Kansas Agricultural Experiment Station Research Reports

Volume 0
Issue 7 *Roundup (1995-2014)*
Article 11

2009

Roundup 2009

Kansas State University. Agricultural Research Southeast Agricultural Research Center Center--Hays

Roundup 2009

Abstract

Roundup is the major beef cattle education and outreach event sponsored by the Agricultural Research Center-Hays. The purpose is to communicate timely, applicable research information to producers and extension personnel. The research program of the Agricultural Research Southeast Agricultural Research Center 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. Roundup 2009 was held at the Agricultural Research Southeast Agricultural Research Center Center--Hays, KS, April 5, 2009

Keywords

Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1016; Kansas Agricultural Experiment Station contribution; no. 09-262-S Kansas; Beef cattle production

ROUNDUP
2009

Report of Progress 1016

Kansas State University
Agricultural Experiment
Station and Cooperative
Extension Service

AGRICULTURAL RESEARCH CENTER–HAYS

ROUNDUP 2009

Statement of Purpose

Roundup is the major beef cattle education and outreach event sponsored by the Agricultural Research Center–Hays. The 2009 program is the 96th 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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Acknowledgments

The authors recognize the dedicated efforts of the support staff who diligently and competently cooperate in the beef cattle research program at the Agricultural Research Center–Hays. Members of this team are:

Justin Bolte	Harvey Jansonius	Tom Lang
Jarett Schmeidler	Wayne Schmidtberger	Matt Woydziak

Contributors

Many have contributed to our research activities. We especially acknowledge the following contributors who provided grants and/or funds or donated products.

Carrico Implement, Hays, KS

Elanco, Indianapolis, IN

Fort Dodge Animal Health, Overland Park, KS

Golden Plains Trucking Inc., Hays, KS

Green Garden Angus, Ellsworth, KS

Intervet, Millsboro, DE

Leiker Trucking Inc., Hays, KS

Midland Marketing Coop, Inc., Hays, KS

Moly Manufacturing, Lorraine, KS

Oakley Veterinary Service, Oakley, KS

Pfizer Animal Health, Pittsburgh, PA

Pharmacia Animal Health, Kalamazoo, MI

Quali Tech, Inc., Chaska, MN

Robt Morgan, Inc., Paris, IL

Schering-Plough Animal Health, Madison, NJ

Scoular Company, Overland Park, KS

Select Sires, Plain City, OH

Sharp Brothers Seed Co., Healy, KS

Southeast Select Sires, Spring Hill, TN

Star Seed, Inc., Osborne, KS

Beef Cow Performance Following Rumen-Protected Choline Supplementation Before and After Calving[1]

J. R. Jaeger[2], S. R. Goodall[3], K. R. Harmoney[2], and KC Olson[4]

Introduction

Choline (Vitamin B4) can become a component of acetylcholine or phosphatidylcholine or supply methyl groups through conversion to betaine. Methyl groups are required for a variety of metabolic reactions including methionine recycling and liver fatty acid mobilization. Choline is rapidly degraded in the rumen; therefore, ruminants have limited intestinal absorption of methyl groups because of ruminal degradation of choline and betaine.

Supplementation of dairy cows with rumen-protected choline (RPC; 12 g/head per day) from 28 days prepartum to 63 days postpartum has been reported to result in increased milk yield and accelerated body weight (BW) loss after calving. To date, no research has been conducted to examine RPC supplementation to prepartum or postpartum beef cows. However, several research trials have evaluated the effect of RPC on feedlot cattle performance and subsequent carcass characteristics.

Our objectives were to determine: (1) the effect of feeding RPC to beef cows during late gestation and (2) the effects of feeding RPC after calving on reproductive performance by lactating cows and growth performance of calves.

Materials and Methods

Animals

Angus-cross cows (n = 181; age = 3 to 11 years) were stratified by age, BW, and body condition score (BCS; 1 = emaciated, 9 = very obese) and assigned randomly to one of two treatment groups: control (CON) and RPC. Treatments were initiated 50 days before the expected beginning of the calving season and continued for 120 days. During the treatment period, cows were maintained in separate groups and received forage sorghum hay ad libitum and 2 lb/head per day of supplement. Supplement contained RPC (4 g/head per day choline) and SQM trace mineral (Quali Tech, Chaska, MN) for RPC-treated cows and SQM trace mineral only for control cows (Table 1). Body weight was measured and BCS estimates were collected on day 0, on day 50, at calving, and on day 120. Backfat (BF) thickness, marbling (MB), and longissimus muscle depth (LMD) were measured in the region of the 12th and 13th ribs on day 0, on day 50, at calving, and on day 120 via ultrasound. Images were collected with Cattle Performance Enhancement Company (CPEC, Oakley, KS) software. Backfat thickness, LMD, and MB were

[1] The authors acknowledge Quali Tech for their donation of trace mineral and rumen-protected choline and Pfizer Animal Health for their donation of Lutalyse and EAZI-BREED CIDR.

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estimated with procedures that incorporated image analysis software developed by John Brethour at the Kansas State University Agricultural Research Center–Hays. These procedures are an integral component of the CPEC product. Marbling scores were coded such that 4.0 = slight00 (low select) and 5.0 = small00 (low choice).

Treatment effect on calf performance was assessed by measuring calf BW on the day of birth and when all calves averaged 56 days of age.

Blood Collection and Radioimmunoassay

Blood was collected via coccygeal venipuncture at -10 and 0 days before estrous synchronization with the Co-Synch + CIDR (controlled internal drug release) system, which occurred 26 days after termination of supplementation. Blood samples were later analyzed for progesterone concentration to determine the proportion of cows cycling at initiation of estrous synchronization. Cows were considered to be estrous-cycling if concentrations of progesterone in serum were elevated (≥ 1.0 ng/mL) at one or both sampling times.

Breeding and Pregnancy Diagnosis

Fixed-time artificial insemination (FTAI) was performed 56 hours after CIDR (Pfizer Animal Health, New York, NY) removal and $PGF_{2\alpha}$ (Lutalyse; Pfizer Animal Health, New York, NY) administration. All cows were injected with gonadotropin-releasing hormone (GnRH; 100 µg of Cystorelin i.m.; Merial, Duluth, GA) at the time of insemination. Artificial insemination was performed by one of two experienced technicians with semen from one of three sires. Cows were exposed to four fertile bulls 10 days after FTAI for 35 days (45-day breeding season).

Pregnancy rate to FTAI was determined by transrectal ultrasonography 33 days after FTAI. Final pregnancy rates were determined 120 days after the end of the breeding season.

Statistical Analyses

Data were grouped to examine changes that occurred during the 50-day prepartum period or during the postpartum period. Weight change (average daily gain [ADG] or loss), calf birth weight, calf ADG at 56 days of age, and change in BF thickness, LMD, and MB were evaluated by analysis of variance with the PROC ANOVA procedure of SAS (SAS Institute Inc., Cary, NC). Estrous cyclicity before estrous synchronization, AI sire, AI technician, pregnancy rate to FTAI, and final pregnancy rate after the end of the breeding season were analyzed with PROC CATMOD of SAS.

Results and Discussion

The average calving date was day 78 of the study. During the 50-day pre-calving period, cows receiving RPC tended to have greater (P=0.06) ADG than CON cows (Table 2), but RPC supplementation had no effect (P >0.20) on BCS, BF, MB, or LMD (Table 2).

During the postpartum period, RPC supplementation had no effect (P>0.20) on BCS, BF, or LMD compared with the CON treatment (Table 3). Postpartum weight loss of CON cows was less than that of RPC cows (P<0.01). In addition, RPC cows lost more weight than CON cows (P<0.01; -196.6 vs. -154.3 lb, respectively) over the entire study. Cows fed RPC also lost MB during the postpartum period, but CON cows gained MB (P<0.01; Table 3).

Increased plasma nonesterified fatty acids lead to increased uptake by the liver, in which nonesterified fatty acids are esterified to triglycerides, oxidized to ketone bodies, or oxidized to carbon dioxide. The esterification of nonesterified fatty acids to triglycerides and their export into very low-density lipoprotein involves choline. In addition, choline serves as a methyl donor for synthesis of carnitine, and carnitine is essential for fatty acid oxidation. The lower plasma levels of nonesterified fatty acids of RPC-supplemented dairy cows previously reported by other researchers may have resulted from more efficient liver function and improved lipid metabolism. These data could explain why RPC-supplemented beef cows in our study lost MB during the postpartum period but CON cows gained MB.

Supplementation with RPC had no effect (P=0.99) on calf birth weight, which averaged 90.0 ± 5.1 lb. Conversely, calves from CON cows tended (P=0.08) to have greater ADG at 56 days of age than calves from RPC-supplemented cows (2.20 ± 0.48 vs. 2.05 ± 0.59 lb/head per day, respectively). Although cows in the current study had an initial average BCS of 5.4 and final average BCS of 5.3, these BCS may not have been adequate to provoke an increase in milk production that was previously observed for fleshy dairy cows that received RPC near the time of calving.

The proportion of cows considered to be estrous-cycling at initiation of estrous synchronization is depicted in Figure 1 and was similar between treatments (P=0.65; 71.6% (58/81) for CON and 74.7% (65/87) for RPC). The proportion of cows that conceived to FTAI is depicted in Figure 2 and tended to be slightly greater (P=0.11) for RPC cows (52.9%, 46/87) than for CON cows (40.7%, 33/81). There was a weak trend (P=0.17) among cows that had not re-established estrual behavior before estrous synchronization for more RPC-supplemented cows to conceive to FTAI (54.5%, 12/22) than CON cows (34.8%, 8/23). In contrast, in a previous study, dairy cows that received either 0, 15, 30 or 45 g/day of dietary choline from week 5 postpartum to week 21 postpartum required more services per cow and were open more days with increasing choline intake. Authors of that study also reported increased milk yield due to RPC-supplementation and concluded that reproductive responses were related more to increased milk production than to the effect of RPC. It is likely that RPC-treated cows in the current study did not have increased milk yield as judged by ADG of their calves at 56 days of age compared with ADG of CON calves. Furthermore, RPC-treated cows in the current study received RPC prepartum and displayed a tendency to have greater ADG during that period. Perhaps improvement of cow performance prepartum played a greater role in regard to subsequent reproductive performance than the decrease in performance that occurred during the postpartum supplementation period. Final pregnancy rate was similar (P=0.49) between CON (91.4%, 74/81) and RPC-supplemented (94.1%, 80/85) cows.

Implications

Periparturient beef cows supplemented with RPC had greater weight loss and MB loss over the length of the study compared with CON cows. Daily gain by beef cows fed RPC tended to be improved during prepartum supplementation and poorer during postpartum supplementation compared with CON cows. In addition, RPC-supplemented cows tended to conceive to FTAI in greater numbers than CON cows. Although the mechanisms responsible for intramuscular fat mobilization and improved reproductive response are not understood, these data were interpreted to suggest that choline supplementation during a specific time of the periparturient period may improve subsequent reproductive performance. Further investigation appears warranted.

Table 1. Supplement composition

	Treatment group	
Ingredient, % dry matter	Control	Rumen-protected choline
Rolled milo	69.05	69.05
Soybean meal (44%)	25.00	25.00
Trace mineral supplement (5.95%)		
Zinc	0.08	0.08
Manganese	0.08	0.08
Copper	0.03	0.03
Choline	0.00	0.54

Table 2. Effect of prepartum supplementation with trace minerals or trace minerals and rumen-protected choline (RPC) on cow performance

	Treatment group		
Item	Control	RPC	SEM
Average daily gain, lb	0.77	0.99	0.03
Body condition score change[1]	-0.40	-0.29	0.06
Backfat change[2], in.	-0.01	-0.02	0.09
Longissimus muscle depth change[3], in.	-0.07	-0.08	0.72
Marbling score change[4]	0.52	0.67	0.06

[1] Body condition score: 1 = emaciated, 9 = very obese.
[2] Backfat measured over 12th and 13th ribs with ultrasound.
[3] Longissimus muscle depth measured over 12th and 13th ribs with ultrasound.
[4] Marbling scores were coded such that 4.0 = slight00 (low select) and 5.0 = small00 (low choice).

Table 3. Effect of postpartum supplementation with trace minerals or trace minerals and rumen-protected choline (RPC) on cow performance

	Treatment group		
Item	Control	RPC	SEM
Average daily gain, lb*	-1.57	-2.45	0.07
Body condition score change[1]	0.03	0.02	0.04
Backfat change[2], in.	-0.01	-0.02	0.12
Longissimus muscle depth change[3], in.	-0.03	-0.03	0.58
Marbling score change[4]*	0.46	-0.03	0.06

[1] Body condition score: 1 = emaciated, 9 = very obese.
[2] Backfat measured over 12th and 13th ribs with ultrasound.
[3] Longissimus muscle depth measured over 12th and 13th ribs with ultrasound.
[4] Marbling scores were coded such that 4.0 = slight00 (low select) and 5.0 = small00 (low choice).
*Means in row differ (P<0.01).

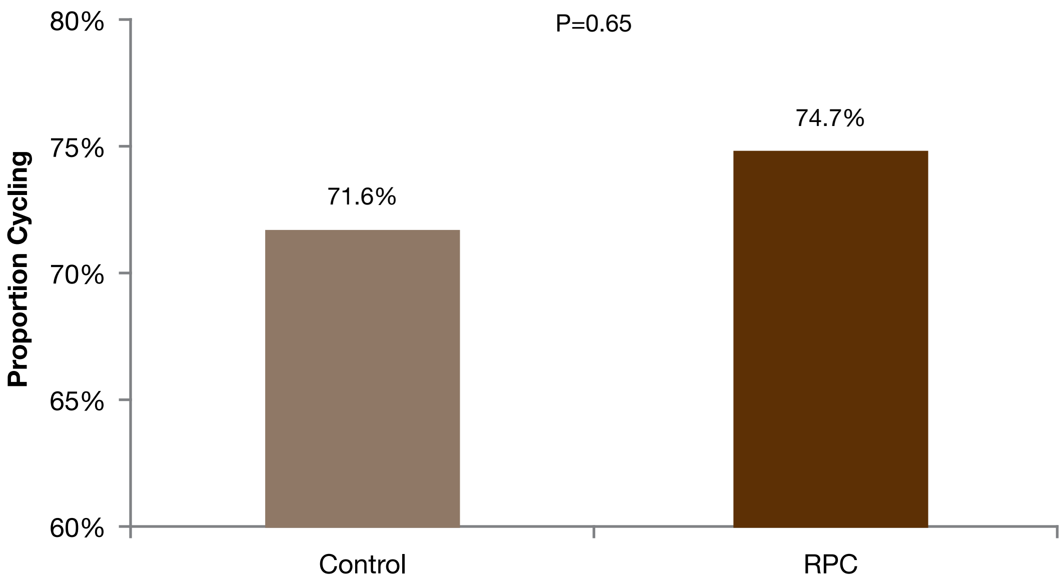

Figure 1. Proportion of cows cycling before estrous synchronization following supplementation with either trace minerals (Control) or trace minerals and rumen-protected choline (RPC) from 50 days before to 70 days after the beginning of the calving season.

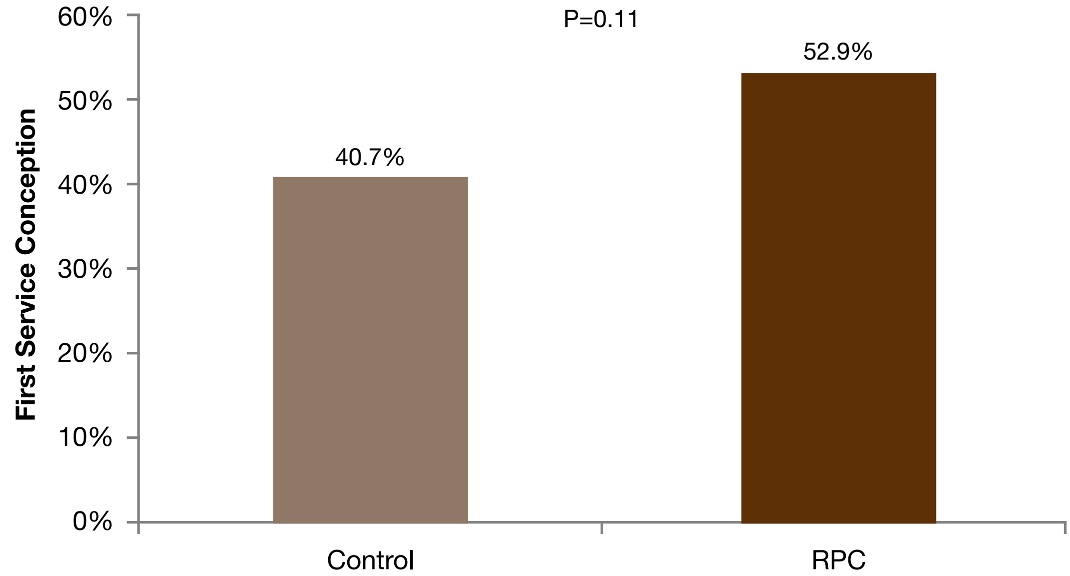

Figure 2. Proportion of cows conceiving to fixed-time artificial insemination after estrous synchronization following supplementation with either trace minerals (Control) or trace minerals and rumen-protected choline (RPC) from 50 days before to 70 days after the beginning of the calving season.

