2006

2006 South Dakota Beef Report

Department of Animal and Range Sciences, South Dakota State University

Agricultural Experiment Station, South Dakota State University

Cooperative Extension Service, South Dakota State University

2006 South Dakota BEEF REPORT

South Dakota State University
College of Agriculture and Biological Sciences
Animal and Range Sciences Department

The faculty members of the Animal and Range Sciences Department are always ready to answer your questions. Our Brookings phone number is (605) 688-5165. Staff members in Rapid City (RC) may be reached at 605-394-2236. Our staff member at Ft. Pierre answers at 605-223-7731. Please feel free to give any one of us a call or check out our departmental website: http://ars.sdstate.edu. You can find this report and other information at http://ars.sdstate.edu/extbeef/Publications.htm

DEPARTMENT OF ANIMAL and RANGE SCIENCES - FACULTY

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BRUNS, Kelly W.	Live Animal/Carcass Evaluation	Teaching
CLAPPER, Jeffrey A.	Swine Reproductive Physiology	Research, Teaching
EIDE, Jennifer	Equine Management	Teaching
GATES, Roger (RC)	Range Management	Extension, Research
HELD, Jeffrey E.	Sheep Nutrition, Production, and Management	Extension, Teaching
JOHNSON, Patricia S. (RC)	Range Science	Research, Teaching
LOE, Erik	Feedlot Management	Extension, Research, Teaching
MCFARLAND, Douglas C.	Muscle Biology	Research, Teaching
MOUSEL, Eric	Range Livestock Management	Extension, Teaching
OLSON, Ken (RC)	Cow-Calf Management	Extension, Research
PERRY, George	Beef Reproductive Management	Research, Extension
PRITCHARD, Robbi H.	Ruminant Nutrition	Research, Teaching
PRUITT, Richard	Cow-Calf Management	Teaching, Research
SMART, Alexander	Range Management	Teaching, Research, Extension
THALER, Robert	Swine Management	Department Head
ULLERICH, Mark	Equine Management	Teaching, Extension
WALKER, Julie (Ft. Pierre)	Cow-Calf Management	Extension
WEAVER, Amanda	Meat Science	Research, Teaching
WERTZ-LUTZ, Aimee	Ruminant Nutrition	Teaching, Research
WRIGHT, Cody L.	Cow-Calf Management	Extension, Research, Teaching
WULF, Duane	Meat Science	Research, Teaching

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Mission

The overall mission of the Department of Animal and Range Sciences parallels South Dakota State University's Land Grant Mission of providing education, research and professional outreach through the Cooperative Extension Service to the Citizens of South Dakota. Two of the specific missions of the Department of Animals and Range Sciences are 1) to conduct research related to the animal and range sciences that will enhance the understanding and development of livestock and related industries and 2) to transfer to the citizens of South Dakota research technology and information on livestock production, range management and related livestock industries, which will enhance the quality of life of all persons. The goal of this Annual Beef Report is to disseminate new knowledge that is discovered at South Dakota State University to the producers and livestock industries of South Dakota.

Biological Variation and Treatment Differences

Variability naturally exists among individual animals and plants. This variation can create problems when interpreting results from experiments. For example: when cattle in one treatment (X) have a numerically higher average daily gain compared to cattle in another treatment (Y), this difference in weight might be due to animal variation and not due to the treatments. Statistical analysis attempts to remove or reduce the natural variation that exists among animals and explains the difference due to the treatments.

In the following research papers, you will see notations similar to ($P < 0.05$). This means that there is less than a 5% chance that the difference between treatments is due to the natural variation that occurs. This indicates that that there is greater than a 95% probability that the differences between treatments are the result of the treatments. You will also notice notations similar to ($P = 0.10$). This means that there is a 10% chance that the difference between treatments is due to the natural variation that occurs. This indicates that that there is a 90% probability that the differences between treatments are the result of the treatments.

In most of the papers you will see an average, or mean, reported as 25 ± 2.3. The first number is the average value for the treatment. The second number is the standard error, or the variability that occurred, and explains how accurately the mean is estimated. There is a 68% probability that the true mean will fall within 1 standard error of the listed mean and a 94% probability that the true mean will fall within 2 standard errors. For this example we are 68% certain that the true mean is between the range of 27.3 and 22.7 and 94% certain that the true mean is between 29.6 and 20.4.

Ways we decrease variability and improve the chance of measuring differences due to treatments include: having several animals in each treatment, replicating treatments several times, and using animals that are as similar as possible. The use of statistical analysis in research allows for unbiased interpretation of results. The use of statistical analysis in the research reported here increases the confidence in the results.

Editorial Committee: Dr. G. A. Perry, Editor
Betty Knutsen, Word Processor and Formatter

Conversion Table

The metric system is frequently used for reporting scientific data. To aid in interpreting these data, the following table has conversions for common measurements from the metric system to the Standard English system.

Metric	English
0 C	32 Fahrenheit
1 milliliter	0.03 ounces
1 Liter	0.26 gallons
100 grams	0.22 pounds
1 kilogram	2.2 pounds
1 meter	3.28 feet

Commonly Used Abbreviations

ADG	Average Daily Gain
ADF	acid detergent fiber
AI	Artificial Insemination
BCS	Body Condition Score
BW	Body weight
cM	Centimorgan
CP	Crude Protein
d	days
DFD	Dark, Firm, and Dry (meat)
DM	Dry matter
DMI	Dry Matter Intake
DNA	deoxyribonucleic acid
EDTA	Ethylene Diamine Tetra Acetic Acid
F/G	feed to gain
g	gravity
GnRH	Gonadotropin Releasing Hormone
GLM	General Linear Model
h	hours
HCW	Hot Carcass Weight
KPH	Kidney, Pelvic, and Heart Fat
LMA	Longissimus Muscle Area
MAS	Marker Assisted Selection
min	minutes
mo	months
NDF	neutral detergent fiber
NE	net energy
PCR	Polymerase Chain Reaction
PG	prostaglandin
PSE	Pale, soft, and exudative
ppb	parts/billion parts
ppm	parts/million parts
32P	Phosphorus Radioactive Isotope
QTL	Quantitative Trait Locus (singular) or Loci (plural)
RFLP	Restriction Fragment Length Polymorphism
RNA	Ribonucleic acid
s	seconds
SNP	Single Nucleotide Polymorphism
TDN	total digestible nutrients
wk	weeks
wt	weight
WW	Weaning Weight
YG	Yield Grade
yr	years
YW	Yearling Weight

