ROUNDUP 2002

Agricultural Research Center—Hays

Report of Progress 891
Kansas State University Agricultural Research Center and Cooperative Extension Service

ROUNDUP 2002

KAES Report of Progress 891

April 2002

Agricultural Research Center–Hays
1232 240th Avenue
Hays, KS 67601-9228

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. The members of this team are:

Jeremy Carder, Harvey Jansonius
Wayne Schmidtberger, Tony Krizek
Matt Woydziak

Report compilation and layout by Diana Dible.

Contributors

Many have contributed to our research activities. We especially acknowledge the following, who have provided grants or have donated products.

Bayer Corp.	**Shawnee Mission, KS**
Elanco Products Co.	**Indianapolis, IN**
Finn Feeds	**Helsinki, Finland**
Fort Dodge Animal Health	**Overland Park, KS**
Green Gardens Angus	**Ellsworth, KS**
Hoechst Roussel	**Somerville, NJ**
Losey Land and Cattle	**Agra, KS**
Moly Manufacturing	**Lorraine, KS**
Oakley Veterinary Service	**Oakley, KS**
Pfizer Animal Health	**Pittsburgh, PA**
Pharmacia Animal Health	**Kalamazoo, MI**
Premier Chemicals	**King of Prussia, PA**
Rhone Merieux, Inc.	**Athens, GA**
Schering-Plough Animal Health	**Madison, NJ**
Sharp Brothers Seed Co.	**Healy, KS**
Jim Scott	**Shawnee Mission, KS**
Zinpro Corporation	**Bloomington, MN**

Note: Trade names are used to identify products. No endorsement is intended, nor is any criticism implied of similar products not mentioned.

Statement of Purpose

Roundup is the major beef cattle educational event sponsored by the Agricultural Research Center–Hays. The 2002 program is the 89th staging of Roundup. The purpose is to communicate timely 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.

Front Cover: *Five steers raised and fed at KSU Ag Research Center–Hays and entered in the 2001 Beef Empire Days Carcass Show. All five placed in the top 20 (1st, 6th, 10th, 11th and 19th). Four are by Angus sires. The steer with horns is 50% Wagyu.*

KAES Contribution No. 02-336-S

Table of Contents

Effect of a 7-day, Pre-harvest 40-g Betaine Regimen on Dressing Percent of Feedlot Steers

John R. Brethour, Brittany Bock, and Rick Goodall
Beef Cattle Scientist, KSU Ag Research Center–Hays;
Assistant Professor, Fort Hays State University;
and Technical Services, Gladwin A. Read Company, Elgin, IL

Introduction

Cattle feeders become more conscious of dressing percent when grade and yield marketing is practiced because payment is based on carcass, rather than live weight. Consequently, any practice that increases dressing percent and increases carcass weight would benefit producers.

Betaine is an amino acid metabolite (tri-methyl glycine) that has several physiological functions, one of which is to help maintain cell turgidity (osmolyte). This function might improve cellular water retention during the stress incurred during transporting animals for harvest.

Materials and Methods

We conducted a series of 11 experiments to evaluate the effects of betaine on the dressing percent of steers. Cattle were divided into two groups seven days before slaughter so that the groups were equal in average weight and average ultrasound measures for backfat and marbling. A single unshrunk weight was taken at that time in the first five experiments, but two weights taken a day apart were averaged in the final six tests. Dressing percent was calculated by dividing the hot carcass weight (adjusted for visual estimates of trim) by the initial weights shrunk four percent.

The ration was primarily finely rolled milo, with sorghum silage, soybean meal, urea, and ammonium sulfate. No phosphorus or potassium supplements were used, but cattle were fed 100 g calcium carbonate and 25 g sodium chloride each day as well as a trace mineral premix that provided zinc, copper manganese, iron, iodine and cobalt. Rumensin, Tylan, and Vitamin A were also fed. Forty grams betaine was added to steer diets one week before slaughter.

In these experiments, steers were mostly Angus, Simmental, and Limousin crossbreds purchased from local auction markets. There were no Brahman or dairy type cattle in these experiments. Within each replication cattle were similar and composition is noted in the summary table. A total of 565 cattle were used in this project and averaged 51 head in each replication.

The first step in the statistical analysis was to correct for extraneous variables using a model that included initial weight, carcass backfat and marbling. Then a non-parametric procedure (Hodges Lehman) was used to estimate the best average for each experimental group. These averages were then subjected to a classical analysis of variance to test the hypothesis of a response to betaine.

Results

Dressing percent is presented in Table 1. In the first experiment, betaine improved dressing percent by more than 1.6 points; however responses in subsequent trials were less than 0.6 percentage points. Some of the trials were delayed until the summer of 2001 to determine if heat stress might provoke a betaine response, but no such response was apparent. In 10 of 11 experiments, steers fed betaine had higher average dressing percents, although the difference was negligible in several replications. When the entire study was combined and analyzed, the weighted average response was 0.34, which was statistically significant ($p < .05$). This is equivalent to 4.4 pounds more carcass weight on a 1300-pound animal.

Conclusions

These results indicate that betaine likely increases dressing percent in cattle. However, additional research should be conducted to identify those situations when an economical response will occur. *

*If Betaine cost is $1.50/hd for the 7-day feeding or 40 g/head/day, and carcass price per pound=$1.00, net back to producer based on these experiments would be $2.90/hd.

This research was supported in part by financial assistance from Finn Feeds, Helsinki, Finland.

Table 1. Effect of a 7-day, pre-harvest 40-g betaine regimen on dressing percent of feedlot steers.

Replication	Number/pen	Date	Cattle Type	Control	Betaine	Response
1	20	Nov 1, 2000	Mixed Angus	63.87	65.48	1.62
2	24	Nov 21, 2000	Mixed Angus	64.41	64.44	0.03
3	15	Dec 7, 2000	Mostly Angus	65.64	65.39	-0.25
4	41	June 20, 2001	Mixed Exotic	62.91	63.33	0.42
5	37	June 20, 2001	Mostly Angus	62.95	63.43	0.49
6	38	Aug 1, 2001	Mostly Angus	63.61	63.84	0.24
7	21	Aug 1, 2001	Angus & Limousin	66.41	66.86	0.46
8	8	Aug 1, 2001	Maine Anjou	65.22	65.78	0.56
9	30	Aug 1, 2001	Mixed Breeds	63.12	63.38	0.26
10	24	Aug 1, 2001	Mixed Breeds	63.44	63.45	0.01
11	27	Aug 1, 2001	Mixed Exotic	63.37	63.47	0.10
Weighted Average				63.78	64.12	0.34

Evaluation of Sources and Levels of Zinc for Finishing Steers

Brittany J. Bock, John R. Brethour, Connie K. Swenson, and A. Bruce Johnson
Assistant Professor, Fort Hays State University;
Beef Cattle Scientist, KSU Ag Research Center–Hays;
Research Nutritionist, and Director of Research, Zinpro Corporation, Inc.

Introduction

Organic minerals are more biologically available to cattle than inorganic forms, often resulting in improved animal performance. Previous research has shown improvements in gain and carcass characteristics with organic minerals over inorganic forms. The organic minerals zinc methionine (ZINPRO®) and zinc amino acid complex (Availa®-Zn) have consistently improved animal performance in finishing steers. Zinc is an essential nutrient in animal diets and is particularly important in feedlot diets due to the naturally low level of zinc commonly found in feed ingredients. Also, relatively high levels of calcium are frequently included in these diets and this may interfere with zinc utilization. This trial was conducted to investigate effects on finishing and carcass performance from feeding different combinations of zinc methionine, zinc amino acid complex and zinc sulfate ($ZnSO_4$, inorganic) at two levels (90 and 120 ppm).

Materials and Methods

Crossbred yearling steers (459 head, average initial weight = 856 lbs) were weighed and backfat and marbling measured with ultrasound prior to the start of the trial on August 20, 2001. They were purchased locally and did not contain either Brahman or dairy influence. Steers were then sorted by source, weight, backfat thickness and marbling score into seven treatment groups. Within each treatment group, three replications of each treatment were created based on optimal days on feed, predicted from initial weights and ultrasound information. Replications 1, 2, and 3 were fed 100, 136 and 155 days and contained 77, 172, and 210 head, respectively, for each treatment, respectively. Steers were implanted with Synovex® on day one of the trial and reimplanted with Synovex® Plus™ approximately 50 days before harvest date.

The diet consisted primarily of finely rolled dry milo, and included sorghum silage, soybean meal, urea and ammonium sulfate. The diet also included 100 g calcium carbonate, 25 g sodium chloride, 300 mg Rumensin, 90 mg Tylan, 30,000 IU Vitamin A per head per day, and a trace mineral premix that provided copper (125 mg/hd/d), manganese (209 mg/hd/d), iron (261 mg/hd/d), iodine (5.2 mg/hd/d) and cobalt (2.6 mg/hd/d). Separate premixes were mixed and fed at 50 g/hd/d to impose the different zinc treatments. The treatments, listing the source of zinc and level of zinc in the final diet, were:

1. Negative control - no added zinc, relying only on that in the natural ingredients
2. Positive control - 60 ppm Zn from $ZnSO_4$
3. Positive control plus 30 ppm Zn from $ZnSO_4$ – total 90 ppm
4. Positive control plus 30 ppm Zn from ZINPRO® – total 90 ppm
5. Positive control plus 30 ppm Zn from Availa®-Zn – total 90 ppm
6. Positive control plus 60 ppm Zn from $ZnSO_4$ – total 120 ppm
7. Positive control plus 60 ppm Zn from Availa®-Zn – total 120 ppm

The data was analyzed using nonparametric procedures to determine potential treatment effects on average daily gain, dressing percent, backfat, marbling, and percent USDA Choice after adjusting the data for initial differences in weight, backfat, marbling and source of cattle. Four animals from Rep 2 were harvested with Rep 1 and four animals from Rep 3 were harvested with Rep 2 to avoid overweight discounts. Data were averaged by pen, after adjustment for differences in number of head.

Results and Conclusions

There were no statistical differences among zinc treatments for average daily gain, dressing percent, backfat, marbling or percent Choice (Table 1). The cattle did gain exceptionally well and apparently were obtaining sufficient zinc from the basal ingredients of milo, 37 ppm (range 12 to 83, n = 5), sorghum silage, 18.3 ppm (range 15 to 23, n = 5) and soybean meal, 75 ppm (range 58 to 122, n = 5). However, zinc is known to interact with several other minerals, such as calcium as previously mentioned, and copper. It is possible that other minerals were not at high enough levels to demonstrate positive treatment effects from the zinc levels fed.

This research was supported in part by financial assistance from Zinpro Corp, Eden Prairie, MN.

Table 1. Effect of zinc source and level on finishing steer performance.

Zinc Source	None	$ZnSO_4$	$ZnSO_4$	$ZnSO_4$ +Zinpro	$ZnSO_4$ +Availa-Zn	$ZnSO_4$	$ZnSO_4$ +Availa-Zn
Zinc Level, ppm		60	60 + 30	60 + 30	60 + 30	60 + 60	60 + 60
Number of head	65	65	64	64	64	65	66
Initial weight, lbs.	850	851	856	854	859	853	856
Adj. final weight, lbs.	1399	1385	1392	1391	1387	1389	1380
ADG, lbs	4.01	3.99	4.20	4.06	3.97	4.03	3.96
Dressing %	66.45	66.58	66.58	66.60	66.71	66.87	66.56
Backfat, inches	.37	.35	.36	.37	.38	.38	.36
Marbling[b]	5.14	5.27	5.11	4.96	5.13	5.36	5.11
USDA Choice, %	47.07	59.44	59.23	44.83	57.26	65.97	53.03

[a] Hot carcass weight/0.64
[b] 5.0 = low choice or minimum small

Evaluation of a 50% Dose of Ivomectin in a Steer Feeding Program

John R. Brethour
Beef Cattle Scientist

Introduction

Ivomectin is widely used in both feedlot and range cattle to control internal parasites. This experiment was conducted to evaluate contentions that the recommended dose of 1 cc per hundred pounds body weight could be reduced by half, and to investigate whether the product might improve carcass quality grade[1].

Materials and Methods

Three replications with about 20 steers per pen (176 total head) were used in this experiment. Replications 1 and 2 were comprised of steers from the same source but blocked so that those that would be ready for harvest first (based on weight and ultrasound backfat) were in Rep 1 and the others in Rep 2. The steers in Rep 2 were from a different location but, both sets of cattle originated in the Hays area. They were mixed exotic and British crossbreds with no Brahman or dairy representation.

Cattle were divided into groups based on weight and ultrasound measures, and similar groups received one of three rates of Ivomec Plus (Meterial Ltd, Iselin, NJ) – 0, .5 cc, and 1.0 cc per hundred pounds body weight – injected subcutaneously in the neck. (Ivomec Plus contains 1% ivomectin and 10% ciorsulon.) Cattle were weighed as they were being dosed in order to assure accurate dosage. All cattle were fed a high-energy finishing ration comprised primarily of dry-rolled corn and milo. Reps 1, 2, and 3 continued 60, 86, and 97 days, respectively, until harvest.

Results and Conclusions

The data collected in this experiment are presented in Table 1. There were no significant differences among the treatments for any of the criteria observed. However, there were numerical improvements in average daily gain when the full dose of ivomectrin was given. This was especially apparent in the Reps 2 and 3. It is possible that the selection of the largest and fattest cattle for Rep 1 resulted in testing of those animals least likely to have a parasite infestation.

The animals used in this experiment had been brought to the research center about seven weeks before the experiment started and were on full feed by that time. Possibly, a response to parasite control is more likely to occur during the initial period of the finishing phase.

There was no improvement in carcass quality grade when ivomectrin was used. In this study initial marbling estimates with ultrasound added precision to evaluation of carcass quality grade.

[1] Ivomec Plus (ivomectin) for this experiment was provided by Oakley Veterinary Service, Dr. Wade Taylor, Oakley, KS.

Table 1. Effect of a half or full dose of ivomectin on performance and carcass quality of feedlot steers.

Item	Ivomec Plus dose[1]		
Rep 1 - 70 days	None	0.5 cc/cwt	1.0 cc/cwt
Number of Head	20	20	19
Average initial weight	1141.3	1153.2	1128.3
Average final weight	1405.2	1400.4	1389.3
Average daily gain	3.77	3.54	3.73
Average dressing percent	63.83	64.26	64.88
Average backfat, in	0.49	0.50	0.50
Average marbling score	5.72	5.75	5.71
Percent Choice	100.00%	95.00%	89.47%
Percent YG 1 & 2	25.00%	20.00%	31.58%
Rep 2 - 86 days			
Number of Head	19	20	18
Average initial weight	1041.4	1044	1055.9
Average final weight	1342.9	1358.9	1376.2
Average daily gain	3.51	3.66	3.72
Average dressing percent	63.2	64.45	64.12
Average backfat, in	0.38	0.41	0.39
Average marbling score	5.41	5.26	5.33
Percent Choice	84.21%	75.00%	83.33%
Percent YG 1 & 2	57.89%	55.00%	61.11%
Rep 3 - 97 days			
Number of Head	20	21	19
Average initial weight	990.6	1002.4	1007.9
Average final weight	1325.9	1307.8	1354.8
Average daily gain	3.46	3.15	3.62
Average dressing percent	64.25	63.22	64.15
Average backfat, in	0.47	0.46	0.46
Average marbling score	5.1	5.04	5.38
Percent Choice	60.00%	71.43%	84.21%
Percent YG 1 & 2	30.00%	23.81%	31.58%
Combined data			
Number of Head	59	61	56
Average initial weight	1057.7	1066.5	1064
Average final weight	1358	1355.7	1373.4
Average daily gain	3.58	3.45	3.69
Average DM intake	26.91	26.75	27.26
Lb DM per lb gain	7.52	7.78	7.39
Average dressing percent	63.76	63.98	64.38
Average backfat, in	0.45	0.46	0.45
Average marbling score	5.41	5.35	5.47
Percent Choice	81.40%	80.48%	85.67%
Percent YG 1 & 2	37.63%	32.94%	41.42%

[1] Meterial Ltd., Iselin, NJ

Comparison of Wagyu- and Angus-Sired Steers

John R. Brethour, Sandy K. Johnson, and Keith R. Harmoney
Beef Cattle Scientist, Livestock Extension Specialist, and Range Scientist

In recent years there has been much interest in improving carcass merit of cattle and capturing the premiums for animals that grade USDA Choice and Prime. The Wagyu breed from Japan possibly has the most profound marbling genetics of any breed in the world. The Japanese grading system has three levels above USDA High Prime and some carcasses contain over 40% intramuscular fat compared to about 10% in Prime carcasses.

This study summarizes an opportunity to compare both performance and carcass merit of calves from Angus and Wagyu sires. Semen of both breeds was available to use on the research center cow herd. Those cows were crossbreds and about 50% Angus with some Simmental, Limousin and South Devon. Attempts were made to randomize semen breed among the cows; however, some heifers were bred to Waygu but not to the corresponding Angus bulls.

Table 1 summarizes the performance of steers fed-out in this study. Birth weights of the Wagyu averaged 15 pounds less than the Angus calves but no correction was made for age of dam. The Wagyu calves were especially vigorous at birth and rose to suckle quickly. There was little or no calving difficulty with either sire breed.

Weaning weights (unadjusted) averaged 56 pounds less for the Wagyu calves, even though they were 11 days older. But differences in growth between the two breeds were more pronounced after weaning and there was a difference of 135 pounds in interpolated yearling weights.

Cattle were sorted for marketing so that backfat would average 0.4 inch and that carcass weights would not exceed 950 pounds. However, some Wagyu steers did not attain those specifications and were sold September 6. This partially accounts for the lower (better) Yield grades among the Wagyu. However, ribeye area among the Wagyu was about the same as that of the Angus and larger if expressed as square inches per 100 pounds body weight. This is surprising because visual assessment made from behind the animal and evaluating the rounds leaves the impression that they are poorly muscled cattle.

Carcass quality grade among the Wagyu steers was disappointing and did not approach the proportion of Premium Choice (average and high choice) and Prime observed among the Angus steers. It is likely that a calf-feeding program is inappropriate with Waygu cattle and that a deferred program that results in harvest at an older age is necessary to attain high quality grades.

Perhaps the most disappointing feature of the Wagyu-sired cattle was that carcass weight per day of age averaged only 1.54 pounds compared to 1.75 pounds for the Angus-sired, even though both sets of calves were managed and fed the same. However, using only one sire to evaluate a breed does not allow for definitive conclusions.

Table 1. Comparison of Angus- and Wagyu-sired steers.

Number of head	24 Wagyu	47 Angus
Average birth date	Feb 7	Feb 18
Average age of dam	4 yr	6 Yr
Average % Angus in dam	47.40%	48.70%
Average birth weight	76.4	91.5
Average weaning weight	520	576
Average yearling weight	863	998
Average weight at harvest	1239	1335
Average age at harvest	508	474
Average carcass weight	776	830
Carcass weight per day of age	1.54	1.75
Average marbling score	5.37	6.18
Average backfat, in.	0.37	0.46
Average REA, sq. in.	13.8	14.1
Carcass yield grade, %		
YG#1	29.17%	4.26%
YG#2	58.33%	46.81%
YG#3	12.50%	46.81%
YG#4		2.13%
Carcass quality grade, %		
Prime		12.77%
CAB	50.00%	55.32%
Choice	20.83%	29.79%
Select	29.17%	2.13%

Seasonal Forage Quality of Rangelands Across Kansas

K. Harmoney, S. Johnson, R. Cochran, E. Vanzant, T. Jones, J. Wilson, D. Yauk, M. Ploger, G. McClure, M. Holder, B. Allen, W. Bell, and H. Jansonius

Range Scientist; Extension Livestock Specialist; Ruminant Nutritionist; Ruminant Nutritionist, University of Kentucky; Wallace County Extension Agent; Hamilton County Extension Agent; Clark County Extension Agent; Edwards County Extension Agent; Clay County Extension Agent; Chase County Extension Agent; Chautauqua County Extension Agent; Coffey County Extension Agent; and Agricultural Technician

Summary

The K-State Research and Extension Forage Task Force surveyed Kansas rangelands during the course of seasonal changes to enable producers and managers to better estimate the feed value of their pasture forage during particular times of the year. Kansas' two distinct rangeland vegetation types, shortgrass and tallgrass prairie, were evaluated. Forage samples were collected monthly from two rangeland sites in each of 10 Kansas counties. Tallgrass vegetation was lowest in acid detergent fiber (ADF) and greatest in crude protein (CP) from May to July, and rapidly increased in ADF and declined in CP the rest of the season. Shortgrass vegetation was also lower in ADF and greater in CP from May to July, but changed less from early summer to winter than did tallgrass vegetation. Degradable intake protein (DIP) was greatest for tallgrass vegetation in May, otherwise DIP was similar between tallgrass and shortgrass except in February and March when shortgrass had greater DIP. DIP was greatest in May and June for both vegetation types and gradually declined from June to December. Undegradable intake protein (UIP) values were greater for tallgrass vegetation than for shortgrass vegetation May through July, but all other months were similar. Seasonal forage quality is different between and within rangeland vegetation types, and identification of dominant vegetation is a key determinant in choosing appropriate animal nutritional management strategies.

