Agricultural Research Center – Hays

Roundup 2013

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Kansas State University Agricultural Experiment Station and Cooperative Extension Service

Roundup 2013

Statement of Purpose

Roundup is the major beef cattle education and outreach event sponsored by the Agricultural Research Center–Hays. The 2013 program is the 99th 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 to increase profit margins for producers in the long term.

Contents

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Transport of up to 12 Hours Following Preconditioning Has No Impact on Health and Performance of Beef Calves During Receiving

E.A. Bailey[1], J.R. Jaeger[2], J.W. Waggoner[3], G.W. Preedy[1], L.A. Pacheco[1], and KC Olson[1]

Introduction

Transport causes stress in recently weaned calves and is a predisposing factor for bovine respiratory disease (BRD) upon arrival at the feedlot. Body weight lost during transport may be recovered slowly during receiving. Previous research evaluating the effects of preconditioning on transport stress focuses on preconditioning vs. no preconditioning in calves subject to a single transport duration; furthermore, previous research focused on transport duration of long-haul calves that were not preconditioned. Thus, our objective was to evaluate the feedlot-receiving performance of preconditioned calves after being transported either 4, 8, or 12 hours prior to feedlot placement.

Experimental Procedures

Procedures in this study were approved by the Kansas State University Animal Care and Use Committee. Angus × Hereford calves (n = 428; initial body weight = 463 ± 74 lb) originating from the Kansas State University commercial cow-calf herds in Manhattan and Hays, KS, were used in this experiment. Calves were weaned at approximately 183 days of age. All calves were dehorned, and steer calves were castrated before 60 days of age.

At the time of maternal separation, calves were weighed individually and given initial vaccinations against respiratory pathogens (Bovi-Shield Gold 5, Pfizer Animal Health, Whitehouse Station, NJ), clostridial pathogens (Ultrabac 7, Pfizer Animal Health), and *H. somnus* (Somubac, Pfizer Animal Health). In addition, all calves were treated for internal and external parasites (Ivomec, Merial Limited, Duluth, GA). Booster vaccinations were administered 14 days later.

Following initial processing, calves were confined to 1 of 15 pens at each location (minimum area = 215 ft^2/calf; bunk space = 18 in./calf). Calves were fed a diet formulated to promote 2.2 lb average daily gain at a dry matter intake of 2.5% of body weight during the weaning phase of the study (Table 1).

All calves were monitored for symptoms of respiratory disease at 7:00 a.m. and 2:00 p.m. daily during the preconditioning phase of our study. Calves with clinical signs of bovine respiratory disease, as judged by animal caretakers, were removed from pens or pastures and evaluated. Calves were assigned a clinical score (scale: 1 to 4; 1 = normal, 4 = moribund), weighed, and assessed for fever. Calves with a clinical illness score >1 and a rectal temperature >104.0°F were treated with therapeutic antibiotics according to label directions (first incidence = Baytril, Bayer Animal Health, Shawnee Mission, KS; 2nd incidence = Nuflor, Merck Animal Health,

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Summit, NJ). Cattle were evaluated 72 hours post-treatment and re-treated based on observed clinical signs.

After 30 days of preconditioning on the respective ranch-of-origin, calves from each location were transported 4 hours to a commercial auction market and commingled for 12 hours on the premises. Following commingling, calves within each treatment were loaded aboard a motor carrier and subjected to transport durations of either 4 (4HR), 8 (8HR), or 12 (12HR) hours from the auction market to the Western Kansas Agricultural Research Center Feedlot.

Upon arrival at the feedlot, calves were stratified by sex and penned according to treatment (6 pens/treatment). Calves were fed a common receiving diet (Table 2) for 57 days and daily dry matter intake was recorded. This diet was formulated to promote 2.2 lb average daily gain at a dry matter intake of 2.5% of body weight during the receiving phase of the study (Table 2).

Animals were fed once daily at 7:00 a.m., and bunks were evaluated each morning at 6:30 a.m. If the previous day's feed was consumed, total feed delivered was increased by approximately 2% over the previous day's feed delivery. Bunks were managed using a slick-bunk management method to minimize feed refusals. Dry matter intake was estimated based on feed delivered to the pen. Calf health was monitored similarly to the weaning phase of the study.

Results and Discussion

We observed no treatment differences in body weight ($P = 0.97$; Table 3) or average daily gain ($P = 0.21$) at the end of the preconditioning period. This result was expected, because all calves were managed in the same manner before application of transportation treatments. We calculated shrink as the difference between body weight taken upon arrival at the feedlot and a body weight taken immediately before transport to the auction facility. The calves transported for only 4 hours shrank less ($P < 0.01$) than calves transported 8 or 12 hours (Table 4). There was no difference ($P = 0.27$) in shrink between calves transported 8 hours or 12 hours.

During receiving, average daily gain was greater ($P < 0.01$) in the 8HR and 12HR calves compared with the 4HR calves. In addition, gain:feed improved in 8HR ($P = 0.02$) and 12HR ($P = 0.05$) calves compared with 4HR calves. Increased average daily gain and improved gain:feed observed in calves transported 8 or 12 hours before receiving can be explained by the replenishment of gut fill lost during transport. There were no differences ($P = 0.85$) in dry matter intake, because we limited receiving intake to 2.5% of body weight/day. We observed no difference ($P = 0.67$) in incidence of undifferentiated fever among treatments during receiving, possibly because overall incidence of fever during receiving was small. Preconditioned calves did not show lasting effects of transport durations of up to 12 hours in length.

Implications

Under the conditions of our study, performance of preconditioned beef calves during feedlot receiving was not affected by transport durations of up to 12 hours. The calves in this study likely benefitted from the action of separating the stressors of weaning and transport with a 30-day ranch-of-origin preconditioning period.

Table 1. Composition of the weaning diet

Ingredient composition	% of dry matter
Alfalfa extender pellets	33.9
Corn gluten feed	18.7
Wheat middlings	14.8
Cracked corn	10.9
Cottonseed hulls	8.1
Dried distillers grain	11.9
Supplement[1]	3.7
Nutrient composition	**Amount**
Crude protein, % of dry matter	16.69
Net energy for maintenance, Mcal/lb	0.77
Net energy for gain, Mcal/lb	0.49

[1] Supplement contained Vitamin A, limestone, molasses, salt, zinc sulfate, and Rumensin 90 (Elanco Animal Health, Greenfield, IN).

Table 2. Composition of the receiving diet

Ingredient composition	% of dry matter
Ground sorghum grain	50.4
Wet distillers grains	11.6
Ground sorghum hay	35.9
Supplement[1]	2.1
Nutrient composition	**Amount**
Crude protein, % of DM	16.82
Net energy for maintenance, Mcal/lb	0.77
Net energy for gain, Mcal/lb	0.49

[1] Supplement also contained Rumensin 90 and Tylan (Elanco Animal Health, Greenfield, IN), ammonium sulfate, calcium, and sodium.

Table 3. Pre-shipment performance of preconditioned beef calves transported for 4, 8, or 12 hours from an auction market to a feedlot

	Length of transport, hours			
Item	4	8	12	SEM
Starting body weight, lb	464	462	462	8.8
Ending body weight[1], lb	491	493	493	7.6
Average daily gain, lb/day	0.90	1.10	1.08	0.114
Incidence of undifferentiated fever, %	4.27	6.84	4.63	3.136

[1]Body weight taken 24 hours prior to application of transport treatments.

Table 4. Performance of preconditioned beef calves transported 4, 8, or 12 hours from an auction market to a feedlot during a 57-day receiving period

	Length of transport, hours			
Item	4	8	12	SEM
Arrival body weight, lb	475	469	466	7.9
Shrink[1], %	2.91[a]	4.81[b]	5.15[b]	0.301
Body weight at end of 29 days, lb	557	554	554	10.3
Body weight at end of 57 days, lb	625	629	625	9.2
Average daily gain, lb/day				
Arrival to day 29	2.82	2.99	3.01	0.189
Arrival to day 57	2.60[a]	2.82[b]	2.77[b]	0.064
Dry matter intake, lb/day	16.5	16.5	16.5	0.01
Gain:feed	0.157[a]	0.171[b]	0.168[b]	0.0050
Incidence of undifferentiated fever, %	2.05	3.08	1.43	1.81

[1] Calculated as the difference between the end body weight from Table 3 and the arrival body weight from the current table. Between the aforementioned weights, calves were subjected to transport treatments.
[a,b] Means within rows without common superscripts differ ($P < 0.05$).

Transport of up to 12 Hours Following Preconditioning Has No Impact on Finishing Performance or Carcass Characteristics of Beef Calves

E.A. Bailey[1], J.R. Jaeger[2], J.W. Waggoner[3], G.W. Preedy[1], L.A. Pacheco[1], and KC Olson[1]

Introduction

Calves subjected to long-haul transport may have increased incidence of disease and lesser performance in the feedlot. Long-haul calves are usually not subject to well-defined preconditioning programs before shipping. Previous research evaluating the effects of preconditioning on transport stress focused on preconditioning vs. no preconditioning in calves subject to a common transport duration. In an earlier report, we found that preconditioned calves subjected to transport of up to 12 hours recouped body weight lost during transport by the end of a 57-day receiving period at the feedlot without health effects (see "Transport of up to 12 Hours Following Preconditioning Has No Impact on Health and Performance of Beef Calves During Receiving," page 1). Our objective was to evaluate the performance of preconditioned calves during finishing after being transported either 4, 8, or 12 hours prior to feedlot placement.

Experimental Procedures

Animal care practices used in this study were approved by the Kansas State University Animal Care and Use Committee. Angus × Hereford calves (n = 428; initial body weight = 463 ± 74 lb) originating from the Kansas State University commercial cow-calf herds in Manhattan and Hays, KS, were used in this experiment. Calves were weaned at approximately 183 days of age. All calves were dehorned, and steer calves were castrated before 60 days of age.

At the time of maternal separation, calves were weighed individually and given initial vaccinations against respiratory pathogens (Bovi-Shield Gold 5; Pfizer Animal Health, Whitehouse Station, NJ), clostridial pathogens (Ultrabac 7; Pfizer Animal Health), and H. somnus (Somubac; Pfizer Animal Health). In addition, all calves were treated for internal and external parasites (Ivomec; Merial Limited, Duluth, GA). Booster vaccinations were administered 14 days later.

Following initial processing, calves were confined to 1 of 15 pens at each location (minimum area = 215 ft^2/calf; bunk space = 18 in./calf). Calves were fed a diet formulated to promote 2.2 lb average daily gain at a dry matter intake of 2.5% of body weight during the weaning phase of the study.

All calves were monitored for symptoms of respiratory disease at 7:00 a.m. and 2:00 p.m. daily during the preconditioning phase of our study. Calves with clinical signs of bovine respiratory disease, as judged by animal caretakers, were removed from pens or pastures and evaluated. Calves were assigned a clinical score (scale: 1 to 4; 1 = normal, 4 = moribund), weighed, and assessed for fever. Calves with a clinical illness score >1 and a rectal temperature >104.0°F were

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treated with therapeutic antibiotics according to label directions (first incidence = Baytril, Bayer Animal Health, Shawnee Mission, KS; second incidence = Nuflor, Merck Animal Health, Summit, NJ). Cattle were evaluated 72 hours post-treatment and re-treated based on observed clinical signs.

After 30 days of preconditioning on their respective ranch of origin, calves from each location were transported 4 hours to a commercial auction market and commingled for 12 hours on the premises. Following commingling, calves within each treatment were loaded aboard a motor carrier and subjected to a transport duration of either 4 (4HR), 8 (8HR), or 12 (12HR) h from the auction market to the Western Kansas Agricultural Research Center Feedlot. Upon arrival at the feedlot, calves were stratified by sex and penned according to treatment (6 pens/treatment). Calves were fed a common diet for a 57-day receiving period, and daily dry matter intake was recorded throughout receiving.

Animals were fed once daily at 7:00 a.m., and bunks were evaluated each morning at 6:30 a.m. If the previous day's feed was consumed, total feed delivered was increased by approximately 2% of the previous day's feed delivery. Bunks were managed using a slick-bunk management method to minimize feed refusals. Dry matter intake was estimated based on feed delivered to the pen. Calf health was monitored once daily during finishing.

After receiving, calves were gradually transitioned to a finishing diet (Table 1). Calves were finished to a common end-point of 0.5 in. of 12th-rib fat and harvested at a commercial packing plant in Dodge City, KS. After a 48-hour chill, carcass characteristics were evaluated for 12th-rib fat thickness; 12th-rib longissimus muscle area; kidney, pelvic, and heart fat; USDA yield grade, USDA quality grade; and marbling score.

Results and Discussion

Growth Performance

We noted no treatment differences ($P = 0.88$; Table 2) in harvest body weight among treatments. Additionally, average daily gain did not differ ($P = 0.92$) among treatments during finishing. Despite feeding to a common backfat end point, we noted no differences ($P = 0.34$) in days on feed. Previous research at this location found that preconditioned calves transported up to 12 hours recouped transport-related body weight loss within a 57-day receiving period. Transport appeared to have no lasting effects upon finishing performance of preconditioned calves used in this study.

Carcass Merit

Hot carcass weight was not different ($P = 0.50$; Table 3) among treatments. Measures of carcass fat content, such as marbling score ($P = 0.52$) and USDA yield grade ($P = 0.25$) also did not differ among treatments. We also evaluated lungs and livers at the packing plant, because they can provide valuable evidence about subclinical disease incurred during finishing. Incidence of either lung lesions ($P = 0.68$) or liver abscesses ($P = 0.10$) did not differ among treatments.