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Effect of Increasing Dietary Concentrations of Dried Distillers Grains plus Solubles on Phosphorus Balance in Finishing Steers[1]

Clint Benson[2], Cody Wright[3], Josh McCarthick[4], and Robbi Pritchard[5]
Department of Animal and Range Sciences

BEEF 2006 – 01

Summary

Eight crossbred steers (initial BW = 972.2 ± 33.5 lb) were used in a replicated Latin square design to determine the effect of increasing dietary concentrations of dried distillers grains plus solubles (DDGS) on phosphorus (P) balance in finishing steers. The control (CON) diet contained 79% dry rolled corn (DRC), 10% cottonseed hulls, 6% soybean meal (SBM), and 5% mineral supplement (total diet P concentration = 0.26%). In each of the remaining three diets, all of the SBM and a portion of the DRC were removed and replaced with DDGS at 12%, 24%, and 36% of the diet (total diet P concentrations = 0.28%, 0.33%, and 0.37%, respectively). Steers were housed in indoor, slatted-floor pens (5.6 x 8.5 ft) during a 21-d diet acclimation period prior to a 5-d total fecal and urine collection period. All samples (feed ingredients, feed refusals, feces, and urine) were analyzed for P concentration. Phosphorus intake increased from 18.6 to 27.8 g/d as the concentration of DDGS was increased in the diet. Fecal P was not affected by treatment. Urinary P, total P excretion, and P retention increased as the level of DDGS in the diets increased. In regression analyses, fecal P, total P excretion, and P retention were influenced by P intake. Urinary P tended to be influenced by P intake. Results of the experiment clearly demonstrate that as the levels of DDGS in the diets of finishing steers increases P excretion increases.

Introduction

Distillers grains are becoming increasingly more prevalent as a feed ingredient in the diets of growing and finishing cattle. Previous research suggests that dried distillers grains (DDGS) can be substituted for corn in finishing diets, up to approximately 30% of the diet dry matter (DM), without sacrificing animal performance. Researchers from the University of Minnesota (Spiehs et al., 2002) and from South Dakota State University (Holt and Pritchard, 2004) have also reported the high concentration of P in distillers grains. Research investigating the impact of DDGS on nutrient excretion is limited. Given the increasing implementation of P-based manure application regulations, understanding the impact of DDGS inclusion on manure P concentrations is important for feedlot managers.

This experiment was conducted to determine the effect of DDGS inclusion on P excretion from steers fed a finishing diet.

Materials and Methods

Eight Angus-cross steers (initial BW = 972.2 ± 33.5 lb) were used in a replicated Latin square design. The control diet (CON) contained 79% dry rolled corn, 10% cottonseed hulls, 6% soybean meal, and 5% of a mineral supplement. In each of the remaining three diets, all of the soybean meal and a portion of the dry rolled corn was removed and replaced with DDGS at 12% (12% DDGS), 24% (24% DDGS), and 36% (36% DDGS) of the diet DM (Table 1).

[1] This project was funded by the South Dakota Corn Utilization Council.
[2] Graduate Student
[3] Associate Professor, Extension Beef Specialist
[4] Senior Ag Research Technician
[5] Distinguished Professor

Table 1. Composition of treatment diets

Item	Treatments			
	CON	12% DDGS	24% DDGS	36% DDGS
	% of diet DM			
Cottonseed hulls	10.0	10.0	10.0	10.0
Rolled corn	79.0	73.0	61.0	49.0
Soybean meal	6.0	0.0	0.0	0.0
DDGS	0.0	12.0	24.0	36.0
Supplement[b]	5.0	5.0	5.0	5.0
Nutrient composition				
Dry matter	89.9	90.2	90.8	91.3
Crude protein	10.8	11.1	13.6	16.2
Neutral detergent fiber	18.2	22.3	26.5	30.7
Phosphorus	0.26	0.28	0.33	0.37

[a]DDGS = dried distillers grains plus solubles

[b]Provides vitamins and minerals to meet or exceed nutrient requirements (NRC, 2000).

On d 0 of the experiment, steers were brought into the indoor metabolism experiment facilities and placed in slatted-floor pens (5.6 x 8.5 ft). Steers were acclimated to their respective treatment diets for 21 d and intake to be used during the subsequent collection period was determined. Following the 21-d acclimation period, steers were moved to collection stanchions. While in the stanchions, steers were fed once daily at 9:00 am. Feed ingredients were sampled three times per week, pooled within week, and dried for 24 h at 140°F using a forced air induction oven. Feed refusals were removed, weighed and sampled daily prior to feed delivery.

Feed refusals were dried in a forced air induction oven at 140°F until no further water loss occurred. Feed ingredients, feed refusals, and fecal material were ground through a 1 mm screen using a Wiley Mill.

Feces and urine were collected over five consecutive days using fecal collection pans and urine collection bags. Fecal pans were emptied at the end of each 24-h period. Feces was weighed, mixed, and sampled in 5% aliquots prior to being frozen at –4°F. Fecal material was pooled by animal within period on a wet weight per day basis, mixed, and dried in a forced-air induction oven until a constant weight was achieved.