Beef Cow Performance Following Rumen-Protected Choline Supplementation for 40 Days Before Calving[1]

J. R. Jaeger[2], S. R. Goodall[3], K. R. Harmoney[2], J. W. Bolte[2], and KC Olson[4]

Introduction

Most forage contains adequate levels of choline (vitamin B4); however, choline is rapidly degraded in the rumen. Therefore, ruminants have limited intestinal absorption of methyl groups that are supplied via choline, and choline may be deficient during periods of high nutritional demand, such as late gestation and early lactation.

Supplementation of dairy cows with rumen-protected choline (RPC; 12 g/head per day) from 28 days prepartum to 63 days postpartum has been reported to result in increased milk yield and accelerated body weight (BW) loss after calving. In a previous study at the Kansas State University Agricultural Research Center–Hays (ARCH) in which cows were fed RPC for 50 days prior to calving and 70 days after calving, cows tended to display improved daily gain before calving but poorer gains after calving. During the entire study, cows receiving RPC displayed greater weight loss and marbling loss, but a greater proportion of these RPC-supplemented cows conceived to fixed-time artificial insemination (FTAI). These data suggest that choline supplementation during a specific time period near calving may improve subsequent reproductive performance, and providing choline only during the prepartum period may prevent weight loss previously observed when choline was supplied after calving and still result in improved reproductive performance.

The objective of the current study was to determine the effect of feeding supplemental RPC during late gestation on cow weight gain, body condition, and subsequent reproductive performance.

Materials and Methods

Angus-cross cows (n = 145; age = 3 to 12 years) were stratified by age, BW, and body condition score (BCS; 1 = emaciated, 9 = very obese) and assigned randomly to one of two treatment groups: control (CON) and RPC. Treatments were initiated 40 days before the expected beginning of the calving season and continued for 40 days. During the treatment period, cows were maintained in separate groups and received forage sorghum hay ad libitum and 2 lb/head per day of supplement. Supplement contained RPC (4 g/head per day choline) and SQM trace mineral (Quali Tech, Chaska, MN) for RPC-treated cows and SQM trace mineral only for CON cows (Table 1). Body weight was measured on days 0 and 40. Body condition scores were determined on day 0 and on the day of

[1] The authors acknowledge Quali Tech for their donation of trace mineral and rumen-protected choline and Pfizer Animal Health for their donation of Lutalyse and EAZI-BREED CIDR.

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calving. Backfat (BF) thickness, marbling (MB), and longissimus muscle depth (LMD) were measured in the region of the 12th and 13th ribs on days 0 and 40 via ultrasound. Images were collected with Cattle Performance Enhancement Company (CPEC, Oakley, KS) software. Backfat thickness, LMD, and MB were estimated with procedures that incorporated image analysis software developed by John Brethour at ARCH. These procedures are an integral component of the CPEC product. Marbling scores were coded such that 4.0 = slight00 (low select) and 5.0 = small00 (low choice).

Blood was collected via coccygeal venipuncture at -10 and 0 days before estrous synchronization. Blood samples were later analyzed for progesterone concentration to determine proportion of cows cycling at initiation of estrous synchronization. Cows were considered to be estrous-cycling if concentrations of progesterone in serum were elevated (≥ 1.0 ng/mL) at one or both sampling times.

Fixed-time AI was performed after estrous synchronization. All cows were injected with gonadotropin-releasing hormone (GnRH; 100 μg of Cystorelin i.m.; Merial, Duluth, GA) at the time of insemination. Artificial insemination was performed by one of two experienced technicians with semen from one of three sires. Cows were exposed to four fertile bulls 10 days after FTAI for 35 days (45-day breeding season).

Pregnancy rate to FTAI was determined by transrectal ultrasonography 31 days after FTAI. Final pregnancy rates were determined 120 days after the end of the breeding season.

Weight change (average daily gain, ADG) and changes in BF thickness, LMD, and MB were evaluated by analysis of variance with the PROC ANOVA procedure of SAS (SAS Institute Inc., Cary, NC). Estrous cyclicity before estrous synchronization, AI sire, AI technician, pregnancy rate to FTAI, and final pregnancy rate after the end of the breeding season were analyzed with PROC CATMOD of SAS.

Results and Discussion

During the supplementation period, ADG, BF, LMD, and MB were not affected (P>0.20) by RPC supplementation (Table 2). Body condition score was not affected (P>0.20) by RPC supplementation (Table 3).

The average calving date was April 5 and did not differ (P=0.72) between treatment groups. The first calf was born on March 1, and the last calf was born on May 12. Rumen-protected choline had no effect (P=0.79) on calf birth weight and averaged 78.9 ± 0.9 lb.

The proportion of cows considered to be estrous-cycling at initiation of estrous synchronization was similar (P=0.82) for CON (60.0%, 42/70) and RPC-supplemented cows (58.1%, 43/74). The proportion of cows that conceived to FTAI is depicted in Figure 1 and tended to be slightly greater (P=0.13) for RPC cows (58.1%, 43/74) than for CON cows (45.7%, 32/70). Final pregnancy rate was similar (P=0.45) between CON (92.8%, 64/69) and RPC-supplemented (89.2%, 66/74) cows.

Implications

Supplementation of periparturient beef cows with RPC during the 40 days prior to calving did not have an effect on cow weight or body condition. However, RPC-supplemented cows tended to conceive to FTAI in greater numbers than CON cows. These data were interpreted to suggest that choline supplementation during the prepartum period may improve subsequent reproductive performance. Further investigation to determine supplementation level and timing appears warranted.

Table 1. Supplement composition

	Treatment group	
Ingredient, % dry matter	Control	Rumen-protected choline
Rolled milo	69.05	69.05
Soybean meal (44%)	25.00	25.00
Trace mineral supplement (5.95%)		
Zinc	0.08	0.08
Manganese	0.08	0.08
Copper	0.03	0.03
Choline	0.00	0.54

Table 2. Effect of prepartum supplementation with trace minerals or trace minerals and rumen-protected choline (RPC) on cow performance

	Treatment group		
Item	Control	RPC	SEM
Average daily gain, lb	-1.92	-2.05	0.08
Backfat change[1], in.	-0.02	-0.02	0.10
Longissimus muscle depth change[2], in.	-0.08	-0.14	0.73
Marbling score change[3]	1.83	1.91	0.06

[1] Backfat measured over 12th and 13th ribs with ultrasound.
[2] Longissimus muscle depth measured over 12th and 13th ribs with ultrasound.
[3] Marbling scores were coded such that 4.0 = slight00 (low select) and 5.0 = small00 (low choice).

Table 3. Effect of prepartum supplementation with trace minerals or trace minerals and rumen-protected choline (RPC) on cow body condition score (BCS)

	Treatment group		
Item	Control	RPC	SEM
BCS[1] at beginning	5.70	5.79	0.06
BCS at calving	4.96	5.00	0.04
BCS change	-0.74	-0.79	0.05

[1] Body condition score: 1 = emaciated, 9 = very obese.

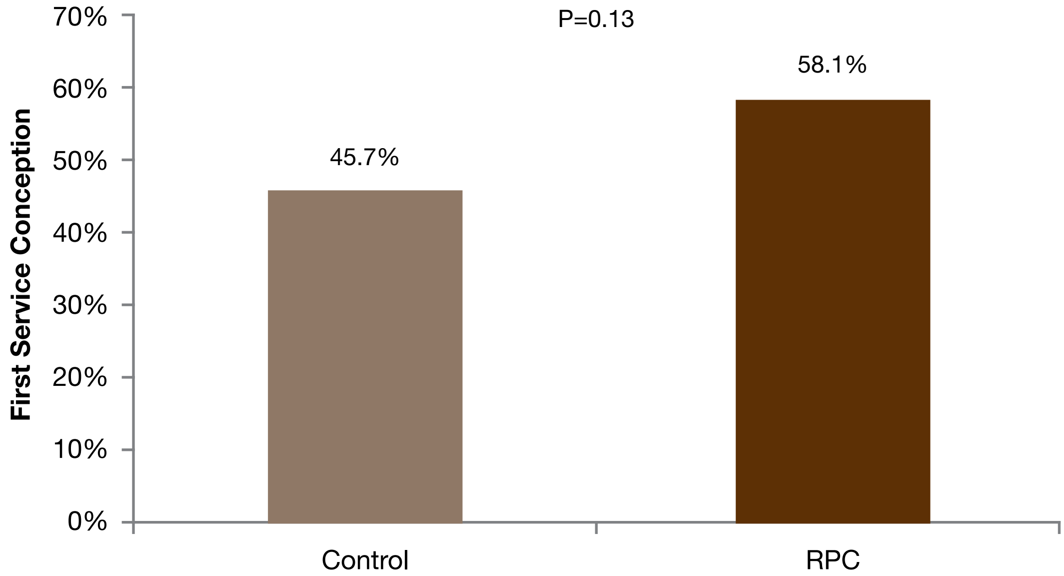

Figure 1. Proportion of cows conceiving to fixed-time artificial insemination following prepartum supplementation for 40 days with either trace minerals (Control) or trace minerals and rumen-protected choline (RPC).

Comparison of a Modified 5-day CO-Synch Plus CIDR Protocol with CO-Synch Plus CIDR in Mature Beef Cows

S. K. Johnson[1], J. R. Jaeger[2], K. R. Harmoney[2], and J. W. Bolte[2]

Introduction

A CO-Synch + CIDR (controlled internal drug release) fixed-time artificial insemination (AI) protocol is commonly used in lactating beef cows and consists of gonadotropin-releasing hormone (GnRH) and a CIDR given at the start of the treatment and CIDR removal and $PGF_{2\alpha}$ administration 1 week later. Fixed-time AI occurs 60 to 66 hours after $PGF_{2\alpha}$ administration. A shortened 5-day CIDR protocol was developed to optimize follicular growth prior to the induction of ovulation. Data from the Ohio State University and other universities indicate a 9 to 10% advantage in AI pregnancy rate with the 5-day compared with the 7-day CIDR protocol. Although the mechanism responsible for this difference is not clear, fertility is higher in cows that are induced to ovulate with relatively larger follicles than in cows with smaller follicles. In mature cows, two injections of $PGF_{2\alpha}$ given 12 hours apart have been needed to achieve luteal regression in cows that have been induced to ovulate by GnRH 5 days earlier in the 5-day protocol. The 12-hour injection interval is not practical in many situations, but a shorter interval might be considered by producers. An interval of 3 hours between injections of $PGF_{2\alpha}$ has been used to induce luteal regression in sheep and may work in this situation.

The objective of this study was to compare pregnancy rate to fixed-time AI between cows synchronized with either a traditional 7-day CO-Synch + CIDR protocol or a 5-day CO-Synch + CIDR protocol with a 3-hour interval between doses of $PGF_{2\alpha}$.

Materials and Methods

Postpartum, lactating Angus and Angus-cross cows (n = 177) were assigned to one of two treatments on the basis of age and calving date. Cows in the control group (7dCIDR; n = 88) received GnRH (2 mL Fertagyl, i.m.) and CIDR insertion on day -7, CIDR removal and PGF2α (2 mL Estrumate) on d 0, and fixed-time AI and GnRH at 56 hours after PGF2α (Figure 1). Treated cows (5dCIDR; n = 89) received GnRH and CIDR on day -5, CIDR removal and two injections of PGF2α (2 mL Estrumate per injection) 3 hours apart on day 0, and fixed-time AI concurrent with GnRH at 72 hours after PGF2α. Two serum samples were collected 9 or 7 days before and at the start of treatment for 5dCIDR and 7dCIDR, respectively, for determination of concentrations of progesterone. Bulls were introduced 10 days after fixed-time AI. Pregnancy rate to AI was determined 31 days after fixed-time AI with transrectal ultrasonography. Cows grazed native pasture for 1.5 months prior to the start of the breeding season and remained in one group until day -7.

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[2] KSU Agricultural Research Center, Hays, KS

Results and Discussion

On day 0, cows were 68 days postpartum (range 29 to 101 days), 5.9 years of age (range 2 to 11 years), and had a body condition score of 5.1 (range 3.5 to 7.5). The mean and distribution of cow body condition and days postpartum is shown in Table 1. The proportion of cows 3 years of age or older (n = 146) that were cycling prior to the start of treatments was 60% compared with 42% for 2-year-old cows (n = 31). There were more cows cycling prior to treatment in the 5dCIDR group than in the 7dCIDR group. This difference could be due to the 7-day interval between blood samples in the 7dCIDR group resulting in some cycling cows being classified as non-cycling.

Pregnancy rate to fixed-time AI was 53.4 and 54.5% for 7dCIDR and 5dCIDR, respectively (Table 2). Numerically, if cows were cycling prior to estrous synchronization, more cows synchronized with the 5dCIDR system conceived to fixed-time AI compared with cows synchronized with the 7dCIDR system (Table 2). In contrast, non-cycling 7dCIDR cows had a numerically higher pregnancy rate to fixed-time AI than 5dCIDR cows. Final pregnancy rate was not different between treatments (Table 2). More data is needed to conclude that there is no difference between these treatments. In Ohio State and Virginia Tech studies, cows that received the 5-day CIDR protocol and only one injection of $PGF_{2\alpha}$ had, on average, 12% lower pregnancy rates than cows with two injections of $PGF_{2\alpha}$.

Implications

Pregnancy rate to the 7-day and 5-day CIDR treatments were similar in this study. The 5-day CIDR protocol may be useful in situations in which scheduling favors the 5-day over the 7-day system.

Table 1. Description of cows

	Treatments	
Item	7dCIDR	5dCIDR
Number	88	89
Cycling, %	43.2	69.7
Non-cycling, %	56.8	30.3
Body condition, mean	5.1	5.1
Distribution, %		
≤ 4	23.9	34.8
5 to 5.5	61.4	49.4
≥ 6.0	14.8	15.7
Days postpartum, mean	72	70
Distribution, %		
> 70 day	52.3	46.1
50 to 70 days	30.7	36.0
< 50 days	17.0	18.0

Table 2. Pregnancy rates

	Treatments	
Item, %	7dCIDR	5dCIDR
Pregnancy rate to AI	53.4 (89)	54.5 (88)
Final	92.0	89.7
Cycling (n)	50.0 (38)	57.4 (61)
Non-cycling (n)	56.0 (50)	48.1 (27)
Cow age, years		
2 (n)	73.3 (15)	56.3 (16)
3+ (n)	49.3 (73)	54.2 (72)

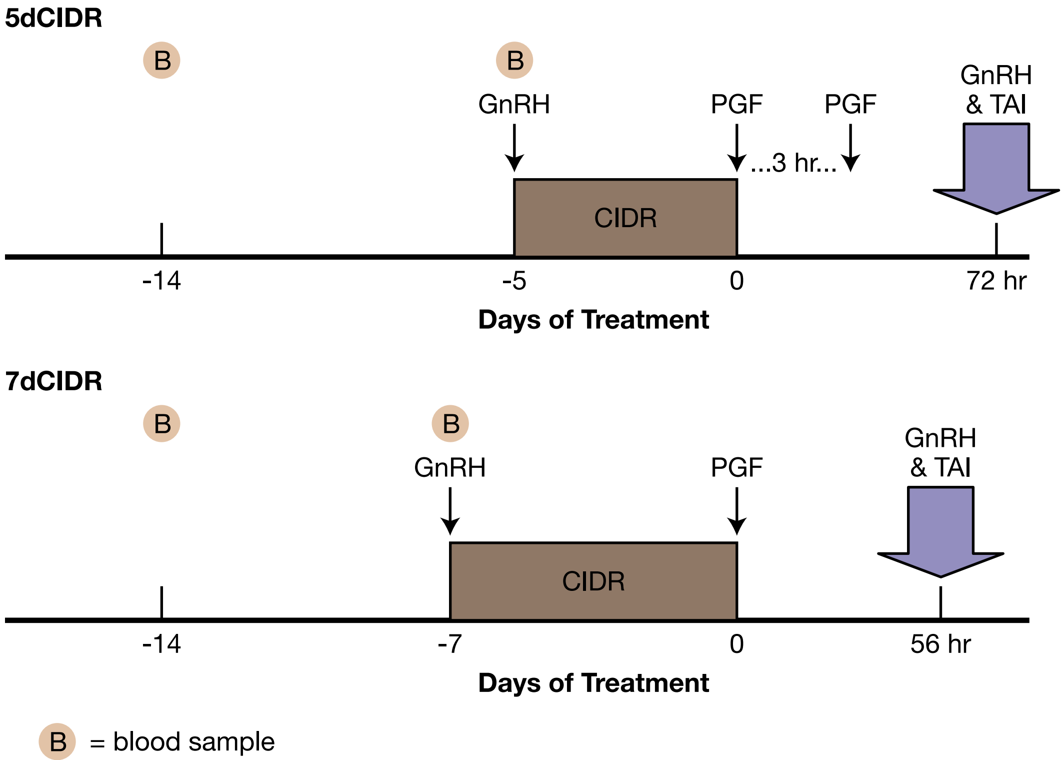

Figure 1. Treatment and sampling schedule.
GnRH = 2 mL Fertagyl, PGF2α = 2 mL Estrumate.