Introduction

Forage quality is the predominant plant factor that determines the potential for animal growth and production on grazing lands. Forage samples from chopped and baled feeds are commonly collected for quality analysis by producers. However, producers rarely sample pastures to determine the quality of rangeland forage available for grazing animal consumption during different periods of the year, even though Kansas' land area consists of approximately 35% rangelands, or about 18 million acres. This information is critical to identify periods when pasture forages are not meeting animal requirements.

Shortgrass prairie and cow/calf systems dominate western rangelands of lower precipitation, while tallgrass prairie and stocker animal production dominates eastern rangelands with greater precipitation. However, many counties in central Kansas have mixed-grass vegetation, and both shortgrass and tallgrass dominated rangelands can be found.

Each vegetation type may respond differently to seasonal climatic conditions. Knowing the seasonal changes for vegetation within regions would aid County Extension Agents, consultants, and producers by providing dependable information to make more educated decisions on animal management during particular periods of the year.

Materials and Methods

Samples were collected monthly by County Agents during the growing season and bi-monthly during the dormant season from May of 1997 to October of 1999 from native rangelands at two cooperating producer rangeland locations in each of ten Kansas counties. Prearranged dates of clipping were determined so that samples from all counties would be collected on the same date. Counties included were Hamilton and Wallace from the west, Clark, Ellis, and Edwards from the central, and Chase, Chautauqua, Clay, Coffey, and Riley from the north and eastern Kansas. Vegetation consisted of mostly short grasses (blue grama, buffalograss, little bluestem, western wheatgrass) in the west and north central, and tall grasses (big bluestem, indiangrass, switchgrass, little bluestem) in the east and south central. Pastures with histories of moderate stocking rates for their respective region were used as sample sites for the project. Ten samples from each collection site were hand clipped, dried, and processed through a grinder.

Samples were then sent to a single laboratory for all quality analyses. Samples were analyzed for ADF and CP. The protein fraction was further analyzed for DIP, the portion available to rumen microbes, and UIP, the portion that escapes to the intestinal tract. Samples were statistically analyzed by grouping the vegetation type (short or tallgrass) of a county for each year and month collected. Unless otherwise noted, significance was based on a level of $P<0.05$.

Results and Discussion

Acid Detergent Fiber

ADF values were much lower in May, June, and July for tallgrass rangelands (36.8, 38.7, and 40.9%, respectively) than for shortgrass rangelands (45.0, 43.7, and 45.0%, respectively) (Fig. 1). ADF values were similar between the two vegetation types during all other months.

Within tallgrass rangelands, May through September all had lower ADF than October through April. From May through September, a significant increase in ADF concentration also occurred every two months, while ADF significantly increased every sampling period from September to December. Within shortgrass rangelands, ADF values were similar May through August, and ADF was significantly lower May through August than October through April.

Within a forage species, digestibility has a negative relationship with ADF. The greater the ADF value is in a forage type, the less digestible the forage. Tallgrasses and shortgrasses had their greatest digestion potential when late spring and early summer ADF values were lowest.

Protein

Tallgrass forage CP reached its greatest levels of 12.3% and 8.2% in May and June, statistically greater than any other time period for tallgrass or shortgrass. Similar to tallgrass vegetation, shortgrass CP significantly rose to 7.0 and 6.9% in May and June, but the rise in CP was less than for tallgrass. April burning of some tallgrass pastures reduced standing dead material and helped to increase average tallgrass CP and decrease ADF in May and June, while shortgrass pastures in western Kansas were not burned. Residual dead standing material from previous seasons likely lowered the overall CP value of unburned pastures. A gradual but significant decline in CP resulted for both vegetation types from July to December (Fig. 2).

Degradable intake protein (DIP) is the portion of CP that is utilized by rumen microbes for microbial growth and proper fiber digestion. When energy and protein are well balanced in a diet, DIP is largely incorporated into microbial cells that become available as a protein source for the grazing animal as the microbes pass out of the rumen into the intestinal tract. Often, as CP concentration increases in pasture forages, so does the total amount of DIP. In this study, increases and decreases in CP are mimicked directly by increases and decreases in DIP (Fig. 2). With lower DIP levels in both grass types from July to April, energy needs may not be met in livestock with high gain potential or those with high energy requirements for maintenance and lactation because DIP will limit forage intake and proper fiber digestion of poor forages.

Undegraded by rumen microbes, UIP passes from the rumen unaltered into the remainder of the gastro-intestinal tract for utilization by the grazing animal. At present, the National Research Council assumes that approximately 80% of the UIP entering the intestines is digested. However, UIP digestibility can vary greatly from this average. No data is available at present to clarify the extent to which UIP from tallgrass and shortgrass is digested in the intestinal tract. In addition, UIP is of nutritional value to cattle only when their protein demands are not sufficiently met by microbial protein (from the DIP) flowing into the intestines. Both factors mentioned above make the interpretation of UIP's importance challenging. Tallgrass vegetation had much greater UIP than shortgrass vegetation during May, June, and July (4.4, 3.1, and 3.1% vs. 2.3, 2.4, and 2.6%, respectively). All other months except December were similar between the two vegetation types. Shortgrass consistently ranged from 2.0-2.8% UIP through the season.

Protein levels were lower than expected in the current study, but forage consumed by fistulated grazing cattle has been found to be 2-3% higher in CP than forage clipped on Kansas Flint Hills rangeland (Launchbaugh and Owensby, 1978). Protein levels were also at their greatest and ADF at its lowest in tallgrass vegetation from May until July in this study (Figs 1 and 2), the period when stocker animals have historically achieved their greatest average daily gains (Launchbaugh and Owensby, 1978). Animal gains during the early grazing season were similar to gains in the late season 7 out of 10 years on continuously stocked shortgrass pasture (Vanzant, 1995). The narrow margin between the lowest and greatest seasonal protein (Fig 2) and ADF (Fig 1) levels on shortgrass range in the current study could have been a factor in the similar response between early and late season gains of previous grazing trials.

Conclusions

Tallgrass prairie is highest in forage quality during the early spring and summer. Quality rapidly declines from July to October. Forage quality was more stable with less fluctuation between seasons in shortgrass vegetation. Seasonal forage quality is quite different between and within rangeland vegetation types throughout Kansas, and identification of dominant rangeland vegetation is a key determinant in choosing appropriate nutritional management strategies.

Literature Cited

Launchbaugh, J.L., and C.E. Owensby. 1978. Kansas Rangelands: Their Management Based On A Half Century of Research. Kansas Agric. Expt. Sta. Bul. 622. 56 p.

Vanzant, E.S. 1995. Range research in western Kansas. *In* Owensby, C.E., R.C. Cochran, K.L. Anderson, E.F. Smith, and E.S. Vanzant, "Fifty years of range research revisited. Proceedings of KSU Range Field Day, October 27, 1995". 118 pp.

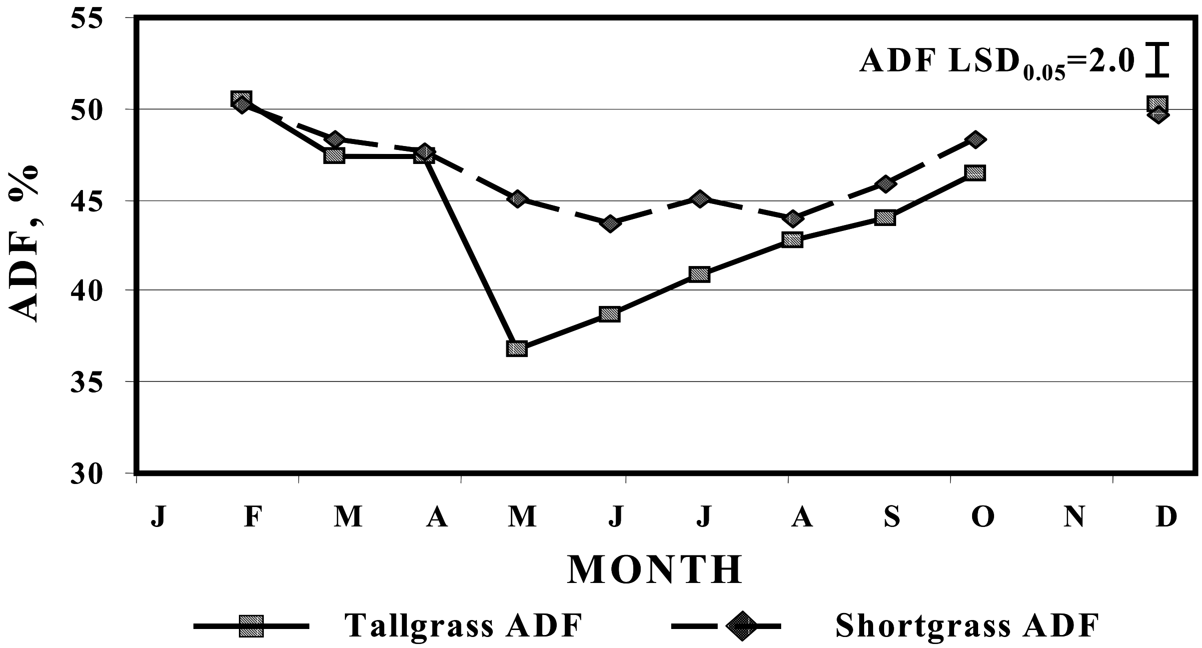


Figure 1. Monthly acid detergent fiber (ADF) percentage of Kansas tallgrass and shortgrass rangeland vegetation from spring of 1997 to fall of 1999.

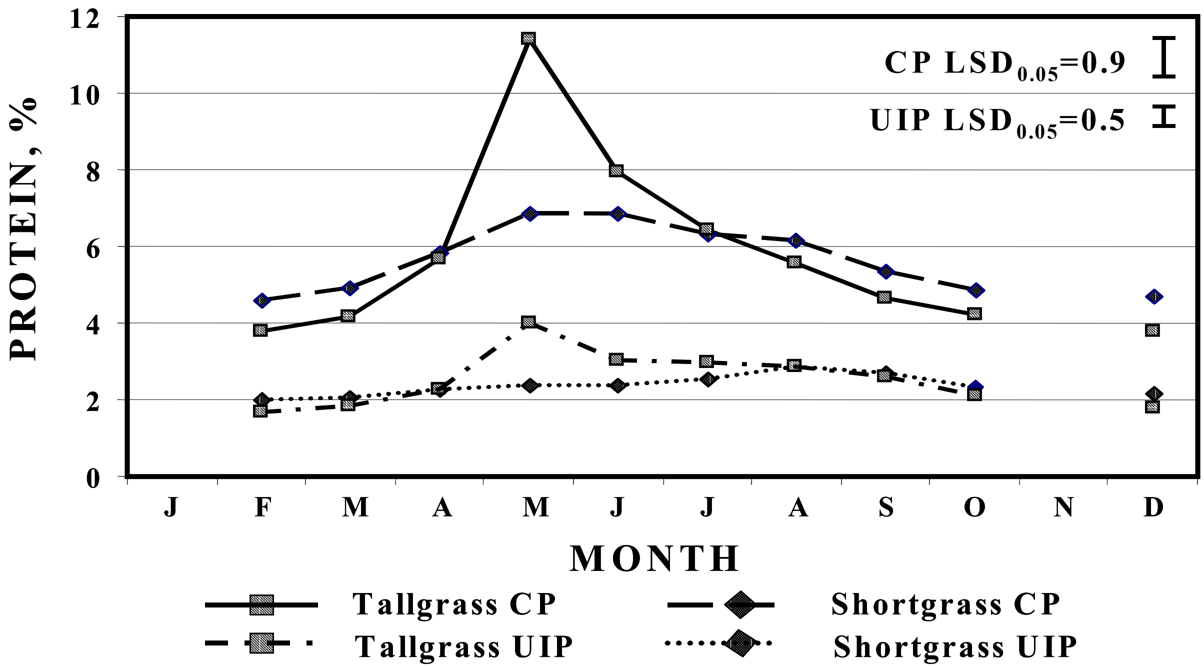


Figure 2. Monthly crude protein (CP) and digestible intake protein (DIP) percentage of Kansas tallgrass and shortgrass rangeland vegetation from spring of 1997 to fall of 1999.

Forage Quality and Animal Production from Brown Mid-Rib Forage Sorghum

Keith Harmoney and John Brethour
Range Scientist and Beef Cattle Scientist

Summary

Chopped standard 'Canex' forage sorghum hay and chopped 'Canex BMR' brown mid-rib forage sorghum hay were compared to 'NK300' forage sorghum silage for growth of feeder steers. Steers were fed one of the three treatments and monitored for weight gain and backfat thickness. 'Canex BMR' steers gained more weight than 'NK300' silage steers, but did not gain more than standard 'Canex' steers. Intake was greater for both 'Canex' and 'Canex BMR' steers. Forage quality tests showed crude protein (CP) was greater and neutral detergent fiber (NDF) and acid detergent fiber (ADF) were lower for the silage. Lignin concentration was lower for 'Canex BMR' forage, which could have produced greater digestibility and the greater gains for the 'Canex BMR' steers compared to the silage steers.

Introduction

Brown mid-rib is a recessive trait found in corn (*Zea sp.*) and sorghum (*Sorghum sp.*) that alters the lignin content of the forage. Lignin is a major undigestable component of forage fiber and a known physical barrier to rumen bacteria, inhibiting the breakdown of other forage fiber components. Forage varieties of the same species that have a higher lignin content often have lower digestibility and greater concentrations of forage fiber. Brown mid-rib varieties have the recessive genes to lower lignin content and thus fiber concentration, and should also be greater in forage digestibility and subsequent animal production. This study was conducted to test the animal production from feeding brown mid-rib vs. non-brown mid-rib forage sorghums to feedlot steers.

Materials and Methods

Standard 'Canex' and 'Canex BMR' (brown mid-rib) forage sorghums were grown separately for hay production on 25 acres each in 2000. Hay was harvested at the late boot to early head stage and allowed to air dry. Windrows were then baled into large rounds without any damage or losses occurring from precipitation. Bales were then chopped through a bale grinder into two respective piles, one for each feed. Ninety-three steers were split into three groups of 31 steers each. These groups were separated into two pen replications, one of 15 animals and the other of 16 animals. Each group was fed either 'Canex BMR' chopped hay, standard 'Canex' chopped hay, or 'NK 300' forage sorghum (non-brown mid-rib) silage *ad libitum*. Forage sorghum silage was harvested during the soft dough stage of grain fill. Each group also received a standard supplement ration consisting of rolled milo, soybean meal, and urea, as well as a Rumensin, Tylan, and mineral premix. Each group of steers spent 106 days on the ration in late fall of 2000 and early winter of 2001. Steers were monitored for forage intake, average daily gain, and ultrasound backfat measurements. Forages were also sampled every 2-3 weeks for neutral detergent fiber (NDF), acid detergent fiber (ADF), acid detergent lignin (ADL), and crude protein (CP) content.

Results and Discussion

At the onset of the trial, initial weights (average 689.2 lbs) and initial backfat measurements (average 2.07 mm) of each group was nearly identical and not significantly different. At the conclusion of the feeding trial, ‘Canex BMR’ steers weighed 914.8 lbs, only 8.5 lbs more than the standard ‘Canex’ steers, but over 20 lbs more than the silage fed steers. Backfat measurements were significantly greater for the silage fed steers, while the ‘Canex BMR’ hay treatment steers were also greater in backfat than the standard ‘Canex’ hay steers. Backfat measurements did not follow the same trends as average daily gain. Daily gain of the ‘Canex BMR’ steers was greater than the silage fed steers. Brown mid-rib steer gain showed signs of being greater than the standard mid-rib steers, but was not statistically different in this trial. Steers also had greater dry matter intake of both ‘Canex’ hay treatments than the silage. Daily forage intake averaged 16.10 lbs for the two ‘Canex’ hay treatments, while daily silage dry matter intake was just over 2 lbs less at 14.05 lbs. This also led to greater total dry matter feed intake for the two ‘Canex’ hay treatments.

The relative difference in forage dry matter intake between the brown mid-rib and silage treatments was greater than the relative difference between the brown mid-rib and silage treatments for average daily gain. This indicated that the energy value of the silage was likely greater than for the two hay treatments because of the grain component and potentially greater digestibility of the silage. The forage quality components of the two ‘Canex’ hay varieties were not statistically different for NDF, ADF, or CP, although the ADF value of the brown mid-rib hay was 1.1 percentage points lower than that of the standard Canex hay. ‘Canex BMR’ hay was statistically lower in lignin content than either the standard ‘Canex’ hay or the silage. Silage and standard ‘Canex’ hay were not different for lignin content. Greater extent of digestion of the brown mid-rib hay could be the reason that daily gain was greater on the brown mid-rib hay than the silage. The ‘NK300' silage was statistically lower in NDF and ADF and greater in CP than the two hay treatments. This supports the expectation that the silage was greater in energy than the two hay treatments. Daily gains did not show the wide gap that might have been expected from observing the intake values alone since energy was greater for the silage. Feeding chopped forage sorghum hay in place of silage for feeding growing rations to steers is a viable alternative. Brown mid-rib hay varieties show signs of being greater in forage quality and animal production potential than standard mid-rib varieties, but did not have significantly greater animal performance in this test. Potential for greater forage quality and greater animal performance is most likely by harvesting forages earlier at a less mature morphological stage.

Table 1. Initial and final weight and backfat values of steers feeding on standard or brown mid-rib Canex forage sorghum hay or NK300 forage sorghum silage.

	Canex (standard)	Canex BMR	NK300 (silage)
Number of steers	31	31	31
Initial weight, lbs†	692.3 a	686.2 a	689.0 a
Final weight, lbs	906.3 a	914.8 a	894.1 b
Initial backfat, mm	2.05 a	2.00 a	2.15 a
Final backfat, mm	2.63 c	2.95 b	3.25 a
Average daily gain, lbs	2.02 a	2.16 a	1.94 b

† Values in rows with the same letter are statistically similar at $P < 0.05$.

Table 2. Daily forage and total feed intake of steers receiving standard or brown mid-rib Canex forage sorghum hay or NK300 forage sorghum silage as the main component of their diet.

	Canex (standard)	Canex BMR	NK300 (silage)
Forage intake, lbs†	16.08 a	16.12 a	14.05 b
Rolled milo, lbs	4.40	4.40	4.40
Soybean meal, lbs	0.68	0.68	0.68
Urea, lbs	0.11	0.11	0.11
Premix, lbs	0.49	0.49	0.49
Total feed intake, lbs	21.76 a	21.80 a	19.72 b

† Values in rows with the same letter are statistically similar at $P < 0.05$.

Table 3. Fiber and crude protein concentrations of standard and brown mid-rib Canex forage sorghum hay and NK300 forage sorghum silage.

	NDF†	ADF	ADL	CP
	---------------	--------------- %	---------------	---------------
Canex (standard)	62.1 a	40.5 a	6.17 a	4.6 b
Canex BMR	62.1 a	39.4 a	4.94 b	4.9 b
NK300 silage	49.1 b	31.7 b	6.14 a	6.7 a

† Values in columns with the same letter are statistically similar at $P < 0.05$.

The Influence of Days Fed on Carcass Traits and Live Weight Gains in Feedlot Heifers

G.L. Bishop, T.E. Lawrence, J.R. Brethour, T.T. Marston, and B.J. Johnson
Graduate Student, Graduate Student, Beef Cattle Scientist, Associate Professor/Extension Cow-Calf Specialist, and Assistant Professor

Introduction

Value-based marketing has increased the need for individual evaluation of feedlot cattle. By marketing cattle on the pen average, cattle feeders run the risk of overfeeding or underfeeding a large portion of the cattle, thus incurring weight, yield grade, and quality grade discounts at the packing plant. One of the most important marketing decisions a feeder will have to make is when to harvest a particular set of cattle. Knowledge of the development of economically important factors such as marbling, subcutaneous fat accretion, muscling, and carcass weight is crucial to producers who desire to manage and market their fed cattle in such a way as to maximize gross return on an individual animal basis. This study was conducted to determine the effect of days on feed on carcass characteristics and live weight gains in heifers.

Materials and Methods

Moderate framed, crossbred heifers (n=160, average weight=796 lbs) were compiled from two sources near Hays, Kansas. Upon arrival to the Agricultural Research Center at Hays, the heifers were vaccinated, implanted with Synovex® Plus™, identified, and penned. The heifers were stratified by source and color and then randomly assigned to one of four harvest groups (92, 113, 134, and 155 days on feed). Initial weight, and ultrasound marbling and back fat estimates were recorded. An ultrasound estimate of marbling and backfat was also recorded at day 54. Ultrasound estimates and live weights were recorded on the day prior to each harvest date. The animals of subsequent kill groups were also ultrasounded and weighed at this time. All heifers were harvested at the same commercial packing facility and carcass measurements of marbling score, 12th rib fat thickness, ribeye area, percent kidney-pelvic-heart fat, and overall maturity were collected approximately 24-hr post harvest.

Results

Table 1 shows the carcass data from each of the four feeding groups. A stepwise increase in carcass weight was observed over the four kill dates. Even though differences in hot carcass weight between harvest dates were variable, it appears that feeding heifers additional days potentially can increase added sellable product and directly impact heifer value. Cattle feeders expect dressing percent to increase with increasing days on feed. Our data indicated that dressing percent did not increase until heifers had at least 134 days on feed. However, as expected, heifers fed 155 days attained the highest dressing percent at 62.1.