Implications

Under the conditions of our study, performance of preconditioned beef calves during finishing or on the rail was not affected by post-sale transport of up to 12 hours following a 30-day preconditioning program. The calves likely benefitted from separating the stressors of weaning and transport with a 30-day ranch-of-origin preconditioning period.

Table 1. Composition of the finishing diet

Ingredient composition	% of dry matter
Ground sorghum grain	73.2
Wet distillers grains	11.7
Sorghum silage	12.1
Supplement[1]	3.0
Nutrient composition	Amount
Crude protein, % of dry matter	13.8
Net energy for maintenance, Mcal/lb	0.86
Net energy for gain, Mcal/lb	0.57

[1] Supplement contained Rumensin 80 and Tylan 40 (Elanco Animal Health, Greenfield, IN), limestone, salt, and trace minerals.

Table 2. Finishing performance of preconditioned beef calves transported 4, 8, or 12 hours from an auction market to a feedlot

	Length of transport, hours			
Item	4	8	12	SEM
Initial body weight, lb	625	629	625	9.2
Harvest body weight, lb	1,227	1,238	1,229	23.5
Average daily gain, lb	3.93	3.92	3.93	0.084
Days on feed	167	161	161	4.4

Table 3. Carcass characteristics of preconditioned beef calves transported 4, 8, or 12 hours from an auction market to a feedlot

	Length of transport, hours			
Item	4	8	12	SEM
Hot carcass weight, lb	752	750	737	13.6
Marbling score[1]	441	445	457	14.7
USDA yield grade	3.13	3.29	3.02	0.153
12th-rib fat thickness, in.	0.43	0.45	0.39	0.031
Longissimus area, $in.^2$	12.4	12.6	12.2	0.23
Kidney, pelvic, and heart fat, %	2.69	2.74	2.69	0.099
Calves with >1 liver abscess, %	15.3	34.6	25.4	8.13
Calves with >1 lung lesion, %	44.4	38.5	37.3	8.99

[1] Marbling score values ranging from 400 to 499 represent a small degree of marbling.

Calf Health and Performance During Receiving Is Not Changed by Fence-Line Preconditioning on Rangelands vs. Drylot Preconditioning

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Introduction

Ranch-of-origin preconditioning can improve the welfare and performance of beef calves by easing the stresses associated with weaning, transport, diet change, and commingling with other calves. Preconditioning methods that involve pasture weaning coupled with maternal contact (i.e., fence-line weaning) have been promoted as possible best-management practices for minimizing stress. Prior studies focused on performance and behavior during preconditioning on the ranch of origin. Little information has been published relating to carryover effects of fence-line preconditioning compared with conventional drylot preconditioning on performance and behavior during feedlot receiving.

Our objectives were to measure growth and health during a 28-day ranch-of-origin preconditioning phase and during a 58-day feedlot receiving phase among beef calves subjected to 1 of 3 ranch-of-origin preconditioning programs. In addition, we recorded incidences of behavioral distress among these treatments during the first 7 days of feedlot receiving.

Experimental Procedures

Angus × Hereford calves (n = 460; initial body weight [BW] = 496 ± 77 lb) originating from the Kansas State University commercial cow-calf herds in Manhattan, KS, and Hays, KS, were used in this experiment. Calves were weaned at approximately 180 days of age. All calves were dehorned, and steer calves were castrated before 60 days of age. At weaning, calves were weighed individually and assigned randomly to 1 of 3 ranch-of-origin preconditioning methods: (1) drylot weaning + dam separation (D), (2) pasture weaning + fence-line contact with dams (PF), and (3) pasture weaning + fence-line contact with dams + supplemental feed delivered in a bunk (PF+S).

All calves were vaccinated against respiratory pathogens (Bovi-Shield Gold 5; Pfizer Animal Health, Whitehouse Station, NJ), clostridial pathogens (Ultrabac 7; Pfizer Animal Health), and *H. somnus* (Somubac; Pfizer Animal Health). In addition, calves were treated for parasites (Ivomec; Merial Limited, Atlanta, GA). Booster vaccinations were administered 14 days later.

Within location, calves assigned to PF and PF+S were maintained for 28 days in a single native pasture (minimum area = 118 acres). Calves were allowed fence-line contact with their dams for 7 days (minimum frontage = 656 ft; 4-strand, barbed-wire fence with the bottom 2 wires electrified). Cows were moved out of visual and auditory range after 7 days. Fresh water, salt, and mineral supplements were available continually. Calves assigned to D were transported

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(<30 miles) immediately after separation from dams and confined within location to a single earth-surfaced pen (minimum area = 215 ft^2/calf; bunk space = 18 in./calf).

Calves assigned to D were fed a diet formulated to promote 2.2 lb average daily gain (ADG) at a dry matter intake (DMI) of 2.5% BW during the preconditioning phase of the study (Table 1). Calves assigned to PF had access to native forage only (Table 2), whereas calves assigned to P+S had access to native forage and received a ration of the diet fed to D at a rate of 1% of BW 3 times weekly. Calves assigned to P+S were sorted into a single pen located adjacent to the fence line shared with dams at 9:00 a.m. on Mondays, Wednesdays, and Fridays during the preconditioning phase. The ration was offered in portable bunks (bunk space = 18 in./calf).

All calves were monitored for symptoms of respiratory disease twice daily during the preconditioning phase of our study. Calves with clinical signs of bovine respiratory disease (BRD) were removed from pens or pastures and evaluated. Calves were assigned a clinical score (scale: 1 to 4; 1 = normal, 4 = moribund), weighed, and assessed for fever. Calves with a clinical illness score >1 and a rectal temperature >04.0°F were treated with therapeutic antibiotics according to label directions (first incidence = Baytril, Bayer Animal Health, Shawnee Mission, KS; second incidence = Nuflor, Merck Animal Health, Summit, NJ). Cattle were evaluated 72 hours post-treatment and re-treated based on observed clinical signs.

After the 28-day preconditioning period, all calves were transported 4 hours from the ranch of origin to the Western Kansas Agricultural Research Center in Hays, KS, and weighed individually upon arrival. At that time, calves were stratified by sex and assigned to 1 of 18 pens by treatment (6 pens/treatment). Animals were fed once daily a receiving diet that consisted of a ground sorghum grain and ground sorghum hay base (Table 3). If the previous day's feed was consumed, total feed delivered was increased by approximately 2% of the previous day's delivery. Bunks were managed using a slick-bunk management method to minimize feed refusals. Dry matter intake was estimated based on feed delivered to the pen. Calf health was monitored as during the preconditioning phase of the study.

Beginning on the morning after feedlot arrival, animal behavior was assessed 3 times daily for 7 days by 2 trained observers. The numbers of calves performing specific behaviors (eating, pacing, vocalizing, drinking, resting, and ruminating) were recorded for each pen. Observations were taken 1 hour before feeding, at the time of feeding, and 6 hours post-feeding. In addition, calves were weighed individually on day 27 and day 58 of the receiving phase of the experiment.

Results and Discussion

Preconditioning Period

Calf ADG during the 28-day preconditioning period tended ($P = 0.08$) to be greater for drylot-weaned calves (D) than for pasture-weaned calves receiving no supplement (PF; Table 4). Based on the chemical analyses of our pasture forage, these results were expected. Another study found that fence-line weaned calves gained more weight than abruptly weaned calves during the first 2 weeks of preconditioning and maintained that difference for 10 weeks post-weaning, but calves in that study were fed a single diet across treatments.

Our treatments were designed such that calves assigned to D were on a greater plane of nutrition than calves assigned to PF or PF+S. This condition is typical of drylot- vs. pasture-preconditioning programs in Kansas. Supplement provided to PF+S calves in our study was designed to train pasture-weaned calves to eat out of a bunk rather than to promote BW gains that were competitive with D; one causative feature of poor initial feedlot performance is stress associated with learning to eat from a bunk. In our study, incidence of undifferentiated fever was not different ($P = 0.22$) among treatments during the preconditioning phase.

Receiving Period

We observed calves at the time of feeding to determine their desire to eat from a bunk during the first 7 days of receiving. A greater (treatment × day; $P < 0.05$) proportion of D than PF came to the bunk at the time of feeding during the first 5 days of receiving (Figure 1). Similarly, a greater proportion (treatment × day; $P < 0.05$) of D than P+S came to the bunk at the time of feeding during the first 4 days of receiving.

During the receiving period, D calves had greater ($P < 0.01$) ADG from arrival to day 58 and greater BW ($P < 0.01$) on d 58 than either pasture-weaned treatment (Table 5). Calves assigned to D had greater ($P < 0.01$) DMI than calves assigned to PF or PF+S. In addition, feed:gain was lower ($P = 0.01$) for D than for PF calves; thus, D calves were more efficient in utilizing feed for BW gain than PF calves during the receiving phase, despite consuming more feed. Providing calves with supplement in a bunk on pasture did not improve receiving ADG ($P > 0.05$) or DMI ($P > 0.05$) compared with pasture-weaned calves receiving no supplement.

Pasture-weaned calves in our study were supplemented infrequently (3 times weekly for 4 weeks) and ate less feed during receiving than drylot-weaned calves. Achieving greater performance and feed intake with pasture-weaned calves during receiving may be possible when supplementation is provided more frequently than in our study.

Incidence of undifferentiated fever during the receiving period was small (0.9%); therefore, we did not report summary statistics on this data. Previous work reported greater incidence of disease during receiving in drylot-weaned calves compared with pasture-weaned calves. In our study, the health of drylot-weaned calves was equivalent to that of pasture-weaned calves. Overall, our cattle were more healthy than in the aforementioned research, so we were unable to detect health differences among treatments.

Implications

We interpreted these data to suggest that animal performance and welfare during the receiving period were not improved by pasture preconditioning + fence-line contact with dams compared with drylot preconditioning + dam separation. Based on our behavior and performance data, previous experience consuming a concentrate-based diet from a bunk appeared to pay greater dividends during receiving than reducing stress associated with maternal separation through fence-line contact with dams. Best management practices for animal welfare may involve initiating diet transitions from forage to grain at the ranch of origin.

Pasture-preconditioning systems may be a lower-cost alternative to conventional drylot-preconditioning systems; however, decreased growth performance during pre-shipment preconditioning and receiving may result.

Table 1. Composition of the preconditioning diet[1]

Ingredient composition	% of dry matter
Alfalfa extender pellets	33.0
Corn gluten feed	18.2
Wheat middlings	14.6
Cracked corn	11.5
Cottonseed hulls	10.9
Dried distillers grain	7.8
Supplement	4.0

Nutrient composition	Amount
Crude protein, % of dry matter	14.28
Net energy for maintenance, Mcal/lb	0.68
Net energy for gain, Mcal/lb	0.42

[1]Diet also contained salt, zinc sulfate, and Rumensin 80 (Elanco Animal Health, Greenfield, IN).

Table 2. Nutrient composition of native pasture forage available to pasture-weaned beef calves (dry matter basis)

Nutrient	Manhattan	Hays
Dry matter, %	89.5	91.3
Crude protein, %	3.2	4.1
Neutral detergent fiber, %	74.4	74.8
Acid detergent fiber, %	51.8	48.6

Table 3. Composition of the receiving diet

Ingredient composition	% of dry matter
Ground sorghum grain	47.8
Wet distillers grains	11.0
Ground sorghum hay	33.9
Supplement[1]	7.3

Nutrient composition	Amount
Crude protein, % of dry matter	16.82
Net energy for maintenance, Mcal/lb	0.68
Net energy for gain, Mcal/lb	0.42

[1] Supplement contained Rumensin 80 and Tylan 40 (Elanco Animal Health, Greenfield, IN), limestone, salt, and trace minerals.

Table 4. Performance of beef calves while subjected to 1 of 3 28-day ranch-of-origin preconditioning regimens

	Drylot	Pasture + supplement	Pasture	SEM
Start weight, lb	498	503	503	31.8
End weight, lb[1]	518	485	481	23.4
Average daily gain, lb/day	0.68[a]	-0.62[ab]	-0.75[b]	0.405
Incidence of fever, %	5.01	0.63	1.91	1.825

[1] Body weight was measured immediately upon feedlot arrival.
[a,b] Means within rows without common superscripts tend to differ ($P = 0.08$).

Table 5. Performance of beef calves subjected to 1 of 3 ranch-of-origin preconditioning regimens during a 60-day feedlot receiving period

	Drylot	Pasture + supplement	Pasture	SEM
Arrival body weight (BW), lb	518	485	481	23.4
BW on d 27, lb	584[a]	549[b]	534[b]	8.6
BW on d 58, lb	697[a]	655[b]	644[b]	9.5
Average daily gain, lb/day				
Arrival to day 27	2.47[a]	2.40[a]	1.96[b]	0.088
Arrival to day 58	3.13[a]	2.93[b]	2.82[b]	0.130
Dry matter intake, lb/day	17.20[a]	17.02[b]	16.98[b]	0.015
Feed/gain, lb	5.49[a]	5.80[ab]	6.04[b]	0.004

[a,b] Means within rows without common superscripts differ ($P < 0.05$).