Length of the Weaning Period Affects Postweaning Growth, Health, and Carcass Merit of Ranch-Direct Beef Calves Weaned During the Fall

J. W. Bolte[1], KC Olson[2], J. R. Jaeger[1], T. B. Schmidt[3], D. U. Thomson[4], B. J. White[4], R. L. Larson[4], N. A. Sproul[2], L. A. Pacheco[2], and M. D. Thomas[5]

Introduction

Bovine respiratory disease (BRD) is the most economically devastating feedlot disease. Risk factors associated with incidence of BRD include (1) stress associated with maternal separation, (2) stress associated with introduction to an unfamiliar environment, (3) poor intake associated with introduction of novel feedstuffs into the animal's diet, (4) exposure to novel pathogens upon transport to a feeding facility and commingling with unfamiliar cattle, (5) inappropriately administered respiratory disease vaccination programs, and (6) poor response to respiratory disease vaccination programs. Management practices that are collectively referred to as preconditioning are thought to minimize damage to the beef carcass from the BRD complex.

Preconditioning management reduces the aforementioned risk factors for respiratory disease by (1) using a relatively long ranch-of-origin weaning period following maternal separation, (2) exposing calves to concentrate-type feedstuffs, and (3) producing heightened resistance to respiratory disease-causing organisms through a preweaning vaccination program. The effectiveness of such programs for preserving animal performance is highly touted by certain segments of the beef industry.

Ranch-of-origin weaning periods of up to 60 days are suggested for preconditioning beef calves prior to sale; however, optimal length of the ranch-of-origin weaning period has not been determined experimentally. The objective of this study was to test the validity of beef industry assumptions about appropriate length of ranch-of-origin weaning periods for calves aged 160 to 220 days and weaned during the fall.

Experimental Procedures

A total of 433 polled, spring-born calves (average body weight (BW) at weaning = 506 ± 81 lb, average birth date = 04/1/2007 ± 22 days) were used for this experiment. One set of calves (n = 265) originated from the Kansas State University Commercial Cow-Calf Unit. The second set (n = 168) originated from the Kansas State University Agricultural Research Center–Hays (ARCH). Bulls were castrated at least 120 days prior to

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the study. At each location, calves were blocked by sex and age and assigned randomly to treatments that corresponded to the length of time between separation from their dam and shipping: 60, 45, 30, 15, or 0 days. Calf age on the day of maternal separation averaged 160, 175, 190, 205, and 220 days of age for calves weaned 60, 45, 30, 15, and 0 days prior to shipping, respectively. The study was initiated on August 29 (75 days before shipping), and the common shipping date for all treatments was November 7 (day 0). Average calf age on the common shipping day was similar among treatments. Body condition score of cows at both locations was measured 75 days before and 14 days after the common shipping date.

All calves were given an initial modified-live vaccination for IBR, BVD, PI3, BRSV, (Bovi-Shield Gold FP, Pfizer Animal Health, Exton, PA) and clostridial disease (Vision 7 with SPUR, Intervet Inc., Millsboro, DE) 2 weeks prior to separation from their dam. They were also individually identified with a color-coded ear tag corresponding to treatment at that time.

On the day of maternal separation, all calves were revaccinated for IBR, BVD, PI3, BRSV, and clostridial diseases with the products previously described; calves were also treated for internal and external parasites with Dectomax (Pfizer Animal Health) and weighed. Calves at both locations were immediately transported a short distance (< 15 miles) to a central home-ranch weaning facility.

Calves were maintained in earth-floor pens (four pens per treatment) at their respective home-ranch weaning facilities for a period of days corresponding to their treatment assignment. Calves were fed a common weaning ration (Table 1) during that period. The ration was formulated to achieve an average daily gain (ADG) of 2.0 lb at a dry matter intake of 2.5% of BW.

Calves were monitored for symptoms of respiratory disease at 7:00 a.m. and 2:00 p.m. daily during the weaning phase of the experiment. Calves with clinical signs of BRD (Table 2), as judged by animal caretakers, were removed from home pens and evaluated. Each calf with clinical signs of BRD was weighed, had a rectal temperature measured, and was given a clinical illness score (Table 2). Calves that presented with a clinical illness score greater than 1 and a rectal temperature > 104.0°F were treated according to the schedule described in Table 3. Cattle were evaluated 72 hours posttreatment and re-treated on the basis of observed clinical signs.

Calves from all treatments and both origins were individually weighed and shipped approximately 180 miles from their respective weaning facilities to an auction market located at Hays, KS, on day 0. Calves from both locations were commingled with respect to gender, treatment, and BW and maintained on the premises of the auction market for 14 hours. The purpose of this step was to simulate pathogen exposure typically encountered by market-ready calves. Calves were shipped 5 miles directly to the ARCH feedlot from the auction market.

Upon arrival at the ARCH feedlot, cattle were individually weighed and assigned randomly to a receiving pen on the basis of treatment and gender. Cattle were fed a receiving ration for a period of 56 days after arrival at the ARCH. Feed intake was measured daily. Calves were monitored for symptoms of respiratory disease, and clinical illness was treated as in the home-ranch weaning phase (Tables 2 and 3). Body weights were measured at 28-day intervals during this receiving phase.

Following the receiving period, replacement heifers were removed, and cattle were placed on a common finishing ration (Table 4). Weights were taken every 60 days throughout the finishing period until slaughter. Cattle were fed to reach an average endpoint of approximately 0.6 in. of backfat at the 12th rib and placed into one of three slaughter groups. Once steers and heifers reached the targeted carcass endpoint, as determined by ultrasound, they were transported 120 miles to a commercial abattoir. At the abattoir, livers were examined for abscesses, and lungs were examined for lesions. After carcasses chilled for approximately 48 hours, they were ribbed and graded. Carcass measurements including 12th rib fat thickness, 12th rib loin eye area, and marbling score were collected with digital imaging software. By using these measurements, yield grade and quality grade were assigned according to USDA guidelines. Kidney, pelvic, and heart fat were determined by difference in carcass weight after removal of all internal fat by dissection.

Results and Discussion

Calf BW was similar ($P>0.8$) among treatments at the beginning of the trial. Calf ADG during the 60 days preceding shipping tended to increase linearly ($P=0.09$) with longer weaning periods (Figure 1). Similarly, calf BW at shipping tended to increase linearly ($P=0.06$) with successively longer weaning periods (Figure 2). This probably occurred because calves were consuming a more energy-dense diet in the weaning facility than what was possible for herd mates that remained with their mothers on pasture. We concluded that under the conditions of our study, successively longer ranch-of-origin weaning periods improved calf BW and ADG prior to shipping. Incidence of undifferentiated fever during the 14-day period following maternal separation was greater ($P<0.01$) for calves on the 60-day weaning treatment than for those on the 45-, 30-, or 15-day weaning treatments (Figure 3). Reasons for the greater incidence of undifferentiated fever seen in the calves on the 60-day weaning treatment were unclear but may have been related to significant variation in daytime and nighttime temperatures that occurred during the first 14 days after maternal separation for that treatment.

Feed intake (dry matter basis) during the first 30 days following shipping was less ($P<0.01$) for calves weaned 0 days than for those weaned 60, 45, 30, or 15 days prior to shipping (Figure 4). More experience consuming dry diets from a feed bunk prior to shipping translated to greater feed intake at the feedlot. Previous experience with concentrate-based feeds may benefit recently received calves in some circumstances; however, ADG and gain efficiency (G:F) in our study were similar ($P>0.12$) among treatments during the first 30 days in the feedlot. Calf BW 30 and 60 days after shipping increased linearly ($P<0.01$) with successively longer weaning periods. This indicates that treatments retained their relative ranks in body size from shipping to the end of the receiving period. Incidence of undifferentiated fever during the first 15 days after shipping was greater ($P<0.01$) for calves weaned 0 days than for those weaned 60, 45, 30, or 15 days (Figure 6).

Calf BW increased linearly (P<0.02) with longer weaning periods from feedlot receiving through 114 days on feed; however, calf BW was similar (P>0.09) between treatments from day 114 until harvest. Dry matter intake during the first 30 days on feed was less for calves weaned 0 days than for those weaned 60, 45, 30, or 15 days; however, dry matter intake was similar (P>0.3) among treatments from day 30 in the feedlot to harvest. Calf ADG and G:F were similar (P>0.2) among treatments from feedlot receiving to 232 days on feed; however, ADG and G:F tended to increase linearly (P<0.06) with longer weaning periods from day 232 to harvest.

Days on feed decreased linearly (P=0.05) with successively longer weaning periods (Figure 7). This probably occurred because calves were slightly larger and more mature physiologically at the time of feedlot placement as length of the ranch-of-origin weaning period increased. Yield grade (Figure 8) and kidney, pelvic, and heart fat increased linearly (P 0.04), whereas fat thickness tended to increase linearly (P=0.06) with successively longer weaning periods. Dressing percentage, hot carcass weight, marbling, and loin eye area were similar (P>0.15) among treatments. Liver and lung scores at harvest also were similar (P>0.3) among treatments. The increase in undifferentiated fever for cattle weaned 0 days before shipping was not associated with significant damage to the lungs or a reduction in marbling score as has been reported by researchers working with market-sourced cattle. Differences in carcass characteristics among treatments may have occurred because calves weaned for longer periods of time were larger and more mature at the time of feedlot arrival.

Implications

In general, there was a great deal of similarity among weaning treatments in terms of health performance and growth performance during finishing. Carcass merit was also similar among treatments. This finding calls into question the validity of beef industry assumptions about the appropriate length of ranch-of-origin weaning periods for cattle that are moved quickly from their ranch of origin to a feedlot and not commingled with market-sourced cattle. Ranch-direct calves that are properly vaccinated before exposure to market conditions may not require ranch-of-origin weaning periods longer than 2 weeks for optimal health and growth performance during receiving and finishing. Although 2 weeks may be appropriate from the standpoint of sickness and ADG, an increase in calf BW prior to shipment to a feedlot or auction market may add value to calves that are sold after a brief ranch-of-origin weaning period.

Table 1. Ingredient and nutritional composition of the weaning diet

Ingredient	Dry matter basis (%)
Extender pellets (alfalfa)	41.82
Corn gluten feed	18.22
Wheat midds	14.68
Cracked corn	10.78
Cottonseed hulls	7.68
Dried distillers grain	3.01
Molasses	1.67
Limestone	1.85
Nutrient composition	**% of dry matter**
CP	15.31
Ca	0.56
P	1.43
NE_m, Mcal/kg	1.44
NE_g, Mcal/kg	0.85

Diet also included salt, zinc sulfate, and Rumensin 80.

Table 2. Scoring system used to classify the severity of clinical illness

Clinical illness score	Description	Clinical appearance
1	Normal	No abnormalities noted
2	Slightly ill	Mild depression, gaunt, +/- cough
3	Moderate illness	Severe depression, labored breathing, ocular/nasal discharge, +/- cough
4	Severe illness	Moribund, near death, little response to human approach

Table 3. Treatment schedule used to treat calves diagnosed with bovine respiratory disease complex

Treat	Drug	Dose	Route of injection
First pull	enrofloxacin (Baytril)	5 mL/CWT	Subcutaneous
Second pull	florfenicol (Nuflor)	6 mL/CWT	Subcutaneous
Third pull	oxytetracycline (Biomycin 200)	5 mL/CWT	Subcutaneous

Table 4. Average ingredient and nutritional composition of the finishing diet

Ingredient	Dry matter basis (%)
Rolled milo	59.43
Sorghum silage	25.47
Soybean meal	11.04
Limestone	2.08
Ammonium sulfate	0.42
Nutrient composition	**% of dry matter**
CP	15.90
Ca	1.01
P	0.33
NE_m, Mcal/kg	1.75
NE_g, Mcal/kg	1.13

Diet also included salt, Rumensin 80, Tylan 40, and trace minerals.

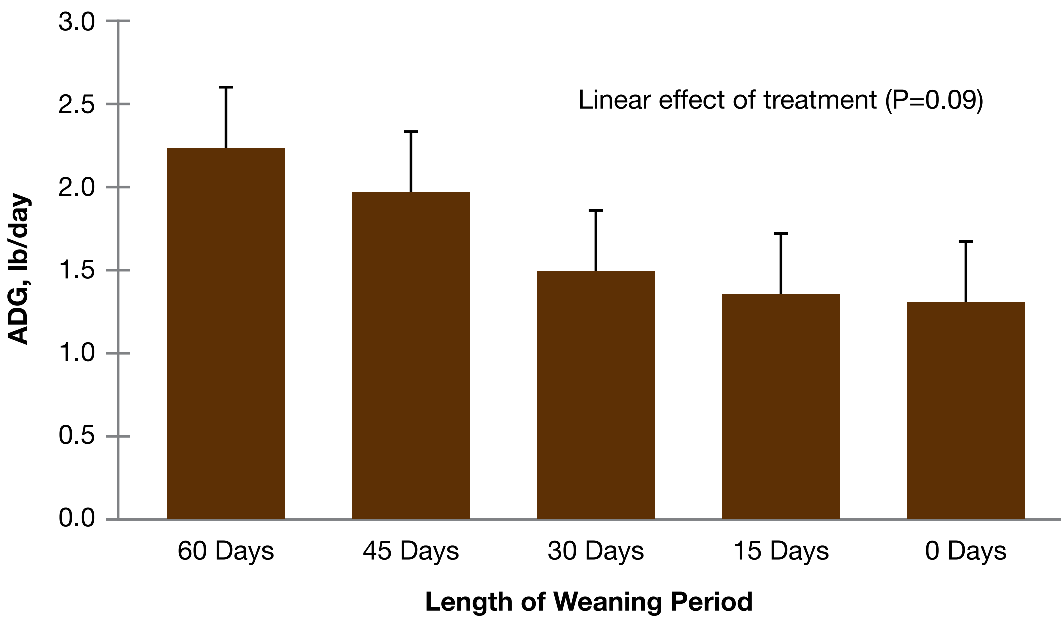


Figure 1. Effect of length of the ranch-of-origin weaning period on average daily gain (ADG) of calves during the 60 days prior to shipment to feedlot.

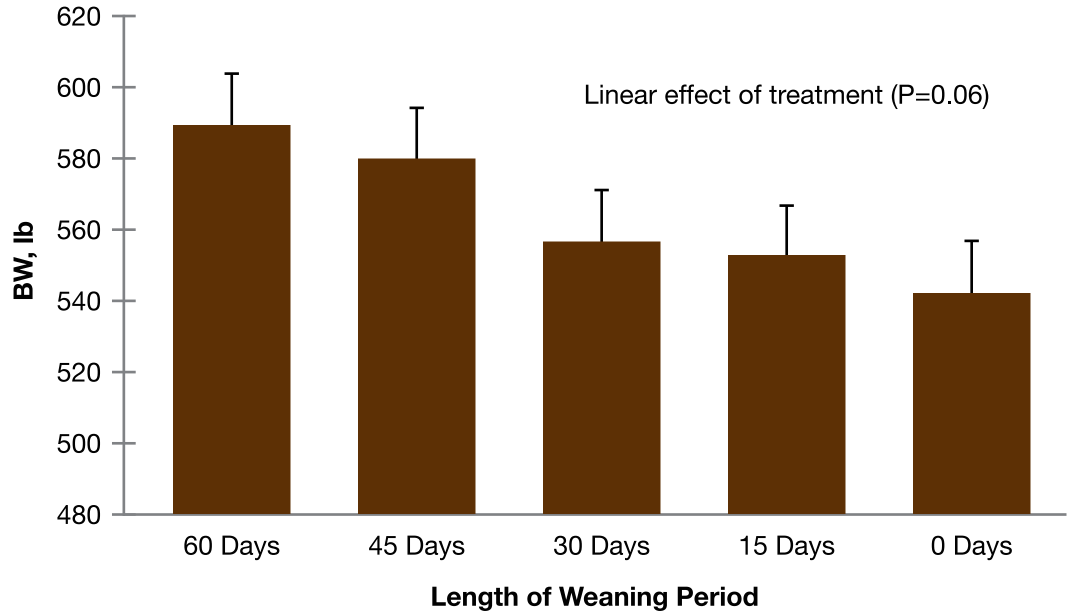


Figure 2. Effect of length of the ranch-of-origin weaning period on body weight (BW) of calves on the day of shipment to a commercial auction market.