Urine was collected in canvas pouches worn by the steers and vacuumed off immediately into 2.9 gal glass carboys via water aspiration. Carboys contained 5.4 N hydrochloric acid in amounts sufficient to maintain urine pH between 2 and 3. Urine was removed from carboys as needed, but not less than every 24 h. Urine was weighed, filtered through two layers of cheesecloth and quantified volumetrically prior to a being sampled (10% aliquot) and frozen. Urine was analyzed on a wet basis. All samples (fecal, urine, feed refusals, and feed ingredients) were analyzed for total phosphorus content (AOAC 3.4.11, 1995).

Experimental design was a replicated Latin square. One steer had to be removed from the study after period two due to health concerns. All data collected on this animal were removed from statistical analyses. Statistical analyses were performed as an unbalanced replicated Latin square with animal as the experimental unit using the PROC MIXED procedure of SAS. Data were analyzed for linear and quadratic effects. Regression analyses were performed using the PROC REG procedure of SAS to determine the effect of P intake on fecal P, urine P, P retention, and P excretion.

Results and Discussion

Phosphorus balance data are presented in Table 2. The amount of P offered to the animals

daily increased in a linear fashion (P = 0.001) as the concentration of DDGS in the diet increased. No differences were detected in amount of P refused; consequently, P intake also increased linearly (P = 0.007) as the dietary concentration of DDGS increased. Linear increases in urine P (P = 0.001), total P excretion (P = 0.025), and P retention (P = 0.020) were observed as the level of DDGS in the diets increased
.

Table 2. Phosphorus balance

	Treatment					Contrasts	
	CON	12% DDGS	24% DDGS	36% DDGS	SEM[a]	Linear	Quadratic
	---------- g/d ----------					---------- *P*-value ----------	
P offered	24.5	27.5	32.8	35.1	2.20	0.001	0.843
P refused	5.9	4.9	7.6	7.3	2.57	0.358	0.853
P intake	18.6	22.6	25.2	27.8	2.94	0.007	0.756
Urine P	3.3	3.8	6.2	7.5	1.05	0.001	0.571
Fecal P	12.7	13.3	17.1	14.8	3.17	0.278	0.528
Excreted P	16.0	17.1	23.3	22.3	3.37	0.025	0.676
Retained P	-1.5	2.7	4.7	5.3	0.91	0.020	0.368

[a]SEM = standard error of the mean.

When regressed on total P intake, urinary P tended to be influenced (P = 0.110) by P intake, but was poorly correlated ($P_{urinary}$ = 0.537 + 0.189 P_{intake}; r^2 = 0.10; Figure 1). Fecal P increased (P = 0.003) as P intake increased and was moderately correlated (P_{fecal} = 0.003 + 0.416 P_{intake}; P = 0.003; r^2 = 0.29; Figure 2). Total P excretion increased as P intake increased (P = 0.001) and was approximately 50% correlated with P intake (P_{total} = 5.324 + 0.605 P_{intake}; r^2 = 0.47; Figure 3). Phosphorus retention increased as P intake increased (P = 0.001) and was also 50% correlated with P intake ($P_{retained}$ = -12.306 + 0.641 P_{intake}; r^2 = 0.50; Figure 4).

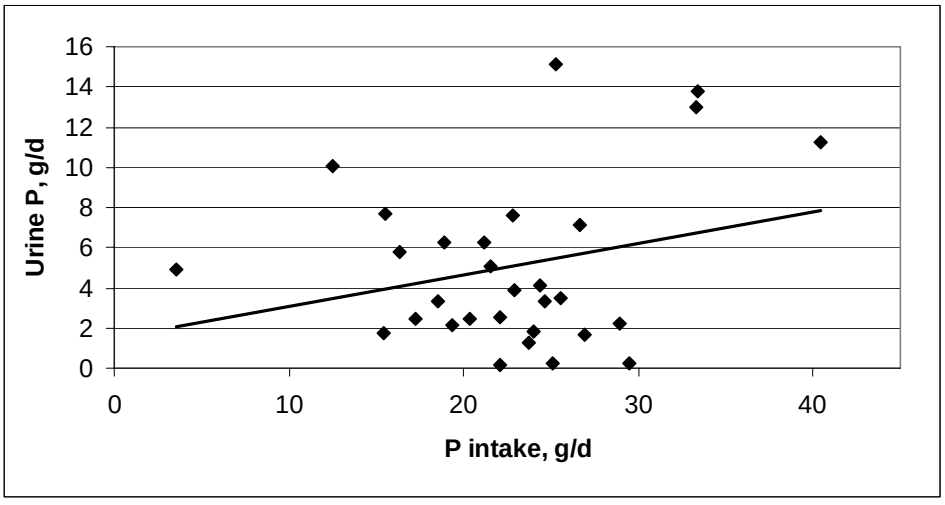

Figure 1. Urinary P regressed on total P intake; P = 0.110; $P_{urinarv}$ = 0.537 + 0.189 P_{intake}; r^2 = 0.10.

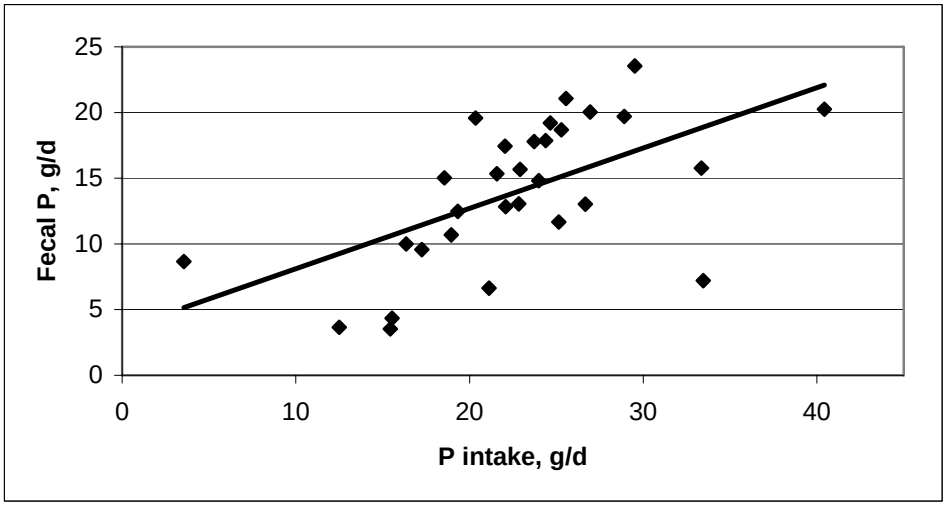

Figure 2. Fecal P regressed on total P intake; $P = 0.003$; $P_{fecal} = 0.003 + 0.416\ P_{intake}$; $r^2 = 0.29$.