Ribeye area was not significantly different from heifers harvested between 92 and 134 days. The heifers fed for 155 days did have the largest ribeye areas. We expected ribeye area to increase and plateau in size with extended feeding. The ratio between ribeye area and hot carcass weight indicates that these heifers were heavily muscled, which may explain why a linear increase in muscling between early harvest dates was not observed. Backfat thickness increased from day 92 to 113, but was not statistically different (P>.05) from day 113 to 134 and 155. Yield grade was statistically higher at day 113 than day 92 (1.98 vs. 1.52, respectively). After day 113, however, there was not a significant increase in numeric yield grade. The distribution of yield grades is presented in Table 2. One notable effect of added days on feed is the shift from entirely YG 1 & 2 carcass at 92 days on feed to a majority of YG 2 & 3 for the remainder of the experiment. As expected, with added days on feed, the distribution of YG 1 & 2 carcasses tended to decrease, while percent YG 3 carcasses continued to increase.

Marbling scores increased at day 134, but then did not change throughout the rest of the experiment. Distributions of quality grades are represented graphically in Figure 1. The increase in days fed resulted in a higher percentage of choice carcasses (14, 18, 35, and 49% for the four kill dates, respectively) concurrent with a decrease in standard carcasses (41, 21, 8, 7% for the four kill dates, respectively). The impact that additional days on feed can have on minimizing discounted carcasses is shown plainly by these data. However, at some point beyond the design of this experiment, these heifers would have likely incurred marketing discounts because of increasing proportions of yield grade 4 and 5 carcasses. Overall maturity was similar (P>.05) for the first three kill groups, then increased on day 155.

Live weights and live weight gains for the four kill groups are shown in Table 3. In weight was similar for all harvest groups. Final weight increased from day 92 to 113, and from day 113 to 134, but then leveled off throughout the end of the experiment. Live weight gains increased initially from day 92 to 113, and then decreased with increasing days fed. As expected, gains begin to decrease at the end of the feeding period as fat deposition increases.

Conclusions

Increasing days on feed impacts carcass characteristics of feedlot heifers. Carcasses tend to become fatter, with increasing quality grade and hot carcass weights. Alternatively, live weight gains begin to decrease later in the feeding period. This contrast requires weighing the opportunity for increased carcass value against decreasing live performance when marketing feedlot heifers. In the present trial, the prevalence of low yield grades possibly indicates that the heifers were not sufficiently finished. In subsequent trials, the heifers should be fed additional days to determine if a possible plateau might occur, which would suggest that marbling development might be reaching genetic potential. More research should be done to determine the relationship between backfat, marbling, and hot carcass weight gains farther out in the feeding period so that analysis could be run to determine the marginal rate of return for increased days on feed.

Table 1. Effect of days on feed on carcass traits.

	Days on Feed			
Item	92	113	134	155
Hot Carcass Weight, lbs	626[a]	660[b]	711[c]	734[d]
Dressing %	59.6[a]	58.8[a]	60.1[b]	62.1[c]
Ribeye Area, in^2	13.7[a]	13.5[a]	14.1[ab]	14.6[b]
Backfat, in	0.27[a]	0.36[b]	0.37[b]	0.42[b]
Yield Grade	1.52[a]	1.98[b]	2.02[b]	2.08[b]
Overall Maturity Score*	169[a]	170[ab]	172[ab]	179[b]
Marbling Score**	315[a]	326[a]	389[b]	396[b]

[a,b,c,d]Within rows, means without a common superscript differ (P<.05)
*A[00]=100, B[00]=200
**400=Sm[00], 500=Mt[00]

Table 2. Effect of days on feed on yield grade.

	Days on Feed			
Item	92	113	134	155
Yield Grade				
% YG 1	61.0	26.8	29.7	26.8
% YG 2	39.0	51.2	64.9	51.2
% YG 3	-	22.0	5.4	22.0

Table 3. Effect of days on feed on live weight gain.

	Days on Feed			
Item	92	113	134	155
In Weight, lbs	810	802	806	805
Out Weight, lbs	1051[a]	1124[b]	1166[c]	1181[c]
0-92 ADG, lb/day	3.04	3.09	3.13	3.07
Overall ADG, lb/day	2.67[a]	2.86[a]	2.67[a]	2.39[b]

[a,b,c]Within rows, means without a common superscript differ (P<.05)

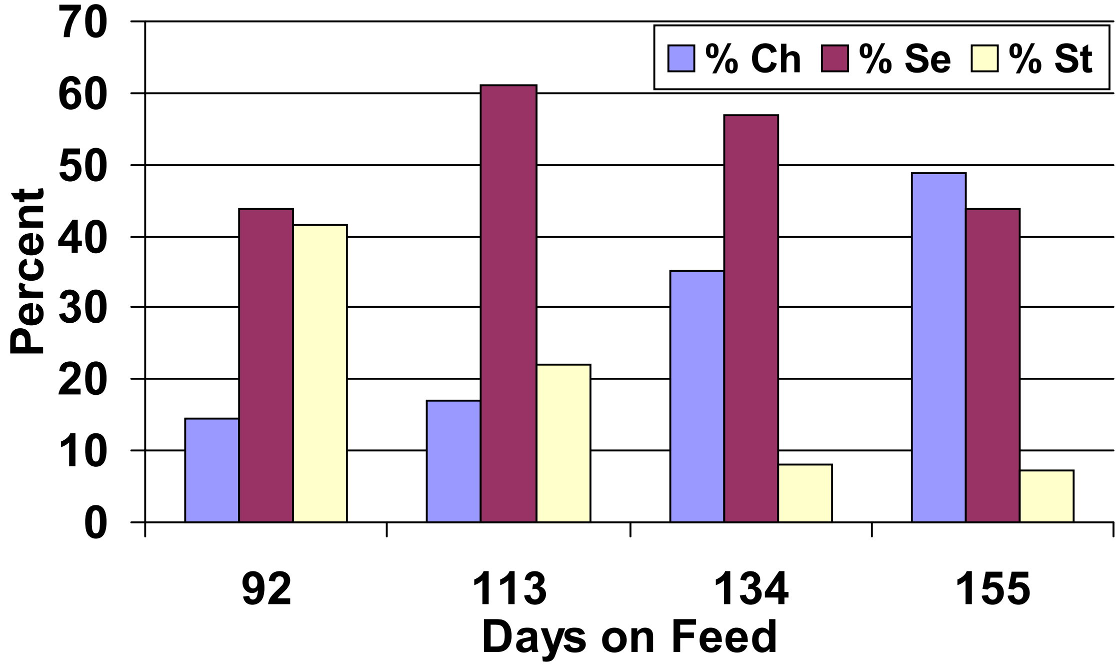


Figure 1. Effect of days on feed on quality grade. Ch=Choice; SE=Select; St=Standard

The Effect of Pregnancy on Feedlot Performance and Carcass Quality

G.L. Bishop, T.E. Lawrence, J.R. Brethour, and T.T. Marston
Graduate Student, Graduate Student, Beef Cattle Scientist,
and Associate Professor/Extension Cow-Calf Specialist

Introduction

During times of cowherd reduction, heifers may offer cattlemen an attractive option as feeder cattle. Management of heifers in the feedyard presents a unique set of challenges. Management of the pregnant female in commercial feeding operations has unique implications on health and performance throughout the feeding phase. Current practices usually include diagnosing pregnancy upon feedyard arrival and the use of an abortifacient to end gestation. These practices require additional veterinary costs, medicine costs, and can have negative impacts on animal health. Previous research has indicated a possible improvement in quality grade with pregnancy. This study examined the impact of pregnancy on feedlot performance and carcass quality in an attempt to determine the effect of allowing heifers in early pregnancy to remain pregnant throughout the feeding period.

Materials and Methods

Sixty-eight spring-born yearling bred heifers, raised at the Hays Experiment Station, were fed in a completely randomized design. Prior to the feeding period, all heifers were estrous synchronized and bred approximately 12 hours after a standing heat was observed. Heifers were classified as either pregnant (PREG) (n=25) or open (OPEN) (n=43) based on ultrasound diagnosis approximately 60 days post-breeding. Heifers were immediately placed in the feedlot and processed, but not implanted. After a short receiving period, the heifers were fed a high concentrate diet until harvest. The finishing ration consisted of finely ground grain sorghum, corn silage, and a supplement (CP = 12.9%, NEg = 0.68 Mcal/lb, Crude Fiber = 5.74%). Ultrasound was used to determine two harvest groups (105 and 147 DOF) of approximately equal backfat endpoints. Cattle were harvested at a commercial packinghouse and carcass data were collected for all animals approximately 24 hours post-harvest. At the time of harvest, fetal age was 153 and 195 days for the 105 and 147 DOF groups, respectively. Pregnancy was visually confirmed at the abattoir.

Results

Carcass data are presented in Table 1. The only significant effect found of pregnancy status was on dressing percent. As expected, dressing percent was lower in pregnant heifers versus non-pregnant heifers. Fetal and fluid weight is suspected to be the most significant factor resulting in this difference. In addition, pregnant heifers tended to be a bit fatter, have higher numerical yield grades, and higher marbling scores, although these differences were not statistically different.

Live performance was not different for pregnant versus non-pregnant heifers (Table 2), though the tendency was for pregnant heifers to have a slightly higher ADG than their non-pregnant counterparts.

The distributions of quality and yield grades are shown in Table 3. These data support the observation that pregnant heifers tended to have higher quality grades and were slightly fatter than non-pregnant heifers. Pregnant heifers had a higher percentage of USDA Prime carcasses (11.6 vs. 16.0), and had a lower percentage of USDA Standard carcasses (0 vs 2.32) than non-pregnant heifers. There were fewer YG 1 (32.0% vs 39.5%) and more YG 3 (16.0% vs 7.0%) carcasses in the pregnant heifers versus their non-pregnant mates.

Conclusions

In the present study, there was no statistical difference observed in carcass quality and live performance between pregnant and non-pregnant heifers. It was observed, however, that pregnancy in feedlot heifers will impact dressing percent. In this study, that decrease would have amounted to a loss of almost 30 pounds of hot carcass weight. This would be a significant factor if the cattle were to be marketed through a system in which value was based on hot carcass weights. In instances where dressing percent was not necessarily a big factor in determining final animal value, avoiding the medicine cost and associated health and performance impacts by allowing pregnancies under 60 days to continue might have economic benefits. Additional research is needed to evaluate the cost-benefit relationship of using abortifacients on incoming feeder heifers at various stages of pregnancy, and the potential benefit of leaving early-pregnancy heifers unaborted.

Table 1. Effects of pregnancy status on carcass traits.

	Pregnancy Status		
Item	Open	Preg	P
Hot Carcass Weight, lbs	797	781	.3471
Dressing %	62.63	60.36	<.0001
Ribeye Area, in^2	13.8	13.3	.1687
Backfat, in	.53	.56	.4309
Yield Grade	2.16	2.36	.1965
Overall Maturity Score*	175	169	.1398
Marbling Score**	494	518	.5645

Table 2. Effects of pregnancy status on live performance.

	Pregnancy Status		
Item	Open	Preg	P
In Weight, lbs	919	922	.8468
Out Weight,lbs	1276	1286	.6453
ADG, lb/day	2.87	2.92	.4426

Table 3. Effect of pregnancy status on quality and yield grade.

	Pregnancy Status	
Item	Open	Preg
Quality Grade		
% Prime	11.6	16.0
% Choice	65.1	64.0
% Select	20.9	20.0
% Standard	2.32	0.0
Yield Grade		
%YG 1	39.5	32.0
%YG 2	53.5	52.0
%YG 3	7.0	16.0

Resynchronization of Estrus in Previously Synchronized Beef Heifers of Unknown Pregnancy Status Using MGA or MGA Plus ECP

S.K. Johnson and J.S. Stevenson
Livestock Extension Specialist and Reproductive Physiologist

Summary

A study was conducted on 439 yearling heifers to determine whether or not estrus might be resynchronized in previously inseminated heifers to accommodate a second artificial insemination (AI) early in the breeding season. Previously inseminated heifers either received no further treatment (Control) or were fed MGA for 7 days beginning 13 days after the average day of initial insemination. In addition, estradiol cypionate (ECP) was given on days 13 and 20 after previous insemination to half of the MGA-fed heifers. Return to estrus was not increased with either MGA treatment and was delayed compared to Controls. Conception rates for heifers inseminated during the targeted resynchronization period (days 20 – 25) were reduced by MGA treatment.

Introduction

A system that would allow a second opportunity to AI heifers that have failed to conceive after the first AI and yet minimize time spent detecting estrus may increase numbers of AI pregnancies. Insertion of an intravaginal progesterone releasing insert or feeding MGA after a previous insemination as a method of resynchronization produced variable responses in earlier studies. Lack of follicular control prior to ovulation may partially explain the variability in previous studies in which resynchronization was attempted. Estradiol can be used to reset follicular dynamics to ensure that a young, fresh ovulatory follicle is ovulated after resynchronization. Estradiol cypionate (ECP) is an estrogen product available in the US market that may work in combination with a progestin to resynchronize the first eligible estrus after a previous AI.

Materials and Methods

Yearling beef heifers used in this study were previously synchronized with a standard MGA + PGF protocol; 0.5 mg of MGA fed per head per day for 14 days and 25 mg of PGF (Lutalyse®, Pharmacia Animal Health, Kalamazoo, MI) 19 days after the last feeding of MGA. Heifers were inseminated based on the AM-PM rule until 72 hours after PGF, at which time all heifers that had not shown heat were inseminated. All heifers used in the experiment were inseminated within 5 days following the initial synchronization.

Immediately following the initial AI, heifers were returned to new pens based on the time they were inseminated. Five days before resynchronization treatments were begun, each pen of heifers was gate cut to divide the heifers into three treatments. Heifers that returned to

estrus before sorting into resynchronization treatments were excluded from the experiment. Treatments for this experiment (Figure 1) were: 1) no further treatment (Control; n=87); 2) melengestrol actetate (MGA; n=176) fed at 0.5 mg/head/day from day 13 (day 0 = mean day of previous insemination) through day 19; and 3) MGA + ECP (n=176), which was the same as the previous treatment plus 0.5 mg of estradiol cypionate administered on days 13 and 20. Heifers were observed for estrus at least twice daily from days 0 to 33 and were reinseminated according to the AM-PM rule.

Pregnancy was determined via ultrasonography on day 33 (check of initial insemination) and day 59 (check of resynchronized insemination).

Results and Conclusions

Resynchronization treatments had no negative effect on the pregnancy rates resulting from the initial insemination; 58/87 (67%), 132/176 (75%) and 112/176 (64%) for Control, MGA, and MGA + ECP, respectively. Mean hours from second injection of ECP to estrus were shorter (P<.01) for Control than for MGA or MGA+ECP; 52 ± 10, 85 ± 6 and 88 ± 6, respectively. The variance (a measure of variability) of the interval from last feeding of MGA to estrus was greater (P<.05) for Control than MGA or MGA+ECP (1501, 711 and 620, respectively). Greater (P<.05) proportions of Control than MGA or MGA+ECP heifers were in heat before and during MGA feeding (Table 1). MGA seems to have delayed estrus in the MGA and MGA+ ECP treated heifers because 14% of heifers in each treatment were in heat more than 25 days after the first insemination, whereas none of the Controls were in heat during this period. Conception rates were lower (P<.05) during the targeted resynchronization period (days 20 to 25) for MGA and MGA + ECP heifers than Control heifers. Total pregnancy rates resulting from the first and second AI did not differ among treatments.

Lower conception rates in the MGA and MGA + ECP heifers indicated that some persistent follicles might have developed in heifers assigned to these treatments. Based on previous results, it was expected that the ECP injection on day 13 would initiate a new wave of follicular growth. A greater variation in cycle duration in yearling heifers may make attempts at resynchronizing estrus more difficult.

Acknowledgements

We thank Losey Brothers, Agra, KS for their cooperation and assistance in the completion of this experiment.

Table 1. Reproductive traits of heifers after resynchronization with MGA or MGA plus ECP*.

	Treatment		
	Control	MGA	MGA+ECP
Number	87	176	176
Hours to estrus**	52 ± 10 [a]	85 ± 6 [b]	88 ± 6 [b]
No. pregnant	58	132	112
Pregnancy Rate (%)	67	75	64
No. not pregnant	29	44	59
No. reinseminated (%)			
Before MGA (< day 13)	3 (10.3)	1 (2.2)	6 (10.2)
During MGA (days 13 to 20)	13 (31)	3 (6.8)	3 (5.1)
After MGA (days 20 – 25)	10 (34.5)	29 (65.9)	34 (57.6)
>day 25	0	6 (13.6)	8 (13.6)
Total	26 (89.7)	39 (88.6)	51 (86.4)
Conception Rate			
Before MGA (<day 13)	3/3	1/1	4/6 (66.7)
During MGA (days 13 to 20)	9/13 (69.2)	2/3 (66.7)	2/3 (66.7)
After MGA (days 20 – 25)	7/9 (77.8)[a]	10/29 (34.5) [b]	16/34 (47.1) [b]
>day 25		5/6 (83.3)	6/8 (75)

*Day 0 = mean day of first insemination
**Hours from ECP injection on day 20
[a,b] Treatments differ (P<.05)

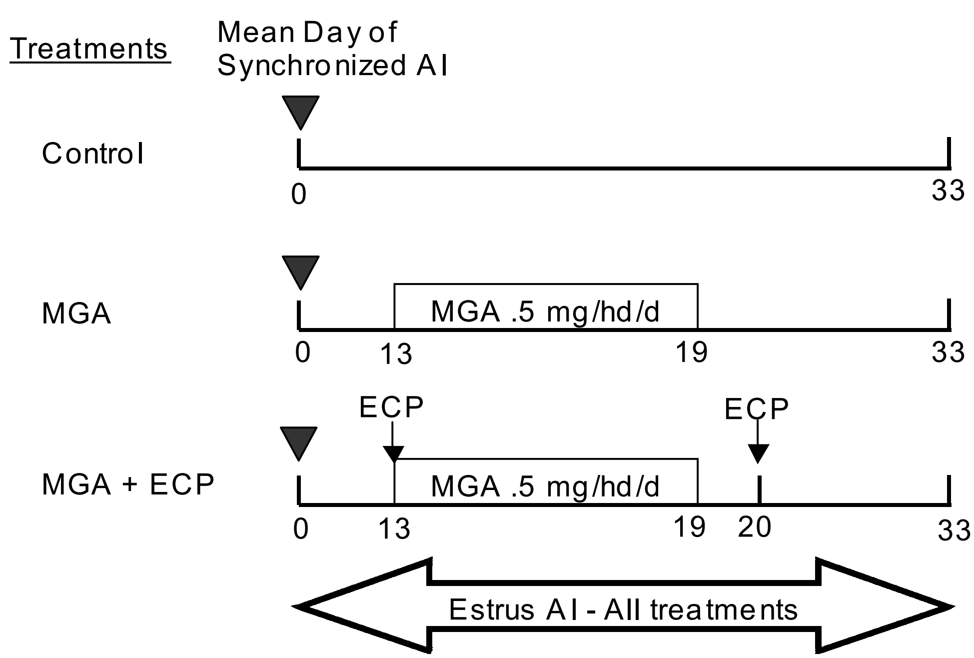


Figure 1. Experimental Protocol

Timed Insemination in Beef Heifers after Synchronization of Estrus and Ovulation with Melengestrol Acetate and Prostaglandin F_2 "

S.K. Johnson, B. Broweleit and K.R. Harmoney
Livestock Extension Specialist, Agricultural Extension Agent, and Range Scientist

Summary

The combination treatment of Melengestrol Acetate (MGA) and Prostaglandin F_2" (PGF) for estrous synchronization of heifers has been widely adopted by producers. Attempts to incorporate timed insemination with the original system produced less than optimal results. Increasing the interval between MGA withdrawal and PGF injection from 17 to 19 days increased estrus response and improved synchrony in heifers. At this interval, most heifers were observed in estrus 60 hours after PGF. The objective of this study was to determine if a single fixed-time insemination would result in pregnancy rates comparable to that for heifers bred after heat detection. Yearling heifers from two herds were fed MGA (.5 mg/hd) daily for 14 days. On day 19 after withdrawal of MGA, heifers received 25 mg PGF (hour 0). Heifers receiving no further treatment served as Controls (n=401) and were inseminated based on the following schedule. Heifers observed in estrus from dark to 0800, 0800 until 1200, and 1200 until dark were inseminated beginning at 1330, 1800 and 0800 the following morning, respectively. In the Timed Bred group (n=158), heifers were inseminated and received an injection of GnRH (100 :g) 60 hours after PGF. Pregnancy rate during the synchrony period (0 to 120 hours) was greater (P<.05) for Control (255/401, 63.6%) than for Timed Bred (74/158, 46.8%) heifers. The cumulative proportions of Control heifers in estrus from 48 to 72 hours, 48 to 84 hours and 48 to 96 hours were 72.1%, 77.8% and 83.3%, respectively. While the synchronized pregnancy rate was not as high in Timed Bred heifers as in Control heifers, the pregnancy rate achieved in this study might be acceptable in some production situations.