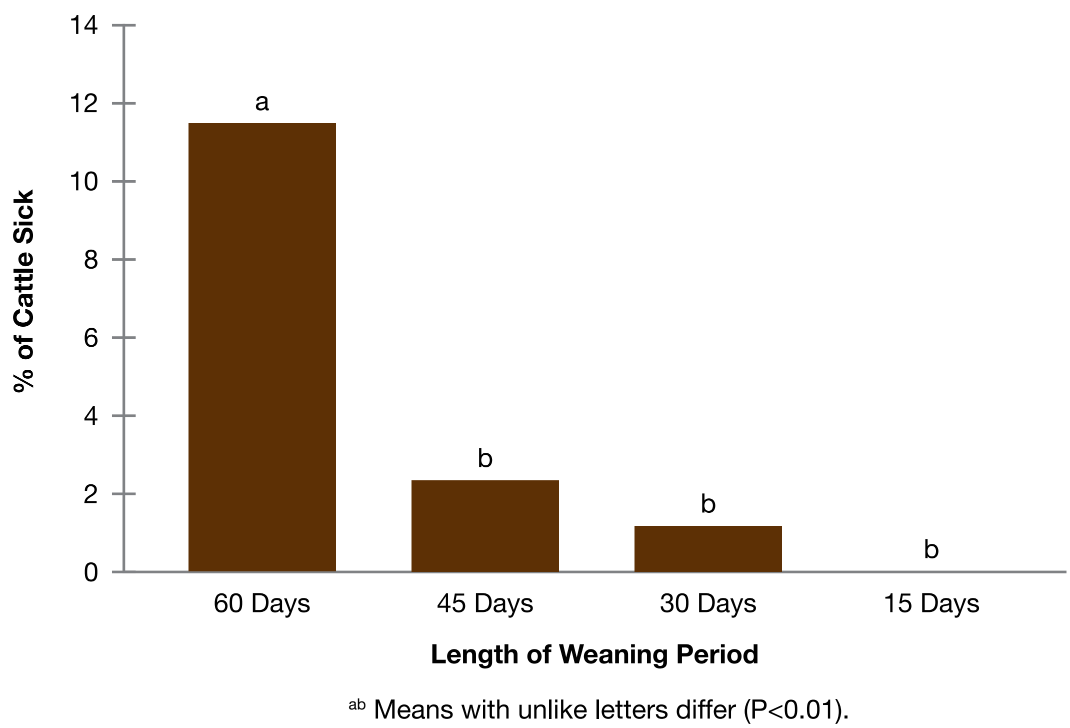


Figure 3. Effect of length of the ranch-of-origin weaning period on incidence of undifferentiated fever in calves during the first 14 days after maternal separation prior to shipment to a commercial auction market.

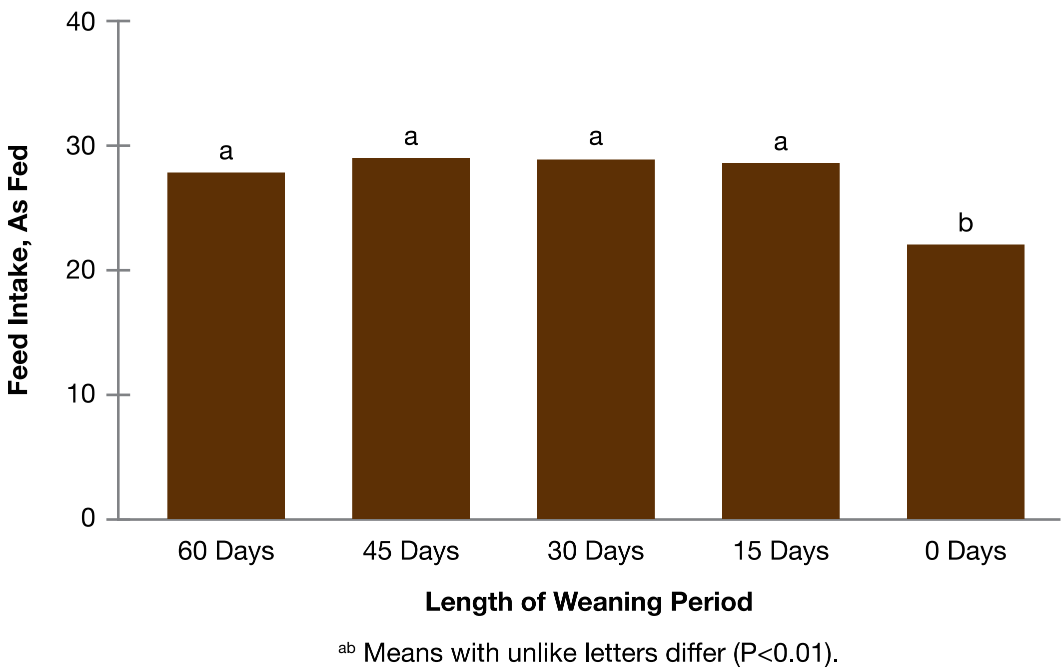


Figure 4. Effect of length of the ranch-of-origin weaning period on feed intake by calves during the first 30 days after feedlot arrival.

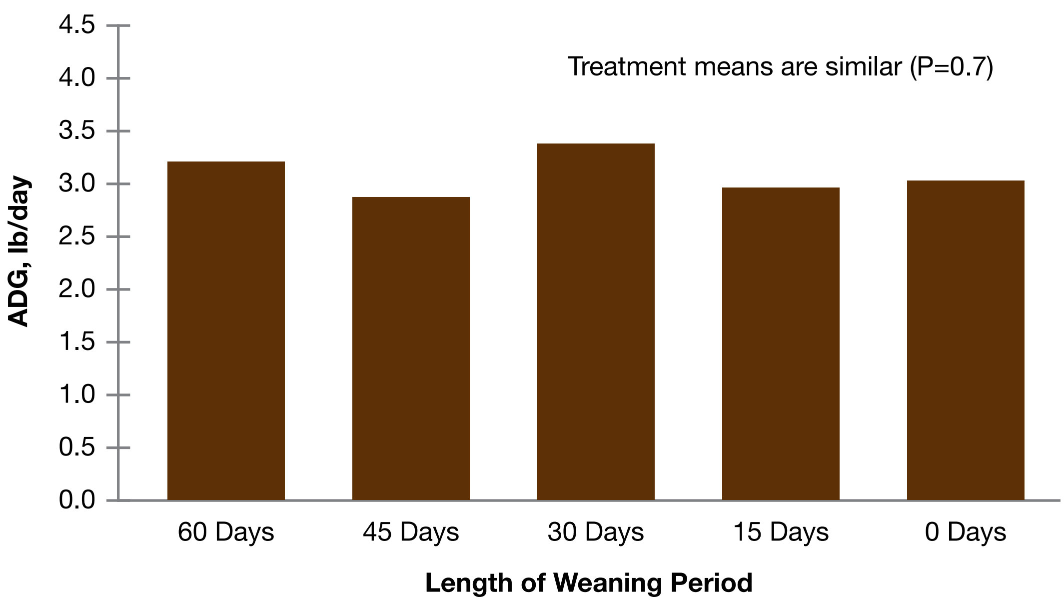
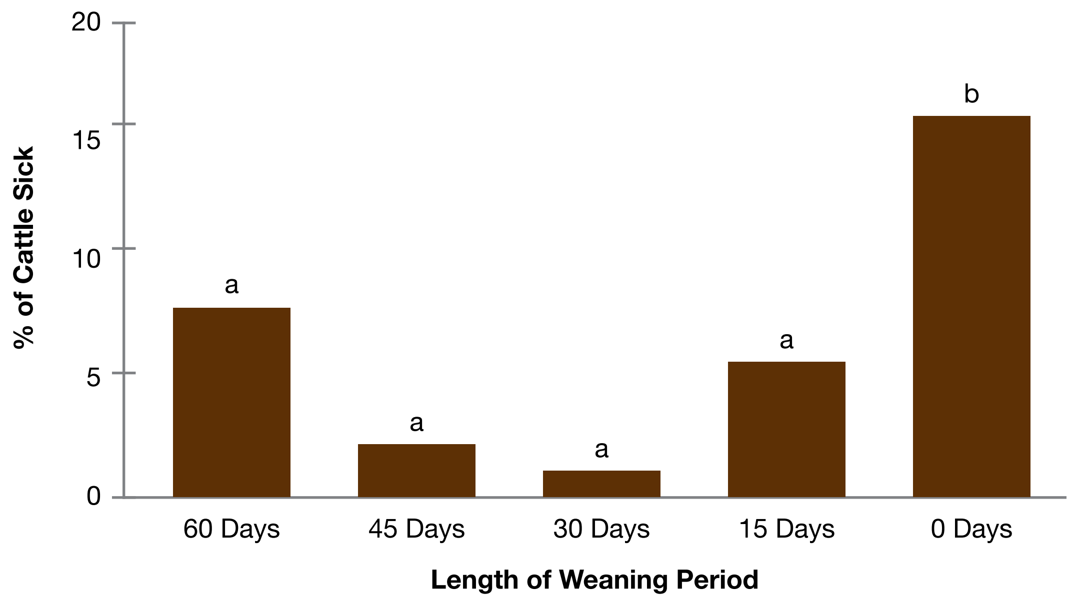


Figure 5. Effect of length of the ranch-of-origin weaning period on average daily gain (ADG) of calves during the first 30 days after feedlot arrival.



[ab] Means with unlike letters differ (P<0.01).

Figure 6. Effect of length of the ranch-of-origin weaning period on incidence of undifferentiated fever in calves during the first 15 days after feedlot arrival.

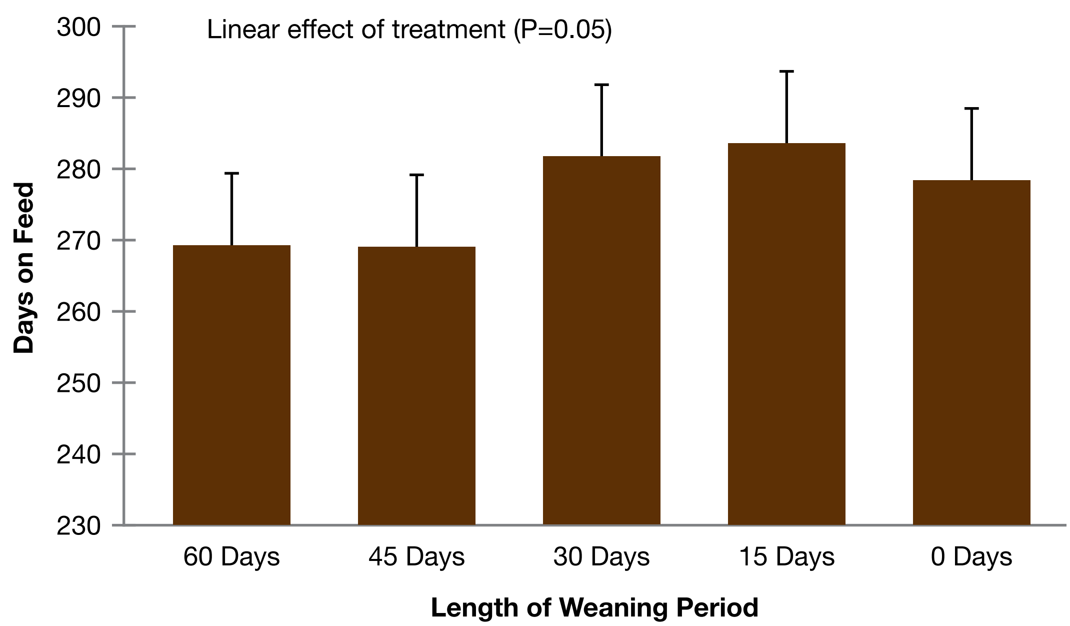


Figure 7. Effect of length of the ranch-of-origin weaning period on days on feed from feedlot arrival to harvest.

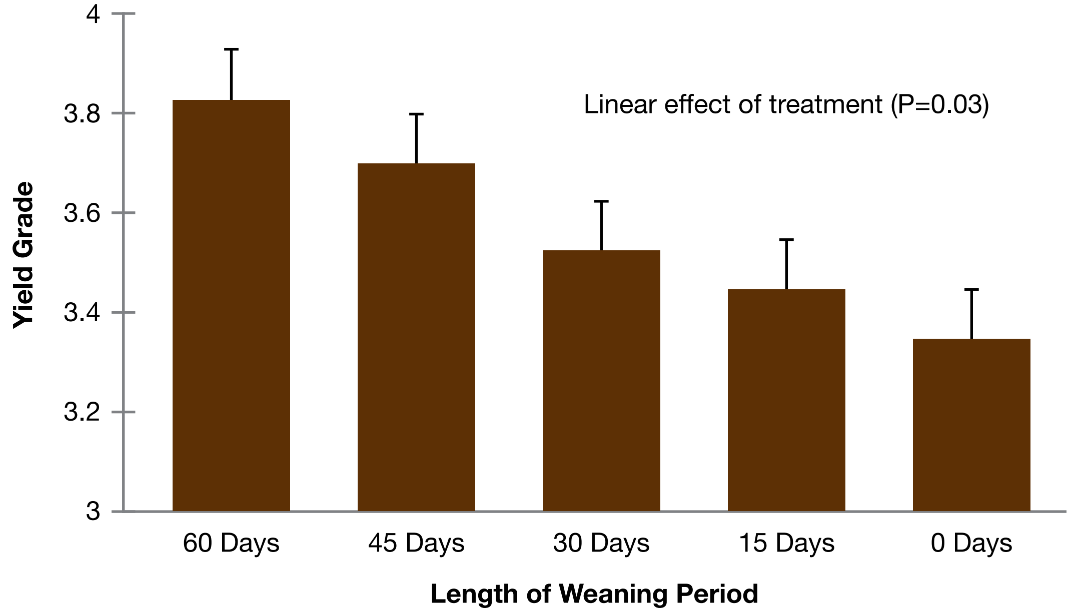


Figure 8. Effect of length of the ranch-of-origin weaning period on USDA yield grade of calves.

Length of the Ranch-of-Origin Weaning Period Does Not Affect Post-Receiving Growth or Carcass Merit of Ranch-Direct, Early-Weaned Beef Calves

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Introduction

Bovine respiratory disease (BRD) is the most economically devastating feedlot disease. Risk factors associated with incidence of BRD include (1) stress associated with maternal separation, (2) stress associated with introduction to an unfamiliar environment, (3) low intake associated with introduction of novel feedstuffs into the animal's diet, (4) exposure to novel pathogens upon transport to a feeding facility and commingling with unfamiliar cattle, and (5) inappropriately administered respiratory disease vaccination programs. Management practices that are collectively referred to as preconditioning are thought to minimize damage to the carcass from the BRD complex.

Preconditioning management can reduce the aforementioned risk factors for respiratory disease by (1) using a relatively long ranch-of-origin weaning period following maternal separation, (2) exposing calves to concentrate-type feedstuffs, and (3) producing heightened resistance to respiratory disease-causing organisms through a preweaning vaccination program. The effectiveness of such programs for preserving animal performance is highly touted by certain segments of the beef industry but poorly documented in peer-reviewed scientific literature.

Ranch-of-origin weaning periods of up to 60 days are suggested for preconditioning beef calves prior to sale; however, optimal length of the ranch-of-origin weaning period has not been determined experimentally. The objective of this study was to test the validity of beef industry assumptions about the appropriate length of ranch-of-origin weaning periods for calves aged 100 to 160 days and weaned during the summer.