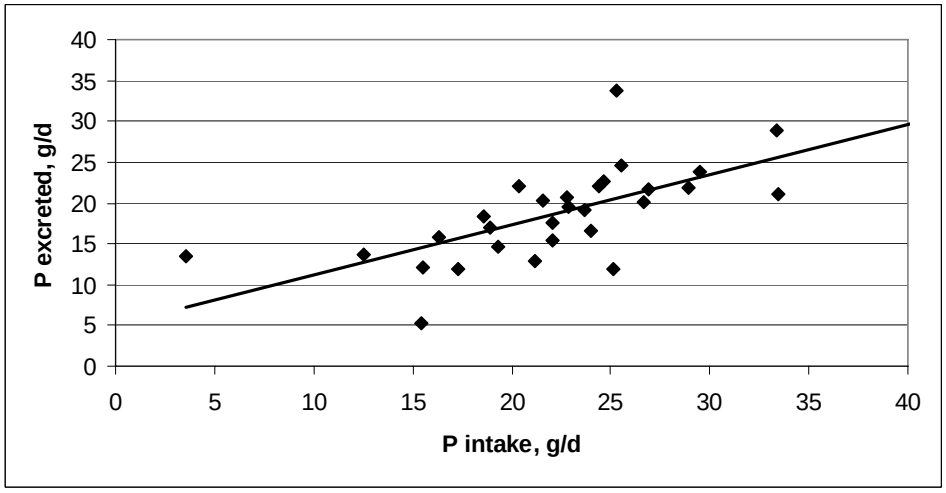

Figure 3. Total P excretion regressed on total P intake; $P = 0.001$; $P_{total} = 5.324 + 0.605\ P_{intake}$; $r^2 = 0.47$.

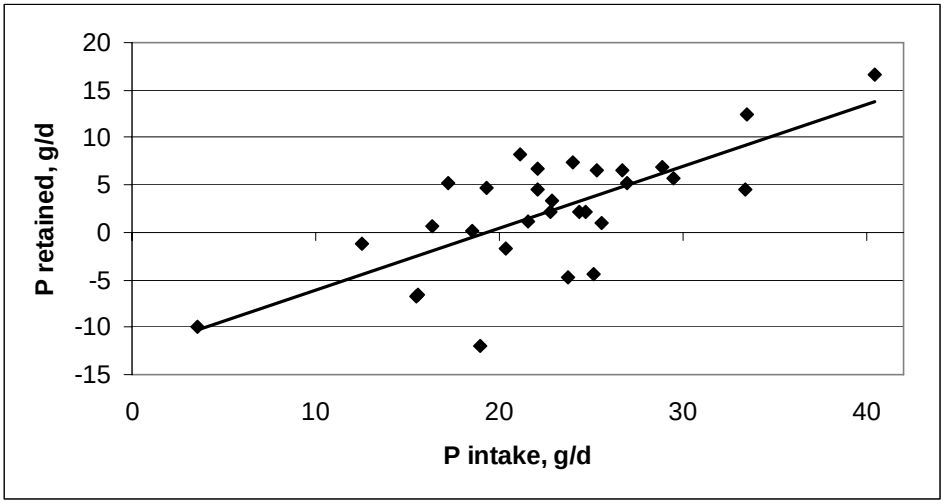

Figure 4. Total P excretion regressed on total P intake; $P = 0.001$; $P_{retained} = -12.306 + 0.641\ P_{intake}$; $r^2 = 0.50$.

Linear increases observed in urinary P and total P excretion are consistent with those reported by Knowlton and Herbein (2001). Knowlton and Herbein (2001) also observed a linear increase in fecal P excretion as P intakes increased (84.7, 135.2, and 161.5 g/d). In the current trial no differences were observed in fecal P contents. As the level of P intake increased, retention of P increased linearly ($P = 0.001$). This effect has not been previously demonstrated. The trend for increased P intake to result in increased P retention can be calculated from the data reported by Geisert et al. (2005) for cattle consuming three levels of P from brewers grits-based diets with inorganic P supplementation. This was not reported or statistically analyzed by the authors.

Results of this experiment clearly demonstrate that as the concentration of DDGS in the diets of finishing steers increases, the amount of P excreted by the animals also increases. Furthermore, these data suggest that a substantial proportion of the total amount of P excreted is contributed by urinary P.

Implications

This experiment demonstrates that as the dietary concentration of DDGS increases, P excretion increases. Beef producers and feedlot managers must be cognizant of increased manure P concentration when developing and implementing manure management plans.