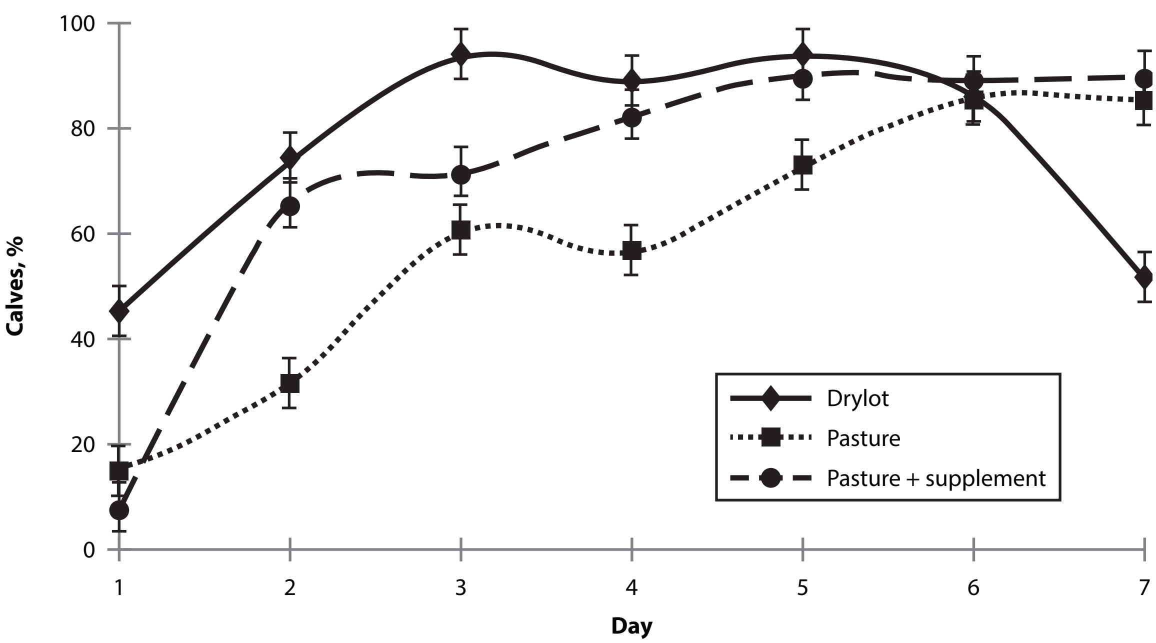

Figure 1. Proportion of calves observed at feed bunks immediately after feed delivery (Treatment × time, $P < 0.05$; Maximum SEM = 4.71).

Weaning Method Influences Finishing Performance without Affecting Carcass Characteristics

E.A. Bailey[1], J.R. Jaeger[2], J.W. Waggoner[3], G.W. Preedy[1], L.A. Pacheco[1], and KC Olson[1]

Introduction

Calf weight gains during preconditioning are variable and can be affected by weaning method. Nutrient restrictions during preconditioning that manifest as decreased weight gain may carry over into the finishing phase and affect performance and carcass characteristics. Previous research demonstrated that modest weight gains during preconditioning resulted in reduced calf body weights for the first 10 weeks of finishing compared with calves fed more aggressively during preconditioning. In contrast, compensatory gain may allow body weight recovery during finishing in cases where nutrient restriction has occurred during preconditioning; therefore, a producer who retains ownership through finishing may be able to utilize a low-input preconditioning program to minimize costs while expecting finishing performance similar to a high-input preconditioning program. Our objectives were to measure growth and health during finishing among beef calves subjected to 1 of 3 ranch-of-origin preconditioning programs.

Experimental Procedures

Angus × Hereford calves (n = 460; initial body weight = 496 ± 77 lb) originating from the Kansas State University commercial cow-calf herds in Manhattan, KS, and Hays, KS, were used in this experiment. Calves were weaned at approximately 180 days of age. All calves were dehorned, and steer calves were castrated before 60 days of age. At weaning, calves were weighed individually and assigned randomly to 1 of 3 ranch-of-origin preconditioning methods: (1) drylot weaning + dam separation (D), (2) pasture weaning + fence-line contact with dams (PF), and (3) pasture weaning + fence-line contact with dams + supplemental feed delivered in a bunk (PF+S).

All calves were vaccinated against respiratory pathogens (Bovi-Shield Gold 5; Pfizer Animal Health, Whitehouse Station, NJ), clostridial pathogens (Ultrabac 7; Pfizer Animal Health), and *H. somnus* (Somubac; Pfizer Animal Health) on the day of weaning. In addition, calves were treated for parasites (Ivomec; Merial Limited, Duluth, GA). Booster vaccinations were administered 14 days later.

Within location, calves assigned to PF and PF+S were maintained for 28 days in a single native pasture (minimum area = 118 acres). Calves were allowed fence-line contact with their dams for 7 days (minimum frontage = 656 ft; 4-strand, barbed-wire fence with the bottom 2 wires electrified). Cows were moved out of visual and auditory range after 7 days. Fresh water, salt, and mineral supplements were available continually. Calves assigned to D were transported (<30 miles) immediately after separation from dams and confined within location to a single earth-surfaced pen (minimum area = 215 ft2/calf; bunk space = 18 in./calf).

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Calves assigned to D were fed a diet formulated to promote 2.2 lb average daily gain at a dry matter intake of 2.5% of body weight (BW) during the preconditioning phase of the study. Calves assigned to PF had access to native forage only, whereas calves assigned to PF+S calves had access to native forage and received a ration of the diet fed to D at a rate of 1% of BW 3 times weekly. Calves assigned to PF+S were sorted into a single pen located adjacent to the fence line shared with dams at 9:00 a.m. on Mondays, Wednesdays, and Fridays during the preconditioning phase. The ration was offered in portable bunks (bunk space = 18 in./calf).

All calves were monitored for symptoms of respiratory disease twice daily during the preconditioning phase of our study. Calves with clinical signs of bovine respiratory disease (BRD) were removed from pens or pastures and evaluated. Calves were assigned a clinical score (scale: 1 to 4; 1 = normal, 4 = moribund), weighed, and assessed for fever. Calves with a clinical illness score >1 and a rectal temperature >104.0°F were treated with therapeutic antibiotics according to label directions (first incidence = Baytril, Bayer Animal Health, Shawnee Mission, KS; second incidence = Nuflor, Merck Animal Health, Summit, NJ). Cattle were evaluated 72 hours post-treatment and re-treated based on observed clinical signs.

After the 28-day preconditioning period, all calves were transported 4 hours from the ranch of origin to the Western Kansas Agricultural Research Center in Hays, KS, and weighed individually upon arrival. At that time, calves were stratified by sex and assigned to 1 of 18 pens by treatment (6 pens/treatment). Animals were fed once daily. If the previous day's feed was consumed, total feed delivered was increased by approximately 2% of the previous day's feed delivery. Bunks were managed using a slick-bunk management method to minimize feed refusals. Dry matter intake was estimated based on feed delivered to the pen. Calf health was monitored as during the preconditioning phase of the study.

After a 60-day receiving period at the feedlot, calves were gradually stepped up onto a finishing ration (Table 1). Calves were finished to a common end-point of 0.5 in. of 12th-rib fat and harvested at a commercial packing plant in Dodge City, KS. After a 48-hour chill, carcass characteristics evaluated were the following: 12th-rib fat thickness; 12th-rib longissimus muscle area; kidney, pelvic, and heart fat; USDA yield and quality grades; and marbling score.

Results and Discussion

Finishing Performance

The body weight difference between D weaned calves and PF weaned calves was 48 lb at the end of the receiving period. The PF weaned calves gained weight at a greater rate ($P = 0.01$; Table 2) during finishing than D weaned calves or PF+S weaned calves that were supplemented during preconditioning. Under the conditions of our experiment, the PF weaned calves compensated for previous nutritional restriction during finishing. In contrast, body weight at harvest ($P = 0.56$) was not different among treatments, likely because we had a predetermined finishing-phase end point based on backfat thickness. The number of days on feed were not different ($P = 0.14$). Based on these data, it is possible for producers who wish to retain ownership during finishing to use pasture weaning in conjunction with minimal supplementation without fear of sacrificing pounds of beef at harvest time.

Carcass Characteristics

Hot carcass weight ($P = 0.49$; Table 3) was not different among treatments. Based on hot carcass weight and harvest determination methodology (common backfat thickness end point), it appears that the nutritional restriction of unsupplemented PF weaned calves during preconditioning did not alter carcass quality. Yield grade ($P = 0.38$), marbling score ($P = 0.92$), and 12th-rib fat thickness ($P = 0.42$) did not differ among treatments.

Implications

Unsupplemented pasture-weaned calves weighed less at the end of the receiving period than drylot-weaned calves but gained weight at a greater rate during finishing. We interpreted this to suggest that that preconditioned calves can compensate for previous nutritional restriction during finishing. Days on feed did not differ, despite cattle being fed to a common backfat end point. Low-input preconditioning programs that involve pasture weaning do not have negative effects on finishing performance or carcass characteristics of beef cattle and may be a means of reducing the cost of preconditioning.

Table 1. Composition of the finishing diet

Ingredient composition	% of dry matter
Ground sorghum grain	74.3
Wet distillers grains	11.8
Sorghum silage	12.3
Supplement[1]	1.5
Nutrient composition	**Amount**
Crude protein, % of dry matter	12.7
Net energy for maintenance, Mcal/lb	0.85
Net energy for gain, Mcal/lb	0.55

[1] Supplement contained Rumensin 80 and Tylan 40 (Elanco Animal Health, Greenfield, IN), limestone, salt, and trace minerals.

Table 2. Performance of beef calves subjected to 1 of 3 ranch-of-origin preconditioning methods during finishing

Item	Drylot	Pasture	Pasture + supplement	SEM
Initial body weight, lb	695^{a}	642^{b}	653^{b}	9.5
Harvest body weight, lb	1,234	1,254	1,229	17.4
Average daily gain, lb	3.52^{b}	3.94^{a}	3.63^{b}	0.084
Days on feed	163	169	164	2.7

[a,b] Means within rows without common superscripts differ ($P < 0.05$).

Table 3. Carcass characteristics of beef calves subjected to 1 of 3 ranch-of-origin preconditioning methods

Item	Drylot	Pasture	Pasture + supplement	SEM
Hot carcass weight, lb	768	755	761	10.7
Marbling score[1]	494	506	507	35.4
USDA yield grade	3.5	3.3	3.3	0.16
12th-rib fat thickness, in.	0.50	0.45	0.48	0.036
Longissimus area, $in.^2$	12.3	12.2	12.4	0.18
Kidney, pelvic, and heart fat, %	2.65	2.43	2.57	0.148

[1] Marbling score values ranging from 400 to 499 represent a small degree of marbling.

Efficiency of Early Weaned Beef Calves Is Not Improved by Restricting Feed Intake During 84-Day Growing Phase

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Introduction

Early weaning can be used by cow-calf producers to reduce stocking rates by 20% to 30% during drought. Ranchers may be reluctant to wean early because of reduced calf weights and reduced revenue compared with weaning calves at conventional ages. To avoid revenue shortfalls, calves can be retained and grown before selling; however, grain prices are currently at unprecedented levels. Feeding grain-based diets to calves less than 125 days of age has been associated with excessive fat accumulation early in the feeding period and decreased carcass weights. Conversely, several researchers have noted marked improvements in feed efficiency when grain-based finishing diets were limit-fed. High feed costs and early fat deposition may be attenuated by limit-feeding a grain-based diet to early weaned calves. Our goal was to measure performance and efficiency of lightweight, early weaned beef calves during an 84-day postweaning growing phase when feed intakes were varied to achieve targeted gains of 1, 2, or 3 lb/day.

Experimental Procedures

Angus × Hereford calves (n = 243; initial body weight = 343 ± 68 lb) originating from the Kansas State University commercial cow-calf herd in Hays, KS, were used in this experiment. All calves were dehorned, and steer calves were castrated before 60 days of age. Calves were weaned at approximately 100 days of age. At weaning, calves were weighed individually and assigned randomly to 1 of 3 rates of gain: 1 lb/day (Logain), 2 lb/day (Midgain), and 3 lb/day (Higain). Calves were fed a common diet (Table 1); growth and health performance were evaluated during an 84-day backgrounding period.

At weaning, calves were blocked by gender and assigned to 1 of 18 pens (6 pens/treatment). Animals were fed once daily. One common diet was formulated using formulation software that predicted calves to gain ~3 lb/day at maximal intake. We fed this diet to all treatments but restricted the intake of the Logain and Midgain calves to a level that decreased their predicted gain to 1 and 2 lb/day, respectively.

Calf body weights were measured at weaning and every 28 days thereafter until the end of the study. Initial feed allowances were determined based on initial body weight and targeted rates of gain. Feed deliveries were adjusted every 28 days to match observed rates of gain. Treatment diets were individually fed once daily at 6:00 a.m. throughout the study. Calves were measured with ultrasound to determine 12th-rib fat thickness, longissimus muscle depth, and marbling score at the end of the 84-day backgrounding phase.

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All calves were vaccinated against respiratory pathogens (Bovi-Shield Gold 5; Pfizer Animal Health, Whitehouse Station, NJ), clostridial pathogens (Ultrabac 7; Pfizer Animal Health), and *H. somnus* (Somnubac; Pfizer Animal Health) on the day of 47 weaning. In addition, calves were treated for internal and external parasites (Ivomec; Merial Limited, Atlanta, GA) at weaning. Booster vaccinations were administered 14 days later.

