.74	4.65	0.94

*Steers were exercised within their pen for 20 minutes every 6 hours for the first 14 days after receiving.

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Table 5. Dry matter pounds delivered, DM intake (lb/hd), treatment group gain, and feed:gain for each period and the entire study

Variable	Management treatment		<i>P</i> -value
	Control	Exercise*	
Days 0–15			
DM delivered, lb	3094	3066	0.76
DM intake, lb/hd/day	8.30	7.53	0.08
Total gain, lb	926.8	1026.8	0.18
Feed:Gain	3.36	3.02	0.08
Days 16–29			
DM delivered, lb	4562	4714	0.45
DM intake, lb/hd/day	14.0	12.9	0.04
Total gain, lb	1123.6	1250.4	0.45
Feed:Gain	4.19	3.88	0.52
Days 30–57			
DM delivered, lb	10774	11357	0.17
DM intake, lb/hd/day	16.7	15.8	0.02
Total gain, lb	2470.8	2560.4	0.51
Feed:Gain	4.37	4.47	0.57
Days 0–57			
DM delivered, lb	18377	19138	0.24
DM intake, lb/hd/day	13.8	12.9	<0.01
Total gain, lb	4548.4	4873.6	0.15
Feed:Gain	4.05	3.98	0.24

*Steers were exercised within their pen for 20 minutes every 6 hours for the first 14 days after receiving.

Saline Experimental Range Dormant Season Wildfire: Short-Term Effect on Forage Production and Plant Composition

Keith Harmony

Introduction

Rangeland wildfires in the southern plains may occur any time of year, but the low humidity, increasing temperatures, and dry and abundant fuel load of late winter and early spring can result in greater wildfire occurrence and severity. Fires that occur before the growing season remove standing residual vegetation and greatly reduce litter cover, so the soil surface may be left bare for several weeks or months before the onset of new pasture growth. Exposure of plant buds to cold temperatures during dormancy, soil water evaporation, and soil crusting from the force of falling precipitation and puddling may lead to the eventual loss of plant density and available soil moisture for plant growth following wildfire. Information collected from a previous wildfire that occurred during mid-March at the Kansas State University Agricultural Research Center - Hays showed that forage production was significantly reduced for two years following the fire. However, timing and conditions leading up to wildfires and conditions following wildfires may allow pastures to respond to each fire differently. In the week of March 5-11, 2017, several wildfires ignited throughout central and western Kansas. One of those fires was the largest known wildfire in Kansas history, the Starbuck Fire, that consumed more than 460,000 acres of Kansas land in Clark, Meade, and Comanche counties. Another fire ignited on the Kansas State University Saline Experimental Range (SER) in northeast Ellis County on March 7, 2017.

Experimental Procedures

The SER pasture area is native, untilled rangeland and consists mostly of blue shale, limy slopes, shallow limy, and loamy plains ecological sites. Dry, dormant grass was abundant, humidity was near 10%, and winds were gusting over 30 mph when the wildfire started. Approximately 6500 acres of rangeland was consumed by the quick spreading fire. The pasture area at the SER that was burned had permanent transects for monitoring rangeland production and plant composition. Transects were in place for two growing seasons before the wildfire occurred. A total of sixteen transects, each approximately 100 yards in length, were established on north, south, east, and west facing slopes in two 800-acre pastures. Along each transect, pasture biomass was estimated by dropping a weighted plate meter in the canopy and measuring the height of the plate to which the forage held the plate above the soil surface. Forage was clipped in a frame directly under the plate and then dried, and a linear calibration equation of the height:forage yield relationship was created from all height and yield measurements. Extra plate height measurements were collected along each transect, and within each year and sampling period the plate height readings for a transect were averaged. The average height for a transect was inserted into the calibration linear equation derived for that particular year and period to estimate available dry matter of the transect. In alternating years, a modified step point method was used to record bare soil, litter, plant basal cover, and the nearest plant species from 100 points along each transect to estimate ground cover and

plant species composition. Pastures with transects were grazed starting in May with the same stocking density all five years of data collection, although stocking was deferred until June after the wildfire in 2017.