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Use of DDGS as the Primary Source of Supplemental Crude Protein in Calf Receiving Diets[1]

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BEEF 2006 – 02

Summary

This experiment was designed to determine whether DDGS could be used as the primary source of supplemental crude protein in receiving calf diets. Diets included 45% oat hay and rolled corn. The control diet included 11.8% SBM as the source of supplemental crude protein. The DDGS was fed at 18.9% of diet replacing SBM. There was 1.3% SBM included in the DDGS diets. Diets were formulated for 13% CP and 48 Mcal/cwt NE_G. The 47-d experiment began at arrival at the feedlot and involved 294 steer calves (604 lb). Calf gains (2.49 vs 2.54 lb/d) and F/G (5.76 vs 5.61) were similar for SBM and DDGS diets, respectively. The steers fed the DDGS consumed slightly less feed (14.34 vs 14.17). Overall morbidity rate was low (2.4%) with no apparent influence from diet. The use of DDGS as a primary source of supplemental CP in calf receiving diets appears to be acceptable in spite of a calculated deficiency in ruminally degradable crude protein.

Key words: Receiving, Calves, DDGS, DIP

Introduction

Feedlots oftentimes use an elevated concentration of crude protein (CP) to allow for depressed intake by newly received calves. The DDGS, now plentiful in this region, provide an attractively priced source of CP. The DDGS also provide readily fermentable fiber and crude fat that would be useful during calf and ruminal acclimation to the feedlot environment. The potential limitation is that DDGS may not provide sufficient levels of ruminally available CP (DIP) to support optimal rumen function. This could lead to depressed intake and inadequate energy balance during this period of stress.

This experiment was designed to determine whether DDGS, substituted for dry rolled corn and soybean meal used in receiving calf diets, would support comparable intake, growth rate, and health.

Materials & Methods

Steer calves (n = 294) received in three drafts were used to quantify the suitability of using DDGS as a major contributor to dietary CP. Receiving diets were based on oat hay (9% CP, 66% NDF) and dry rolled corn (DRC). The control diet (SB) used soybean meal as the source of supplemental CP needed to provide 13% CP diets. The test diet (DG) involved substituting 18% DDGS for 7.6% points DRC and 10.2% points SBM to produce a similar 13% CP diet. The actual formulation of these diets, based upon weekly ingredient sampling and feed batching records, is depicted in Table 1.

[1] This project was funded by MBI and the SD Ag Experiment Station.
[2] Distinguished Professor
[3] Professor

Table 1. Diet formulations and compositions

Item	Diet		SEM
	SB[a]	DG[a]	
Oat hay, %	45.13	45.28	0.53
Rolled corn, %	41.46	29.93	0.33
DDGS, %		18.91	0.23
Supplement, %[b]	13.41	5.88	0.11
SBM[c]	11.84	1.30	
TM salt[c]	0.30	0.25	
Limestone[c]	0.96	0.88	
Monocalcium PO_4	0.30		
Ground corn[c]		3.44	
DM, %[d]	80.7	81.5	0.84
CP, %[d]	12.9[f]	13.4[g]	0.12
NDF, %[d]	34.8[f]	40.8[g]	0.80
NE_m[e]	80.5	80.6	
NE_G[e]	48.0	48.6	

[a] Refers to primary source of supplemental CP; SB = SBM, DG = DDGS.
[b]Provided as a pelleted supplement to target diet levels of: Ca 0.57%, P 0.38%, K 1.6%, Zn 50 ppm, Cu 10 ppm, Vitamin A 1000 IU/lb, Vitamin E 10 IU/lb and monensin 20g/T.
[c] Diet contribution as proportion of supplement actually fed.
[d] Determined.
[e] Calculated assuming DDGS at 103% NE_G content of corn.
[f,g] Means differ ($P < 0.05$).

Calves were managed and maintained as the individual drafts that arrived and all calves received were used in the experiment. After allowing an overnight rest with access to long hay and water, calves were processed. This involved tagging, weighing, vaccinating for clostridial (Ultrabac-7[4]) and viral (Resvac 4[3]) diseases and treating for parasites (Cydectin[5]). The body weight (BW) recorded while processing was used to stratify all calves within a draft by BW before randomly assigning to diet and subsequently to replicate. The diet replicate classification represented a pen of 9 or 10 steers. Pen assignments were made such that treatments were uniformly distributed across the 30 pens used in the experiment.

Cattle were fed twice daily at an amount intended to minimize feed carryover but not restrict intake. Diets were top dressed on long hay for 2 d to facilitate calf adaptation to the feedlot environment. Individual feed ingredients were sampled weekly for proximate analysis. Actual diet formulations and compositions were reconstructed from these analyses and feed batching records. These data were compiled at 7-d intervals.

The initial BW was the weight obtained during processing. Interim and final BW were recorded in the morning prior to feeding. Interim weight data were collected at 22 d on feed for drafts 1 and 2 and at 26 d on feed for the third draft of calves. Final weights were recorded after 47 d on feed for all calves. To calculate cumulative performance, the final body weight was assessed 3% shrink. Pen was considered the experimental unit in a statistical model that included draft, diet, and replicate. Diet effects on production variables were tested using the error term diet within draft.

Results & Discussion

Actual dietary CP was slightly higher ($P < 0.05$) for the DG diet (Table 1). This was in part due to variability of CP content of corn, which comprised less of the DG diet and in part to DDGS that had lower moisture content than anticipated. When actual dry inclusion levels of ingredients and assayed CP values for those ingredients were used in the NRC Model, the estimated DIP balances were -52 g/d and -177 g/d for SB and DG diets, respectively. If the DIP

[4] Pfizer Animal Health
[5] Fort Dodge Animal Health

level was inadequate to support ruminal function, a reduction in intake would be anticipated. Over the 47 d period, DMI tended (P = 0.08) to be lower for steers fed the DG diet, but this was only a 1.2% difference. The effect on DMI was expressed in the latter half of the test (Table 2). The growth rate and efficiency of growth were not affected by this slight reduction in DMI.