All calves were monitored for symptoms of respiratory disease twice daily during our study. Calves with clinical signs of respiratory disease were removed from pens and evaluated. Calves were assigned a clinical morbidity score (scale of 1 to 4; 1 = normal, 4 = moribund), weighed, and assessed for fever. Calves with a clinical illness score >1 and a rectal temperature >104°F were treated with therapeutic antibiotics according to label directions (first incidence = Baytril, Bayer Animal Health, Shawnee Mission, KS; second incidence = Nuflor, Merck Animal Health, Summit, NJ). Cattle were evaluated 72 hours after treatment and re-treated based on observed clinical signs.

Results and Discussion

Daily gain increased ($P < 0.01$) as feed allowance increased (Table 2). At the end of the 84-day experiment, Higain calves weighed more ($P > 0.01$) than either Midgain or Logain calves. We were unsuccessful in reaching our targeted average daily gain for the Midgain and Higain treatments, likely due to limitations of the prediction equations used by our formulation software.

Feed intake was greater ($P < 0.01$) for the Higain treatment than for the Midgain treatment; moreover, feed intake of the Midgain treatment was greater ($P < 0.01$) than for the Logain treatment (Table 2). Unexpectedly, feed efficiency did not differ ($P = 0.83$) among treatments. Previous research noted that feed efficiency of older cattle increased dramatically when feed intake was restricted; we expected comparable increases in efficiency in our lightweight, early weaned calves.

Backfat over the 12th rib was greater in the Higain calves than either the Logain ($P < 0.01$) or the Midgain ($P = 0.02$) calves, but there were no differences ($P = 0.14$) in marbling score among treatments (Table 3). Longissimus muscle depth was less in the Logain calves than either the Midgain ($P = 0.04$) or Higain ($P < 0.01$) calves. The influence of our treatments on body composition may have an impact on finishing performance and carcass characteristics of the current set of calves. Early weaned calves fed a concentrate diet after weaning have been noted to have poor performance during finishing and achieve a target backfat end point at lighter body weights, which would reduce the total beef production potential of early weaned calves. One of the goals of this trial was to utilize restricted feeding to overcome this phenomenon while also minimizing the amount of forage, which is scarce during times of drought, fed to early weaned calves. Incidence of undifferentiated fever was not different among treatments ($P = 0.95$) and was relatively mild (6% or less) overall. It has been previously noted in the literature that limit-feeding newly weaned calves a concentrate diet can increase morbidity.

Implications

Lightweight, early weaned calves that were fed a grain-based diet at restricted rates did not exhibit improved feed efficiency relative to their full-fed counterparts. In addition, limitations were associated with predicting feed intake and performance of lightweight, early weaned calves fed a grain-based diet. We did influence body composition with the current treatment structure, which may have an impact on finishing performance.

Table 1. Composition of backgrounding diet on a 100% dry matter basis

Ingredient	% of dry matter
Dry-rolled sorghum grain	52.9
Dried distillers grains	23.8
Sorghum silage	18.0
Supplement[1]	5.3
Nutrient	
Crude protein, %	15.58
Net energy for maintenance, Mcal/lb	0.82
Net energy for gain, Mcal/lb	0.55

[1] Supplement contained Rumensin 80 and Tylan 40 (Elanco Animal Health, Greenfield, IN), limestone, salt, and trace minerals.

Table 2. Performance of beef calves fed a common diet to achieve targeted gains of 1, 2, or 3 lb/day

	Targeted average daily gain			
	1 lb/day	2 lb/day	3 lb/day	SEM
Weaning weight, lb	341	341	347	11.5
Final weight, lb	444[a]	468[a]	510[b]	9.0
Average daily gain, lb				
Arrival to d 28	1.07[a]	1.51[b]	1.87[c]	0.102
Day 28 to 56	1.54[a]	1.62[a]	2.00[b]	0.099
Day 56 to 84	1.02[a]	1.46[b]	1.96[c]	0.107
Overall	1.21[a]	1.53[b]	1.94[c]	0.064
Feed intake, lb/day	5.83[a]	7.66[b]	9.50[c]	0.055
Feed:gain	4.81	5.03	4.88	0.300

[a, b,c] Values with different superscript letters are different, $P < 0.05$.

Table 3. Growth and health characteristics of beef calves fed a common diet to achieve targeted gains of 1, 2, or 3 lb/day

	Targeted average daily gain			
	1 lb/day	2 lb/day	3 lb/day	SEM
Backfat over the 12th rib, in.	0.132[a]	0.139[a]	0.162[b]	0.0085
Marbling score[1]	475	468	456	9.2
Longissimus muscle depth, in.	1.52[a]	1.58[b]	1.63[b]	0.026
Incidence of fever, %	4.89	6.05	5.85	3.046

[1] Marbling score values ranging from 400 to 499 represent a small degree of marbling.
[a,b] Values with different superscript letters are different, $P < 0.05$.

Effects of Infrequent Dried Distillers Grains Supplementation on Spring-Calving Cow Performance

B.W. Bennett[1], J.W. Waggoner[2], J.R. Jaeger[3], A.K. Sexten[1], and KC Olson[1]

Introduction

Feed and supplement costs and the expenses associated with delivery of winter supplements account for a large proportion of the total expenditures on cow-calf operations. Cattle grazing low-quality dormant native range (<6% crude protein) are typically unable to consume sufficient protein from the forage base, which hinders microbial activity and forage digestion. Therefore, protein supplementation is required to maintain cow body weight and body condition score during the last trimester of pregnancy. Low cow body condition scores at calving are common and may negatively affect lactation, subsequent re-breeding rates, and calf weaning weight. Failure to maintain proper nutritional status during this period severely affects short-term cow performance, reduces overall herd productivity, and limits profit potential.

The most effective means of supplying supplemental protein to cows consuming dormant native range is to provide a small amount of high-protein feedstuff (>30% crude protein). Dried distillers grains with solubles (DDGS) are a by-product of the ethanol refining process that supply the recommended 30% crude protein level, are readily available, and are often more economical than traditional feedstuffs.

With the rising costs of inputs in today's cow-calf sector, reducing cost is necessary to maintain the viability of the national cowherd. Reducing the frequency of supplement delivery results in less labor and use of fuel, effectively reducing input costs; however, this system is viable only as long as cow performance is maintained. The objective of this study was to examine the effects of infrequent DDGS supplementation on cow body weight and body condition score.

Experimental Procedures

Animals, Treatments, and Diets

Pregnant Angus-cross cows (n = 120; initial body weight = 1,239 lb ± 170 lb; initial body condition score = 5.0 ± 0.5) were maintained on common native rangeland pastures (Table 1) at the Kansas State University Agricultural Research Center–Hays (ARCH) for 84 days before the expected onset of calving. Cows were stratified by age, body condition score, and weight and assigned randomly to 1 of 3 supplement treatments: dried distillers grains with solubles daily (DDGD), dried distillers grains with solubles every 3 days (DDG3D), and dried distillers grains with solubles every 6 days (DDG6D). Dried distillers grains with solubles were offered to supply 0.5 lb/cow per day of crude protein (1.8 lb DDGS/cow per day). For example, cattle receiving supplement once every 6 days received 3 lb of crude protein (10.8 lb DDGS/cow) on the day of supplementation. Cows were sorted daily into treatment groups, and supplement was delivered at approximately 8:30 a.m. Only one set of bunks was available; therefore, on days when multiple supplement treatments were fed, each group would be given ample time to finish

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the supplement before being moved out of the feeding area. Cows were supplied half their expected dry matter intake with forage sorghum hay daily to ease grazing pressure and ensure ample forage intake. At the onset of calving, cows were no longer sorted by treatment but were fed DDGS daily in a common pasture and had unrestricted access to forage sorghum hay. Cows were maintained in this manner until summer turnout (May 7, 2012).

Data Collection

Cow body weight and body condition score were measured every 28 days for the duration of the study, immediately following calving (within 12 hours), and on day 132 (prior to turnout). Body condition scores were assigned by two independent, qualified observers using a 9-point scale (1 = extremely emaciated, 9 = extremely obese). Calf birth weight was also recorded within 12 hours of calving.

Estrous Cyclicity Determination

Blood samples were collected from all cows via jugular venipuncture 10 days before initiation of ovulation synchronization and on the day ovulation synchronization was initiated. Samples were collected with 16 × 100 mm vacutainer tubes, then immediately placed on ice, allowed to clot for 24 hours at 4°C, and centrifuged (1,500 × g) for 10 minutes. Serum was decanted into 12 × 75 mm plastic tubes and immediately frozen (-20°C). Concentration of progesterone (P4) in serum was subsequently quantified by radioimmunoassay. When a sample from either collection date contained concentrations of P4 ≥ 1 ng/mL, that cow was considered to have re-established estrual behavior.

Estrus Synchronization

Ovulation was synchronized using a modified 7-day CO-Synch+CIDR (controlled internal drug release) protocol; cows were inseminated by fixed-time artificial insemination 60 to 64 hours after CIDR removal. Cows were exposed to fertile bulls 10 days after fixed-time artificial insemination for the remaining 35 days of a 45-day breeding season. Conception to fixed-time artificial insemination was determined via ultrasound 35 days after insemination, and final pregnancy rate was determined via ultrasound 35 days after the end of the breeding season.

Statistics

Performance data were analyzed using the GLM procedure of SAS (SAS Inst. Inc., Cary, NC). Initial and calving body weight, body weight change, initial and calving body condition score, body condition score change, calf birth weight, and average calving date were used as the dependent variables. Reproductive data were analyzed using the CATMOD procedure of SAS (SAS Institute Inc., Cary, NC). Differences were considered significant at $P \leq 0.05$.

Results and Discussion

Cow Performance

Initial body weight and body condition score did not differ among treatments ($P > 0.05$, Table 2). Body weight and body condition score at calving also did not differ among treatments. As a result, the overall change in body weight and body condition score throughout the experiment did not differ ($P = 0.82$ and $P = 0.74$, respectively). Supplementation frequency did not affect calf birth weight or average calving date, nor were any long-term effects of supplementation observed, because cow body weight among treatments at turnout was similar ($P > 0.05$).

Reproductive Performance

The proportion of cows considered to be estrual at initiation of ovulation synchronization did not differ ($P = 0.86$) between supplementation frequency treatments and averaged 37.0%. Frequency of supplementation did not affect first service conception rate (68.5%; $P = 0.90$) or final pregnancy rate (96.3%; $P = 0.55$).

Implications

These data suggest that, under the conditions of our study, DDGS may be supplemented as infrequently as once every 6 days without adversely affecting performance of spring-calving cows. The labor and fuel savings associated with reducing supplementation frequency will result in lower overall supplementation costs.

Table 1. Nutrient composition (dry matter basis) of native rangeland forage, dried distillers grains with solubles (DDGS), and forage sorghum hay

	Nutrient composition		
Item	Native range	DDGS	Sorghum hay
Dry matter, %	74.43	89.24	86.61
Crude protein, %	7.49	29.53	6.93
Net energy for maintenance, Mcal/lb	0.32	0.88	0.48
Net energy for gain, Mcal/lb	0.08	0.55	0.23
Neutral detergent fiber, %	59.18	30.39	59.30
Acid detergent fiber, %	44.43	17.08	36.89
Total digestible nutrients, %	42.57	76.59	52.75
Calcium, %	0.58	0.08	0.49
Phosphorus, %	0.11	0.80	0.15
Sulfur, %	0.09	0.43	0.10

Table 2. Performance of cows receiving dried distillers grains with solubles (DDGS) daily (DDGD), every 3 days (DDG3D), and every 6 days (DDG6D)

	Treatment				
Item	DDGD	DDG3D	DDG6D	SE[1]	*P*-value
Number of cows	38	31	37		
Initial weight, lb	1241.7	1256.4	1239.6	28.56	0.91
Calving weight, lb	1243.3	1256.5	1247.0	29.32	0.95
Weight change, lb	1.53	0.26	7.41	8.63	0.82
Turnout weight, lb[2]	1312.8	1329.2	1301.2	28.94	0.80
Initial body condition score[3] (BCS)	5.07	5.18	4.97	0.08	0.23
Calving BCS	5.28	5.31	5.16	0.08	0.37
BCS change	0.21	0.13	0.19	0.08	0.74
Calf weight, lb	84.6	86.9	83.4	1.68	0.33
Avg. calving date	03/24/2012	03/22/2012	03/22/2012		0.20

[1] Standard error.

[2] Weight at turnout onto summer native rangeland pasture (day 134; May 7, 2012).

[3] Scale: 1 = emaciated and 9 = extremely fat.

Effect of Banamine on First-Service Conception Rate in Non-Transported Replacement Heifers

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Introduction

The development of replacement heifers requires many resources (feed, labor, etc.), so the inherent cost to establish new genetics is often high. Timely conception and maintenance of pregnancy are vital to the long-term success and retention of replacement females in the herd. Improvement of first-service conception rate remains challenging for many operations despite enhanced knowledge and use of heifer management strategies.

Facility limitations often dictate that cattle be processed and bred in a central location, then transported to other locations for the remainder of the breeding season. The physiological stress associated with handling and transportation increases serum cortisol concentrations, which may be used as an indication of animal stress. Physiological stress has been correlated with an inability for the embryo to suppress $PGF_{2\alpha}$ secretions and failure of maternal recognition. Early embryonic loss accounts for the greatest proportion of reproductive failure. Injection of Banamine (flunixin meglumine; Merck Animal Health, Summit, NJ) at breeding or post-breeding has been demonstrated to inhibit production of $PGF_{2\alpha}$, mitigate the effect of transportation stress, and allow for pregnancy maintenance.