Introduction

The MGA/PGF system, developed by Colorado State University, is the most widely used system to synchronize estrus in heifers. More producers may incorporate artificial insemination (AI) into their heifer development programs if they had a reliable fixed time insemination protocol. The original MGA/PGF system consisted of feeding MGA for 14 days and then waiting an additional 17 days to give PGF. Increasing the interval between MGA withdrawal and PGF injection from 17 to 19 days increased estrus response and improved synchrony in heifers. With this interval between MGA and PGF, a majority of heifers were observed in estrus 60 hours after PGF. The objective of this study was to determine if synchrony was tight enough with this system that a single fixed-time insemination would result in pregnancy rates comparable to that for heifers bred after heat detection.

Materials and Methods

Yearling heifers from two herds were used in the study. Herd 1 consisted of 118 head of Angus cross, South Devon cross and Limousin cross heifers from the Agricultural Research Center–Hays. Herd 2 included 441 head of black and black baldy heifers from Losey Brothers, Agra, KS. Heifers were fed MGA (.5 mg/hd) daily for 14 days in a total mixed ration. On day 19 after withdrawal of MGA, heifers received 25 mg PGF (Lutalyse®, hour 0). The injection of PGF was given between 1600 and 1900 so that the timed insemination would begin in the morning. Heifers receiving no further treatment served as Controls (C; n=401) and were inseminated based on the following schedule. Heifers observed in estrus from dark to 0800, 0800 until 1200, and 1200 until dark were inseminated beginning at 1330, 1800 and 0800 the following morning, respectively. In the Timed Bred group (n=158), heifers were inseminated and received an injection of GnRH (100 :g; Factrel®) 60 hours after PGF. Actual time of insemination for the Timed Bred heifers was 63.5 – 68.5 hours in both herds. Timed Bred heifers observed in estrus before 38 hours were inseminated on the same time schedule as Control heifers and were not inseminated at 60 hours (n=7). For determination of pregnancy rate during the synchrony period, these heifers were all classified as open.

The length of the total AI period varied with location. Heifers were exposed to bulls after AI for a total breeding season of 53 days in Herd 1 and 60 days in Herd 2. Conception rates to AI were determined via ultrasound between 30 and 55 days after the initial insemination.

Results and Discussion

The single time period when the most Control heifers were observed in estrus occurred at 60 hours after PGF (38.9%, Figure 1). The cumulative proportions of Control heifers in estrus from 48 to 72 hours, 48 to 84 hours and 48 to 96 hours were 72.1%, 77.8% and 83.3%, respectively. Pregnancy rate during the synchrony period (0 to 120 hours after PGF), determined at 30 – 55 days after the timed insemination, was greater ($P<.05$) for Control (255/401, 63.6%) than for Timed Bred (74/158, 46.6%) heifers. Using the same 14/19 day MGA/PGF system but no GnRH at insemination, others have found pregnancy rates to a single timed insemination at 72 hrs after PGF (53%) or a double insemination at 65 and 85 hours after PGF (49%) did not differ.

Conception rates to a single sire in Control heifers in Herd 2 were examined for heifers detected in estrus by 0800 (43/54, 79.6%), from 0800 to 1200 (14/19, 73.7%) and 1200 to dark (101/138, 73.2%) and did not differ. Studies in which estrus was detected with an electronic detection system have indicated the optimum time for insemination is between 4 and 12 hours after first observation of heat. Typically the Heat Watch System® will detect animals up to 6 hours before they are observed by normal visual detection. Inseminating heifers 3 times per day rather than two, resulted in excellent conception rates and helped spread daily labor needs.

Synchronized pregnancy rates differed (P<.05) between sires within herds and between herds. Conception rates for bulls used in Herd 1 were 32.7% (17/52) and 61.0% (36/59) and for Herd 2 were 67.4% (211/313) and 66.3% (67/101). The low conception rates to AI in Herd 1 were also reflected in the overall breeding season pregnancy rates. In Herd 1, the same bulls that were used for AI were used for natural service. Season long pregnancy rates are in Table 1 and were not different between treatments for Herd 2 but were lower (P<.05) in the Timed Bred heifers than in the Control heifers in Herd 1.

Because of the low fertility of one sire in Herd 1, results from Herd 2 are more likely what might be expected in herds with top management. Producers that place a high value on the genetics available from AI sires and for which time is at a premium, may find the pregnancy rates to timed insemination achieved in this study to be acceptable.

Acknowledgements

We thank Losey Bros., Agra, KS and Stephanie Eckroat, Hays, KS for cooperation and assistance in the completion of this experiment.

The authors appreciate the donations of Lutalyse® from Pharmacia and Upjohn and Factrel® from Fort Dodge Animal Health.

Table 1. Pregnancy Rates in Control or Timed Bred Heifers after Synchronization with MGA/PGA

	Synchrony Period *		Season Long **	
	Control (%)	Timed Bred (%)	Control	Timed Bred (%)
Herd 1	28/59 (47.5) [a]	23/59 (39) [b]	49/59 (83.1)[a]	41/59 (69.5)[b]
Herd 2	227/342 (66.4) [a]	51/99 (51.5) [b]	324/342 (94.7)	93/99 (93.9)
Combined	255/401 (63.6)[a]	74/158 (46.6)[b]	375/401 (93)[a]	134/158 (84.8)[b]

* Synchrony period = 0 to 120 hours after PGF
** Entire Breeding Season 53 - 60 days
[a,b] Means differ P<0.05

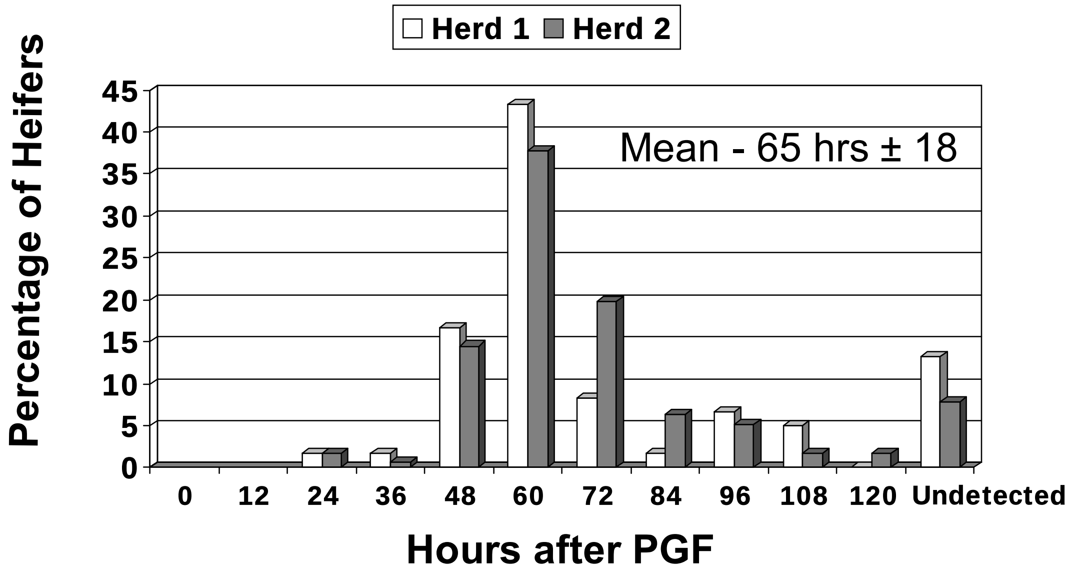


Figure 1. Timing of estrus in control heifers.

Effect of Feeding Sunflower Seeds to Mature Beef Cows on Reproduction and Calf Performance

S.K. Johnson, J.S. Stevenson, K.R. Harmoney, and J.R. Brethour
Livestock Extension Specialist; Reproductive Physiologist, Range Scientist, and Beef Cattle Scientist

Introduction

Evidence increasingly indicates that supplementing cow diets with fat can improve both postpartum reproduction and calf survival. Calf weaning weights have also been reported to be heavier from cows receiving fat supplementation. The addition of fat to postpartum cow diets has been shown to increase follicular growth, increase concentrations of progesterone and increase the number of early postpartum cows with luteal activity. All these changes are associated with the resumption of estrous cycles in postpartum cows. In addition, research has shown that pregnancy rates improved with feeding supplemental fat to first calf heifers and mature cows. Feeding oilseeds such as sunflower or safflower to first calf heifers prior to calving improved cold tolerance as measured by a rectal temperature response to cold exposure. The improved cold tolerance has been related to more glucose available for metabolism and heat production and possibly more brown adipose tissue.

Most data available to date has been on feeding supplemental fat to first calf heifers. The precise length of supplementation required to achieve enhancement in reproductive performance is unknown. Because fat supplementation pre-calving has slightly increased birth weight, although not calving difficulty, this area requires further study.

The objectives of the current study were to determine the effects on cow reproductive performance, body condition, and calf performance from feeding a locally available source of fat, sunflowers, fed to mature cows either pre-calving, post-calving, or both.

Materials and Methods

Two hundred and seventy-seven mature (3 – 12 yrs of age) Angus, South Devon, and Simmental cross cows were fed a low fat (2.6%) or high fat (32.1%) supplement, either pre-calving or post-calving, in a 2x2 factorial arrangement of treatments. Cows were assigned to treatments by expected calving date, age, winter feeding group and weight. The primary ingredient in the high fat supplement was sunflower seeds that had been processed through a roller mill to crack the hulls. The low fat supplement was composed primarily of ground milo and soybean meal and was developed so that the two supplements would be isocaloric and isonitrogenous. Cows also received 25 lbs of sorghum-sudan hay each day.

Supplements were group fed and began an average of 64 days prior to calving. Cows were managed in four groups based on supplement type and calving group. Cows that had conceived to a timed insemination were in the early calving group and those that conceived to natural service were in the late calving group. The post-calving supplementation started approximately one week after calving. Each week, pairs were moved from their pre-calving supplementation group to the post-calving supplementation group. Post-calving supplementation was continued through a 5-day AI period, at which point all cows were taken to summer pastures. The average length of the post-calving supplementation period was 76 days.

Cow body condition and backfat were measured in January at the start of pre-calving supplementation, in February just prior to calving (late-calving cows were worked two weeks after the early calving group), at the start of the breeding season in May, and at weaning time in September. Scale problems prevented cow weight information in January and February, but weights were obtained at subsequent time points.

To determine the proportion of cows cycling prior to the start of the breeding season, two serum samples were collected 14 days apart in conjunction with the administration of Prostaglandin F_2" (Lutalyse®, PGF) used to synchronize estrus. Cows with concentrations of progesterone > 1 ng/ml at one or both samples were considered to have resumed normal estrous cycles prior to the beginning of the breeding season. The breeding season began on the day of the second PGF injection and cows were inseminated 6-12 hours after estrus was observed. Cows were exposed to bulls (1:38) for an additional 53 days beginning 9 days after the last cow was inseminated. Artificial insemination (AI) conception rate was determined by ultrasonography 44-50 days after AI. Pregnancy rate for the entire breeding season was determined via palpation 45 days after bulls were removed.

Results and Discussion

There was no effect of type of supplement fed pre-calving on reproductive measures. However, the proportion of cows cycling at the beginning of the breeding season and the pregnancy rate to AI was greater ($P<.05$) for cows receiving milo as compared to sunflowers post-calving, 74% vs 65% and 44% vs 32%, respectively. Pregnancy rate for the entire breeding season (95.4%) did not differ due to treatment. Other research showed an average of 53% of mature cows cycling at the onset of the breeding season in 1,718 mature cows sampled from herds in Kansas. Given the relatively high percentage of cows cycling at the beginning of the breeding season in this study, it is not surprising that the addition of fat to the diet had no beneficial effect.

Cows fed sunflowers pre-calving had less backfat just prior to calving (1.5 mm vs 1.9 mm) and a greater loss in body condition score (-.2 vs -.1) and backfat (-.4 mm vs -.1 mm) from January to February as compared to controls. Cows receiving the milo supplement pre-calving experienced a greater decrease in backfat from February to May than Sunflower supplemented cows (-.9 mm vs -.7 mm).

Post-calving supplementation with milo resulted in a higher body condition score and less backfat loss from February to May than the sunflower cows (5.2 vs 4.7 and -.3 mm vs -.6 mm, respectively). The only difference noted in cow weights was in May when cows receiving milo post-calving were heavier than cows receiving sunflowers (1094 lbs vs 1060 lbs). These differences in cow weight and condition may explain the increased proportion of cows cycling and becoming pregnant to AI in the cows that received milo post-calving. The change in body condition from May to September was positive for cows fed sunflowers post-calving (.3) and negative for cows fed milo (-.1).

Calf birth weights averaged 90 lbs and did not differ with treatment. The time from birth to when the calf was standing was similar between treatments (mean=32 minutes). The weather during the calving season was relatively mild and thus no natural test of calf vigor occurred. There was a significant Pre x Post supplementation type interaction for the May calf weight. This was due to calves whose dams had received sunflowers post-calving being heavier than calves whose dams had received milo post-calving if they received milo pre-calving, but weights decreased if they had received sunflowers pre-calving. Calf weight gain from May to September was greater in the group that was fed milo post-calving.

The beneficial effects observed in other studies from feeding supplemental fat were not detected in this study. The cows used in this study were in an acceptable body condition when they started the study, lost some body condition during lactation, but still averaged a body condition score of 5 at weaning. It is not clear if supplemental fat may be beneficial for cows in poorer body condition and/or experiencing more challenging winters. This study supports many others that show the importance of body condition late in gestation and weight change prior to breeding on reproductive performance.

Acknowledgements

We thank the following individuals for technical assistance with this project: Betty Hensley, Stacy Campbell, Justin Gleghorn, and Les Wankel.

The authors appreciate the donation of Lutalyse® from Pharmacia and Upjohn.

Table 1. Cow data.

	No.	Jan. BCS	Jan. BF (mm)	Feb. BCS	Feb. BF (mm)	Change BCS (J-F)	Change BF (J-F; mm)
Pre-calving							
Milo	133	5.5	2.0	5.4	1.9[a]	-.1[a]	-.1[a]
Sunflowers	136	5.5	1.9	5.3	1.5[b]	-.2[b]	-.4[b]

	No.	May BCS	May BF (mm)	May Wt.	Change BCS (F-M)	Change BF (F-M; mm)	% Cycling	AI Preg. Rate	Preg. Rate
Pre-calving									
Milo	133	5.0	1.0	1074	-.4	-.9[a]	66%	37%	94%
Sunflowers	136	4.9	.9	1080	-.5	-.7[b]	73%	39%	96%
Post-calving									
Milo	135	5.2[a]	1.0	1094[a]	-.3[a]	-.8	75%[a]	44%[a]	96%
Sunflowers	134	4.7[b]	.9	1060[b]	-.6[b]	-.8	64%[b]	32%[b]	94%

	No.	Sept. BCS	Sept. BF (mm)	Sept. Wt.	Change BCS (M-S)	Change BF (M-S; mm)
Pre-calving						
Milo	133	5.0	.9	1207	0.0	-0.1
Sunflowers	136	5.0	.9	1218	0.1	0.0
Post-calving						
Milo	135	5.0	.9	1216	-.1[a]	-0.1
Sunflowers	134	5.0	.9	1209	.3[b]	0.0

* Time from birth to calf standing, minutes.
[a, b] Means differ (P<.05)

Table 2. Calf data.

	No.	Birth Wt.	Up*	May Wt.	Sept. Wt	Gain (M-S)
Pre-calving						
Milo	136	88	32	228	523	2.2
Sunflowers	136	91	32	229	524	2.2
Post-calving						
Milo	134			228	528	2.3[a]
Sunflowers	132			229	519	2.2[b]

* Time from birth to calf standing, minutes.
[a, b] Means differ (P<.05)

Variations of the CoSynch Protocol for Timed Breeding in Postpartum Beef Cows

S.K. Johnson[1], D.E. Grum[2], M.L. Day[2]
[1]K-State Livestock Extension Specialist, [2]Ohio State University

Summary

The objective of this study was to determine if the responsiveness of postpartum beef cows to a GnRH-PGF (CoSynch) synchronization system could be improved by addition of a progestin or by increasing the responsiveness of follicles to GnRH. Postpartum beef cows (n=1035) from two herds (10 locations) were assigned by calving date and age to one of four treatments. All cows received an injection of $PGF_2\alpha$ (25 mg, i.m.) on day 0 and GnRH (100 μg, i.m.) on day 2 at timed insemination. Treatments were: 1) 100 μg GnRH, on day -7 (GnRH-PGFCoSynch); 2) 100 μg GnRH on day -14 and day -7 (+GnRH); 3) 100 μg GnRH, on day -7 and an intravaginal insert (CIDR-B) containing 1.38 g of progesterone from day -7 to 0 (GnRH/CIDR); 4) CIDR-B from day -7 to 0 (CIDR). Pregnancy rate to timed insemination was lower (P<.05) in CIDR (39%) vs GnRH-PGF Cosynch (47%). Pregnancy rates in +GnRH (50%) and GnRH/CIDR (45%) were similar to GnRH-PGFCoSynch. For cows < 60 days postpartum (n=297), pregnancy rate was higher (P<.05) for cows in +GnRH compared to GnRH-PGF CoSynch (53% vs 36%, respectively). An additional injection of GnRH one week prior to the CoSynch treatment was beneficial for cows less than 60 days postpartum at breeding. The addition of a CIDR to the CoSynch system did not improve pregnancy rates and reduced pregnancy rates if GnRH was not given at the time of CIDR insertion.

Introduction

The use of estrous synchronization systems for timed insemination that include an injection of GnRH, an injection of PGF 7 days later and a second injection of GnRH 48 hours after PGF are increasingly being applied in beef cattle. Two limitations of this approach are its effectiveness in anestrous cows and the failure to synchronize ovulation in a portion of cyclic cows. Short-term exposure to progestins will induce the onset of estrous cycles in a proportion of anestrous cows. An injection of GnRH will induce ovulation and provide a source of progestin exposure in anestrous cows, but the response is variable. In cows on days 13-17 of the estrous cycle at the time of GnRH treatment, the dominant follicle does not ovulate or becomes atretic, resulting in estrus 5-7 days later, or 2-4 days before timed insemination. Providing an exogenous source of progestin during the period between the first GnRH injection and PGF is one possible solution to this problem. Alternatively, the probability that ovulation will occur in response to the initial GnRH injection may be enhanced by a pretreatment with GnRH.

The objective of this study was to determine if the responsiveness of postpartum beef cows to a GnRH-PGF synchronization system for timed insemination could be improved by the addition of a progestin or an additional injection of GnRH.

Materials and Methods

Spring calving, postpartum beef cows from 2 herds (Kansas and Ohio) were assigned by days postpartum and age to one of four treatments (Table 1). Cows used in Kansas were from the Agricultural Research Center–Hays and those in Ohio were owned by Shugert Farms, Lore City, OH. Cows included in the study were at least 30 days postpartum at the time of insemination in Kansas and at least 24 days in Ohio. All cows received a 25 mg injection of PGF (Lutalyse®) on day 0 and a 100 μg injection of GnRH (Cystorelin®) on day 2 immediately after timed insemination. Treatments (Figure 1) were: 1) 100 μg GnRH, on day -7 (GnRHCoSynch-PGF); 2) 100 μg GnRH on day -14 and day -7 (+GnRH); 3) 100 μg GnRH, on day -7 and an intravaginal insert containing 1.38 g of progesterone (CIDR-B®) from day -7 to 0 (GnRH/CIDR); 4) CIDR-B® from day -7 to 0 (CIDR).

Serum progesterone was determined in 50 primiparous and 98 multiparous cows in Kansas to determine the proportion of animals cycling prior to the onset of treatments. The multiparous cows represented the last 40% of the herd to calve. Samples were taken on days -14 and -7 for GnRH-PGFCoSynch, GnRH/CIDR and CIDR and on days -21 and -14 for +GnRH cows. Cows were classified as anestrous if concentrations of progesterone were < 1 ng/ml in both samples or classified as cycling if concentrations of progesterone in one or both samples were > 1 ng/ml.

Cows were inseminated to one of four sires in Kansas and one of 6 sires in Ohio. Natural service sires were placed with the cows 10 - 26 days after the timed insemination for the remainder of the breeding season. Pregnancy was diagnosed by transrectal ultrasound between 75 and 50 days following timed insemination.

Results and Conclusions

Pregnancy rate to timed insemination was lower (P<.08) in CIDR (39%) than GnRH-PGF CoSynch (47%). The reduction in pregnancy rate in the CIDR group may be a reflection of the importance of GnRH in setting up the timing of follicular growth in a timed insemination program. Pregnancy rates in +GnRH (50%) and GnRH/CIDR (45%) were similar to GnRH-PGFCoSynch. Other studies have reported a 0-10% improvement in pregnancy rate from the addition of a CIDR to the CoSynch protocol. Discrepancies in results may be related to the proportion of cows cycling in each study.

Cows less than 60 days postpartum on day 0 had a lower (P<.05) pregnancy rate (39%) compared to cows 60-80 days postpartum (50%) or > 80 days postpartum (47%). For cows < 60 days postpartum (n=297), pregnancy rate was higher (P<.05) for cows on +GnRH compared to GnRH/PGF (53% vs 36%, respectively).

An additional injection of GnRH one week prior to the CoSynch treatment may be beneficial for cows less than 60 days postpartum at breeding. The addition of a CIDR to the CoSynch system did not improve pregnancy rates and reduced pregnancy rates if GnRH was not given at the time of CIDR insertion.