Table 2. Receiving period (47-d) calf performance by diet

		SB[a]	DG[a]	SEM
Initial BW		601	593	4.0
Interim BW		668	662	3.5
Early[b]	ADG	2.68	2.79	0.069
	DMI	12.30	12.12	0.059
	F/G	4.62	4.38	0.144
D 47 BW		743	737	4.5
Late[c]	ADG	3.40	3.39	0.43
	DMI*	16.62	16.46	0.027
	F/G	4.89	4.91	0.063
Cumulative[d]				
Final	BW	721	715	4.4
	ADG	2.49	2.54	0.031
	DMI‡	14.34	14.17	0.034
	F/G	5.76	5.61	0.081

[a] Refers to primary source of supplemental CP; SB = SBM, DG = DDGS.
[b] Early interim period of 26 or 22 d.
[c] Late interim period of 21 or 25 d.
[d] Includes 3% shrink of d 47 body weight for all cumulative production variables.
* Means differ P = 0.05.
‡ Means differ P = 0.08.

The possibility exists that intake was also lower than optimum in the SB diet due to the small but negative DIP value associated with that diet. If this occurred, it may have marginalized the impact of the greater deficiency of DIP for the DG diet. However, intake expressed relative to metabolic mass was 111 g/kgW$^{0.75}$ during the last 12 d of the study. This would be an expected DMI if crude protein needs were being met. The NRC Model predicted DMI at 93 g/kgW$^{0.75}$ for these conditions. Based on these comparisons, DIP was probably not limiting intake.

Health problems were minimal with no mortalities and an overall morbidity rate of 2.4%. This infers that the negative DIP in this DG diet did not adversely affect the health status of calves experiencing the stressful transitions of weaning and shipping to the feedlot. However, it would not be appropriate to presume CP adequacy of these diets in higher risk cattle based solely on this experiment.

Diets containing 13% CP appeared to be adequate for the feedlot receiving period in calves. A more negative DIP diet including DDGS did not affect production efficiencies adversely. The DDGS supplemented diet provides an alternative source of crude protein that can be used to reduce feed costs.

Effect of Single vs. Pulsing Doses of Estradiol 17-β and Trenbolone Acetate in Finishing Steers Fed a High Concentrate Diet[1]

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Department of Animal and Range Sciences

BEEF 2006 - 03

Summary

The effect of implant dosing pattern on anabolic response was evaluated in predominately Angus steers (n=192). Steers, except the control, were implanted with 1 of 3 different implant strategies. Cumulatively all implant treatments received a dose of 24 mg estradiol 17-β (E_2) and 120 mg trenbolone acetate (TBA). Dosing patterns were 8 mg E_2 and 40 mg TBA given 3 times; 12 mg E_2 and 60 mg TBA given 2 times or 24 mg E_2 and 120 mg TBA given 1 time. Implanted cattle had heavier body weights, increased average daily gain, and lower feed conversion compared to non-implanted controls. There were no differences among the implant treatments for cumulative 133 d body weight gain or average daily gain. Carcass quality was not affected by implant or implant dosing pattern. Dosing pattern did have an affect on growth patterns.

Introduction

There has been a great deal of research conducted to determine the optimum anabolic dose needed to maximize anabolic response. However, research is limited in establishing the threshold dose needed to stimulate anabolic response and determine if implant dosing patterns affect anabolic response. For this experiment, multiple low doses of anabolic hormones were given in an effort to sustain anabolic concentrations. A comparison could then be made between those steers receiving multiple low doses of anabolic agents and those receiving a single high dose of anabolic agent. The objective of this study was to determine the effect of implant dosing pattern on finishing steer performance and carcass characteristics.

Materials and Methods

Predominately Angus steers (n=192) which were previously in a backgrounding experiment, were assigned to this experiment. Steers had been vaccinated and treated for parasites prior to initiation of the backgrounding experiment. The steers were not implanted during the backgrounding experiment.

All implant treatments were designed to provide a cumulative dose of 24 mg of estradiol 17-β (E_2) and 120 mg of trenbolone acetate (TBA). The 4 treatments evaluated were 1) no implant control; 2) 8 mg E_2 and 40 mg TBA administered on days 0, 42 and 84; 3) 12 mg E_2 and 60 mg TBA administered on days 0 and d 63; and 4) 24 mg E_2 and 120 mg TBA administered on day 0 (Table 1).

Table 1: List of Implant Treatments

	Treatments			
	1	2	3	4
		E_2:TBA, mg		
Day				
0	--	8:40	12:60	24:120
42	--	8:40	--	--
63	--	--	12:60	--
84	--	8:40	--	--

[1] This project funded by the Beef Nutrition Program and the SD Ag Experiment Station.
[2] Graduate Student
[3] Distinguished Professor
[4] Associate Professor

Steers were stratified by body weight, separated into two weight categories (light 774 ± 63 lb and heavy 867± 49 lb) and randomly assigned within each weight category to an implant treatment during a 20 d pre-test phase. Cattle were acclimated to the final diet by day 0. The lighter group was started on experiment 14 d after the heavier group. A total of 24 pens were used (8 steers/pen and 3 pens/treatment within each weight category). Steers were stepped up from a 45% roughage diet to the final diet using a 4-step process. The roughage source for the final diet was initially corn silage; this was replaced by oat hay at d 98 for the heavy group and d 84 for the light group. All treatments were fed similarly (Table 2) except that for the last 21 days on feed, oatlage replaced oat hay for the lighter group only. Feed ingredients were assayed weekly and DMI and diet composition (except NE_m and NE_g) were calculated from the laboratory values.