Even in cattle that do not require transportation after breeding, human interaction and handling often result in increased stress. These unavoidable stressors potentially hinder first-service conception rates to an even greater extent; therefore, the objective of this study was to evaluate the effect of Banamine on first-service conception rates in non-transported replacement heifers.

Experimental Procedures

Animals and Treatments

Angus-cross heifers (n = 220; body weight = 809 ± 81 lb; body condition score = 5.3 ± 0.4, scale 1 = emaciated and 9 = extremely fat) originating from the Commercial Cow-Calf unit at Kansas State University (Manhattan, KS) and the Agricultural Research Center–Hays (Hays, KS) were utilized. All heifers were developed at the feedlot at the Agricultural Research Center–Hays following weaning and were then returned to their respective origins for the entire breeding season. Prior to initiation of ovulation synchronization, heifers were stratified by origin, body weight, and condition score, and assigned randomly to 1 of 2 treatments: (1) injection with physiological saline (CON) or (2) injection with Banamine (BAN). Treatments were administered subcutaneously at 1 mL/100 lb of body weight 14 days after fixed-time artificial insemination.

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Estrous Determination

Blood samples were collected from heifers via jugular venipuncture 10 days before and on the day ovulation synchronization was initiated. Samples were collected into 16 × 100 mm vacutainer tubes, immediately placed on ice, allowed to coagulate for 24 hours at 4°C, then centrifuged (1,500 × g) for 10 minutes. Serum was decanted into 12 × 75 mm plastic tubes and immediately frozen (-20°C). Concentration of progesterone (P4) in serum was quantified by radioimmunoassay. When a sample from either collection date contained a concentration of P4 ≥ 1 ng/mL, that heifer was considered to be pubertal.

Ovulation Synchronization

Ovulation was synchronized using a modified 7-day CO-Synch+CIDR (controlled internal drug release) protocol, and heifers were inseminated by fixed-time artificial insemination 60 to 64 hours after CIDR removal. Heifers were exposed to fertile bulls 10 days after fixed-time artificial insemination for the remaining 35 days of a 45-day breeding season. Conception to fixed-time artificial insemination was determined via ultrasound 35 days after insemination, and final pregnancy rate was determined via ultrasound 35 days after the end of the breeding season.

Statistics

Body weight and body condition score data were analyzed using the GLM procedure of SAS (SAS Institute Inc., Cary, NC). Reproductive data were analyzed using the CATMOD procedure of SAS. Differences were considered significant at $P \leq 0.05$.

Results and Discussion

Heifer body weight and body condition score at breeding were not different between treatments ($P > 0.05$; Table 1). Proportion of heifers pubertal before onset of ovulation synchronization was 98.2% and was not affected by location. Treatment with BAN did not affect first-service conception rate ($P = 0.87$) or final pregnancy rate ($P = 0.39$; Table 1).

Implications

These data suggest that, under the conditions of our study, injection of Banamine 14 days after fixed-time artificial insemination did not improve first-service conception or final pregnancy rates in non-transported replacement heifers.

Table 1. Reproductive performance of heifers injected with physiological saline (CON) or flunixin meglumine (BAN) 14 days after fixed-time artificial insemination.

	Treatment			
Item	CON	BAN	SE[1]	*P*-value
Number of heifers	111	109		
Body weight, lb	813.7	804.6	7.78	0.41
Body condition score[2]	5.3	5.3	0.04	0.60
FSCR[3], %	42.3	41.2	0.05	0.87
Final pregnancy rate, %	79.3	84.4	0.04	0.39

[1] Standard error.
[2] Scale: 1 = emaciated and 9 = extremely fat.
[3] First-service conception rate.

Cover Systems for Wet Distillers Grains Stored in Concrete Bunkers[1]

J.W. Waggoner[2] and J.R. Jaeger[3]

Introduction

Recent research conducted at the Agriculture Research Center in Hays, KS, and funded by the Kansas Corn Commission demonstrated that storing wet distillers grains (WDG) in concrete bunkers was a viable storage option for producers in Kansas. In the previous experiment, bunkers of WDG were covered with silage plastic and stored for 211 days with minimal changes in nutrient composition. However, covering large piles with silage plastic can be tenuous, and producers are interested in other low-cost covering methods or leaving piles uncovered. The objective of this project was to evaluate the nutrient quality and product loss effects of three different cover systems for WDG stored in concrete bunkers: (1) no cover, (2) plastic cover, and (3) stock salt.

Experimental Procedures

Concrete storage bunkers were assigned randomly to one of three cover system treatments: No cover (Uncovered), 6-mil black plastic and tires (Plastic), and 2 lb/ft^2 of stock salt (Salt). On August 30 and September 1, 2011, 6 truckloads (3 per day) of WDG were received at the Agricultural Research Center–Hays and unloaded directly into concrete bunker silos. Covering system treatments were applied on the day of arrival. Grab Samples of WDG were obtained from each load on the day of arrival to assess nutrient quality prior to storage.

Sampling to document nutrient composition changes over time was initiated on September 28, 2011. Samples were obtained every 28 days from 2 randomly selected locations within each bunker using a commercially available grain probe. Samples were obtained at a depth of approximately 24 in. and were composited within bunker and frozen for later analysis. At the conclusion of the project, samples were submitted to a commercial laboratory (SDK Labs, Hutchinson, KS) for nutrient analysis.

At the conclusion of the storage period (April 18, 2012), all remaining WDG were removed from each individual bunker and the total amount of product remaining was weighed and recorded for determination of total product loss (shrink).

Results and Discussion

A day × cover system interaction ($P \leq 0.05$) was observed for both dry matter and crude protein content of WDG (Tables 1 and 2). Dry matter content of WDG covered with Plastic or Salt were not different at any time point during the 196-day study ($P > 0.05$); however, dry matter content of WDG that was left uncovered was more variable and ranged from 34.6 to 50.4% during the course of the study. Crude protein content (dry matter basis) also did not differ significantly ($P > 0.05$) among plastic and salt-covered WDG at any time points but increased over time in uncovered WDG (day $P < 0.01$). An effect of day ($P < 0.01$) was observed for acid detergent fiber concentration of stored WDG (Table 3). Total product loss (Table 4) was great-

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

[2] Kansas State University Southwest Research-Extension Center, Garden City, KS.

[3] Kansas State University Agricultural Research Center–Hays.

est for the uncovered (73.3%), followed by the salt-covered pile (28.5%), and lowest for WDG covered with plastic and tires (16.6%) during the storage period. Collectively, the observed variation in dry matter content, increase in crude protein content, and exceptionally high level of product loss in uncovered WDG demonstrates that WDG does not store well for extended periods when left exposed to the elements.

Implications

This project documented that uncovered WDG stored in concrete bunkers will substantially deteriorate during a 196-day storage period, as indicated by the 73.3% shrink value observed in this study. Covering WDG with 2 lb stock salt/ft^2 of surface of the pile maintained product nutrient quality over the storage period, but the product shrank considerably (28.5%). Covering WDG with plastic remains the best method of covering WDG stored in concrete bunkers for longer storage periods, but the ability of the salt cover system to maintain product quality over the 196-day duration of this project indicates that salt also may be an effective cover system for WDG stored in concrete bunkers.

Table 1. Effects of storage and cover system on dry matter content (%) of wet distillers grains stored in concrete bunkers (day × cover; *P* ≤ 0.05)

	Treatment[1]			
Day	Uncovered	Plastic	Salt	SEM[2]
0	38.2[a]	36.1[a]	38.0[a]	1.10
28	40.0[a]	38.1[b]	38.1[b]	
56	42.4[a]	35.4[b]	37.5[b]	
84	43.6[a]	35.5[b]	36.4[b]	
112	48.0[a]	36.3[b]	37.3[b]	
140	50.4[a]	35.7[b]	37.2[b]	
168	35.3[a]	35.6[a]	37.5[a]	
196	34.2[a]	34.4[a]	35.4[a]	

[1] Treatments: No cover (Uncovered), 6-mil black plastic and tires (Plastic), and 2 lb/ft^2 of stock salt (Salt).
[2] SEM = Common standard error of the mean.
[a,b] Means within a row without a common letter differ $P \leq 0.05$.

Table 2. Effects of storage and cover system on dry matter crude protein content (%) of wet distillers grains stored in concrete bunkers (day × cover; $P \leq 0.05$)

	Treatment[1]			
Day	Uncovered	Plastic	Salt	SEM[2]
0	35.8[a]	33.1[a]	33.4[a]	1.56
28	36.1[a]	34.1[a]	35.4[a]	
56	37.8[a]	33.9[b]	37.8[a]	
84	43.6[a]	33.9[b]	35.3[b]	
112	41.2[a]	34.5[b]	36.5[b]	
140	50.5[a]	34.5[b]	35.1[b]	
168	51.0[a]	35.0[b]	34.8[b]	
196	52.5[a]	36.2[b]	35.9[b]	

[1] Treatments: No cover (Uncovered), 6-mil black plastic and tires (Plastic), and 2 lb/ft^2 of stock salt (Salt).
[2] SEM = Common standard error of the mean.
[a,b] Means within a row without a common letter differ $P \leq 0.05$.

Table 3. Effects of storage and cover system on dry matter acid detergent fiber content (%) of wet distillers grains stored in concrete bunkers (day $P < 0.01$; cover $P = 0.10$; day × cover; $P = 0.25$)

	Treatment[1]			
Day	Uncovered	Plastic	Salt	SEM[2]
0	20.0	19.3	18.0	1.35
28	19.6	19.4	19.4	
56	19.4	19.5	18.5	
84	23.1	19.1	19.9	
112	20.6	19.6	20.6	
140	27.8	20.9	20.0	
168	24.0	20.5	21.1	
196	23.0	22.5	20.2	

[1] Treatments: No cover (Uncovered), 6-mil black plastic and tires (Plastic), and 2 lb/ft^2 of stock salt (Salt).
[2] SEM = Common standard error of the mean.

Table 4. Effects of storage and cover system on total product loss (shrink) of wet distillers grains stored in concrete bunkers (as-is basis)

	Treatment[1]		
Item	Uncovered	Plastic	Salt
Initial weight, lb	95,360	103,840	98,660
Final weight, lb	25,455	86,645	70,570
Shrink weight, lb	69,905	17,195	28,090
Shrink, %	73.3	16.6	28.5

[1] Treatments: No cover (Uncovered), 6-mil black plastic and tires (Plastic), and 2 lb/ft^2 of stock salt (Salt).

Effects of Sample Handling Method on Prussic Acid (Hydrocyanic Acid) Content of Forage Sorghum

J.W. Waggoner[1] and J.D. Holman[1]

Introduction

Prussic acid (hydrocyanic acid or hydrogen cyanide) poisoning is commonly associated with drought or frost-damaged forage and grain sorghum. Prussic acid is toxic to livestock (Table 1) due the accumulation of cyanide gas within leaf tissue. Hydrogen cyanide is volatile and will dissipate from plant tissues as the leaf tissue dries; therefore, frost-damaged forages should not be grazed for at least 5 days following a frost. Only limited information is available to producers regarding the best method for handling forage samples prior to analysis of prussic acid content. The objective of this study was to evaluate the effects of different sample handling methods (refrigeration or freezing in open or sealed bags) on prussic acid content of forage sorghum.

Experimental Procedures

A representative sample was obtained from a single field of forage sorghum in Ford County approximately 24 hours following a hard freeze (October 7, 2012). The sample was chopped into approximately 1- to 3-in. pieces and thoroughly mixed. The processed sample was then equally divided into 18 individual samples, placed in plastic bags, and assigned randomly to five different handling methods (3 replicates per treatment). The handling methods evaluated were (1) delivered to the lab the same day (FRESH), (2) refrigerated for 7 days prior to analysis (REFR), (3) frozen for 7 days prior to analysis (FRZR), (4) placed on a pickup dash in an open (unsealed) plastic bag for 7 days prior to analysis (PUOPEN), and (5) placed on a pickup dash in a sealed plastic bag for 7 days prior to analysis (PUSEAL). All samples were submitted to a commercial forage testing laboratory (Servi-Tech Laboratories, Dodge City, KS) for analysis of dry matter, prussic acid, crude protein, and acid detergent fiber concentration. All data were analyzed using the ANOVA procedure of SAS (SAS Institute Inc., Cary, NC). Means were separated using a least-significant difference test and were considered significant at $P \leq 0.05$.

Results and Discussion

Sample handling method influenced dry matter, prussic acid, crude protein, and acid detergent fiber concentrations ($P \leq 0.05$; Table 2). Dry matter content was similar among FRESH, REFR, FRZR, and PUSEAL ($P > 0.05$) but was greater for PUOPEN. The relative difference among these samples indicates the importance of placing samples intended for subsequent analysis in a sealed bag. Prussic acid, crude protein, and acid detergent fiber contents were similar among FRESH, REFR, and FRZR sampling handling methods ($P > 0.05$). Significant changes ($P \leq 0.05$) in these analyses were observed in samples that were placed in the pickup for 7 days (PUSEAL or PUOPEN), with the most dramatic differences observed for prussic acid content, which was reduced from 597 ppm in FRESH to 109 ppm in PUOPEN. The marked reduction observed in prussic acid content was likely due to the volatile nature of prussic acid and clearly demonstrates the need for proper sample-handling protocols. The absence of a significant difference in prussic acid content of FRESH, REFR, and FRZR handling methods indicates that forage samples may be placed in the refrigerator or freezer for up to 7 days before analysis.