Acknowledgements

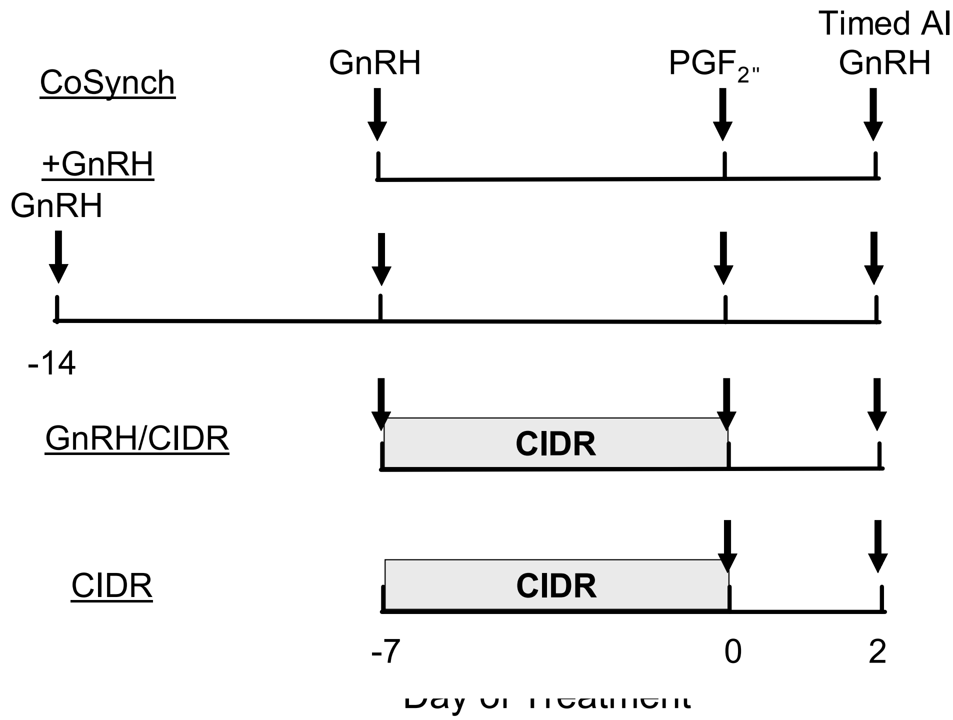
We thank Shugert Farms, Lore City, Ohio and Stephanie Eckroat, Hays, KS for cooperation and assistance in the completion of this experiment.

The authors appreciate the donations of Lutalyse® from Pharmacia and Upjohn, Cystorelin® from Merial and CIDR-B® from Dec-Interag.

This study was supported by a grant from Select Sires.

Table 1. Description of cows used in study.

		Days Postpartum at AI	
Cow Age	Number	Range	Mean ± SD
Kansas			
primiparous	50	52 - 120	95 ± 14
multiparous	231	30 - 104	59 ± 14
Ohio			
primiparous	139	37 - 104	83 ± 15
multiparous	618	24 - 126	70 ± 18
Total	1038		71 ± 19



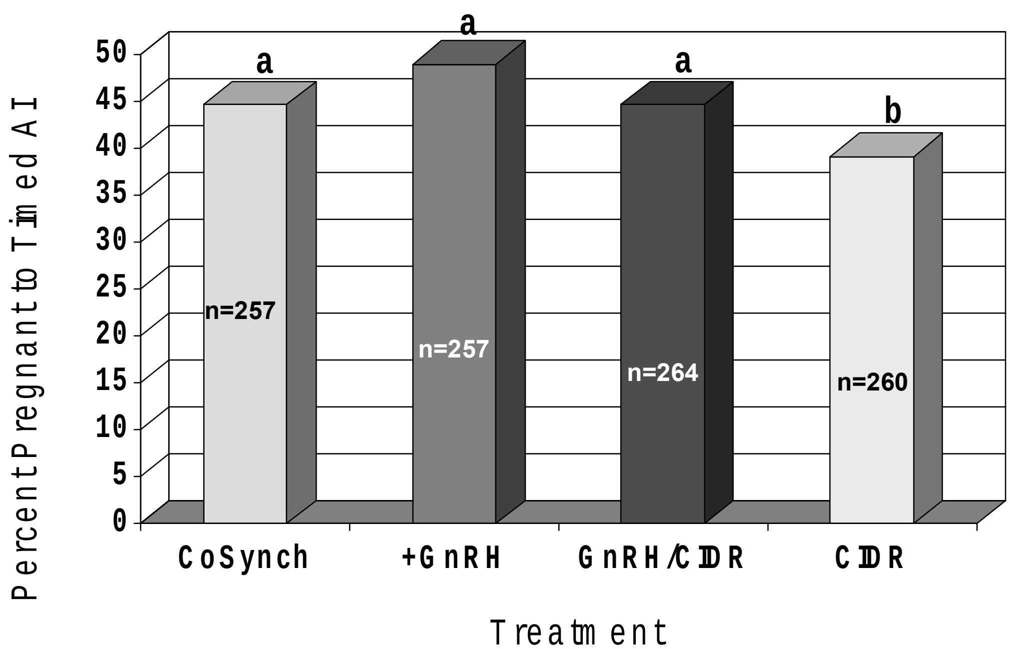
PGF_2" – Lutalyse® (Pharmacia and Upjohn) 25 mg, i.m.
GnRH – Cystorelin® (Merial) 100 μg, i.m.
CIDR – CIDR-B® (DEC-InterAg) contained 1.38 g progesterone

Figure 1. Schedule of Treatments.

Table 2. Pregnancy rate in cyclic and anestrous cows in response to timed insemination.

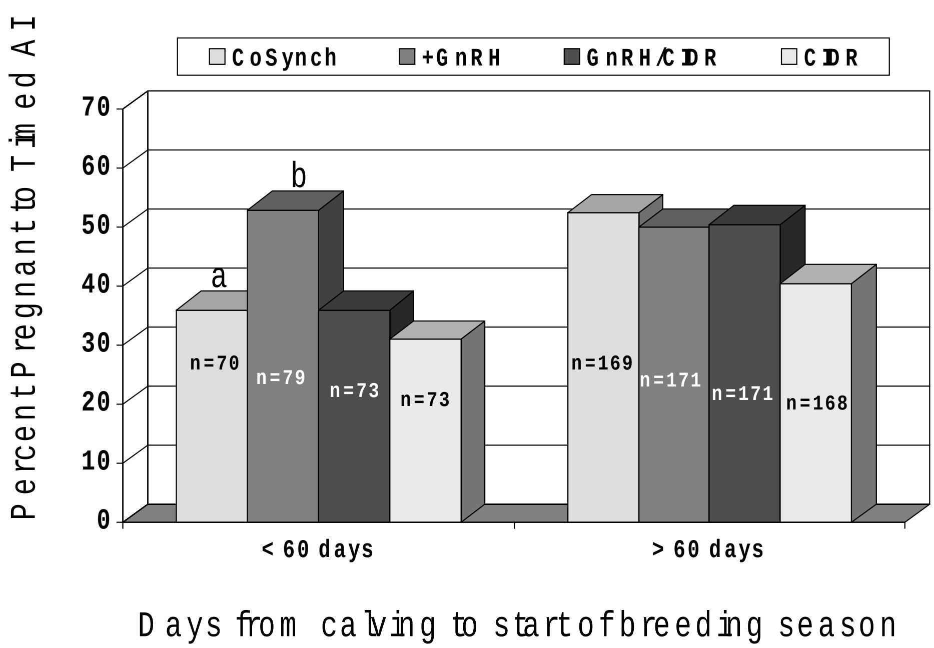
	Total	GnRH-PGF	+ GnRH	GnRH-CIDR	CIDR
Primiparous					
Total	50	13	13	12	12
Cycling (%)		5/9 (56)	3/4 (75)	5/10(50)	6/9 (67)
Anestrous (%)		1/4 (25)	4/9 (44)	1/2 (50)	2/3 (67)
Multiparous					
Total	98	24	25	25	24
Cycling (%)		3/8 (35)	2/4 (50)	5/10 (50)	3/13 (23)
Anestrous (%)		8/16 (50)	9/21 (43)	3/15 (20)	4/11 (36)

Primiparous cows, 36% anestrus, 52 to 120 days postpartum (x = 95 d)
Multiparous cows, 64% anestrus, 30 to 61 days postpartum (x = 47 d)



a,b Means with different superscripts differ, P<.08

Figure 2. Pregnancy rate to timed AI.



a,b Within days, means with different superscripts differ, P<.05

Figure 3. Effect of interval between calving and breeding on pregancy rate.

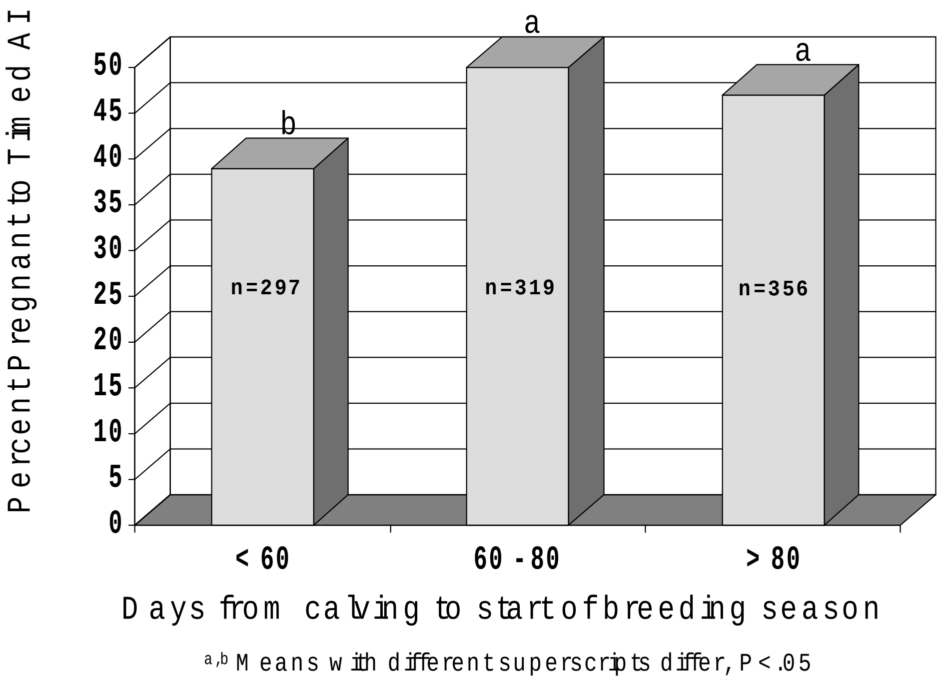


Figure 4. Effect of interval between calving and breeding on pregnancy rate.

Growth Characteristics and Development of Perennial Complementary Cool-Season Grasses for Grazing

Keith Harmoney, Carlyle Thompson, John Brethour, and Sandy Johnson
Range Scientist, Soils Scientist, Beef Scientist,
and Livestock Extension Specialist

Summary

Ten cool-season grass varieties were evaluated for first-year growth in the variable climate of west-central Kansas. Introduced grasses had greater initial seedling density, tiller density, and dry matter production than did native western wheatgrass. ‘Slate’ intermediate wheatgrass and ‘Lincoln’ smooth bromegrass had the two best overall ratings for summer production. All introduced grasses also had greater growth than native western wheatgrass during the fall period.

Introduction

The major cost of cow/calf operations for west-central Kansas, beside the cost of original animal purchase, is stored feed cost for winter diets. Of the 1.55 million mature cows and heifers that calved during 1997 in Kansas, 151,000 were in a nine county area surrounding Hays, KS (USDA, 1997). Winter feeding in this geographic region typically lasts 4-5 months, from November or December until April. In just one month, producers could incur more than $3 million in opportunity costs for winter feeding fair quality hay to 151,000 cows and heifers at fall 2000 hay prices. The ability of a producer to manage systems that utilize grazed forages during the late fall, winter, and early spring months could drastically reduce the cost of buying or attaining stored feed, as well as reduce labor inputs during those time periods. Winter grazing of cool-season forage is utilized extensively in parts of Texas, Oklahoma, and southern Kansas, but has not been used to its potential as a common source of winter feed in west-central Kansas. Cool-season grasses need to be evaluated for their potential as complementary forage.

The objectives of this study to:

1) Quantify early spring initial growth, spring regrowth, and fall growth distribution characteristics of perennial cool-season grasses for grazing system compatibility with native range.
2) Quantify plant and tiller densities to evaluate summer and winter survival of cool-season grasses following defoliation from grazing.
3) Develop an understanding of relationships between morphological advancement, leaf growth rates, canopy biomass, forage quality, and growing degree days for initial growth and regrowth of these perennial cool season grasses.

Materials and Methods

Ten perennial cool-season grass cultivars were selected for testing. These were smooth bromegrass (SB) cv. ‘Lincoln’, intermediate wheatgrass (IW) cvs. ‘Slate’ and ‘Oahe’, tall wheatgrass (TW) cvs. 'Jose' and 'Alkar', pubescent wheatgrass (PW) cvs. 'Manska' and 'Luna', Russian wildrye (RW) cv. 'Bozoisky', and western wheatgrass (WW) cvs. 'Barton' and 'Flintlock'. Cultivars were spring seeded at two sites (10 Apr 00 and 28 Apr 00) into four replications per site for evaluation as complementary forages to be grazed during the spring, fall, and possibly winter. Species and cultivars were selected because of suggested tendencies for adaptation to west-central Kansas.

After seeding, seedling densities were counted within two 0.2-m^2 frames from each plot. Stands were counted again for tiller density after plants had established in mid-summer. Forage was clipped from a 0.1 m^2 area from two locations in each plot during the summer to determine yield.

Individual tillers from each variety were randomly selected and identified within each plot. At 3.5 day intervals, length of the most recently developed leaf was measured. When a measured leaf formed a collar and stopped elongation, leaf width was also measured. Stage of maturity of each tiller was also noted. Density, yield, maturity, and leaf elongation were measured during both the summer and fall. Results included in this report are for the establishment year only. Grazing will be initiated the second year of the stand for evaluating effects of animal interaction on forage growth.

Results and Discussion

Emergence of all grass varieties occurred within three days of each other. During the establishment phase of these grasses, all intermediate, pubescent, and tall wheatgrass varieties had similar seedling densities and were similar to smooth bromegrass (>350 seedlings m^{-2}). Both western wheatgrass varieties and the Russian wildrye variety tended to have lower seedling densities and seedling growth than most other cultivars. Seedling densities for all grasses were above the level acceptable to develop adequate stands for grazing.

After 10 weeks of growth, plant densities were hard to discern, and tiller densities were used for comparison of cultivars. 'Jose' TW had the greatest tiller density, followed by 'Slate' and 'Oahe' IW, and 'Alkar' TW (Table 1). 'Slate' IW had the greatest dry matter production by this time with 1388 kg ha^{-1} of dry matter forage, followed by 'Manska' PW and 'Oahe' IW (Table 1). Once again, the western wheatgrasses and Russian wildrye had significantly lower tiller densities and dry matter production than the top cultivars. Tiller density had a strong relationship with dry matter production, with more than 50% of the variation in dry matter production attributed to tiller density.

The Haun index is used to compare morphological development of the different cultivars. Since all grasses were spring seeded and were not induced to flower, all growth during the summer was vegetative in form rather than reproductive. The Haun index value in this instance indicates the relative number of photosynthetically active leaves present on each tiller during a given period of time. The greater the index value, the greater the number of retained green leaves. Smooth bromegrass had the greatest number of retained leaves, with a Haun value of 6.1. The two western wheatgrass cultivars were close behind with 5.3 and 5.2 retained leaves, respectively. 'Bozoisky', 'Oahe', and 'Slate' followed with more than 4 retained active leaves.

Leaf growth rate has also been correlated with grass dry matter yield in other studies. 'Lincoln' SB had the greatest leaf growth rates of 7.4 cm per 3.5 d interval, while 'Bozoisky' RW had 6.3 cm of growth per 3.5 d interval (Table 1). 'Oahe', 'Slate', 'Flintlock', 'Manska', and 'Luna' were statistically equal with 5.0-6.0 cm of growth per 3.5 d interval. Leaf growth and dry matter yield were not highly correlated during the first 10 weeks of growth. Grasses with the greatest leaf growth rates per 3.5 d interval tended to have lower tiller densities, while grasses with the greatest tiller densities tended to have much lower leaf growth rates.

All cultivars were given a ranking for initial summer growth. Rankings were from 1-10, with 1 being the highest rank or the greatest value for each of four traits: tiller density, dry matter production, Haun index, and leaf growth per interval. 'Slate' IW had the greatest combined rank of all grasses (Table 2). 'Slate' ranked highly in tiller density and dry matter production, while its middle ranking in Haun index and leaf growth rate kept it from being the overwhelming top producer up to this point. 'Lincoln' also had a high combined rank score, but lower dry matter production and tiller density limited its combined ranking. 'Oahe' and 'Manska' were the only other cultivars close to 'Slate' or 'Lincoln' in combined score ranking.

Fall growth was less than summer growth for all grasses. More than 150 mm of precipitation fell during late June and July, allowing cool-season grasses to remain productive even with increasing temperatures. August and September were extremely dry and hot, and cool-season grasses did not show any significant growth. Although early October temperatures were better suited for cool-season grass growth, dry conditions still limited leaf elongation. 'Alkar' TW had one of the lowest summer leaf elongation rates, 4.3 cm per 3.5 d growing period (Table 1), but also had the highest leaf elongation rate during early fall (2.3 cm per 3.5 d growing period) (Table 3). 'Alkar' growth rate was significantly greater than 'Jose' TW growth, even though both varieties are of the same species. All non-native cool-season grasses showed greater fall leaf elongation than the native western wheatgrass varieties (Table 4).

This work gives an early indication of possible cool-season grass species and varieties best adapted to west-central Kansas. Since leaf production tends to be greater in forage quality and is selected for consumption by grazing animals, greater leaf production in a complementary cool-season grass is desirable. Leaf extension has also been shown to be highly correlated with forage yield. Early measurements show that several introduced species and cultivars showed greater or equal leaf growth to native western wheatgrass. These introduced grasses show great potential for growth and production for grazing animals. Late summer climate in west-central Kansas was extremely hot and dry in 2000, yet all grass species and cultivars showed acceptable tiller densities during fall measurement. Ability to survive hot, dry summer conditions is requisite of grasses to be implemented in grazing systems.

Future Work

Tiller densities following winter stress also need to be determined. Great extremes between hot, dry summers and cold winters may limit the number of cool-season grasses that will maintain acceptable tiller densities for grazing. Furthermore, exposure to stress from grazing animals and regrowth following grazing needs to be examined. Grazing stress combined with the extreme weather conditions may alter growth habits seen during the first establishment season. Repeated summer heat stress, drought stress, winter cold stress, and grazing stress will further indicate which of these grasses has characteristics that will enable them to persist and maintain stands for grazing. Continued tiller density, leaf growth, morphology, and forage quality measurements will take place to investigate which species and cultivars will be most persistent and productive in the central Kansas environment.

Table 1. Ten week growth summary of 10 cool-season perennial grasses.

Grass	Density (tillers m^{-2})†	Grass	Dry Matter (kg ha^{-1})†
‘Jose’ tw	1589a	‘Slate’ iw	1388a
‘Slate’ iw	1290ab	‘Manska’ pw	1311ab
‘Oahe’ iw	1224ab	‘Oahe’ iw	1185abc
‘Alkar’ tw	1218ab	‘Jose’ tw	966bcd
‘Manska’ pw	1172b	‘Luna’ pw	939bcd
‘Luna’ pw	919bc	‘Alkar’ tw	922bcd
‘Bozoisky’ rw	738cd	‘Lincoln’ sb	878cde
‘Lincoln’ sb	584cde	‘Barton’ ww	746de
‘Barton’ ww	522de	‘Bozoisky’ rw	565de
‘Flintlock’ ww	359e	‘Flintlock’ ww	465e

Grass	Haun Index†	Grass	3.5 Day Leaf Growth (cm)†
‘Lincoln’ sb	6.1a	‘Lincoln’ sb	7.4a
‘Barton’ ww	5.3b	‘Bozoisky’ rw	6.3ab
‘Flintlock’ ww	5.2b	‘Luna’ pw	5.6bc
‘Bozoisky’ rw	4.6c	‘Manska’ pw	5.5bcd
‘Oahe’ iw	4.4cd	‘Flintlock’ ww	5.2bcd
‘Slate’ iw	4.1de	‘Slate’ iw	5.1bcd
‘Manska’ pw	3.9e	‘Oahe’ iw	5.0cd
‘Luna’ pw	3.8ef	‘Barton’ ww	4.8cde
‘Jose’ tw	3.5f	‘Alkar’ tw	4.3de
‘Alkar’ tw	3.5f	‘Jose’ tw	3.7e

†Values with the same letter are statistically equal.

Table 2. Initial growth combined rank score of 10 perennial cool season grasses.

Grass	Score
‘Slate’ iw	15
‘Lincoln’ sb	17
‘Oahe’ iw	18
‘Manska’ pw	18
‘Luna’ pw	22
‘Bozoisky’ rw	22
‘Jose’ tw	24
‘Barton’ ww	27
‘Flintlock’ ww	28
‘Alkar’ tw	29

Table 3. Fall growth summary of 10 cool-season perennial grasses.