Table 2: Formulations and Compositions of Finishing Diets[a]

	Diets[b]	
	1	2
Corn silage	5.92	--
Oat hay[c]	--	3.00
Whole shell corn	55.15	55.90
High moisture ear corn	26.83	28.70
Soybean meal	7.80	8.30
Liquid supplement[d]	4.30	4.10
	100.0	100.0
DM[e]	71.0	81.0
CP[e]	12.5	13.1
NDF[e]	13.2	13.5
NE_m, Mcal/cwt[f]	92.0	92.4
NE_g, Mcal/cwt[f]	61.4	61.5

[a]DM basis.
[b]Diet 1 was fed until d 98 (heavy group)and d 84 (light group) when diet 2 was fed.
[c]Replaced with oat silage for the lighter group at 112 d on feed.
[d]Provided monensin at 29 g/T and urea at 0.76% of final diet; supplied minerals and vitamins to meet or exceed nutrient requirements (NRC, 2000).
[e]Calculated from lab assays
[f]Calculated from tabular values

Body weights were recorded prior to feeding every 21 d except the final weight which was at a 28 d interval. The final body weight was recorded in the morning and cattle were shipping that evening to Tyson Fresh Meats, Dakota City, NE. Slaughter occurred the following morning and individual cattle identity was tracked through the slaughter process. Carcass data were collected approximately 30 h after slaughter. Hot carcass weight was recorded and ribeye area and subcutaneous rib fat were measured. Marbling scores and KPH fat, (%) were assigned by an USDA grader, Yield Grade was calculated from the carcass values collected. Three calves were realized and removed from the data for reasons not related to treatments. Carcass data were not captured on 9 steers.

Data were analyzed as a completely random design with a 2 x 4 factorial arrangement of treatments with factors of weight group and implant treatment. Steer performance was analyzed using pen as the experimental unit. Carcass data were analyzed using the individual as the experimental unit. All performance and carcass variables were analyzed using the General Linear Model (GLM) procedure of SAS. If the GLM evaluation of treatment was significant ($P < 0.05$) then treatment means were separated using Fishers T test.

Results and Discussion

The interim performance is summarized by weigh dates (Table 3) and cumulative intervals (Table 4) corresponding to implant dates. Only main effects of treatment are reported as no weight group x treatment interaction occurred. The cumulative intervals depict how growth curves responded to implant dosages. During the first 42 d, implants did not affect (P = 0.1082) ADG or DMI but F/G was lower (P < 0.05) for implanted cattle.

Table 3: Interim Performance by Treatment[a]

	Treatment				
	1	2	3	4	SEM
Implant dose (E_2:TBA), mg	--	8:40	12:60	24:120	
Frequency	--	3	2	1	
Initial BW	817	818	821	825	2.96
1 to 21 d					
BW, lb	887	896	898	905	4.52
ADG, lb	3.37	3.70	3.64	3.79	0.19
DMI, lb	19.50	19.66	19.31	19.83	0.44
F/G	5.95	5.56	5.41	5.33	0.23
22 to 42 d					
BW, lb	984[b]	997[bc]	1000[bc]	1018[c]	7.24
ADG, lb	4.59	4.84	4.86	5.37	0.21
DMI, lb	22.05	22.18	21.68	22.71	0.59
F/G	4.87[b]	4.61[bc]	4.49[c]	4.26[c]	0.12
43 to 63 d					
BW, lb	1056[b]	1074[bc]	1073[bc]	1093[c]	7.67
ADG, lb	3.43	3.63	3.46	3.61	0.19
DMI, lb	22.96	23.61	22.76	24.09	0.47
F/G	6.77	6.64	6.71	6.79	0.32
64 to 84 d					
BW, lb	1119[b]	1146[c]	1149[c]	1164[c]	6.97
ADG, lb	3.01[b]	3.44[c]	3.64[c]	3.35[bc]	0.15
DMI, lb	23.24	24.01	23.21	24.47	0.44
F/G	7.78	7.04	6.42	7.56	0.43
85 to 105 d					
BW, lb	1195[b]	1233[c]	1235[c]	1239[c]	7.98
ADG, lb	3.64	4.17	4.07	3.60	0.21
DMI, lb	23.76[b]	25.13[cd]	24.20[bc]	25.54[d]	0.38
F/G	6.74	6.03	6.03	7.32	0.39
106 to 133 d					
BW, lb	1267[b]	1326[c]	1319[c]	1329[c]	7.84
ADG, lb	2.56[b]	3.32[c]	3.01[bc]	3.20[c]	0.16
DMI, lb	23.29[b]	25.46[cd]	24.48[bc]	25.89[d]	0.40
F/G	9.15	7.73	8.29	8.31	0.44

[a]Calculated using unshrunk live body weight.
[b,c,d]Means in the same row without a common superscript differ (P < 0.05).

Table 4: Cumulative Intervals of Steer Performance Corresponding to Implanting[a]

	Treatments				
	1	2	3	4	SEM
Implant dose (E_2:TBA), mg	--	8:40	12:60	24:120	
Frequency	--	3	2	1	
1 to 42 d					
ADG, lb	3.98	4.27	4.25	4.58	0.16
DMI, lb	20.77	20.92	20.49	21.27	0.47
F/G	5.22[b]	4.91[c]	4.83[c]	4.68[c]	0.10
43 to 83 d					
ADG, lb	3.22	3.54	3.55	3.48	0.13
DMI, lb	23.10	23.81	22.98	24.28	0.44
F/G	7.23	6.81	6.49	7.13	0.29
1 to 63 d					
ADG, lb	3.80[b]	4.06[b]	3.99[b]	4.25[c]	0.11
DMI, lb	21.50	21.82	21.25	22.21	0.40
F/G	5.67[b]	5.41[c]	5.34[c]	5.23[c]	0.09
64 to 133 d					
ADG, lb	3.02[b]	3.61[c]	3.52[c]	3.36[c]	0.11
DMI, lb	23.42[b]	24.93[cd]	24.01[bc]	25.36[d]	0.35
F/G	7.80[b]	6.92[cd]	6.84[d]	7.60[bc]	0.25
1 to 84 d					
ADG, lb	3.60[b]	3.90[c]	3.90[c]	4.03[c]	0.07
DMI, lb	21.94	22.37	21.74	22.77	0.38
F/G	6.10[b]	5.76[c]	5.58[c]	5.66[c]	0.08
85 to 133 d					
ADG, lb	3.02[b]	3.68[c]	3.47[c]	3.37[bc]	0.13
DMI, lb	23.49[b]	25.32[cd]	24.36[bc]	25.74[d]	0.38
F/G	7.83[b]	6.90[d]	7.07[cd]	7.68[bc]	0.24
1 to 133 d					
ADG, lb	3.39[b]	3.82[c]	3.74[c]	3.79[c]	0.06
DMI, lb	22.51[b]	23.45[cd]	22.70[bc]	23.87[d]	0.33
F/G	6.65[b]	6.15[c]	6.07[c]	6.31[c]	0.08

[a]Calculated using unshrunk live body weight.
[b,c,d]Means in the same row without a common superscript differ ($P < 0.05$).