Experimental Procedures

A total of 400 polled, spring-born calves (average body weight (BW) at weaning = 359 ± 69 lb, average birth date = 03/21/2006 ± 19.5 days) were used for this experiment. One set of calves (n = 200) originated from the Kansas State University Cow-Calf Unit. The second set (n = 200) originated from the Agricultural Research Center–Hays (ARCH). Bulls were castrated at least 14 days prior to the study. At each location, calves were blocked by sex and age and assigned randomly to treatments that corresponded to

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the length of time between separation from their dam and shipping: 60, 45, 30, 15, or 0 days (n = 40/treatment per location). Calf age on the date of maternal separation was 100, 115, 130, 145, and 160 days for calves weaned 60, 45, 30, 15, and 0 days relative to shipping, respectively. The study was initiated on June 15 (75 days before shipping), and the common shipping date for all treatments was August 24 (day 0).

All calves were given an initial modified-live vaccination for IBR, BVD, PI3, BRSV, (Bovi-Shield Gold FP, Pfizer Animal Health, Exton, PA) and clostridial disease (Vision 7 with SPUR, Intervet Inc., Millsboro, DE) 2 weeks prior to separation from their dam. They were also individually identified with a color-coded ear tag corresponding to treatment at that time.

On the day of maternal separation, all calves were revaccinated for IBR, BVD, PI3, BRSV, and clostridial diseases; they were also treated for internal and external parasites with Dectomax (Pfizer Animal Health) and weighed. Calves were immediately transported a short distance (< 15 miles) to a central home-ranch weaning facility.

Calves were maintained in earth-floor pens (four pens per treatment) at their respective home-ranch weaning facilities for a period of days corresponding to their treatment assignment. Calves were fed a common weaning ration during that period that was based on chopped hay, soybean meal, and sorghum grain. It was formulated to achieve an average daily gain (ADG) of 2.0 at a dry matter intake of 2.5% of BW.

Calves were monitored for symptoms of respiratory disease at 7:00 a.m. and 2:00 p.m. daily during the weaning phase of the experiment. Calves with clinical signs of BRD, as judged by animal caretakers, were removed from home pens and evaluated. Each calf with clinical signs of BRD was weighed, had a rectal temperature measured, and was given a clinical illness score (Table 1). Calves that presented with a clinical illness score greater than 1 and a rectal temperature > 104.0°F were treated according to the schedule described in Table 2. Cattle were evaluated 72 hours posttreatment and re-treated on the basis of observed clinical signs.

Calves from all treatments and both origins were individually weighed and shipped from their respective weaning facilities to an auction market located at Russell, KS, on August 24 (day 0). Calves from both locations were commingled with respect to gender, treatment, and body weight and maintained on the premises of the auction market for 14 hours. During that time, calves were moved through the normal processing facilities. The purpose of this step was to simulate pathogen exposure typically encountered by market-ready calves. Calves were shipped directly to the ARCH from the auction market.

Upon arrival at the ARCH feedlot, cattle were individually weighed and assigned randomly to a receiving pen on the basis of treatment and gender. Cattle continued to be fed the diet introduced after maternal separation for a period of 56 days after arrival at the ARCH. Feed intake was measured daily. Calves were monitored for symptoms of respiratory disease, and clinical illness was treated as in the home-ranch weaning phase. Body weights were measured at 28-day intervals during the receiving phase.

Following the receiving period, replacement heifers were removed, and cattle were placed on a common finishing ration (Table 3). Weights were taken every 60 days throughout the finishing period until slaughter. Cattle were fed to reach an average endpoint of approximately 0.4 in. of backfat at the 12th rib and placed into one of three slaughter groups. Once steers and heifers reached the targeted carcass endpoint, as determined by ultrasound, they were transported approximately 180 miles to a commercial abattoir. At the abattoir, lungs were examined for lesions. After carcasses chilled for approximately 24 hours, they were ribbed and graded. Carcass measurements including 12th rib fat thickness; 12th rib loin eye area; kidney, pelvic, and heart fat; USDA yield grade; USDA quality grade; and marbling score were collected by a trained evaluator blinded to treatment.

Results and Discussion

Calf BW at feedlot receiving tended to decrease linearly (P=0.06) with successively earlier weaning dates (Figure 1); however, calf BW was similar (P>0.2) among treatments from day 30 after feedlot arrival to harvest. Feed intake (dry matter basis) during the first 30 days following shipping increased linearly (P<0.01) as the length of the ranch-of-origin weaning period increased; however, dry matter intake was similar (P>0.3) among treatments from day 30 following shipping to harvest.

Daily gain and gain efficiency (G:F) in our study were similar (P=0.4) among treatments during the first 30 days in the feedlot (Figures 2 and 3, respectively). Similarly, calf ADG and G:F were similar (P>0.2) among treatments from day 30 in the feedlot until harvest.

Incidence of undifferentiated fever was similar (P=0.18, data not shown) among treatments prior to shipping. In fact, only three calves were treated for respiratory disease, and none expired during the pre-shipment phase of this study. In addition, incidence of undifferentiated fever was similar (P=0.12) among treatments during the first 30 days in the feedlot (Figure 4).

Days on feed tended to increase linearly (P=0.06) with successively longer weaning periods (Figure 5). Dressing percentage; fat thickness; hot carcass weight; kidney, pelvic, and heart fat; marbling; loin eye area; and yield grade were similar (P>0.2) among treatments. Liver and lung scores also were similar (P>0.3) among treatments.

In general, finishing performance and carcass merit of early-weaned lightweight calves was not improved by ranch-of-origin weaning periods of between 15 and 60 days.

Implications

Under the conditions of our study, ranch-of-origin weaning periods between 15 and 60 days did not improve post-receiving growth performance, health performance, or carcass merit of early-weaned lightweight calves compared with shipping calves immediately after maternal separation.

Table 1. Scoring system used to classify the severity of clinical illness

Clinical illness score	Description	Clinical appearance
1	Normal	No abnormalities noted.
2	Slightly ill	Mild depression, gaunt, +/- cough
3	Moderate illness	Severe depression, labored breathing, ocular/nasal discharge, +/- cough
4	Severe illness	Moribund, near death, little response to human approach

Table 2. Treatment schedule used to treat calves diagnosed with bovine respiratory disease complex

Treat	Drug	Dose	Route of injection
First pull	enrofloxacin (Baytril)	5 mL/CWT	Subcutaneous
Second pull	florfenicol (Nuflor)	6 mL /CWT	Subcutaneous
Third pull	oxytetracycline (Biomycin 200)	5 mL /CWT	Subcutaneous

Table 3. Average ingredient and nutritional composition of finishing diet

Ingredient	Dry matter basis (%)
Rolled milo	59.43
Sorghum silage	25.47
Soybean meal	11.04
Limestone	2.08
Ammonium sulfate	0.42
Nutrient composition	% of dry matter
CP	15.90
Ca	1.01
P	0.33
NE_m, Mcal/kg	1.75
NE_g, Mcal/kg	1.13

Diet also included salt, Rumensin 80, Tylan 40, and trace minerals.

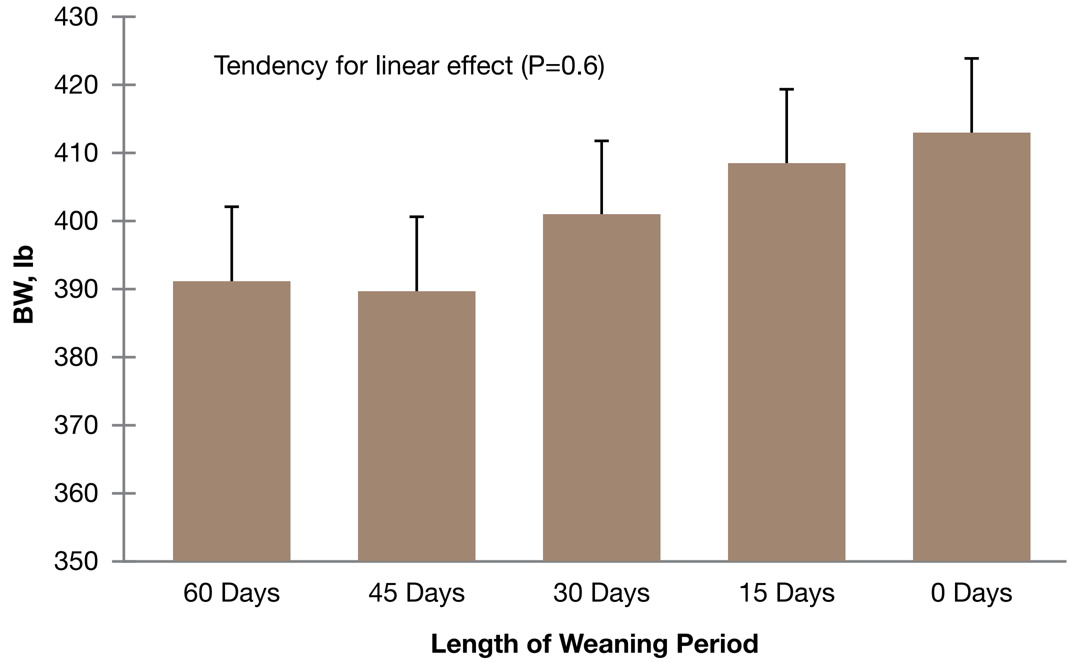

Figure 1. Effect of length of the ranch-of-origin weaning period on body weight (BW) of lightweight calves at feedlot arrival.

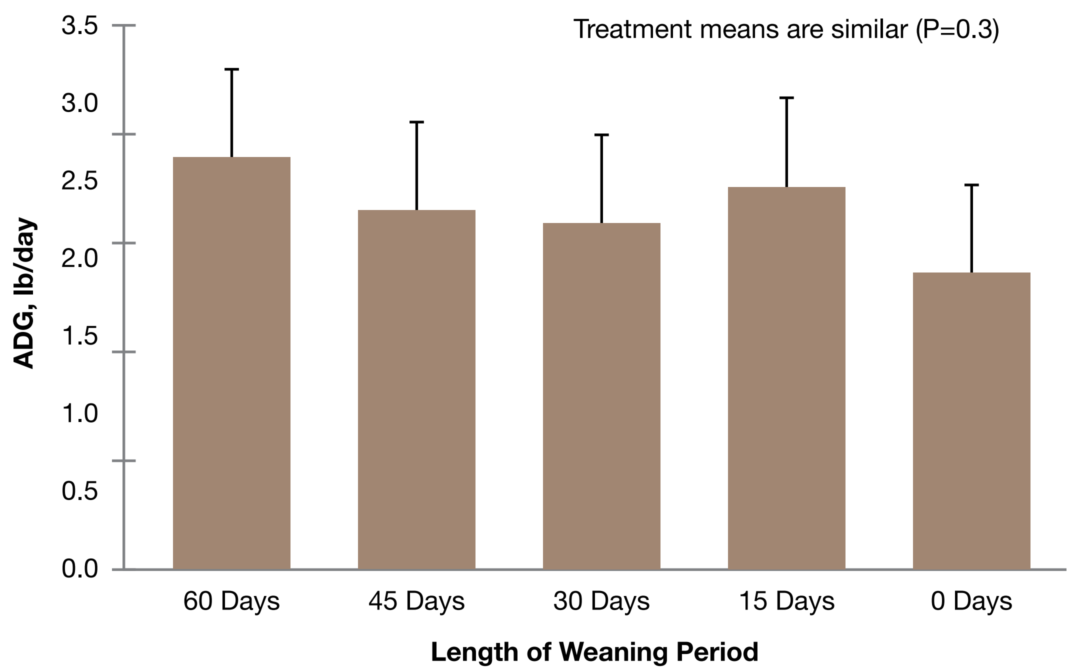

Figure 2. Effect of length of the ranch-of-origin weaning period on average daily gain (ADG) of lightweight calves during the first 30 days after feedlot arrival.

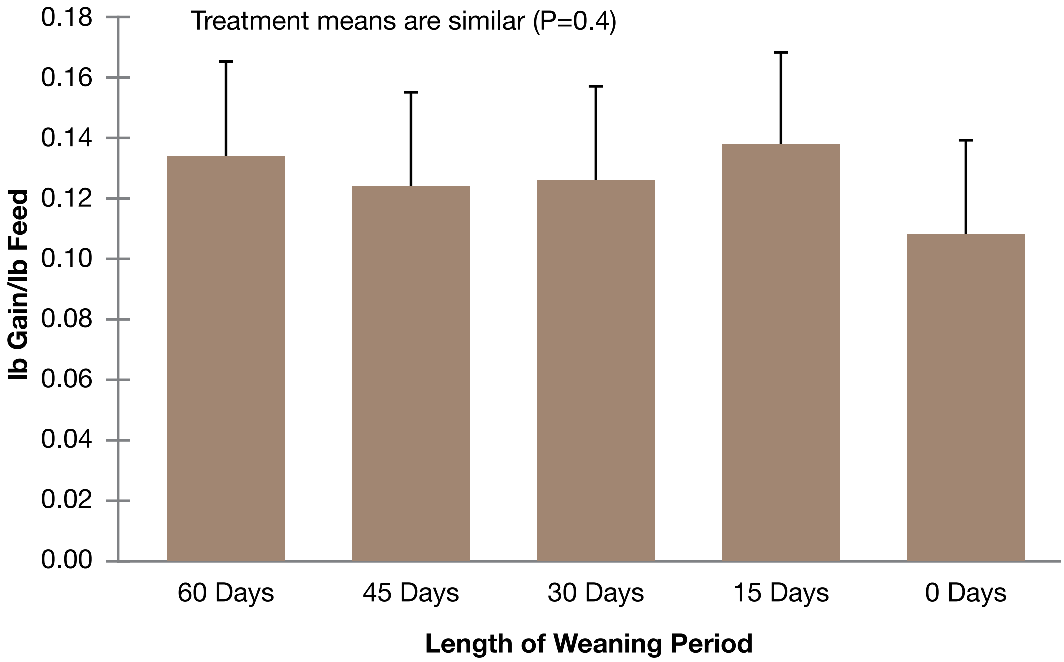

Figure 3. Effect of length of the ranch-of-origin weaning period on growth efficiency of lightweight calves during the first 30 days after feedlot arrival.

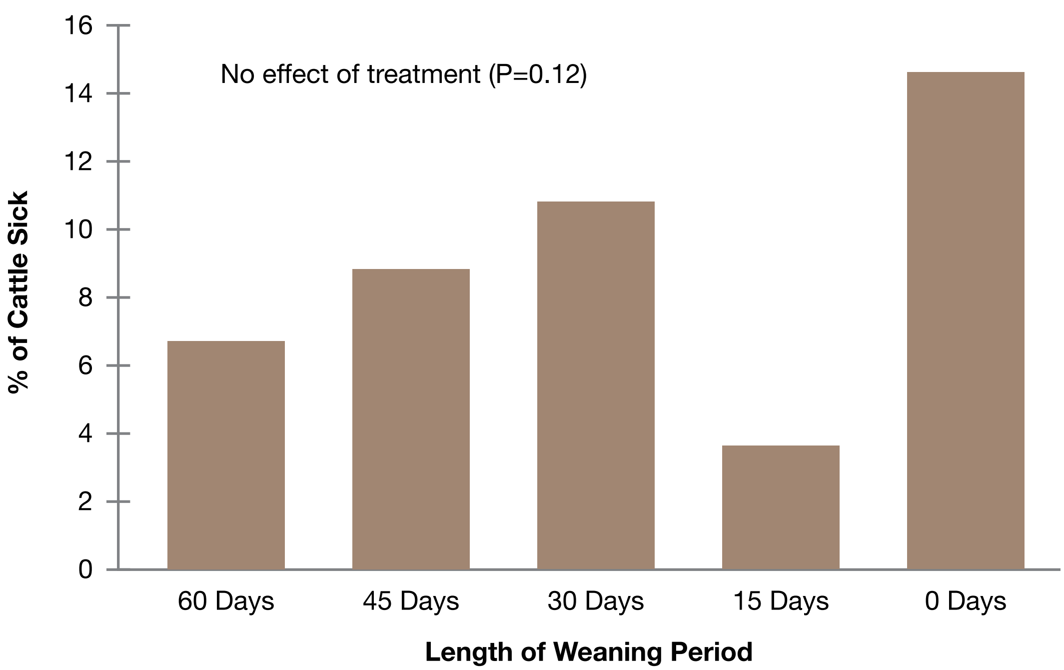

Figure 4. Effect of length of the ranch-of-origin weaning period on incidence of undifferentiated fever in lightweight calves during the first 30 days after feedlot arrival.