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[1] Kansas State University Southwest Research-Extension Center, Garden City, KS.

Implications

Sample handling method may influence prussic acid content of forage samples. The results of this study indicate that forage samples may be refrigerated or frozen in sealed plastic storage bags for up to 7 days before analysis of prussic acid content, but samples should not be left in unsealed containers in an unprotected environment for an extended period.

Table 1. Level of prussic acid (dry matter basis) in forage and potential effects on animals[1]

Prussic acid, ppm	Effect on animals
0–500	Generally safe; should not cause toxicity
500–1,000	Potentially toxic; should not be used as only source of feed
1,000 and above	Dangerous to cattle and will usually cause death

[1] Holman, J., K. Roozeboom, D.B. Mengel, and D. Blasi. “Prussic Acid Poisoning,” Kansas State University Agricultural Experiment Station and Cooperative Extension Service, MF3040, 2012.

Table 2. Effect of sampling handling method on chemical composition of forage sorghum

	Treatment[1]					
Item	FRESH	REFR	FRZR	PUOPEN	PUSEAL	LSD (0.05)[2]
Dry matter, %	27.6[a]	27.7[a]	27.6[a]	71.5[b]	28.2[a]	13.9
Prussic acid, ppm	597[a]	551[a]	536[a]	109[c]	419[b]	90
Crude protein, % of dry matter	17.6[a]	17.3[a]	17.5[a]	18.8[b]	17.6[a]	0.6
Acid detergent fiber, % of dry matter	30.7[a]	30.9[a]	30.9[a]	32.7[b]	31.8[c]	0.8

[1]Treatments were: FRESH = delivered to lab on same day; REFR = sample placed in refrigerator for 7 days; FRZR = sample placed in freezer for 7 days; PUOPEN = sample placed in pickup for 7 days in unsealed plastic bag; PUSEAL = sample placed in pickup for 7 days in sealed plastic bag.
[2] LSD (0.05) = least significant difference. Values within rows that differ by more than the LSD are statistically different ($P \leq 0.05$).
[a,b,c] Within a row, means without a common superscript differ ($P \leq 0.05$).

Spread of Yellow Old World Bluestem in Native Rangeland Pastures

J. Lafantasie[1], K. Harmoney[2], A. Pettibone[1], A. Rusk[1], B. Nicholson[1], and S. Casey[2]

Introduction

Old world bluestems (OWB) were widely introduced in the central and southern Great Plains as warm-season perennial grasses for soil conservation and forage. Old world bluestems are native to most of temperate and tropical Asia, Australia, Eurasia, and sub-Saharan geographic regions of Africa; therefore, monocultures of OWB are productive in hot, moist environments, yet are capable of persisting in hot, dry environments. Introduced species of OWB are bunch grasses typically without stolons or rhizomes, and they spread primarily by producing and dispersing great quantities of seed. In Kansas, Oklahoma, and Texas, OWB have escaped areas where seeded and invaded native rangelands. This invasion is undesirable because of competition with native grasses and negative effects on rangeland insect, rodent, and bird communities. The impacts of OWB invasion on grazing animal behavior in native rangelands are not yet known.

In native rangelands near Hays, KS, we have observed patches of yellow OWB (*Bothriochloa ischaemum*) establishing and appearing to spread over time. The origin of seed for establishment in these native rangelands is presumed to be by natural wind dispersal from nearby plants in ditches and waste areas, by wild animal transport, or by movement of seed incidentally collected on vehicles and transported from the source to native rangelands. The pastures where invading yellow OWB patches were found had never been overseeded nor had any hay fed within the pasture to introduce OWB seed; however, the amount of spread, if any, of the observed patches of OWB was not known or quantified. The objective of this study was to quantify the spread, if any, of invading OWB patches within two native rangeland pastures.

Experimental Procedures

Research was conducted on patches of yellow OWB on Harney and Roxbury silt loam soils of native rangelands near Hays, KS. The locations of the patches were considered to be a loamy upland range site and a loamy lowland range site owned by the Kansas State University Agricultural Research Center–Hays and Fort Hays State University. The native vegetation surrounding the patches of OWB consists mostly of blue grama, sideoats grama, buffalograss, western wheatgrass, and Japanese brome.

The perimeter of two yellow OWB patches was flagged in 2003. Yellow OWB plants were considered to be part of a patch if they were within 18 in. of another yellow OWB plant. Yellow OWB plants outside of the patches were also found and flagged by walking a grid outside of the patch. A Trimble TDS Recon remote unit with Windows Mobile operating system was used to run Field Solo GIS Mapping software to record the GPS coordinates of the patch perimeter flags, then to record the GPS coordinates of the flags marking yellow OWB plants outside of the patch. The antenna of the GPS unit was attached to a gimbal support mechanism that allowed the GPS antenna to rest in a vertical position directly over the point to be marked. A real-time kinetic (RTK) system was used with a permanent fixed known point base station to

[1] Fort Hays State University Department of Biology.
[2] Kansas State University Agricultural Research Center–Hays.

send coordinate corrections to the remote rover GPS system to ensure sub-centimeter corrections and accuracy of the marked coordinate points.

In 2011 and 2012, the perimeter of the yellow OWB patches and the individual yellow OWB plants outside of the patches were flagged again. In 2011 and 2012, the GPS antenna was mounted to a pole unit with a bubble leveling mechanism to ensure that the GPS coordinate was recorded in a vertical position over the flagged point.

Once recorded, the GPS coordinates were translated by ARCGIS software to create a map area of the yellow OWB patches and the individual plants around the patch. Calculations were made within the software to determine patch sizes and the number of individual plants around each patch.

Results and Discussion

The upland site in 2003 contained two separate patches of yellow OWB that were a total of 2,369 ft^2 in size (Figure 1). Additionally, 86 individual plants were found outside the patches. When mapped again in 2011, the two patches had increased to eight patches, and total patch size had increased to 6,389 ft^2. Outside the patches, 417 individual yellow OWB plants were found. This was an increase of 331 new individuals outside the patches and an increase in patch size of 4,020 ft^2. The patches more than doubled in size, growing to 2.7 times the original size, in 8 years. The two separate large patches found at this site in 2003 had grown in size so they were nearly one contiguous patch in 2011. The new small patches and individuals appeared to increase and disperse in a northerly direction.

The lowland site in 2003 contained a smaller yellow OWB patch than the upland site. The lowland patch was 312 ft^2 in 2003, and 24 individual plants were present outside the patch (Figure 2). In 2012, the patch had increased in size to 1,128 ft^2, and 106 individual plants were found outside the patch. This was an increase of 816 ft^2 and 82 new individuals. The patch more than tripled in size (3.6 times the original size) in 9 years. New individuals and the patch both spread in a noticeable northerly direction.

Implications

Yellow OWB has excluded almost all native vegetation within the patches. The patches found in these pastures are increasing in size by compounded growth rates of 13–15% each year. At this rate, the upland site will have a yellow OWB patch 1 acre in size within 16 years, 2 acres in size within 21 years, and 3 acres in size within 24 years, and the lowland site will have a yellow OWB patch 1 acre in size within 25 years, 2 acres in size within 31 years, and 3 acres in size within 33 years. For now, we conclude that yellow OWB will continue to increase in native pastures and exclude native grasses in patches if it is not targeted for greater animal use or control.

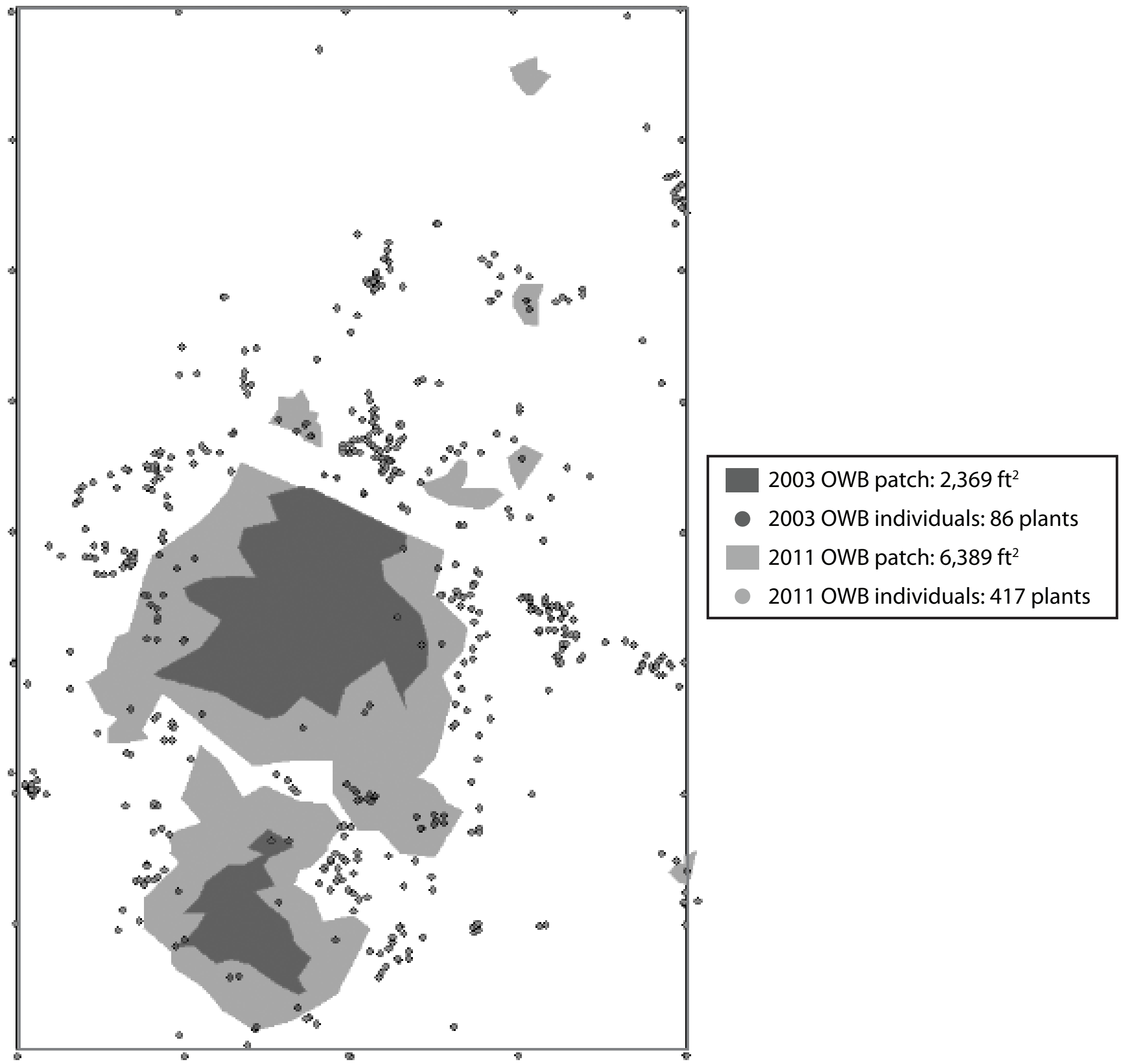

Figure 1. Upland range site with yellow Old World bluestem (OWB) patches and individual plants mapped in 2003 and 2011.

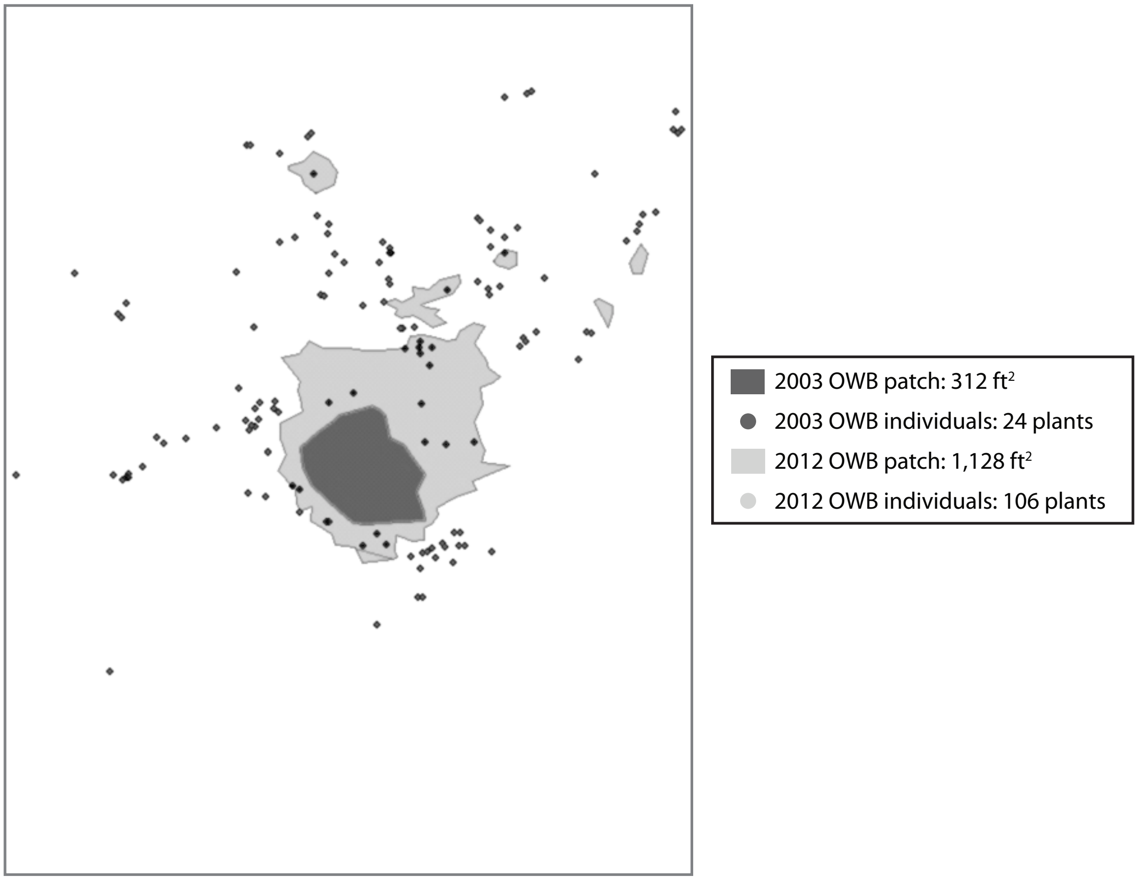

Figure 2. Lowland range site with yellow Old World bluestem (OWB) patches and individual plants mapped in 2003 and 2012.