Grass	Haun Index†	Grass	3.5 Day Leaf Growth (cm)†
‘Barton’ ww	4.1a	‘Alkar’ tw	2.3a
‘Flintlock’ ww	4.1a	‘Luna’ pw	2.2ab
‘Lincoln’ sb	3.9ab	‘Manska’ pw	2.1ab
‘Jose’ tw	3.3bc	‘Lincoln’ sb	1.9ab
‘Alkar’ tw	3.2c	‘Slate’ iw	1.9ab
‘Manska’ pw	3.2c	‘Bozoisky’ rw	1.8ab
‘Slate’ iw	3.2c	‘Jose’ tw	1.7b
‘Oahe’ iw	3.1c	‘Oahe’ iw	1.7b
‘Luna’ pw	3.0c	‘Flintlock’ ww	0.8c
‘Bozoisky’ rw	2.9c	‘Barton’ ww	0.6c

†Values with the same letter are statistically equal.

Control and Utilization of Japanese Brome

Keith Harmoney
Range Scientist

Summary

Pastures containing dense stands of Japanese brome were subjected to prescribed burning or early grazing to control or utilize the cool-season invader. Burning, grazing, and a combination of burning and grazing all reduced the density of Japanese brome in pastures. Burning, grazing, and burning and grazing all produced similar quantities of residual dry matter as that of the idle control pasture by the end of the growing season.

Introduction

Annual bromes, namely Japanese brome and downy brome, are regarded as highly invasive, noxious weeds. They are non-native, winter annual grasses that begin growth in the late fall or early winter and mature quickly the following spring. They have invaded cropland under cultivation as well as under fallow, and are commonly found in great concentrations in several native rangeland areas. Annual bromes are high quality forages at immature growth stages, but become lower in quality and unpalatable to grazing animals when mature and seed heads are produced. Stems become lignified and less digestible, and awns and calluses in the seedhead become rigid, stiff, and sharp. Utilization and control of annual brome in short-grass rangeland has not recently been investigated in west-central Kansas. Because it is a cool-season grass, herbicides used to control Japanese brome would also tend to reduce composition of desired cool-season grasses, such as western wheatgrass, on native rangeland. Control measures are then limited to animal management and other cultural practices. Burning and grazing management are two low input practices most likely to affect Japanese brome concentrations. This study was initiated to investigate management practices for the control and utilization of Japanese brome.

Methods

A pasture with high density of annual brome was divided into paddocks of three replications of four treatments, for a total of 12 paddocks. Treatments under investigation are a control (idle rangeland with no grazing or burning), prescribed spring burning, early spring grazing, and a combination of early spring burning and grazing. Annual brome density was measured in four permanent plots within each paddock by counting annual brome plants before treatment application. Two permanent transects also were placed in each paddock to follow range plant vegetative trends. Annual brome densities were again counted following treatment application. Biomass was determined at the start and end of the growing season by clipping standing vegetation from two frames in each paddock. Population of annual bromes, differences in litter composition, and other vegetative composition changes were measured.

Prescribed burning treatments were applied on 12 Apr 00, with wind conditions less than 10 mph from the southeast, 82% relative humidity, and a temperature of 37^{o}F. Grazing only treatments were applied 26-28 Apr 00, and again 30 May 00 to 8 June 00. Grazing was applied to the burned and grazed combination treatments between 30 May 00 and 8 June 00.

Results and Discussion

The annual brome population among treatment paddocks did not differ in mid-March before treatments were applied. Population ranged from 83 plants/ft^2 to 119 plants/ft^2 (Figure 1). Annual brome density in all paddocks under investigation averaged 101 plants/ft^2 at the inception of the study.

Annual brome densities following treatment applications in the grazed, burned, and burned and grazed paddocks was significantly lower than the idle treatment (Figure 1). Idle paddocks contained an average of 108 plants/ft^2. Grazed only paddocks averaged 51 plants/ft^2, while the burned and the burned and grazed combination averaged 29 and 35 plants/ft^2, respectively. Both the burned and burned and grazed combination reduced annual brome densities significantly from their first observations. Grazed only paddocks averaged 32 plants/ft^2 less than the first observation, but this difference was not statistically significant.

The presence of annual brome and the use of prescribed burning may alter moisture characteristics of the soil profile. Annual brome utilizes moisture early in the spring that would be available to desirable grasses later in their growth period. Burning blackens the soil surface and may increase soil surface temperatures, reduce litter and shading, thus exposing the soil profile to more rapid drying. The grazed only treatment had greater moisture content than either of the treatments that included burning. In a 12-inch soil profile 0.75 inches in diameter, the grazed only paddocks averaged 3.72 inches of moisture, while the burned and burned and grazed pastures averaged 3.40 and 3.41 inches/ft of moisture respectively.

Since bulk densities affect holding capacity of soils, moisture was also determined based on a percentage of the soil dry weight. Grazed only paddocks had 19.8% moisture, and were significantly different than the burned only and the grazed and burned combination, which had 18.4% and 18.2% moisture, respectively. The idle paddocks were not different than any of the other three treatments, averaging 19.2% soil moisture, or 3.67 inches/ft of soil. The greater presence of annual bromes in the control treatment may have slightly reduced the moisture content compared to the grazed only, but did not reduce the soil moisture as much as either of the burned treatments.

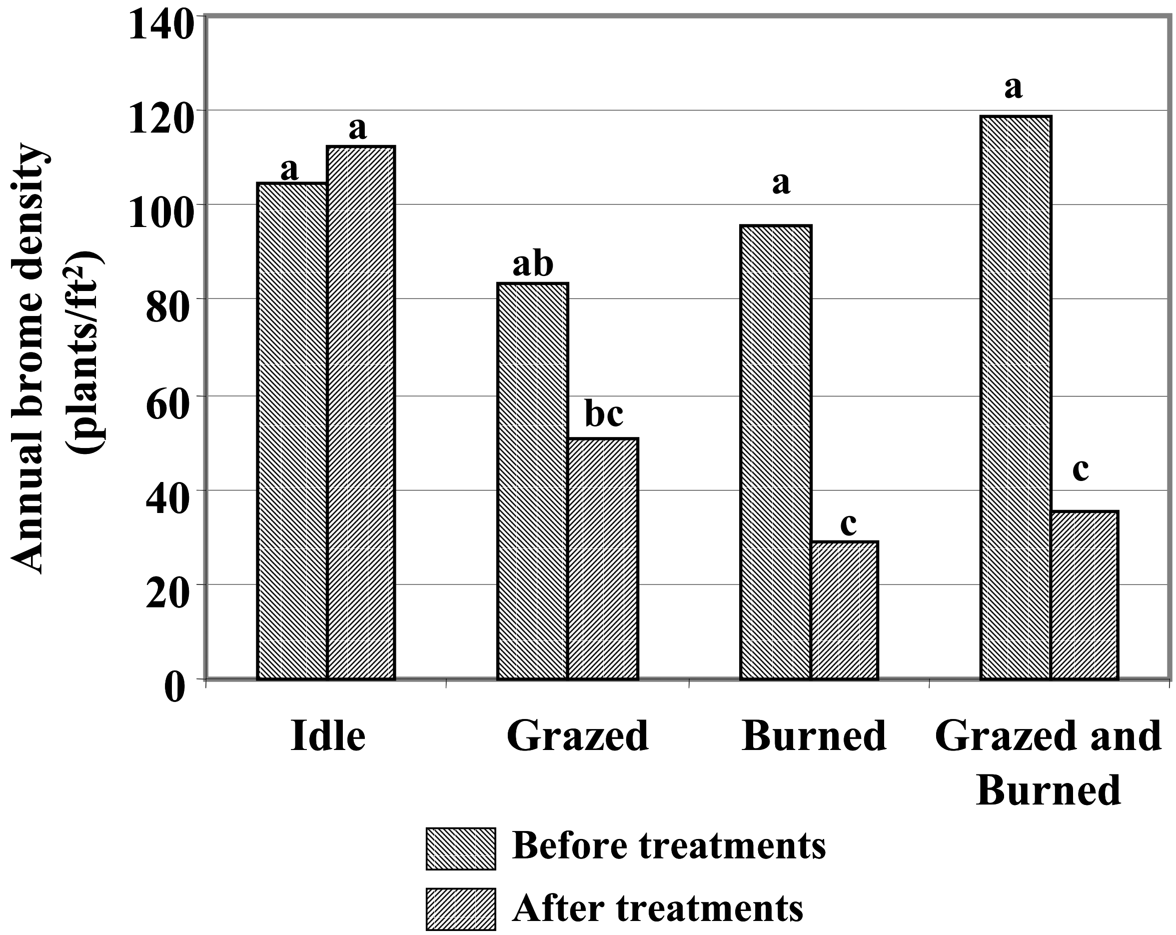
End of season dry matter residue was not different among management treatments. Idle, grazed, burned, and burned and grazed areas had 2307, 2305, 1999, and 1819 lb/ac, respectively.

Range condition of the treatments was quite similar among paddocks. The idle, burned, and burned and grazed combination paddocks were in fair to good range condition with 49.8, 50.1, and 54.3% of climax vegetation, respectively. The grazed only paddocks contained 66.4% of climax vegetation, which was mostly attributed to a greater concentration of big bluestem.

Management systems to either utilize or control annual bromes showed that both methods have potential to reduce populations of the noxious weeds. Utilization of the early season forage through early grazing would allow producers to get some benefit from the presence of annual brome species. Grazing early also conserved moisture, which would have the potential benefit of more moisture available for more desired native species later in the season. Although burning reduces litter and standing residue, end of season biomass was not different between treatments with burning and treatments without burning. Burning currently shows no detrimental effects compared to the idle or grazed only treatments. Populations of invasive weed species in burned treatments were less than or equal to idle and grazed treatments, and dry matter production was equal.

Future Work

Annual measurements over the course of several years need to take place. Repeated prescribed burning may eventually result in lower production and dry matter accumulation, especially during years of low precipitation. Trends in both the annual brome populations and the native rangeland vegetation in response to early grazing and prescribed burning combinations will be closely monitored. Effects of treatments on soil moisture status will also continue. Several years of data need to be collected in order to fully realize whether treatments are effective or if patterns of precipitation are more effective in manipulating annual brome populations.



†Bars with the same letter are statistically equal.

Figure 1. Annual bromegrass densities from permanent plots within each treatment, before and after treatment application.†

Modified Intensive-Early Stocking on Shortgrass Rangeland

Keith Harmoney and John Brethour
Range Scientist and Beef Scientist

Summary

Modified intensive-early stocking places more animals on pasture early in the season compared to season-long continuous stocking, but then also leaves a portion of the animals on pasture during the last half of the season. Modified intensive-early stocking at a 1.6X rate early in the season was evaluated to determine animal production and carcass quality. Average daily gain and mean total individual animal gain were similar for animals of both systems during the first half of the grazing season. No difference was found for average daily gain or total animal gain for steers remaining on pasture season-long. The modified intensive-early system produced more beef on a land area basis because of the greater early stocking density. Steers from the season-long continuous grazing system had greater carcass weight and carcass quality than steers from the modified intensive-early grazing system. Modified intensive-early stocking at a 1.6X rate can improve beef production on a land area basis when compared to season-long continuous stocking.

Introduction

Intensive-early stocking is a common management practice on tallgrass rangeland in eastern Kansas. On shortgrass rangeland in western Kansas, intensive-early stocking using double density stocking the first half of season had no production advantage over continuous season-long stocking. Over several years, continued intensive-early stocking was found to reduce the composition of desired western wheatgrass, important for early season animal gains. It was hypothesized that gains per animal could be maximized and gains per acre could be increased by reducing the density of animals early in the season to less than double the season-long density, then allowing some animals to remain on pasture season-long.

Materials and Methods

A comparison was made between continuous season-long stocking of steers on shortgrass native rangeland and intensive-early stocking (IES) steers at 1.6 times (1.6X) the density early in the season, then removing the heaviest animals half-way through the season. Four replications of 10 animals for the continuous system and four replications of 16 animals in the 1.6X intensive-early treatment were used. Mean May beginning steer weight was 589 lb and 587 lb for the modified 1.6X IES and continuous systems, respectively in 1999, and 639 lb for both the IES and continuous systems in 2000.

Animals were shrink weighed after overnight exclusion from food and water before treatment allotment and again just before the onset of pasture grazing. Animals were stocked the first week of May 1999 and the last week of April 2000. Intensive-early stocking concluded in mid-July of 1999 and the end of June 2000. Animals again were excluded from food and water overnight and then weighed. The six heaviest animals were removed from the intensive-early system at the conclusion of the early stocking period half-way through the grazing season and placed directly in the feedlot. Animals from the continuous season-long stocking and animals that remained season-long following intensive-early stocking were removed from rangelands the first week of October 1999 and mid-September 2000. Steers again were excluded from food and water overnight and weighed.

Animals from both treatments were placed in the feedlot following grazing in order to follow effects of the grazing treatments through to slaughter. Feedlot and slaughter data are available for animals from the 1999 grazing season only. Feedlot and slaughter data will be available for animals from the 2000 grazing season in the summer of 2001.

Results and Discussion

For the animals that were on pasture during the first half of the season, average daily gains and total gains per animal were not statistically different between stocking systems. Continuously stocked animals gained 128 lb during the first period, while intensive-early stocked animals gained 114 lb during the first period (Figure 1). However, the intensive-early stocked system produced 54 lb ac^{-1} beef during the first half of the grazing season, which was greater than the continuously stocked system at 38 lb ac^{-1}. For animals that remained on pasture season-long from both systems, no difference was found between average daily gains and total gains per animal during the last half of the season. This resulted in no difference in total season gain or season average daily gain of animals that stayed on pasture during the entire grazing season from either of the two systems. Animals from the continuously stocked pastures gained 207 lb through the season, while animals that grazed season long from the intensive-early system gained 196 lb through the season. Late season gain ac^{-1} was also similar between the two stocking systems. Animals from the intensive early system gained 25 lb ac^{-1}, while continuously stocked animals gained 23 lb ac^{-1} during the last half of the season. Total gain on a land area basis was greater for the entire season both years from the intensive-early stocking system (79 lb ac^{-1}) with greater animal densities during the early period than from the continuously stocked system (61 lb ac^{-1}). Animals from the more densely stocked intensive-early system had similar early and late gains, but produced more beef on a land area basis. Before entering the feedlot, the steers from the modified IES system produced a greater return on investment of \$38.42 and \$18.28 per acre in 1999 and 2000, respectively. Continuous season-long stocking produced \$32.61 and \$11.10 per acre in 1999 and 2000, respectively.

Carcass data from 1999, however, revealed that animals from the continuous season-long stocking system had greater total carcass weight and greater quality than the animals that remained the entire season from the intensive-early system. Steers from the continuous system had greater total gain (516 lb) during the feedlot phase than did steers from the intensive-early system that stayed season-long (472 lb). Steers from the continuous system also had greater carcass weight (829 lb) than steers from the intensive-early system (801 lb). Carcass quality was also greater for the steers from the continuous system averagiing a higher grade of Choice meat than the intensive-early steers (5.47 versus 5.18, respectively).

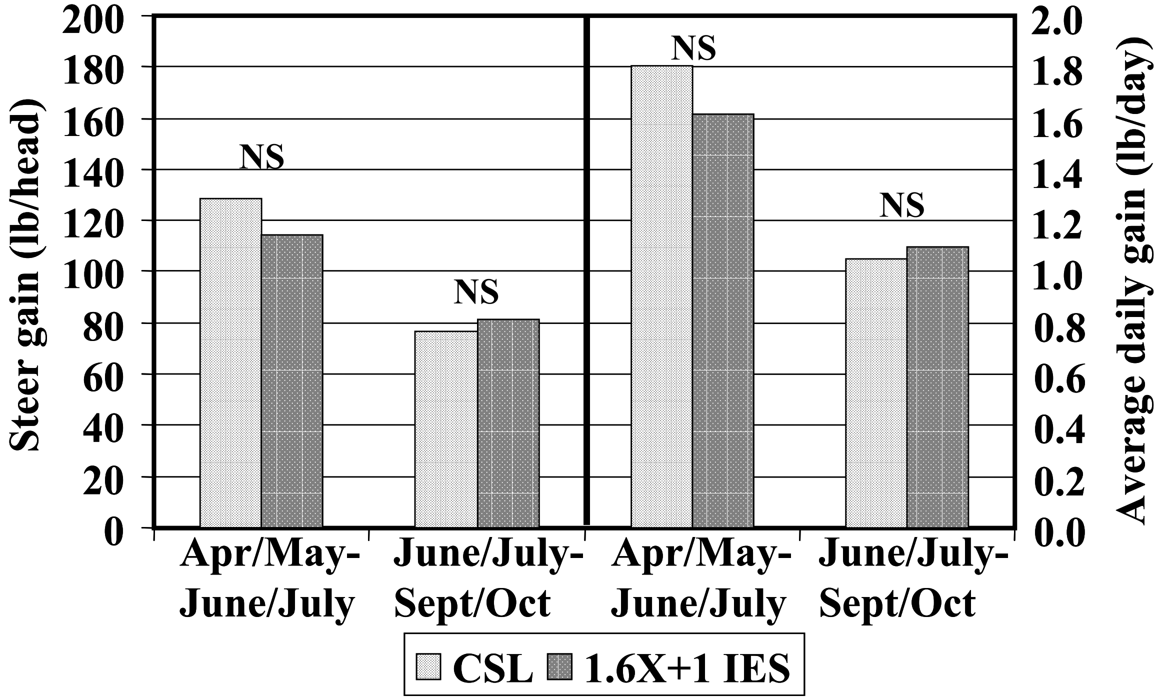
Two years of data show that intensive-early stocking at a 1.6X rate and then allowing animals to graze season-long at a 1X rate allows animals to attain maximum individual performance, similar to continuously stocked animals at a lower initial stocking density. However, because initial stocking densities are greater from the 1.6X intensive-early stocking system, greater beef production on a land area basis results. The intensive-early system allows a greater number of animals to attain maximum individual performance, thus increasing beef production efficiency on a land area basis. This system improves gain on a land area basis compared to a previous intensive-early double stocking system in which a 2X number of animals were placed on pastures during the first half of the grazing season.

No difference was found in previous trials for beef production on a land area basis between continuous and intensive-early double stocking. Modified intensive-early stocking at a 2X rate also showed no improvement over continuous season-long stocking. The 1.6X modified IES produced more beef on a land area basis and also allows producers to market animals twice during the year, rather than once.

With current levels of production, applying animal market prices to previous years shows that price margin between initial purchase and time of sale greatly affects return on investment. There is more volatility and greater risk in intensive-early stocking with greater price margin. Returns from continuous season-long stocking tend to be more stable from year to year.

Future Work

Feedlot gain data and carcass data at slaughter will be taken for all steers involved in the grazing study during the 2000 season to see if trends follow 1999 observations. Carcass data will be the last data recorded and analyzed from this project. A similar project will begin in the near future to compare animal performance between continuous season-long stocking and modified IES, but with a greater emphasis on grazing effects from these two systems on native shortgrass rangeland plant populations and pasture productivity.



NS= not significant.

Figure 1. Steer performance on native range for continuous season-long and 1.6X modified intensive-early stocking systems.

Measurements for Predicting Performance of Feedlot Steers

John R. Brethour
Beef Scientist

Introduction

Ultrasound has been an effective technology to predict future carcass merit of feedlot cattle. However, measures taken with that technology, such as backfat thickness and marbling score, have not been correlated with feedlot gain. In clustering cattle for precision marketing, knowledge of future growth rate, as well as changes in carcass composition, would enhance the profitability of the procedure by enabling early marketing of poor-gaining cattle while retaining those with additional growth potential.

Frame score provides an indication of an animal's growth curve, which can be used to project expected finishing weight for slaughter cattle or mature weight for breeding cattle. Frame score and muscle score are the two attributes in the USDA Feeder Cattle grading scheme. In the Beef Improvement Federation guidelines are formulas and tables for calculating frame score from a measure of hip height and animal age. The classical formula for the conversion of hip height to frame score is:

$$\text{Frame Score} = -11.548 + .04878\,(\text{Height}) - 0.0289\,(\text{Days of Age}) + 0.00001947\,(\text{Days of Age})^2 + 0.0000334\,(\text{Height})\,(\text{Days of Age}).$$

However, age of the typical feedlot animal is not known. Alternative estimates of frame score have been made from hip height and animal weight. Hip height, which can be conveniently obtained with a measuring stick constructed specifically for that purpose, is the predominate indicator of frame size. Hip height is also the primary measure used in video imaging systems that classify cattle into biological types and sort them into outcome groups that are expected to finish alike.

This widespread interest in, and use of, frame score and hip height inspired this research to determine if the measure might complement information obtained from ultrasound that would make cattle clustering procedures more effective. The primary objective was to determine the ability of hip height measures to project future feedlot gains and carcass composition.

Materials and Methods

Four different groups of cattle were involved in this study:

Experiment 1. This included 139 head that were evaluated shortly after arrival when the steers averaged 811 pounds and were fed an average of 157 days after the evaluations were made. Age of cattle was not known but they were probably about 15 months old. The cattle were crossbred involving both British and continental breeds. In this particular experiment the cattle were also measured with a video imaging system built by Cattle Scanning Systems (Rapid City, South Dakota). It appeared that this system expressed a frame score from two height and one width measurements but the exact formulas are proprietary and not available. The cattle were then measured for hip height and ultrasound backfat and marbling.