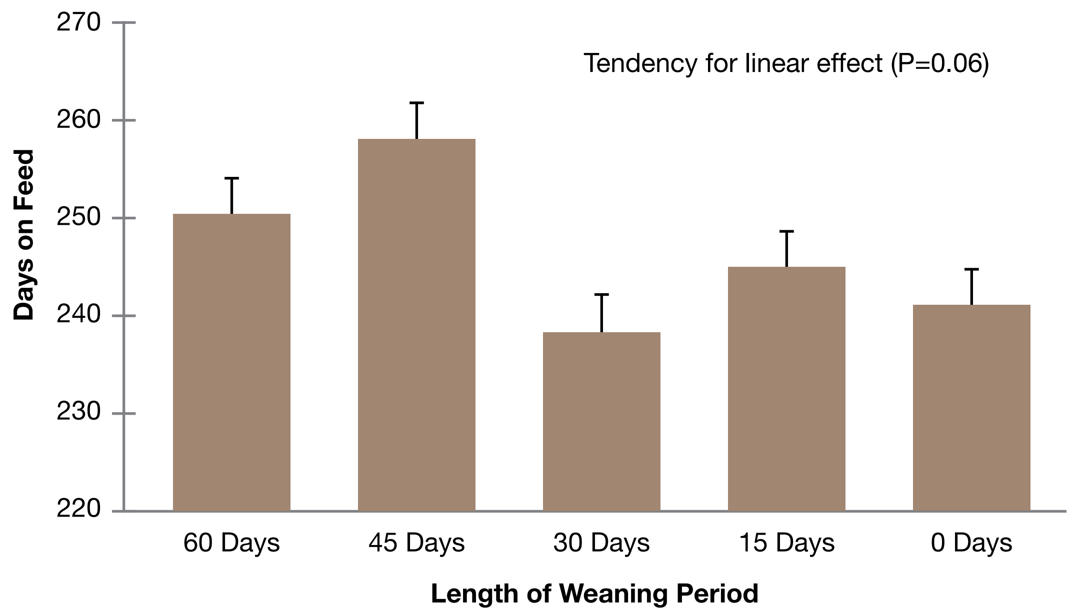

Figure 5. Effect of length of the ranch-of-origin weaning period on days fed from feedlot receiving to harvest.

Using Sequential Feeding of Optaflexx and Zilmax to Enhance Value in Cull Cows

M. J. Daniel[1], M. E. Dikeman[1], J. R. Jaeger[2], and J. A. Unruh[1]

Introduction

Beef cows are culled from herds because of reproductive inefficiency, poor performance, old age, farm downsizing due to high production costs, or other reasons. Since 1999, an increasing number of producers are either selling cows in better physical condition or feeding cows a high-concentrate ration for 50 to 100 days prior to harvest. According to the 2007 National Market Cow and Bull Quality Audit, cow carcasses are heavier and leaner and have more desirable muscle and fat color scores than carcasses in 1999. Although these improvements are positive steps toward increasing the value of cull cows, use of growth promoting agents, such as steroid implants and β-adrenergic agonists, can increase muscling and leanness more efficiently than feeding a concentrate ration alone. Currently, there are two β-agonists on the market for use in beef cattle in the United States: Optaflexx (ractopamine hydrochloride; Elanco, Greenfield, IN), a β_1-agonist, and Zilmax (zilpaterol hydrochloride; Intervet Inc., Millsboro, DE), a β_2-agonist. These growth promotants have been studied individually and in combination with implants (primarily in young steers and heifers), but no published research has investigated feeding a sequence of these growth promoting agents. Therefore, our objective was to investigate effects of feeding Optaflexx for 25 days followed by Zilmax for 20 days plus a 3-day withdrawal on cull cow performance, carcass traits, meat quality, and economic value.

Materials and Methods

Sixty cull cows meeting established criteria (primarily of "British" breeding, not pregnant, between 2 and 8 years of age, between 1,000 and 1,300 lb, and having a body condition score between 2 and 4) were placed on a concentrate ration (Table 1) for 82 days and assigned to one of four treatments: (1) Control = fed a concentrate ration for 82 days, (2) Optaflexx = fed a concentrate ration for 57 days then supplemented with Optaflexx for 25 days, (3) Zilmax = fed a concentrate ration for 59 days then supplemented with Zilmax for 20 days plus a 3-day withdrawal, and (4) Optaflexx + Zilmax = fed a concentrate ration for 34 days then supplemented with Optaflexx for 25 days followed by Zilmax for 20 days plus a 3-day withdrawal. On day 0, all cows were implanted with Revalor-200 (Intervet Inc.) per the manufacturer's instructions. There were five cows per pen, creating three replicate pens for each treatment. At the end of feeding, cows were transported to a commercial harvest facility and humanely slaughtered.

Hot carcass weights were recorded at harvest. At 72 hours postmortem, trained university personnel evaluated the following carcass traits: ribeye area; adjusted fat thickness; percentage kidney, pelvic, and heart fat; yield grade; lean and fat color; and marbling. At 4 days postmortem, carcasses were fabricated, and the wholesale rib, tenderloin, and shoulder clod were retrieved. Longissimus steaks (aged for 21 days), psoas major steaks

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(aged for 21 days), and infraspinatus steaks (aged for 14 days) were evaluated for tenderness. A portion of the longissimus muscle was enhanced with a 0.1M solution of calcium lactate to a target pump of 10% at 4 days postmortem, and tenderness was evaluated after 14 days of aging. Steaks (1-in. thick) were cooked to an internal temperature of 158°F and chilled overnight at 32°F. Eight 0.5-in. cores were removed parallel to the muscle fiber direction. Warner-Bratzler shear force (WBSF) values were collected on each core by shearing perpendicular to the direction of the muscle fiber.

Data were analyzed as a completely randomized design. For performance traits, the GLM procedure of SAS (SAS Institute Inc., Cary, NC) was used with pen was the experimental unit. Carcass data and tenderness were analyzed with the MIXED procedure of SAS with animal as the experimental unit. One cow was removed because of sickness, and one cow was removed because she had a negative average daily gain, leaving a total of 58 cows in the data set. Means were separated ($P<0.05$) with the least significant difference procedure.

Results and Discussion

Weights at the beginning of the feeding period were similar for all treatments. There were no statistical ($P>0.05$) differences in average daily gain, finished weight, hot carcass weight, or dressing percentage among treatments (Table 2), although there were some numerical differences.

There also were no differences ($P>0.05$) among treatments for adjusted fat thickness; percentage kidney, pelvic and heart fat; or yield grade (Table 2). However, there was a trend ($P=0.18$) for ribeye areas to be larger in the Zilmax and Optaflexx + Zilmax treatments (Figure 1). In addition, although not significant ($P=0.30$), marbling scores tended to be lowest in the Optaflexx treatment (Slight60) and highest in the Optaflexx + Zilmax treatment (Small00, Figure 2). Cows within the Optaflexx + Zilmax treatment also had numerically, although not significantly, more desirable lean color score compared with the other three treatments (Table 2).

Warner-Bratzler shear force values for nonenhanced longissimus steaks were similar for the Control, Optaflexx, and Optaflexx + Zilmax treatments (Figure 3). However, WBSF values for the Zilmax treatment were distinctively higher ($P<0.05$) than those of the other three treatments (Table 3). These data indicate that feeding either no β-agonist, Optaflexx, or the combination of Optaflexx followed by Zilmax will yield more tender longissimus steaks than feeding Zilmax alone.

There were no differences among treatments for WBSF values of enhanced longissimus steaks, and WBSF values for enhanced steaks from Zilmax-fed cattle were noticeably lower than for nonenhanced steaks from Zilmax-fed cattle (Table 3). Therefore, we conclude that enhancement with calcium lactate is beneficial in improving tenderness for Zilmax-fed cattle.

Infraspinatus steaks from Control cows had higher ($P<0.05$) WBSF values than steaks from cows in treatments that contained only Optaflexx or only Zilmax (Table 3). We predict that this difference is due to a collagen dilution effect in which the growth promotants increased muscle cell growth and diluted the effects of collagen. Warner-Bratzler shear force values were not different among treatments for steaks from the psoas major muscle.

Economic analysis was conducted by comparing initial cow value with harvest cow value while factoring in feed, transportation, and treatment costs. There were no significant differences in net revenue among treatments. However, cows increased in value from $54.50/cwt to $77.02/cwt over the 82-day feeding period. In addition, cows from the Control and Optaflexx + Zilmax treatments numerically had the highest net revenue, whereas cows from the Optaflexx-only treatment generated the least net revenue (Figure 3). The Zilmax-only treatment fell intermediate in the revenue analysis, likely because the amount of gain was not substantial enough to offset the cost of adding Zilmax.

Implications

Feeding Zilmax alone or a combination of Optaflexx + Zilmax had no statistically significant ($P>0.05$) effect on performance characteristics; however, there was a trend for cows supplemented with Zilmax alone or in combination with Optaflexx to have increased ribeye area measurements. In addition, feeding a sequence of Optaflexx followed by Zilmax can improve longissimus muscle tenderness compared with feeding Zilmax alone and could be beneficial in increasing marbling and lean color scores.

We conclude that feeding a high-concentrate ration to cull cows for 82 days can be quite profitable because of the increase in value of the cows. In addition, we do not recommend feeding Optaflexx or Zilmax alone, but for different reasons. We recommend that Zilmax should be fed only in sequence following feeding of Optaflexx to optimize performance and meat quality.

Table 1. Basic feed ration

Ingredient	Dry matter basis (%)
Ground sorghum grain	76.95
Sorghum silage	20.04
Soybean meal (44%)	1.61
Minor/supplement[1]	1.40

[1] Minor ingredients = urea, calcium, salt; for the Optaflexx and Optaflexx + Zilmax treatments, Optaflexx was added at 0.00044 lb for 25 days; for the Zilmax and Optaflexx + Zilmax treatments, Zilmax was added at 0.00023 lb for 20 days.

Table 2. Carcass traits of cull beef cows fed β-agonists

Item	Control	Optaflexx	Zilmax	Optaflexx + Zilmax	P-value
Initial weight, lb	1160	1150	1149	1154	0.93
Final weight, lb	1385	1382	1426	1427	0.53
Average daily gain, lb	3.43	3.26	3.84	3.79	0.63
Hot carcass weight, lb	815	820	849	859	0.42
Dressing percentage, %	59.0	59.3	59.7	60.2	0.58
Adjusted fat thickness, in.	0.35	0.37	0.34	0.38	0.92
Kidney, pelvic, and heart fat, %	1.5	1.3	1.3	1.5	0.60
Yield grade	2.6	2.6	2.2	2.5	0.46
Lean color[1]	5.4	5.3	5.4	4.4	0.27
Fat color[2]	2.6	2.8	2.4	2.5	0.62

[1] Scale: 1 = pale red, 7 = dark red.
[2] Scale: 1 = bleached white, 5 = canary yellow.

Table 3. Muscle tenderness of cull cows fed β-agonists

Item	Control	Optaflexx	Zilmax	Optaflexx + Zilmax	P-value
Longissimus WBSF, lb	9.76[a]	8.75[a]	12.41[b]	10.42[a]	0.03
Enhanced longissimus WBSF, lb	8.97	8.73	9.59	9.48	0.60
Infraspinatus WSBF, lb	9.72[b]	8.36[a]	8.73[ab]	8.42[a]	0.04
Tenderloin WBSF, lb	6.46	6.49	6.66	6.13	0.12

[ab] Within a row, means without a common superscript letter differ ($P<0.05$).

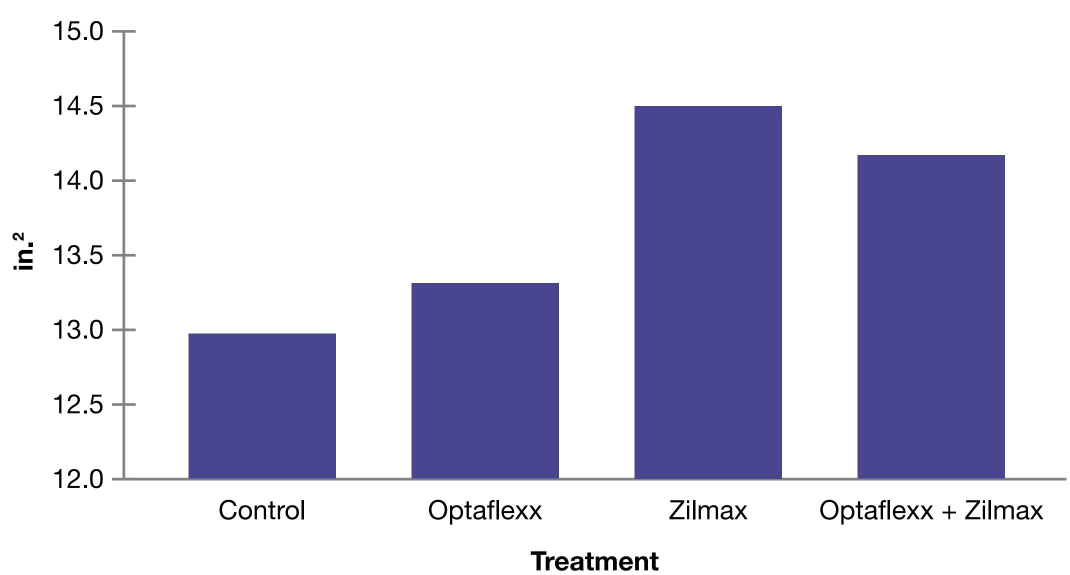

Figure 1. Ribeye area measurement of cull cows fed β-agonists.

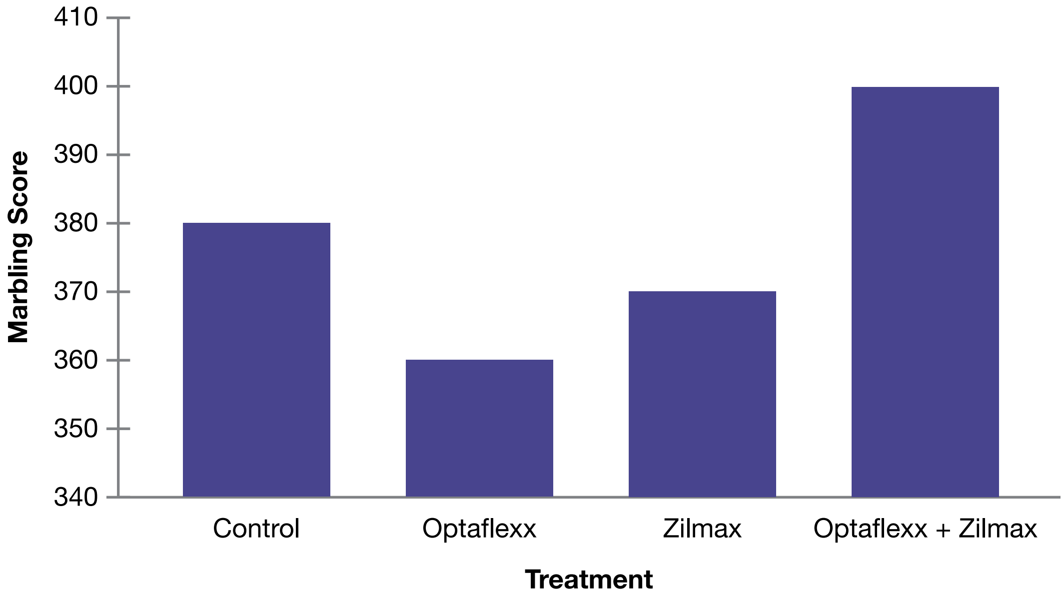

Figure 2. Marbling scores of cull cows fed β-agonists.
Marbling Score: 300 = slight00, 400 = small00, etc.

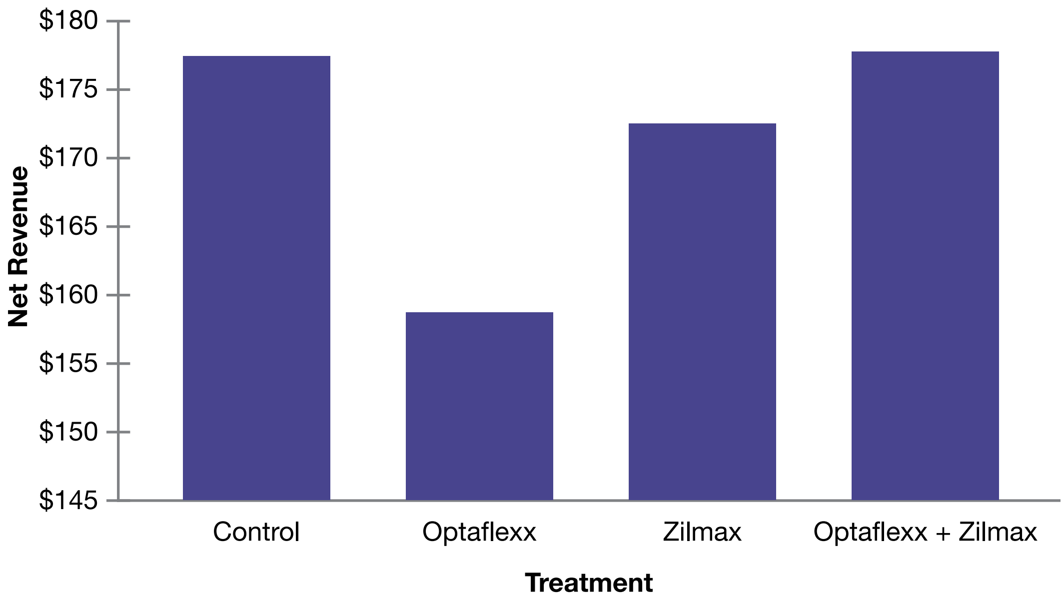

Figure 3. Net revenue.