Precipitation Effects on Shortgrass Rangeland: Vegetation Production and Steer Gain

K. Harmoney[1] and J.R. Jaeger[1]

Introduction

Recent drought conditions raised concerns about having enough rangeland forage production to sustain animals for the current grazing season, having sufficient forage for winter stockpiling, animals gaining enough weight during the summer on drought-stressed forage, and producing enough forage the next growing season after the drought to sustain herd size. Available soil water from precipitation is the main limiting factor to total forage production in most regions. Other factors such as prior grazing history (stocking rate) and time of year in which grazing took place also can affect forage production in future growing seasons. To plan for future drought periods, it would be beneficial to know the amount of pasture production that could be expected from decreasing amounts of precipitation so that producers can make informed stocking decisions. This project was conducted to determine the relationships between historical precipitation records, native rangeland forage yields, and stocking steer individual gains.

Experimental Procedures

Shortgrass rangelands at the Kansas State University Agricultural Research Center–Hays near Hays, KS, have been used for grazing research since the 1940s. Various studies during this time period have monitored different aspects of rangeland plant composition, forage production, and grazing animal weight gains, and in some years all three. For studies with similar stocking rates, rangeland production was compared with annual precipitation or specific monthly combinations of precipitation data for 36 years to find the best relationships between the times of year precipitation is received and end of the growing season forage production. Figure 1 depicts year analyzed, forage production, and precipitation from each year. Animal gain data for one of these grazing studies was then correlated to seasonal precipitation periods to analyze precipitation effects on steer gain.

Results and Discussion

The time period of precipitation with the greatest relationship to end of growing season forage production was precipitation from October of the previous year (OctPY) through September of the current year ($r^2 = 0.61$, Figure 2). Late fall precipitation of the previous year and winter precipitation are important for early spring cool-season grass growth, namely western wheatgrass and annual bromes. The OctPY through September time period also includes precipitation that would fall during the main growing period of the dominant forage in the shortgrass rangeland system, namely warm-season grasses.

The two-month period that had the greatest relationship with end-of-season forage production was May and June precipitation ($r^2 = 0.56$, Figure 3). This two-month period represents the most rapid growth period of warm-season grasses in western Kansas; therefore, precipitation during this time period is a reasonable predictor of end-of-season forage production.

Often, anecdotal references are heard that state the need for a heavy winter of snow and precipitation to provide moisture for the next growing season. For the 36 years of experiments that

[1] Kansas State University Agricultural Research Center–Hays.

had forage production data under similar stocking rates, OctPY to April of the current year precipitation (late fall, winter, and early spring precipitation) had almost no relationship to end-of-year forage production ($r^2 = 0.11$, Figure 4). Because the dominant warm-season grasses are not growing during this period, precipitation during this time may evaporate or be used by cool-season forages before the warm-season grasses are able to utilize it; furthermore, the lack of precipitation during the winter does not indicate that a lack of forage production will occur, because precipitation in May and June can still produce favorable forage growth. Therefore, precipitation during this late fall, winter, and early spring time period alone had little effect on total forage production during the growing season. Precipitation one and two years prior to the current growing season also had no relationship with current-year forage production (r^2 = 0.07 and 0.00, data not shown). For drought planning, stocking at a recommended moderate stocking rate for the rangelands being utilized, then adjusting that stocking rate based on condition and vigor of the vegetation entering the winter dormant season, should be the baseline for spring stocking rates, because winter precipitation had almost no relationship to end-of-season forage production. Further refinements of the stocking rate could be based on May precipitation and May and June precipitation combined, because nearly half of the variation in end-of-season forage production can be explained by precipitation that occurs during this time period. However, sequential years of drought may cause grass tiller and plant loss and place rangelands in a state of lower vigor and lower plant density; therefore, beginning season stocking rates may need to be reduced and further adjustments may need to occur during the spring growing season if precipitation is lacking.

Producers are also concerned about animal gain during the grazing season, especially during drought years when producers question forage quality. Thirteen years of stocker studies show that when animals are managed with consistent vaccination, growth implant, stocking rate, and supplement strategies, spring rains have a slight negative relationship with spring animal gain ($r^2 = 0.26$, Figure 5). As spring precipitation increases, individual animal daily gains decrease over the same time period. Individual animal daily gains during the last half of the growing season, July through September, had almost no relationship with rainfall during the last half of the growing season ($r^2 = 0.03$, Figure 6); however, when looking at total animal gain during the grazing season, an evident negative relationship with precipitation from OctPY to September of the current year was present ($r^2 = 0.50$, Figure 7). As precipitation increased, total animal gain decreased. Available plant water is necessary for plant cells to divide, and cell division occurs as plants develop leaves, stems, and seedheads. Plant water allows plants to grow and mature, and as plants mature, forage quality declines. Periods of drought place plants into a position of moisture stress, thus plants do not have the available water to develop and mature as quickly. Therefore, plants in a drought remain in a less mature stage of development for a greater length of time through the growing season and have greater forage quality for a longer period of time.

Implications

As long as animals have adequate forage available to meet daily dry matter intake needs during drought, the forage consumed should be of greater quality. Animals that do not perform well during drought periods are likely limited by heat stress that may accompany the drought and reduce performance, are limited by lack of available forage to meet daily dry matter intake needs, or are consuming the prior year's residual forage that remains the following grazing season. In general, grazing animals are likely not limited by forage quality of native rangelands during dry years.

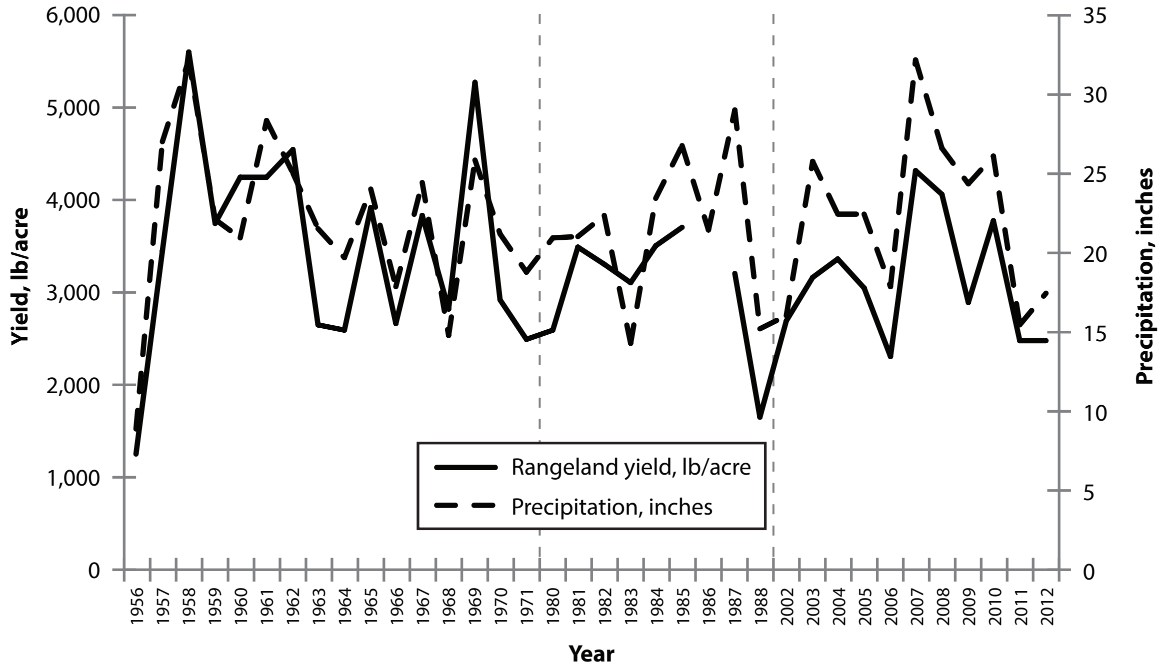

Figure 1. Thirty-six years of rangeland yield data and annual precipitation from October of the previous year through September of the current year at Hays, KS. Vertical dashed lines indicate years of new grazing studies from which vegetative production and precipitation data were collected.

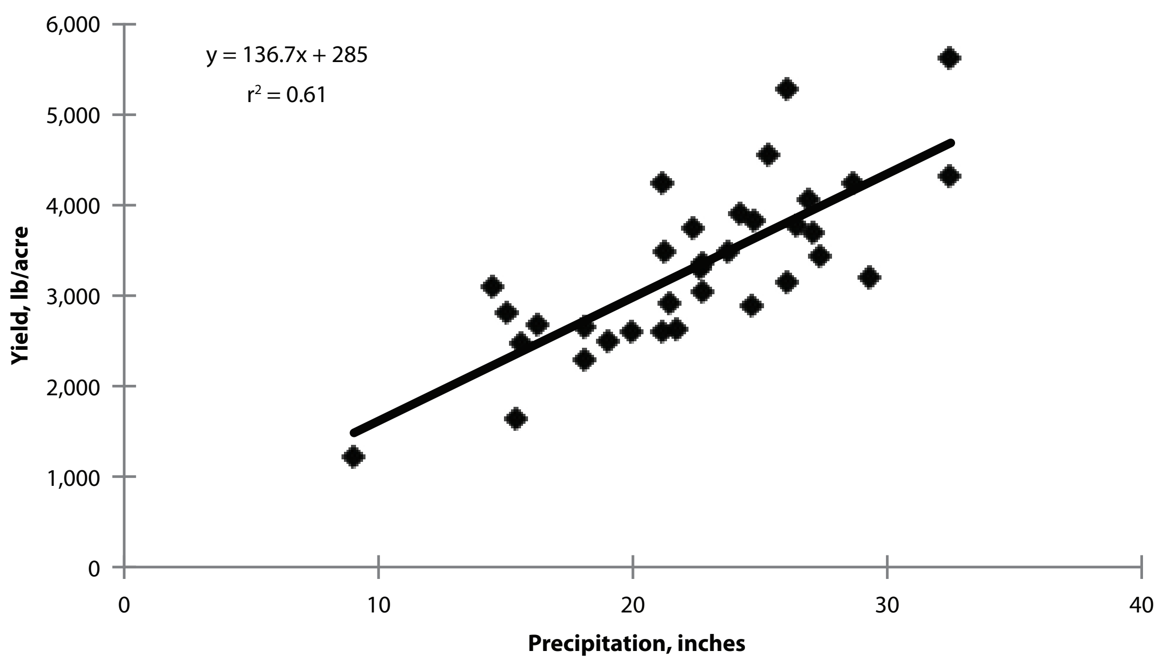

Figure 2. The relationship of 36 years of rangeland yield and annual precipitation from October of the previous year through September of the current year at Hays, KS. The steadily increasing solid line and tightly grouped points indicate that rangeland yield increased steadily and predictably as total water year precipitation increased.