Experiment 2. In this study 113 steers were measured just before harvest when they averaged 1261 pounds. They were about 16 months old and were mostly Angus and Angus-cross cattle. Measurements included hip height, ultrasound backfat, marbling score and muscle depth, and weight. Hip height was converted to frame score using an equation published by the Micro Beef Technologies (Amarillo) cattle management system.

$$FS = -18.09148 + 1.121666 * HH + 0.03365 * WT - 2.003599 * WT / HH - 0.012205 * HH^2 + 13.133611 * (WT / HH^2)$$

Where FS is Frame score, HH is hip height in inches, and WT is live weight in pounds.

The primary reason these cattle were measured just before harvest was to determine the relationship of the various measures with dressing percent. Muscle depth was a measure derived from a sagittal ultrasound image taken across the longissimus muscle in the region of the first two lumbar vertebrae. It is the maximum linear distance through the muscle from the bottom of the subcutaneous fat layer to the transverse processes that extend from the vertebrae.

Experiment 3. This involved 68 more cattle from the group used in Experiment 2 but these were held for a 37-day interval from evaluation until harvest. The average weight of these deferred cattle was 1228 pounds.

Experiment 4. There were 178 steers in this experiment that were marketed in three groups 70, 86, and 100 days after evaluation (the statistical model used in the analysis corrected for effects related to these time intervals). The breed composition was variable representing the many crosses typical of feeder cattle in northwest Kansas. Average weight at evaluation was 1062 pounds.

Hip height was more variable in the first and last experiments, values for the standard deviation of hip height were 1.43, 1.09, 1.25, and 1.42 inches, respectively, in the four studies.

The most important dependent value in using frame score among feedlot cattle is the weight at which a target carcass composition is reached. In this study, we used the projected weight at which a carcass at harvest would have 10 mm backfat. Other studies have indicated good correspondence between this backfat measure and percent fat in the carcass. Data for each carcass was extrapolated by calculating the number of days between the actual carcass backfat thickness and 10 mm (.4 inch) using the equation $T = (\text{logn}(10) – \text{logn}(A))/k$, where A is the carcass backfat, k is a rate constant (01 was used) and T is the number of days in the interval between harvest and when 10 mm backfat would be attained. Weight at 10 mm backfat was obtained by the equation $Y = (X + 2.2 * T)/ .64$, where X is the carcass weight when backfat was measured, T is the interval to 10 mm backfat and Y is the weight at 10 mm backfat. This assumes a constant 2.2 pounds carcass gain in the interval around harvest and that dressing percent = .64.

Other dependent variables considered included average daily gain from evaluation until harvest with final weight corrected to a standard dressing percent of .64, individual dressing percent, carcass backfat thickness, carcass marbling score, and carcass weight.

There has been some concern that manually measuring hip height may not be as accurate as video imaging because of the difficulty in positioning animals in a squeeze chute. However, Figure 1 indicates good correspondence between hip height and a frame score value estimated from video imaging in Experiment 1.

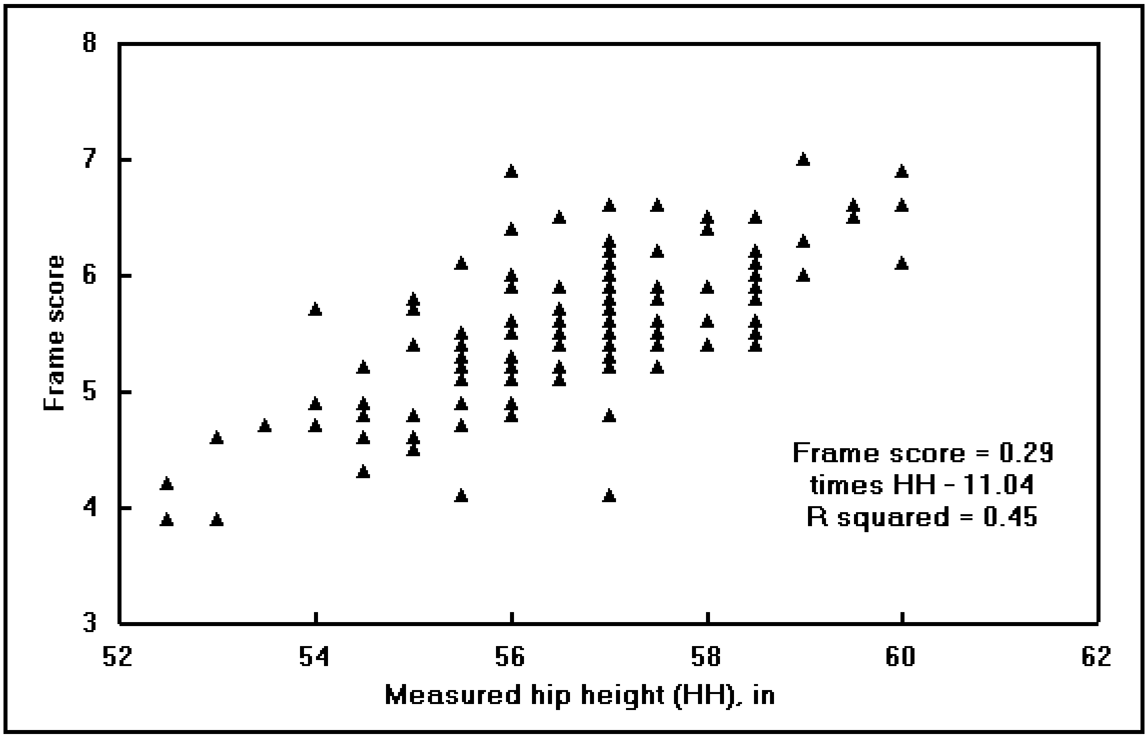


Figure 1. Relationship of measured hip height and frame score from video imaging.

Results

Figure 2 summarizes the results of this study and presents the correlations as R^2 values, which express the percent of variation in the dependent variable that is accounted for by the predictor variable. Because of the large number of animals in the experiments, most of the correlations are statistically significant. However, a squared correlation coefficient usually must be above .4 or .5 to have much utility. For example Figure 3 portrays the relationship of hip height and weight at 10 mm backfat in Experiment 3. The correlation of .50 (square root of the R^2 parameter) is highly significant, but the standard deviation of 125 pounds seems unacceptably large.

Prediction variables	ADG	10 mm Wt	Carcass backfat	Carcass marbling	Dressing percent	Carcass weight
			Dependent variables			
Experiment 1						
Hip height	0.091	0.136	0.020	0.005		0.184
Frame score	0.059	0.132	0.056	0.021		0.159
Live weight and ultrasound backfat and marbling	0.074	**0.175**	**0.153**	0.208		0.341
Experiment 2						
Hip height		0.085	0.000	0.051	0.001	0.241
Frame score		0.086	0.001	0.084	0.001	0.236
Muscle depth		0.112	0.022	0.000	**0.161**	0.092
Live weight and ultrasound backfat and marbling		0.383	0.467	0.533	0.028	0.661
Experiment 3						
Hip height	0.009	**0.181**	0.019	0.006	0.008	0.307
Frame score	0.010	0.179	0.016	0.006	0.006	0.322
Muscle depth	**0.151**	0.020	0.000	0.039	0.104	0.086
Live weight and ultrasound backfat and marbling	0.050	**0.494**	0.393	**0.446**	0.034	0.778
Experiment 4						
Hip height	0.055	**0.246**	0.040	0.000	0.001	0.215
Frame score	0.052	0.225	0.045	0.000	0.001	0.181
Muscle depth	0.021	0.073	0.020	0.010	0.100	0.046
Live weight and ultrasound backfat and marbling	0.098	**0.601**	**0.448**	**0.382**	0.065	0.732

Figure 2. Correlations (R square values) between various predictor variables and performance and carcass attributes. Values in bold are discussed in the manuscript.

In Figure 2 the predictors of average daily gain are all poor. The highest correlation is from muscle depth in Experiment 3, but the value is only .15. This was especially disappointing because the ability to predict future gain would probably be the most useful tool from this project.

Hip height was significantly correlated with steer weight at 10 mm backfat, especially in Experiments 3 and 4, but the accuracy of that prediction was probably too poor for the model to be useful. In all but the first experiment, the combination of ultrasound backfat, marbling score and animal weight was more than twice as powerful in predicting a weight endpoint at 10 mm backfat and represented a constant carcass composition. In the first experiment, the evaluations were made at arrival when backfat averaged only 1.8 mm. Other studies have shown that there is a need to delay ultrasound evaluations for projecting days to harvest until there has been adequate time on a high energy ration for genetic differences in fat deposition rates to be expressed and when the cattle average over 3 mm backfat. That accounts for the poor prediction of carcass backfat in Experiment 1.

The correlations based on frame score differed little from those based on hip height, apparently because frame score was calculated from hip height. Both were ineffective in predicting carcass backfat or carcass marbling, but ultrasound measures had high correlations with those traits in Experiments 2, 3 and 4.

No satisfactory model was discovered for projecting individual dressing percent. That was disappointing because dressing percent varies immensely among individual animals with standard deviations usually exceeding 150 basis points. In addition to the regressions presented in Figure 3, many models that involved products and ratios of weight, hip height and muscle depth were tested without discovering significant increases in prediction accuracy. There tended to be increases in dressing percent as carcass weights increased:

Carcass weight, lb	Dressing Percent
700-800	63.21
800-850	63.62
850-900	64.38
900 +	64.60

Regression of dressing percent on animal size is complicated by the formula for dressing percent, carcass weight divided by live weight, which infers that dressing percent is inversely proportional to live weight.

Correlations with carcass weight were generally high with all predictors, but higher when based on live weight than on ultrasound or linear measures.

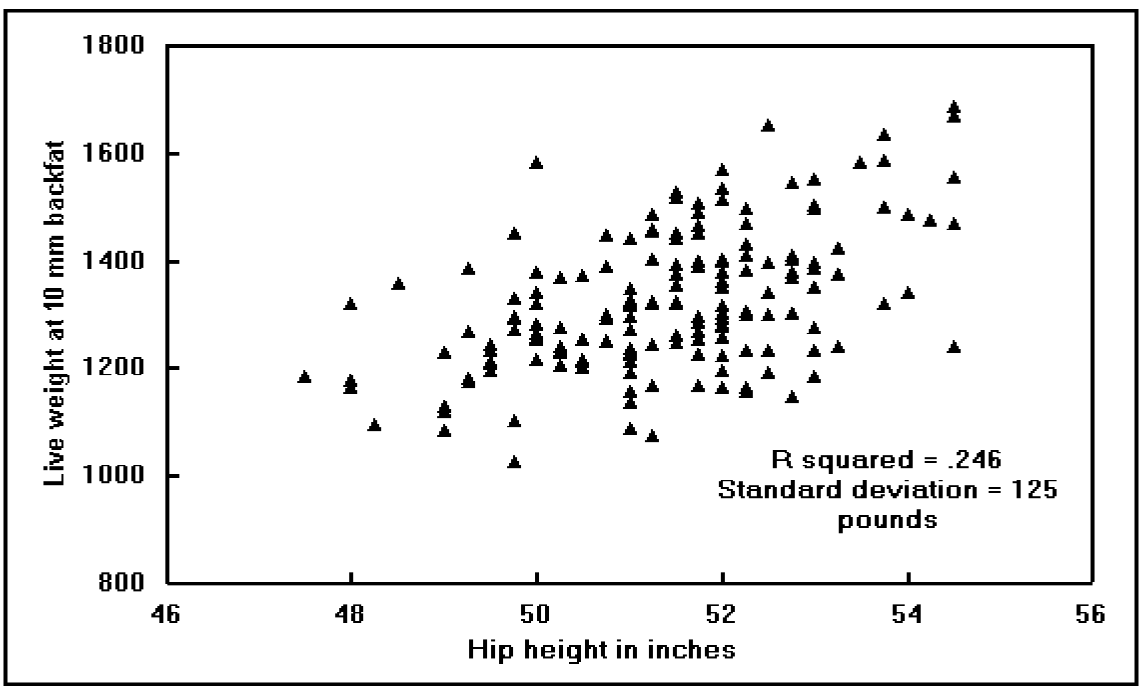


Figure 3. Relationship of hip height and weight at 10 mm backfat (Experiment 4). Even though the R squared is highly significant, the standard deviation seems too large for the prediction to be useful.

Implications

Hip height and frame score have been effectively used for many years in describing cattle for marketing and classifying seedstock individuals. However, applications involving those measures to predict important attributes in feedlot cattle were disappointing in this study. Several items might explain this. Possibly the cattle used in these experiments did not have the variability in frame score that might be encountered with animals from other regions. Frame score seems to effectively describe mature body size among breeds, but most of the steers in this study were crossbred. Selection for weight, per se, may result in body size that is independent of height. Also, selection for leanness and marbling may have resulted in carcass composition being independent of size. Cattle are marketed well before they reach mature body weight. The conclusion seems to be that there is need to search for measures that are more effective than hip height to describe and predict cattle growth and development.

Tracking Carcass Gain in Feedlot Cattle

John R. Brethour
Beef Scientist

Introduction

Marketing feedlot cattle is evolving from pricing cattle on a live weight basis to selling on carcass value and where payment is made on carcass weight. That will require an understanding of carcass weight gain rather than live weight gain. Live weight gain normally diminishes as the days on feed lengthen, but carcass gain may be more level throughout the feeding period and may extend at profitable levels for a longer time.

Research is in progress to attempt to document the rate of carcass gain in the final phases of finishing cattle. It was provoked from an experiment involving serial slaughter that was conducted at Manhattan about 10 years ago and reported in the 1992 Cattlemen's Day report (Table 1). That study showed that live weight gain was curtailed and feed efficiency worsened as cattle were fed an extra 14 or 28 days, and effectively showed the importance of not overfeeding cattle when they are to be marketed on a live weight basis. But, the same study also showed that carcass gain was almost the same as live weight gain during those 14-d and 28-d extended intervals and that marketing strategy would favor extended feeding if grade and yield marketing had been practiced.

Materials and Methods

In Experiment 1 (Table 2), we marketed from a group of cattle that had been on feed about 100 days at four intervals, 0, 42, 70, and 105 days. The results showed that carcass gain maintained at over 2.4 pounds per day for 42 and 70 days but dropped considerable when cattle were held for an additional 35 days. As expected, both backfat thickness and quality grade improved as days on feed lengthened. There was little change in dressing percent, but it is difficult to repeat weighing conditions for the final weight in serial slaughter trials of this type.

The experience from the first trial enabled us to develop a more rigid protocol for Experiment 2. In this case we divided 134 steers into three equal groups based on weight, backfat thickness, and breed. Those cattle had been on feed about 120 days and averaged 1200 pounds when the first group was slaughtered. Cattle that were projected to be overweight or Yield grade 4 within the 50-day trial were eliminated from the study. Results are shown in Table 3. Carcass gain was 2.74 lb/d during the first 28 days and 2.57 lb/d in the next 22 days. That was 81% and 77% of live weight gain, respectively.

Results

Knowledge of dressing percent would assist in monitoring carcass gain. However, there are not accurate formulas available to predict dressing percent on an individual animal basis. Figure 1 demonstrates the immense variation in individual dressing percent that we commonly experience. In this set of steers, which had a mean dressing percent of 63.9, the effective range (the confidence interval is a measure of where 95% of the observations are likely to fall) was from 60.5% to 67.3%. Many believe that dressing percent is closely associated with carcass fatness. However, it has been difficult for us to document that contention as shown in Figure 2. There is a better relationship between ribeye area and dressing percent (Figure 3). Also, carcass weight and dressing percent are significantly correlated (Figure 4), but this might be expected because dressing percent is calculated as the ratio of carcass weight to live weight.

In the first experiment the poor performance of the set of steers fed for an additional 105 days (over 200 days total) might have resulted from some poor performing (“tail enders”) cattle being carried into this group. In order to enable precise marketing so that each animal is sold near the day of maximum profitability, it would be valuable to be able to predict future gain when cattle are reimplanted midway in the feeding period and harvest poor performing cattle as soon as possible. The variability in gain during the last half of the feeding period is striking (Figure 5) with a confidence interval ranging from 1.9 to 4.4 pounds per day in a set of steers from a recent experiment.

It is commonly believed that effective culling can be based on the first period gain from arrival to reimplanting, but our results (Figure 6) show very little correlation between first period gain and the end phase gain to slaughter. That may result from variations in animal fill causing considerable error in estimating gains over a short interval, compensatory gain from one period to another, and inherent differences among animals in patterns of growth and development. Also, there was little correlation between carcass backfat thickness and end stage gain (Figure 7), but a significant association between carcass ribeye area and gain (Figure 8). But the last two figures were from a set of cattle that were predominately Angus and Angus crosses. A sample that had a broader mix of British and Exotic breeds might be expected to show higher correlations of both backfat and muscling with performance.

Implications

One views with envy the progress with precision agricultural technology in crop production. This research in tracking carcass gain, estimate dressing percent, and predicting performance is an effort to bring some of the precepts of precision agriculture to cattle feeding.

Table 1. Additional days on feed and finishing performance (1992 Cattlemen's Day - Report of Progress 651).

	Additional days fed		
	0	14	28
Number of steers	96	96	96
Initial wt, lb	701	702	703
114-day weight	1093	1094	1094
Final weight	1093	1124	1158
Additional 14 or 28 days			
Average daily gain		2.07	2.28
Feed/gain		10.07	9.33
Hot carcass weight	683	719	744
Dressing percent	62.50	63.90	64.20
Daily carcass gain		2.57	2.18
Incremental carcass gain/d			1.79
Carcass gain/live gain		124%	96%
Backfat thickness, in	0.48	0.53	0.55
Rib eye area, sq in	12.4	13.0	13.4
Marbling score	5.1	5.4	5.3
Percent Choice	67%	71%	75%

Table 2. Additional days on feed and finishing performance ARCH (Experiment 2).

	Additional days fed			
	0	42	70	105
Number of steers	20	28	60	32
101-day weight	1047	1041	1039	1011
Final weight	1047	1210	1292	1327
Additional 42, 70, or 105 days				
Daily gain		4.01	3.62	3.01
Hot carcass weight	660	763	831	870
Dressing percent	63.80	63.49	64.57	64.39
Daily carcass gain		2.45	2.44	2.00
Incremental carcass gain/d			2.43	1.10
Carcass gain/live gain		61%	68%	66%
Backfat thickness, in	0.22	0.27	0.38	0.46
Marbling score	4.2	4.8	5.0	5.6
Percent Choice	10%	57%	58%	91%

Table 3. Additional days on feed and finishing performance ARCH (Experiment 2).

	Additional days fed		
	0	28	50
Number of steers	46	45	43
120-day weight	1200	1203.1	1190
Final weight	1200	1298.3028	1357.0355
Additional 28 or 50 days			
Daily gain		3.40	3.34
Hot carcass weight	761	838	890
Dressing percent	63.47	64.78	65.14
Daily carcass gain		2.74	2.57
Incremental carcass gain/d			2.36
Carcass gain/live gain		81%	77%
Backfat thickness, in	0.29	0.35	0.40
Marbling score	4.7	5.0	4.9
Percent Choice	37%	58%	44%

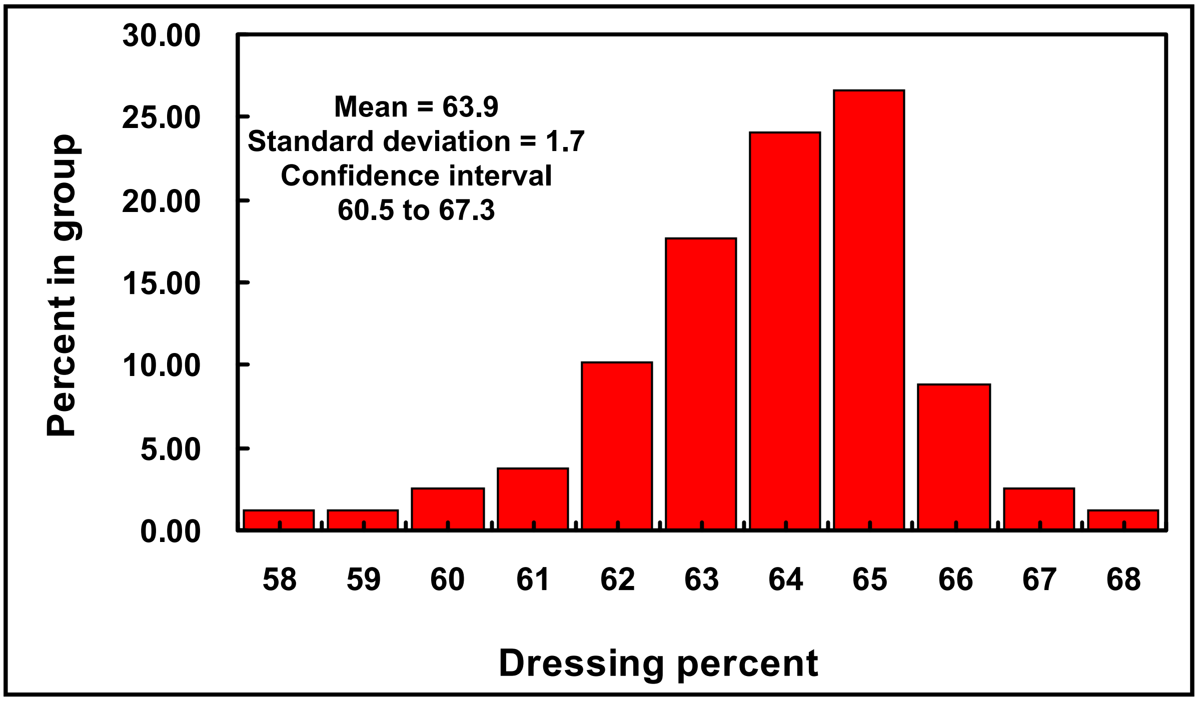


Figure 1. Distribution of individual dressing percent among 79 steers.