Beef Production and Vegetation Trends from Modified Intensive-Early Stocking

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

Introduction

Beef production on western Kansas rangelands is primarily dominated by mature beef cows and their calves. To have management flexibility during years of low precipitation, producers also should include in their livestock program young stocker animals that can be marketed at any time. This enables producers to destock and restock rangelands without liquidating their main breeding herd. Intensive-early stocking (IES), a practice in which young animals are stocked at greater densities for the first half of the growing season and then are removed for the last half of the growing season, effectively utilizes early season vegetation at its highest level of nutrition. On shortgrass rangeland in western Kansas, individual animal gain during the early growing season and total-season beef production on a land area basis is similar between animals stocked at twice the season-long stocking density early (2X IES) and animals stocked season long at a normal stocking density (SLS). Also in western Kansas, when a modified IES system, which stocked at a 2X IES rate during the early season and then removed half of the animals at mid-season (2X + 1 IES), was implemented, early season animal gains were 15% lower than for SLS in 2 out of 4 years, and full-season individual animal gains were 25% lower for the 2X + 1 IES system in 3 of 4 years. It was hypothesized that maximum early season gain per animal could be retained and gain per acre could be increased by reducing the density of animals early in the season to less than the 2X IES density and then removing the heaviest animals at mid-season. Removing the heaviest animals, rather than random selection, results in a uniform set ready for placement into a feedlot. This study was performed to compare a 1.6X + 1 IES system with continuous SLS with regard to animal performance and resulting changes in vegetative characteristics.

Materials and Methods

The study site was located at the Kansas State University Agricultural Research Center–Hays. Pastures consisted mostly of loamy upland range sites with small inclusions of limy upland and loamy lowland range sites. Dominant grass vegetation included blue grama, buffalograss, sideoats grama, western wheatgrass, and Japanese brome; the key forb species was western ragweed. Angus and Angus × Hereford steers were withheld from feed and water for 6 to 12 hours and weighed. Animals were assigned to treatments and pastures and implanted with Synovex-S (Fort Dodge Animal Health, Overland Park, KS). Animals were stocked at a recommended moderate stocking rate (3.5 acre/steer) for the study pastures for the early May through early October SLS system. The IES 1.6X + 1 system stocked animals at 1.6 times the stocking density of SLS from May through mid-July (1.6X) and at a 1X rate for the remainder of the grazing season. In mid-July, animals were again held without feed or water and were weighed. The heaviest animals from each IES 1.6X + 1 pasture were removed and placed in the feedlot to achieve a 1X stocking density on rangeland for the remainder of the season. All other animals returned to pasture. Animals on pasture were then fed a 0.2 lb crude protein/steer per day supplement.

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In early October, animals were again withheld from feed or water for 6 to 12 hours and weighed. Animals were then placed directly into a feedlot. Stocking comparisons were made from 2002 to 2008. General linear models of SAS (SAS Institute Inc., Cary, NC) were used for statistical analysis of average individual animal performance and of land area productivity.

Results and Discussion

Animal Performance

Average daily gains (1.71 vs. 1.54 lb/day) and total gains per animal (128 vs. 115 lb) were different (P=0.042) between the SLS and IES 1.6X + 1 animals during the first half of the grazing season (Figure 1). No difference (P=0.67, P=0.64) was found between average daily gains (1.35 vs. 1.37 lb/day) and total gains per animal (106 vs. 107 lb) for the SLS and 1.6X + 1 systems during the last half of the season (Figure 1). Animals from the more densely stocked IES system had slightly lower gains halfway through the season and had daily gain and total gain similar to animals from SLS system during the last half of the season. Total individual animal gain (234 vs. 222 lb; Figure 2) and average daily gain (1.53 vs. 1.45 lb/day) was not different (P=0.15) between the SLS and the 1.6X + 1 system for animals on pasture the entire grazing season. Each year, total gain on a land area basis (86 vs. 69 lb/acre) was greater (P=0.008) for the IES system with greater animal densities (Figure 2). After initial costs of purchase and interest on grazing animals, return per acre was greater in 3 of 7 years for the 1.6X + 1 system (P=0.0035), equal the remaining 4 years, and averaged $11.74/acre greater across all years (Figure 3).

Animal data were also applied to historic market pricing for the 25 years prior to the start of this study, from 1977 to 2001. The 1.6X + 1 system returned an average of $6.05/acre more than the SLS system during that 25-year span. Both systems had 1 year of negative returns, and the 1.6X + 1 system had a greater return than the SLS system in 22 of 25 years. Returns per acre ranged from -$3.65 to $58.82 for the SLS system and from -$9.19 to $76.74 for the 1.6X + 1 system during those 25 years.

Animals from the modified 1.6X + 1 system had lower gains during the early season than animals from the SLS system. Animals from double-stocked IES systems have historically had early season gains similar to those of animals from SLS, so the results in the early season gains from the 1.6X + 1 system were somewhat unexpected. Further, animals from the 1.6X + 1 system that remained on pasture season long had total-season gain similar to animals from the SLS system. In a previous trial at this location, late-season gains were 25% lower in 3 of 4 years for a 2X + 1 system than for an SLS system. Therefore, lowering the density early in the season to a 1.6X rate allowed enough quantity and quality of forage late in the season for animals to maintain expected individual performance. Total gain per acre increased for the 1.6X + 1 system as a result of the greater early stocking density. Years in which the 1.6X + 1 system did not return more dollars than the SLS system were a matter of start and mid-season market price relationships rather than animal performance.

Vegetation Trends

Vegetation trends were analyzed from this experiment from fall 2001 to fall 2008. Western wheatgrass, blue grama, and sideoats grama composition changes have not differed between the 1.6X + 1 and SLS systems. In a previous trial, western wheatgrass composition was reduced and other botanical shifts occurred with annual use of a modified 2X + 1 system. End-of-season standing dry matter has been similar in the 1.6X + 1 and SLS treatments (Figure 4), and annual changes in end-of-season vegetation proportions of the two systems have paralleled each other because of yearly differences in precipitation (Figures 5, 6, 7). Buffalograss increased in both grazing systems but increased at a slightly greater rate (0.6% annually) in the 1.6X + 1 system than in the SLS system (Figure 8). This was the only vegetative component found to have any statistical significance between the two systems. It was hypothesized that less desirable vegetation would eventually increase and dominate from annual use of the 1.6X + 1 system because of the greater total-season stocking rate. These changes did not occur but may eventually take place with many more consecutive years of implementing the 1.6X + 1 system on the same pasture. Little evidence exists so far that the 1.6X + 1 system is altering vegetation; thus, it may be a useful stocking strategy to implement during short-term, consecutive seasons. The 1.6X + 1 system also could be used in a rotation of years with other systems stocked at a moderate rate but has yet to be analyzed in western Kansas when used in this manner. It is not known how long western rangelands can support annual use of this practice without any adverse effects. After 7 years, adverse vegetation effects are not yet evident.

Implications

Animal production on a per-acre basis was greater in the modified IES 1.6X + 1 system than in the SLS system, and season-long individual animal performance was maintained in both systems. The modified 1.6X + 1 system also had greater dollar value return per acre compared with the SLS system. Major vegetation component trends were not different between the two systems after 7 years. The 1.6X + 1 system would be an acceptable alternative to SLS during a short number of consecutive years on western Kansas native rangelands.

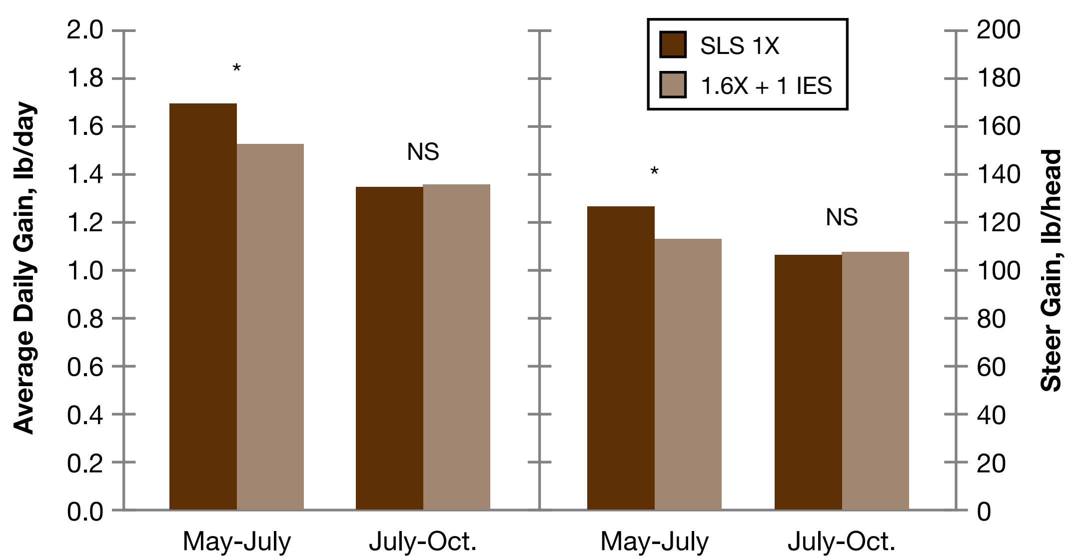

Figure 1. Early and late-season individual animal performance from continuous season-long stocking (SLS) and 1.6X + 1 intensive-early stocking (IES) systems.
NS = not significant. * = significant at $P<0.05$.

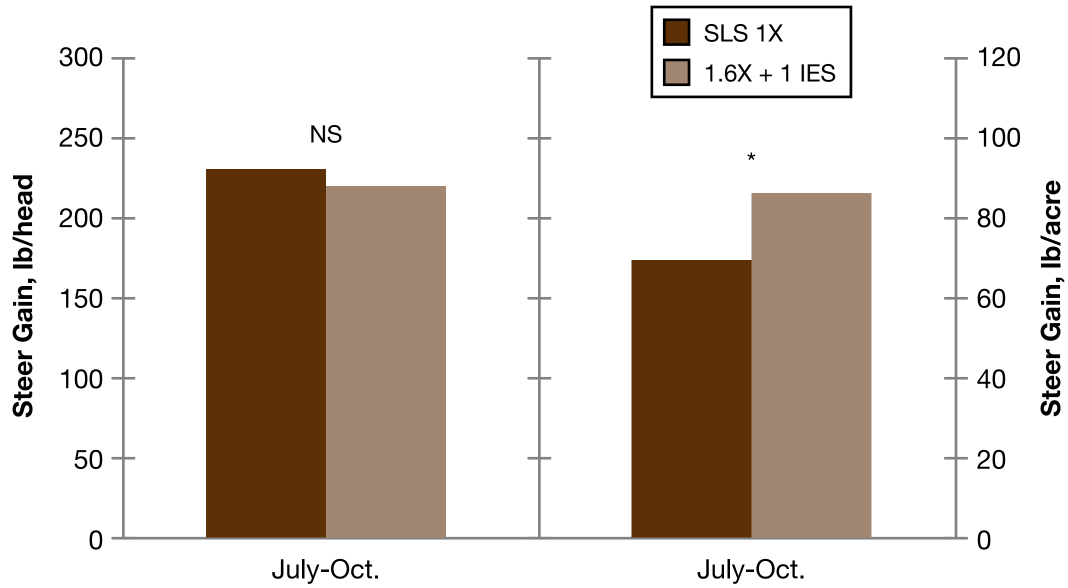

Figure 2. Full-season individual animal gain and total steer gain from a continuous season-long stocking (SLS) system and cattle remaining on pasture from a 1.6X + 1 intensive-early stocking (IES) system.
NS = not significant. * = significant at P<0.05.

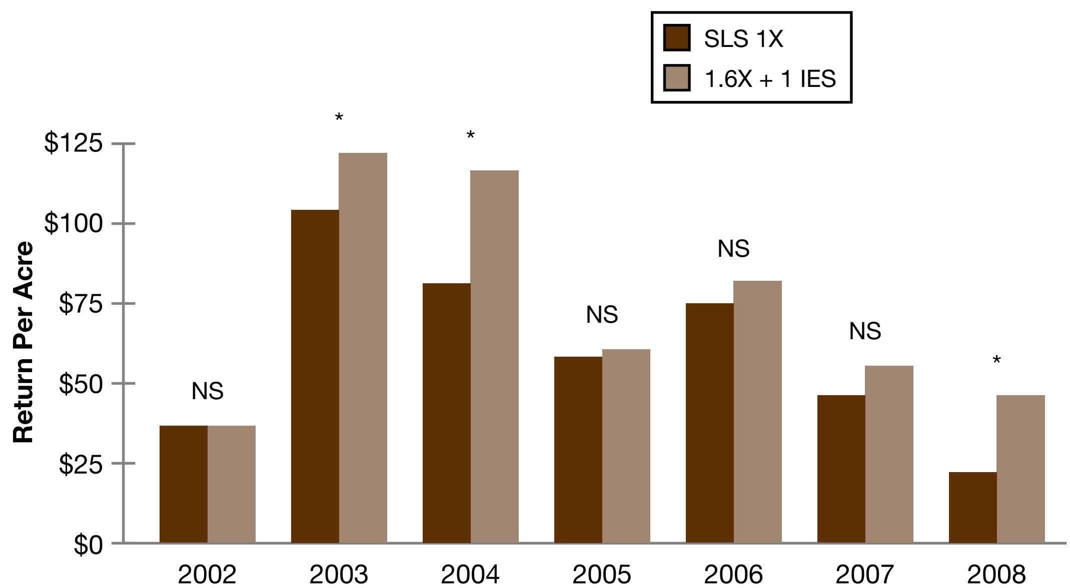

Figure 3. Net return per acre after purchase and interest costs of animals from a continuous season-long stocking (SLS) system and a 1.6X + 1 intensive-early stocking (IES) system.
NS = not significant. * = significant at P<0.05.

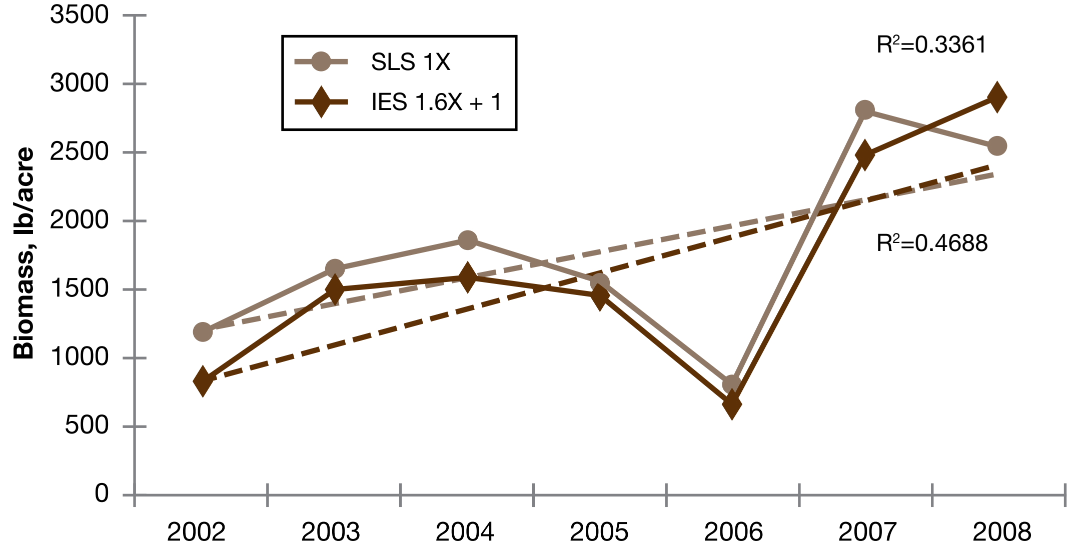

Figure 4. End-of-season biomass from a continuous season-long stocking (SLS) system and a 1.6X + 1 intensive-early stocking (IES) system.
No statistical difference was found in biomass trend between stocking systems over years.