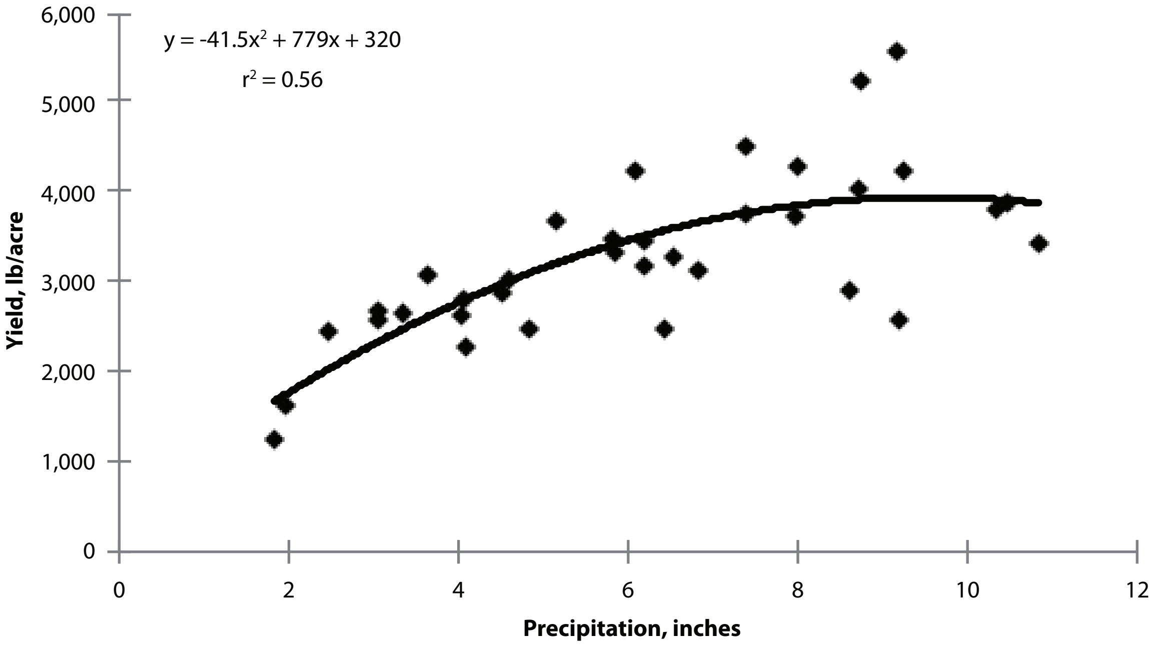

Figure 3. The relationship of 36 years of rangeland yield and total precipitation in May and June at Hays, KS. The increasing solid line and tight grouping at less than 7 inches of precipitation indicates that rangeland yield steadily increased as May and June total precipitation increased up to 7 inches, after which yields became more scattered.

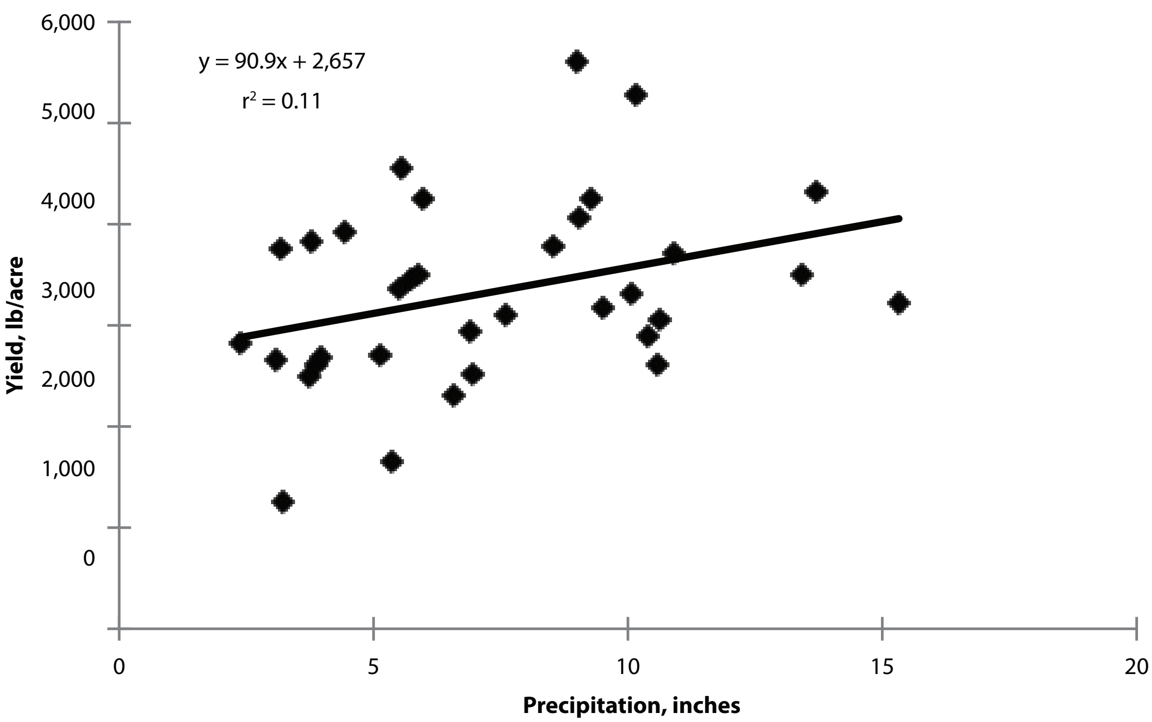

Figure 4. The relationship of 36 years of rangeland yield and total precipitation from October of the previous year to April of the current year at Hays, KS. The nearly flat solid line and broad point scattering indicates that winter precipitation had little effect on end-of-season rangeland yield.

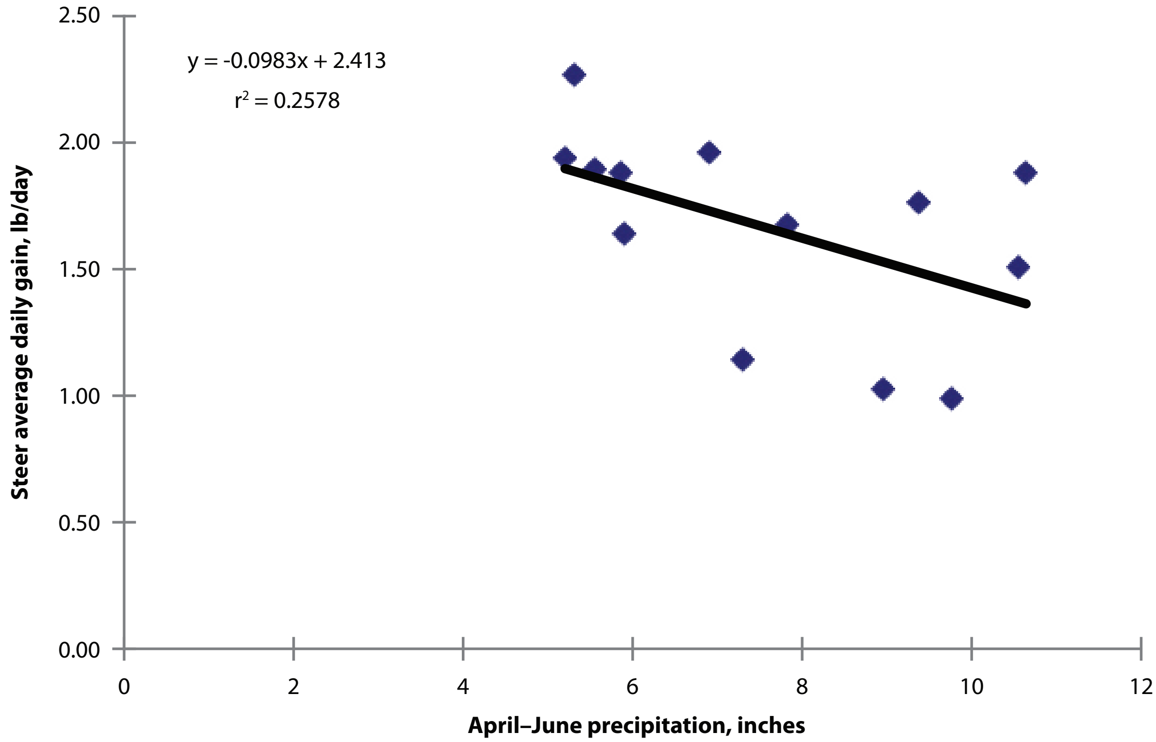

Figure 5. Relationship between stocker steer spring individual animal daily gain and spring precipitation from April through June 1999–2012 at Hays, KS. The declining solid line indicates that steer individual gain decreased as spring precipitation increased.

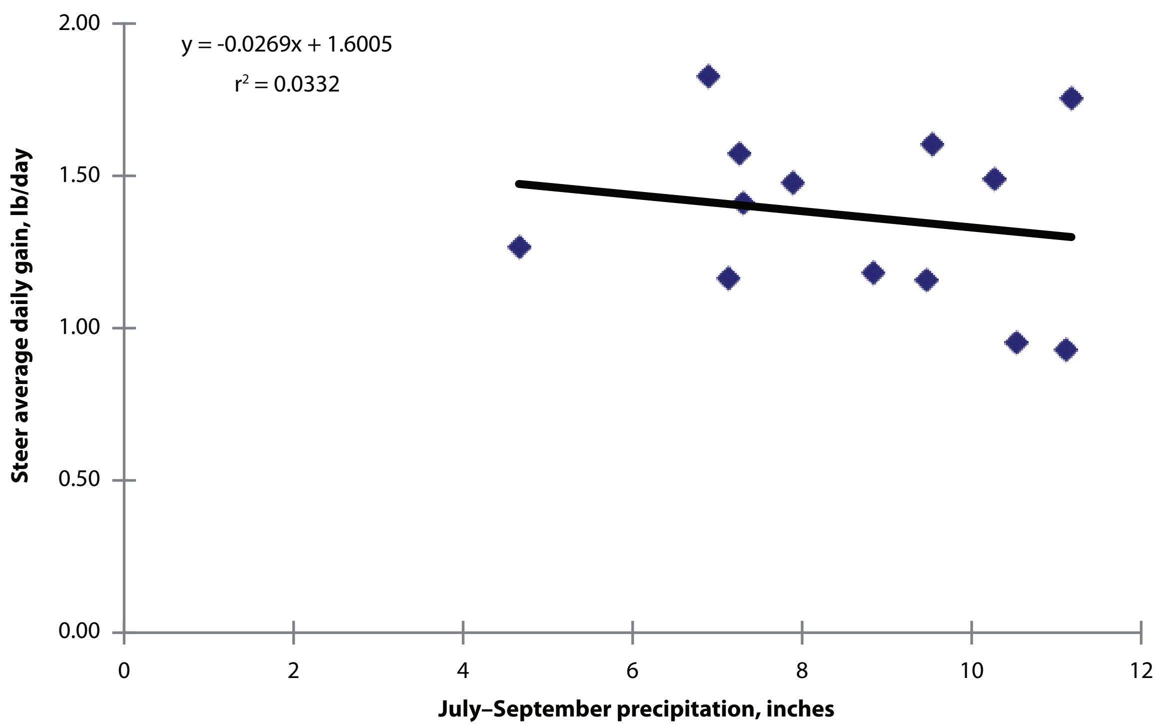

Figure 6. Relationship between stocker steer late summer individual animal daily gain and late-summer precipitation from July through September 1999–2012 at Hays, KS. The nearly flat solid line indicates that late-season precipitation had little effect on steer gain.

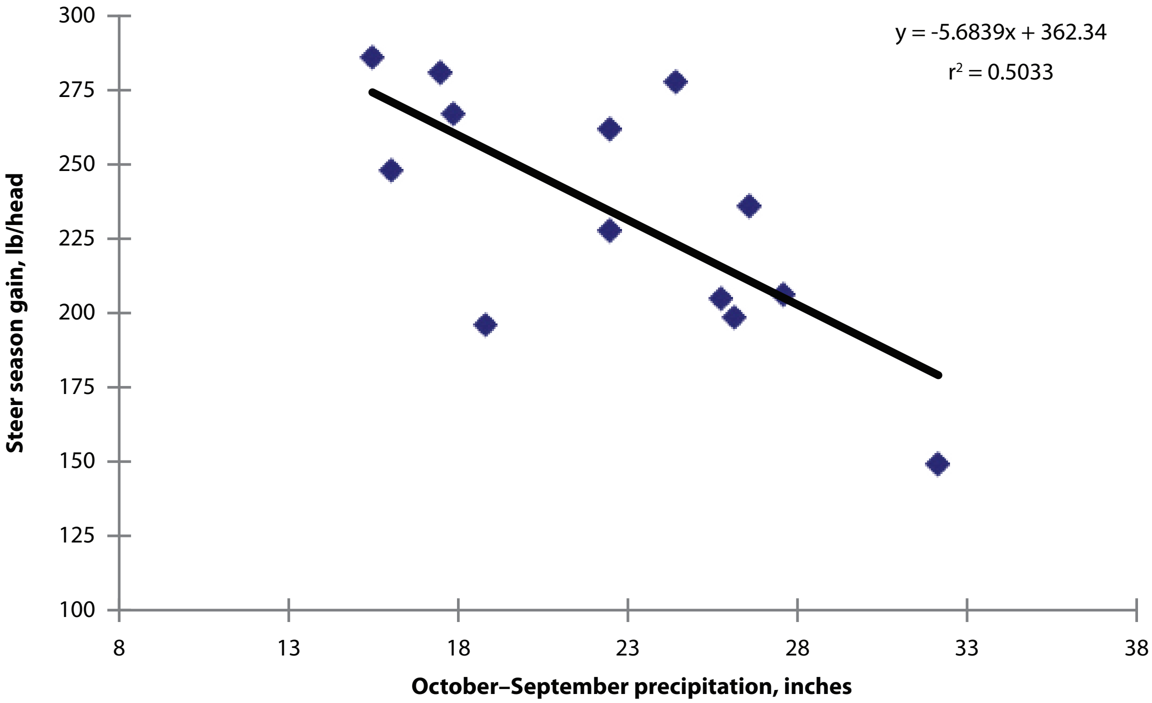

Figure 7. Relationship between stocker steer individual total season animal gain and annual precipitation from October of the previous year through September of the current year in 1999–2012 at Hays, KS. The steadily declining solid line indicates that steer total individual gain steadily declined as seasonal precipitation totals increased.

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