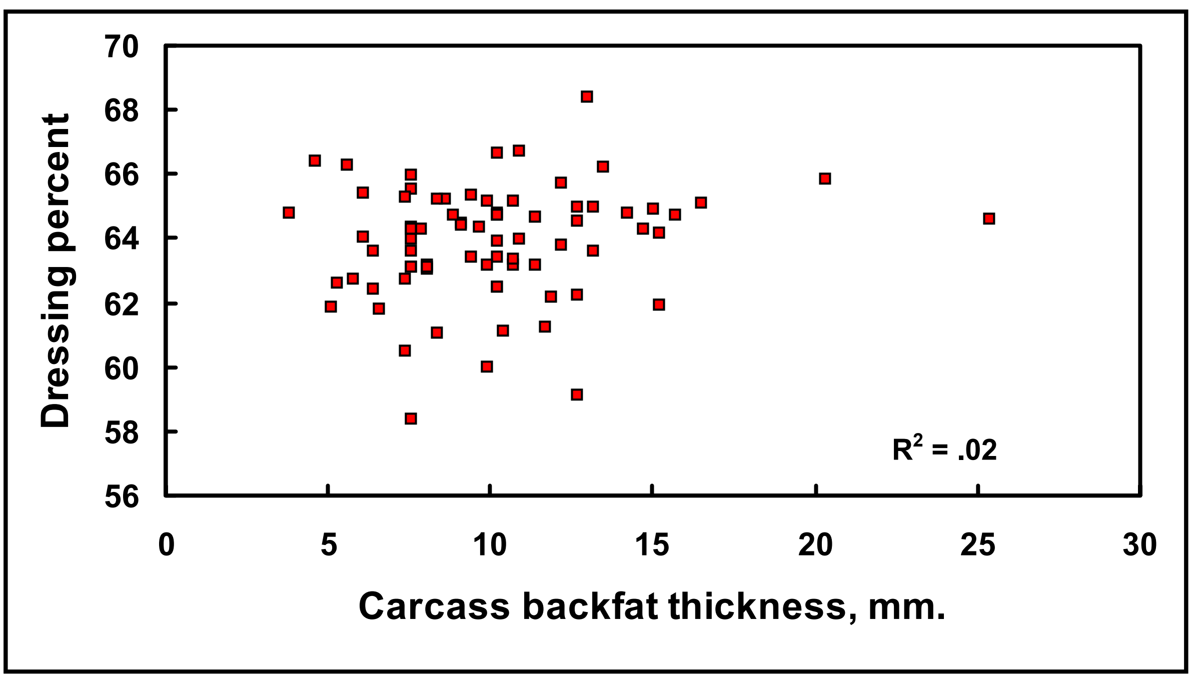


Figure 2. Relationship of carcass backfat thickness to dressing percent.

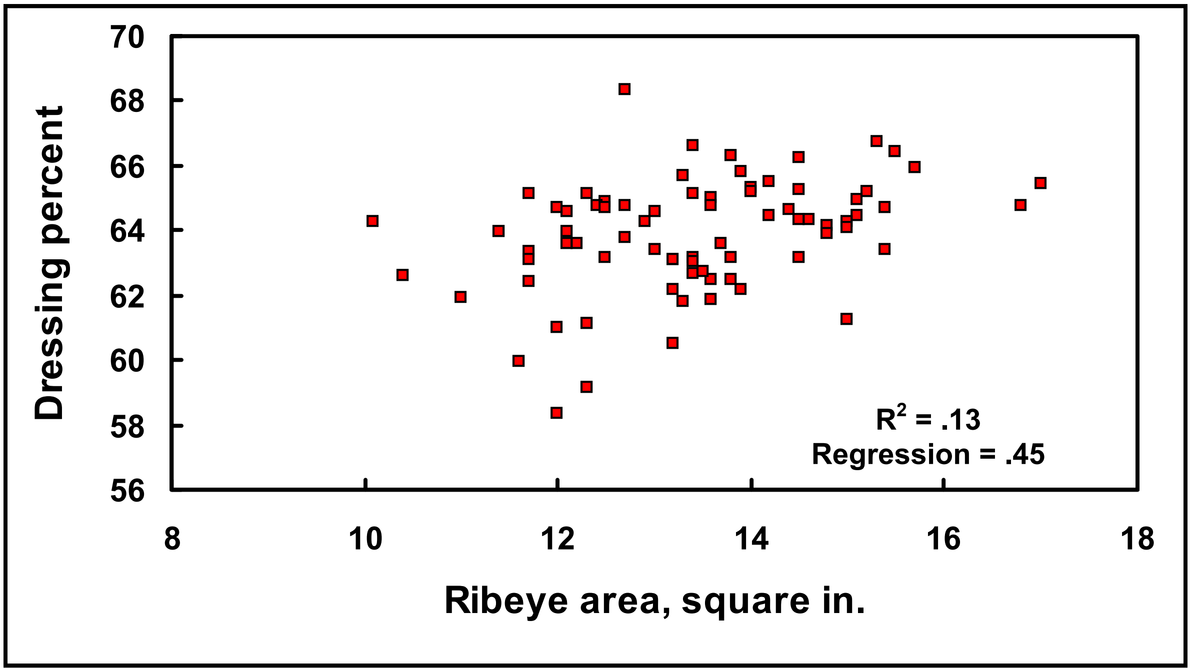


Figure 3. Relationship of carcass ribeye area to dressing percent.

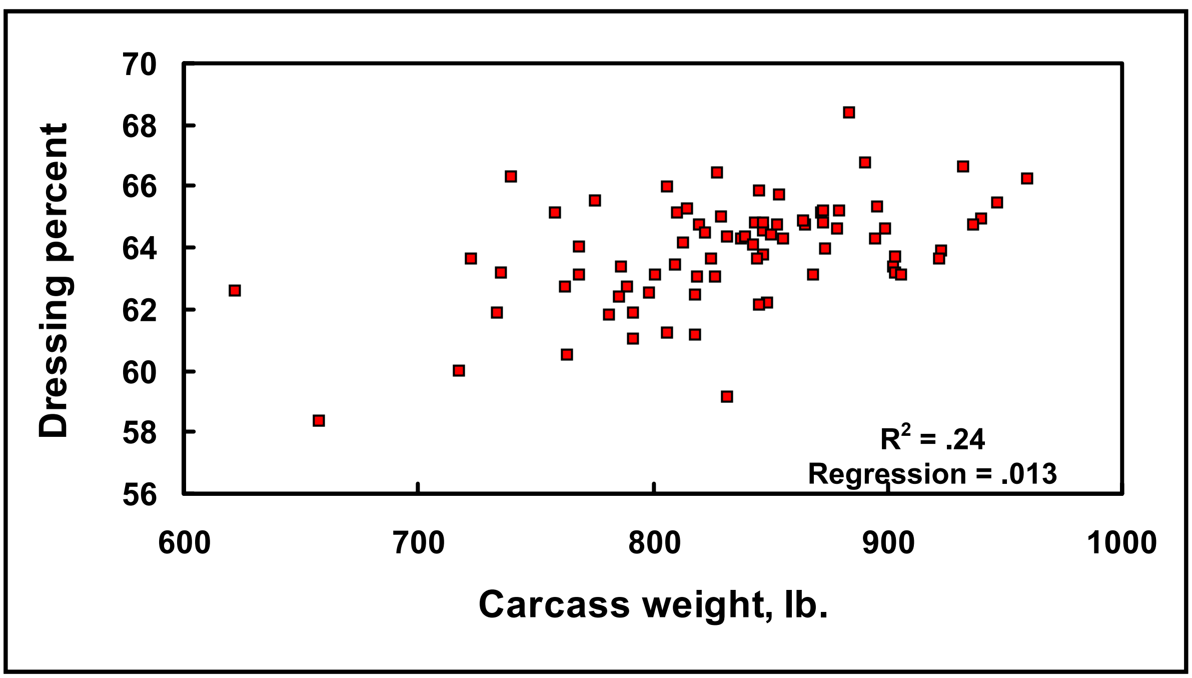


Figure 4. Relationship of carcass weight to dressing percent.

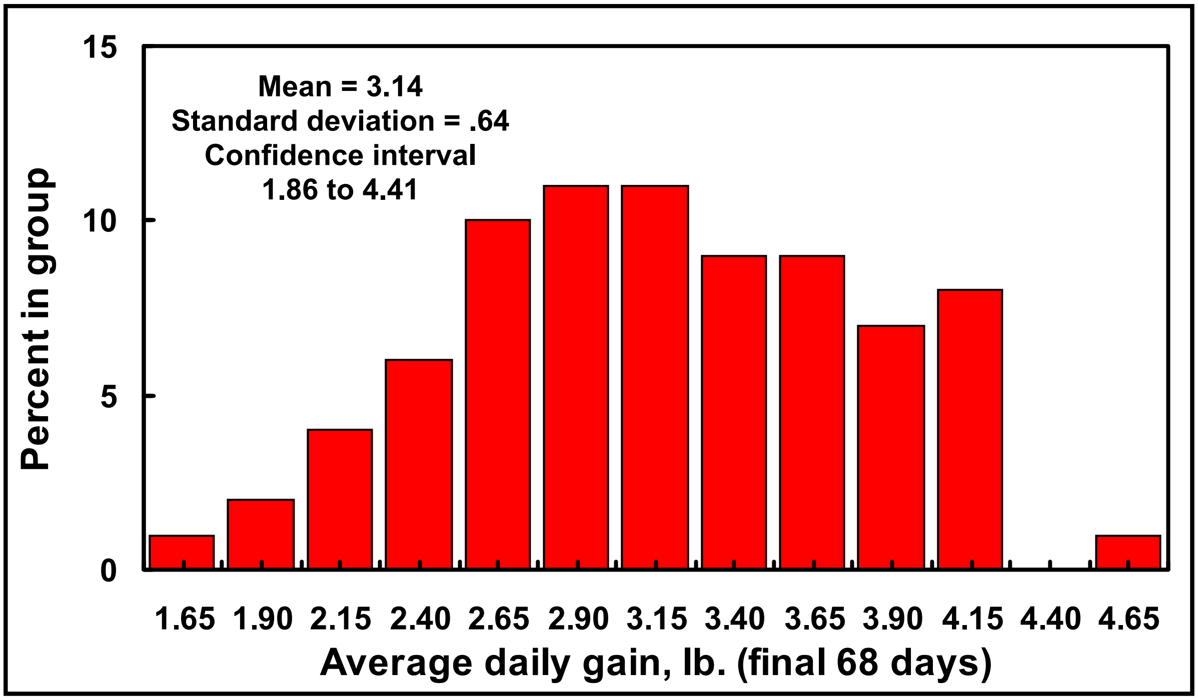


Figure 5. Distribution of final 68-day average daily gain among 79 steers.

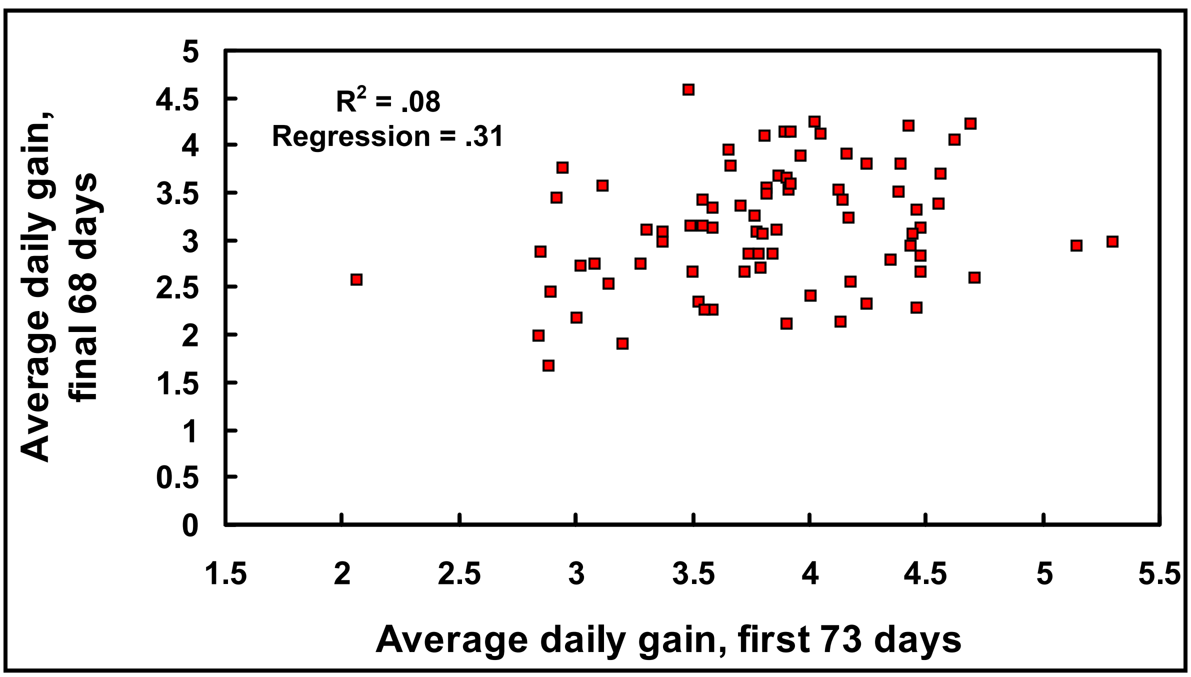


Figure 6. Relationship of first period gain to second period gain.

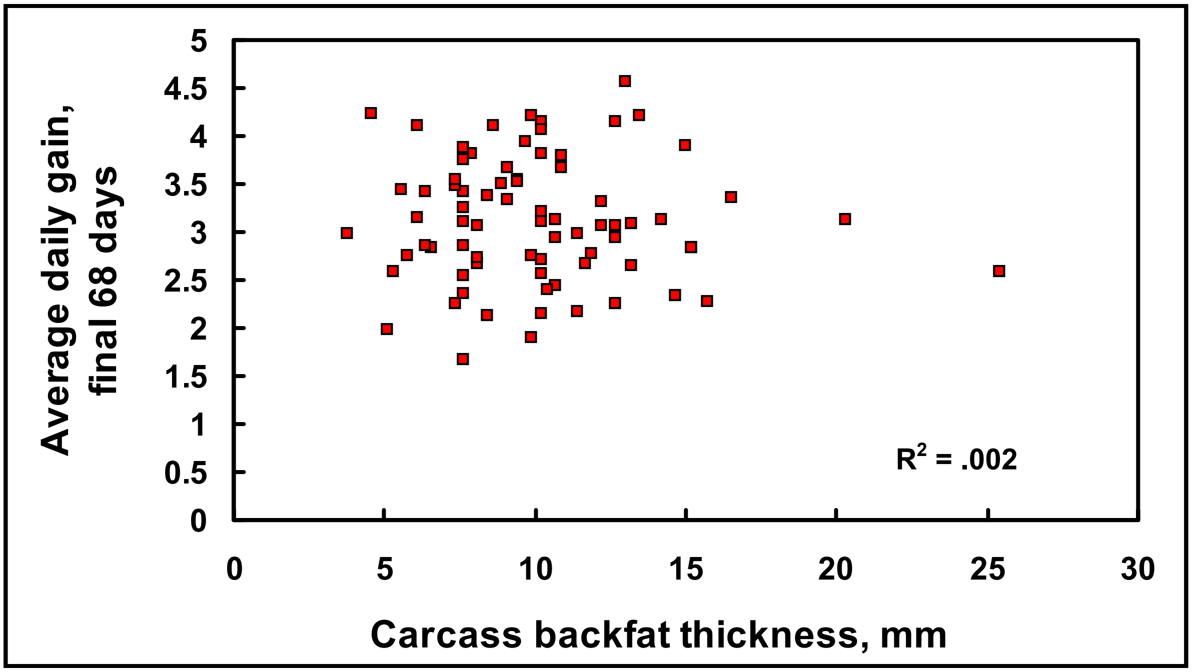


Figure 7. Relationship of carcass backfat thickness to final gain.

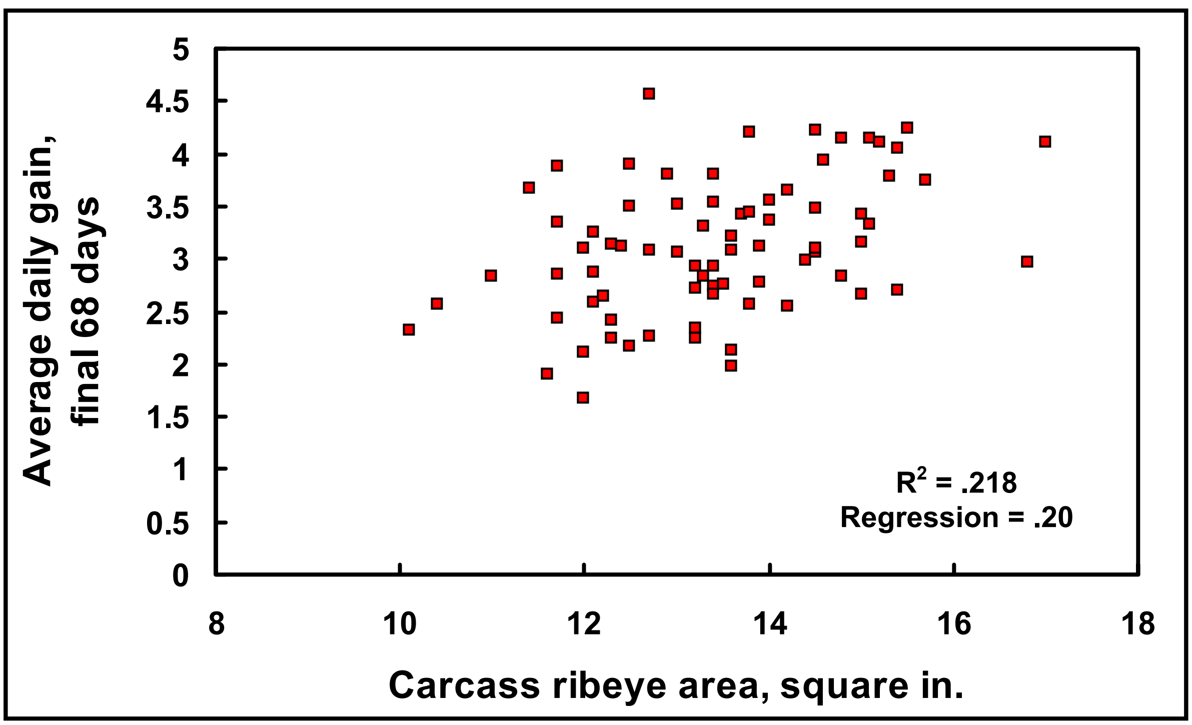


Figure 8. Relationship of carcass ribeye area to final gain.

Failure to Predict Beef Tenderness with B-Mode Ultrasound – A Brief Note

John R. Brethour and Les Wankel
Beef Cattle Scientist and Assistant Instructor

There is much interest in improving beef tenderness and the trait appears to be heritable. Ultrasound is an effective tool to measure other carcass traits in the live animal and enable genetic selection to improve those attributes. A project was conducted to determine if tenderness could be assessed from patterns in the ultrasound image using technology similar to that used for estimating marbling.

Three or four images were collected from each of 155 Simmental steers used in a NCBA sponsored tenderness study. These were acquired in the sagittal plane across the longissimus muscle in the region of the first and second lumbar vertebrae. Images were aquired with a 17cm, 3.5 MHz transducer array on an Aloka 500 ultrasound instrument. The steers were later harvested and shear force measurements were made on rib steaks.

A 200 X 100 pixel region of interest from the ultrasound images was subjected to an extensive set of parameterizing patterns in those pictures using procedures that had been effective in estimating marbling score. Those included first order statistics such as mean and standard deviations (both global and also from small and variously shaped filters) of the pixel values. In addition, a unique second order, run length – gray level emphasis procedure that has been especially effective in assessing marbling was tested. (This procedure autocorrelates with Markovian statistics and time series methods that are also used for pattern classification.)

The best four-variable predictor model had a multiple correlation (R^2) of 0.09. While this was statistically significant because of the large number of observations, the association seems too low to have practical predictive value. However, these analyses are based on the image portrayed with B-mode ultrasound. It is likely that the differences in tenderness are caused by molecular differences that are beyond the resolution of this technology. A different ultrasound technology operating in the frequency, rather than the time domain, and sometimes referred to as “A – mode” might be effective in estimating tenderness. Also, these cattle were similar in age. When older cattle are evaluated for tenderness, connective tissue (collagen) becomes a factor and those structures might be imaged and estimated with procedures similar to those we evaluated.

K-State Research and Extension publications are available online at:
http://www.oznet.ksu.edu/library

Note: Trade names are used to identify products. No endorsement is intended nor is any criticism implied of similar products not named.

Kansas State University Agricultural Experiment Station and Cooperative Extension Service, Manhattan, KS 66506

SRP 891 April 2002

600