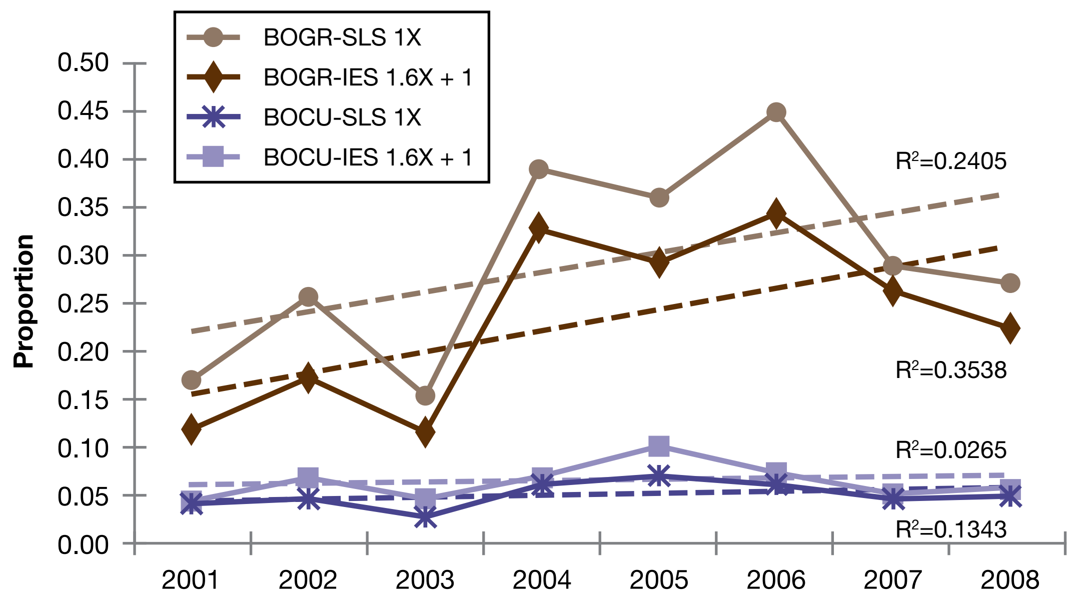

Figure 5. Blue grama (BOGR) and sideoats grama (BOCU) composition in a continuous season-long stocking (SLS) system and a 1.6X + 1 intensive-early stocking (IES) system.
No statistical difference was found in BOGR or BOCU proportion trends between stocking systems over years.

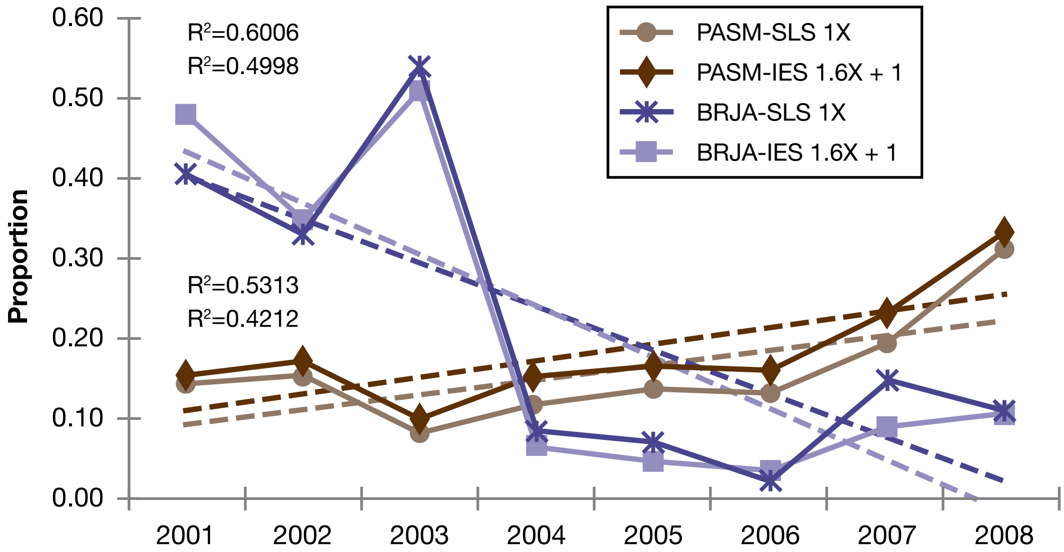

Figure 6. Western wheatgrass (PASM) and Japanese brome (BRJA) composition a continuous season-long stocking (SLS) system and a 1.6X + 1 intensive-early stocking (IES) system.
No statistical difference was found in PASM or BRJA proportion trends between stocking systems over years.

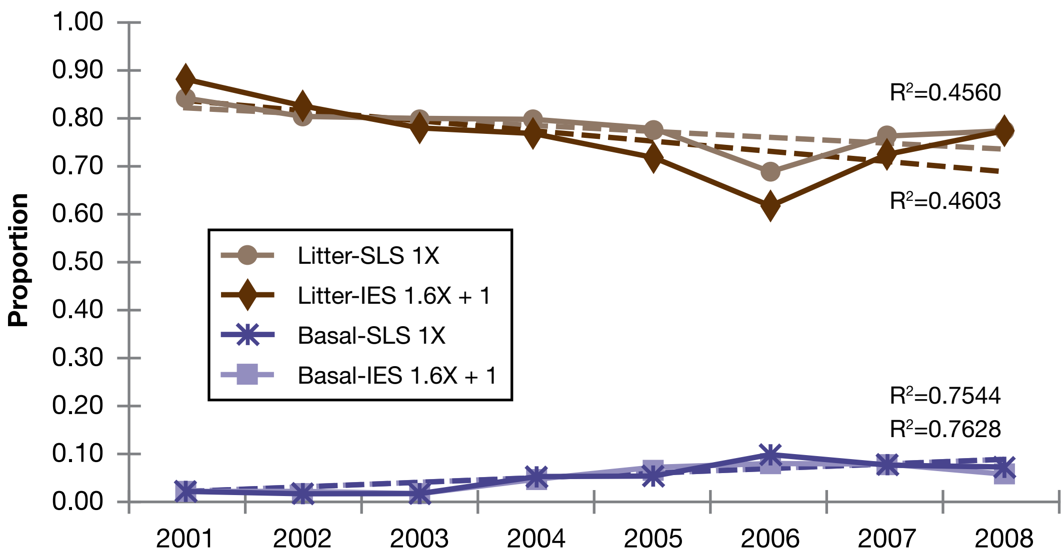

Figure 7. End-of-season litter cover and basal cover from a continuous season-long stocking (SLS) system and a 1.6X + 1 intensive-early stocking (IES) system.
No statistical difference was found in litter cover or basal cover trends between stocking systems over years.

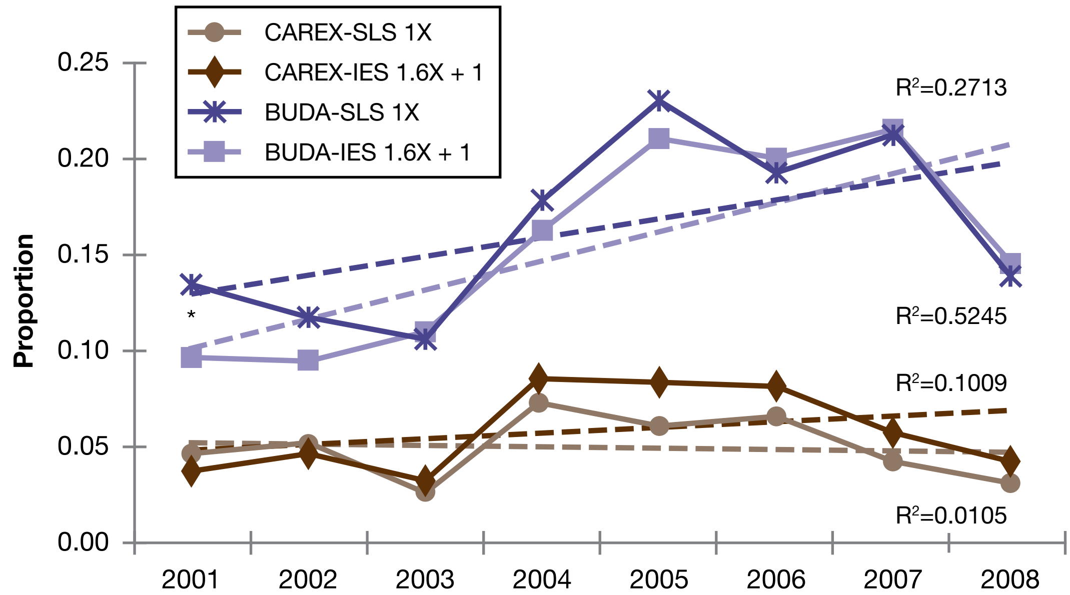

Figure 8. Buffalograss (BUDA) and sedge (CAREX) composition in a continuous season-long stocking (SLS) system and a 1.6X + 1 intensive-early stocking (IES) system.
No statistical difference was found in CAREX proportion trend between stocking systems over years. BUDA trend was statistically different at $P<0.05$ between stocking systems over years.

Glyphosate Application Rate and Timing to Control Old World Bluestems

K. R. Harmoney[1] and P. W. Stahlman[1]

Introduction

Caucasian and yellow old world bluestems (OWB; *Bothriochloa* spp.), found in portions of Asia and Australia have been widely introduced in the Great Plains as warm-season perennial grasses for conservation and forage for hay or grazing. These OWB are escaping into native rangelands, may remain or increase in native stands indefinitely, and have unknown effects on growth, reproduction, and utilization of native grasses when grown together. Old world bluestem seedlings produce more growth than many native grass species and are highly competitive with some native grasses in greenhouse environments. But cattle gains have been lower for animals grazing OWB than for animals grazing native species in trials in central Kansas. Old world bluestems are useful for conservation and hay production, yet they threaten native grassland ecosystems. Attempts have been made to control established OWB in pasture settings with varied success. Glyphosate has been the most cost-effective form of herbicide control in trials thus far.

Materials and Methods

This study investigated how well different glyphosate application rates and timings reduced or controlled Caucasian OWB vegetation in 2006 and 2008. Twelve treatments were applied and analyzed for visual percentage controlled, surviving plant frequency, dry matter production, and seed head production. Treatments included glyphosate with ammonium sulfate applied early at a five-leaf stage of growth with 1, 2, or 3 lb/acre glyphosate; an early application of 1, 2, or 3 lb/acre glyphosate followed by a second sequential application 8 weeks later of either 1 or 2 lb/acre glyphosate; and a late-only application of 1, 2, or 3 lb/acre glyphosate. General linear models of SAS (SAS Institute Inc., Cary, NC) were used for statistical analysis of visual control, plant frequency, seed head density, and dry matter production.

Results and Discussion

Old world bluestem treated only once with 1, 2, or 3 lb/acre glyphosate either early or late still had more than 50% plant frequency at the end of the growing season (Table 1). Sequential applications for which at least one of the early or late glyphosate applications was 2 lb/acre or more resulted in plant frequencies of less than 20% and were the only treatments that produced fewer than 1000 lb/acre dry matter through the season (Table 1). Untreated plots produced more than 4,000 lb/acre dry matter. Plant frequency was directly related to dry matter yield, and plots with greater OWB control had lower plant frequency and lower OWB yield (Figure 1). Plots sprayed with 1 or 2 lb/acre glyphosate early had enough OWB survive that stands produced more than 20 seed heads/ft^2 (Table 1); thus, a significant seed source remained even after treatment.

A single application of up to 3 lb/acre glyphosate either early or late in the season does not appear to be an effective method to control OWB. However, sequential applications

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of glyphosate have been effective at reducing OWB plant frequency, dry matter production, and seed head production. In a previous study, sequential application with 1 lb/acre glyphosate early and late resulted in 12% frequency of OWB and was more effective than sequential application with other herbicides. Other rates of glyphosate were not tried in that experiment. In the current trial, all other sequential application glyphosate treatments resulted in lower plant frequency than the 1 lb/acre glyphosate early and late sequential application treatment. Applications in 2006 were on very dry vegetation and soils, which were more detrimental to plant growth and resulting herbicide uptake and effectiveness than conditions in 2008. Thus far, sequential application of glyphosate appears to be the most effective treatment to control OWB, and the sequential application should include one treatment either early or late of 2 or 3 lb/acre glyphosate for best control, especially during dry years (Table 1).

Summary

A sequential herbicide application in which either the early or late application is 2 or 3 lb/acre glyphosate appears to control OWB as well as other sequential application combinations. During dry years, increased rates may be necessary to account for OWB plants' reduced ability to uptake herbicide. A single glyphosate application is not sufficient to control Caucasian OWB. A second year of treatment is likely necessary for stands that receive only a single application during a growing season.

Table 1. Frequency, dry matter production, seed head density, and visual control of old world bluestem (OWB) stands at the end of the growing season following different rates and timings of glyphosate application

Treatment[1]	OWB frequency (%)	Dry matter production (lb/a)	Seed head density (heads/ft^2)	Visual control (%)
Control/no chemical	96.6[a]	4215[a]	76.4[a]	0.0[h]
1 lb early	87.8[ab]	3466[ab]	62.3[b]	21.6[g]
1 lb late	80.4[bc]	3336[b]	5.3[d]	72.2[e]
2 lb early	72.0[c]	2640[bc]	21.9[c]	65.3[f]
2 lb late	66.8[cd]	2457[cd]	1.9[d]	83.4[d]
3 lb early	56.2[d]	1730[de]	6.5[d]	74.1[e]
3 lb late	55.8[d]	2322[cd]	2.3[d]	87.1[cd]
1 lb early/1 lb late	32.7[e]	1039[ef]	1.3[d]	90.7[bc]
2 lb early/1 lb late	17.9[f]	469[f]	0.1[d]	95.3[ab]
3 lb early/1 lb late	7.4[gf]	516[f]	0.0[d]	98.3[a]
1 lb early/2 lb late	10.9[gf]	827[f]	0.1[d]	96.7[ab]
2 lb early/2 lb late	4.9[gf]	678[f]	0.2[d]	97.4[a]
3 lb early/2 lb late	3.0[g]	771[f]	0.0[d]	98.6[a]

[1] Treatments in lb/acre glyphosate.
[abcdefgh] Within a column, values without a common superscript differ ($P<0.05$)

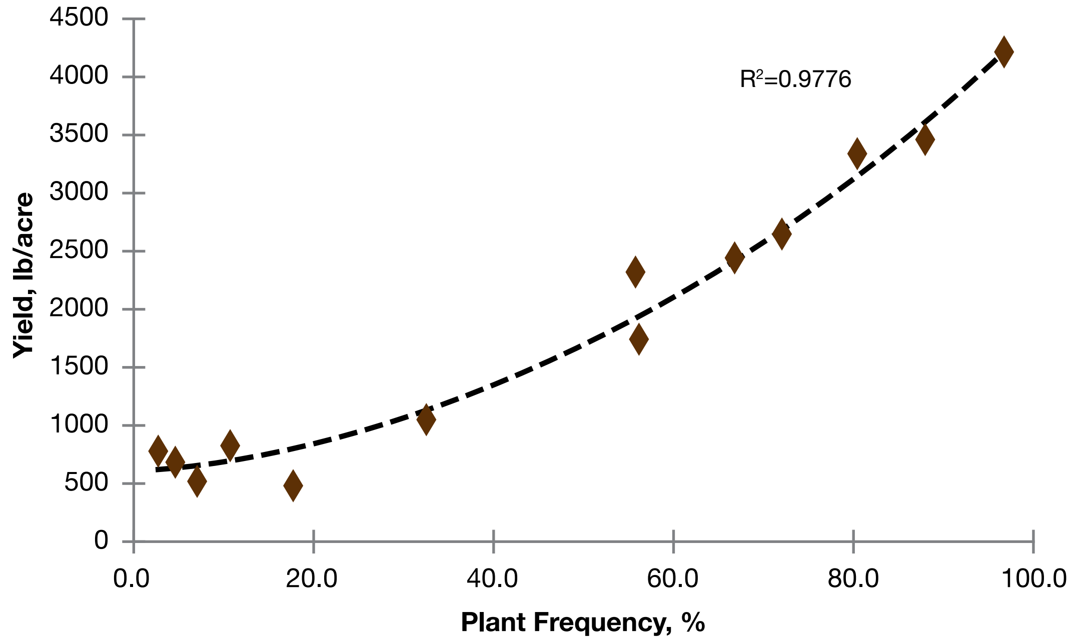

Figure 1. Caucasian old world bluestem plant frequency and resulting dry matter yield at the end of the growing season following different glyphosate application rates and timings.

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