Results and Discussion

In the two years prior to the fire, growing season precipitation was just below average in 2015 and well above average in 2016. Available standing forage in late July averaged across both years was 1770 lb/acre. In 2017, the year of the wildfire, available dry matter was just over 1330 lb/acre in late July. Dry matter was reduced about 25% compared to the average of 2015 and 2016, even though similar precipitation occurred in the spring of 2017. In 2018, available dry matter once again was near 1770 lb/acre, even though precipitation in April, May, and June was less than 65% of 2016 and 2017 during the same months. In 2019, available dry matter production by the end of July nearly reached 1670 lb/acre with precipitation in April, May, and June similar to 2018 (Table 1).

In 2015, litter covered 59% of the soil surface, but following the wildfire litter cover was reduced to 23% of the soil surface. Reductions in litter cover are usually expected following both wildfire and prescribed fire. Plant basal cover was reduced by just under 1%, from 7% to near 6% of the soil surface. Big bluestem (*Andropogon gerardii*), western wheatgrass (*Pascopyrum smithii*), and buffalograss (*Bouteloua dactyloides*) all increased their plant composition in the stand. Little bluestem (*Schizachyrium scoparium*), blue grama (*Bouteloua gracilis*), and western ragweed (*Ambrosia psilostachya*) all slightly declined in plant composition. Therefore, rhizomatous and stoloniferous grass species slightly increased in composition following the wildfire, while bunchgrass species slightly declined following the wildfire.

In 2019, the third growing season after the fire, litter cover greatly increased 47% and bare soil was greatly reduced. Litter cover was fully restored within two complete growing seasons after the wildfire. Rhizomatous species such as western wheatgrass and big bluestem that increased directly following the fire in 2017 had slight reductions in 2019. The bunchgrass little bluestem and short rhizome species sideoats grama (*Bouteloua curtipendula*) had small increases in basal composition from 2017 to 2019. Western ragweed composition declined in 2017 after the fire and had another small decline from 2017 to 2019. By the end of the third full growing season following the wildfire, composition of most grass species returned close to pre-wildfire levels (Table 2).

Implications

Even though timely precipitation occurred in the spring directly following the wildfire, forage production was reduced that season, although not to the extent of previous wildfires. The substantial loss of litter cover and consequential loss of water from runoff and evaporation prior to the onset of new growth is a likely reason that forage production was reduced in the first year following dormant season wildfire. Negative effects on forage production will be lessened with shorter time frames between burning and new growth emergence and with greater precipitation following the fire. Forage production may not be affected past the first growing season. Bunchgrass species, such as little bluestem and blue grama, are most susceptible to stand reductions following dormant season wildfires, while rhizomatous and stoloniferous grass species are most likely to be

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unaffected and may increase following wildfire. Over time, plant composition will likely return to pre-fire proportions if stocking management is not significantly altered.

Table 1. Available dry matter in July of each year prior to the wildfire, during 2017 in the year of the wildfire, and the two years after the wildfire

Year	Yield (lb/acre)	
2015	1583	
2016	1963	Average 1773
2017	1335	
2018	1772	
2019	1669	Average 1721

Table 2. Soil cover traits and plant species composition prefire in 2015, the year of the fire in 2017, and postfire in 2019

	2015	2017	2019	2015–2017 Change	2017–2019 Change
Soil cover trait	----- % -----				
Basal cover	0.07	0.06	0.05	-0.01	-0.01
Litter cover	0.59	0.23	0.70	-0.37	0.47
Bare soil	0.34	0.71	0.25	0.37	-0.46
Plant species					
Western wheatgrass	0.02	0.04	0.02	0.02	-0.01
Big bluestem	0.14	0.19	0.16	0.05	-0.03
Little bluestem	0.28	0.24	0.26	-0.04	0.02
Sideoats grama	0.27	0.27	0.29	0.00	0.02
Blue grama	0.04	0.02	0.03	-0.02	0.00
Buffalograss	0.07	0.08	0.07	0.02	-0.01
Western ragweed	0.06	0.03	0.01	-0.03	-0.02



Figure 1. A Saline Experimental Range pasture site one month following the wildfire on March 7, 2017.



Figure 2. The same Saline Experimental Range pasture site two months following the wildfire on March 7, 2017.



Figure 3. Bunchgrass species such as these little bluestem plants are most susceptible to stand reductions following dormant season wildfires. Notice the lack of new tillers in the little bluestem crown on the left compared to the right.

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