From d 1 to 63, implanted cattle had lower ($P < 0.05$) F/G compared to non-implanted cattle; with cattle in treatment 4 having greater ($P < 0.05$) ADG compared to other treatments. From d 64 to 133, implant treatments caused increased ($P < 0.05$) ADG, treatments 2 and 4 tended to have increased ($P < 0.10$) DMI compared to control and treatment 3. After the second anabolic dose was given to cattle in treatment 3 (d 64 to 133), F/G was decreased ($P < 0.05$) compared to cattle in treatment 4. Treatment 2 tended to decrease ($P < 0.10$) F/G compared to treatment 4. After the third anabolic dose was given to treatment 2 (d 85 to 133), F/G was decreased ($P < 0.05$) compared to treatment 4 and treatment 3 tended to have reduced ($P < 0.10$) F/G compared to treatment 4.

Implant treatments had increased ($P < 0.05$) cumulative carcass adjusted ADG compared with control steers (Table 5). Dosing pattern did not affect ($P > 0.05$) cumulative carcass adjusted ADG among implant treatments. Cumulatively,

treatments 2 and 4 caused increased ($P < 0.05$) DMI compared to control. Cumulative DMI for treatment 3 was similar ($P > 0.05$) to the control and lower ($P < 0.05$) compared to treatment 4. Treatment 2 and 3 caused decreased ($P <. 0.05$) cumulative carcass adjusted F/G compared to control. Since cumulative ADG did not differ among implant treatments, the decrease ($P < 0.05$) in cumulative carcass adjusted F/G for treatment 3 compared to treatment 4 is probably accounted for by decreased DMI.

Although dosing pattern did not cause a difference in cumulative ADG it did affect the pattern of growth. For the first 63 d (Table 4) the change in ADG relative to control was 6.8, 5.0 and 11.8% for treatment 2, 3 and 4, respectively. From d 64 to 133, the response was 19.5, 16.6 and 11.3%, respectively. The response was 21.9, 14.9 and 11.6%, respectively, from d 85 to 133. Cattle receiving multiple low doses of E_2 and TBA seemed to have a slower decline in growth as days on feed increased verses those cattle receiving a single dose of E_2 and TBA (Figure 1).

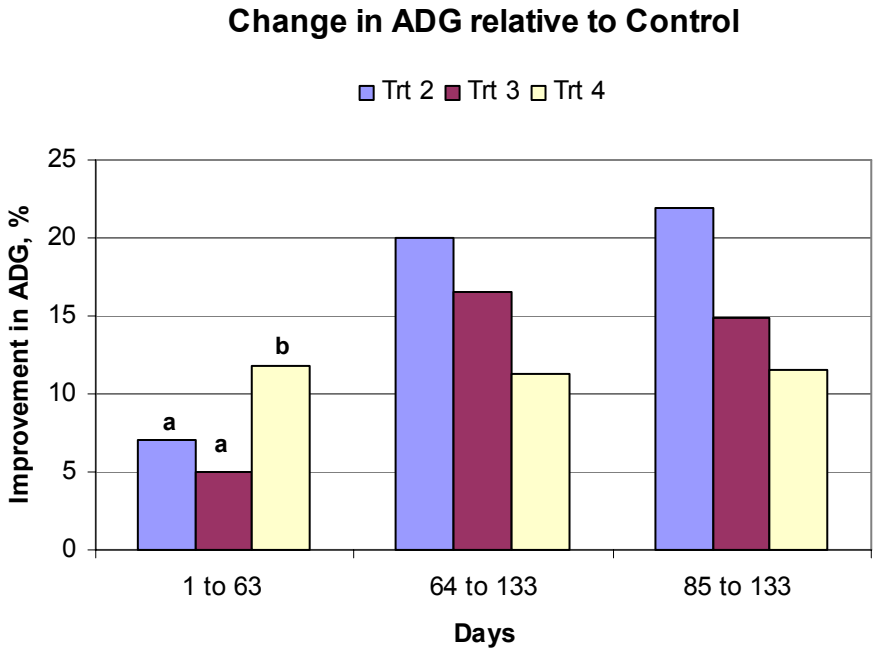

Figure 1. The effect of implants on improvement in ADG relative to cattle which were not implanted. Treatment 1 = control; Treatment 2 = 3 doses 8 mg E_2 and 40 mg TBA ; Treatment 3 = 2 doses 12 mg E_2 and 60 mg TBA; Treatment 4 = 24 mg E_2 and 120 mg TBA. [a, b] Means in the same group without a common superscript differ ($P < 0.05$).

Repeated administration of anabolic doses appears to sustain the anabolic response. The response in F/G (calculated using live, unshrunk body weight) to dosing pattern is more evident when F/G is viewed as % over controls (Figure 2). From d 1 to 63 the improvement in F/G relative to control was 4.6, 5.8 and 7.8% for treatment 2, 3, and 4, respectively. From d 64 to 133 the response was 11.3, 12.3 and 2.6%, respectively. From d 85 to 133, the % F/G improvement over controls was 11.9, 9.7 and 1.9% respectively.

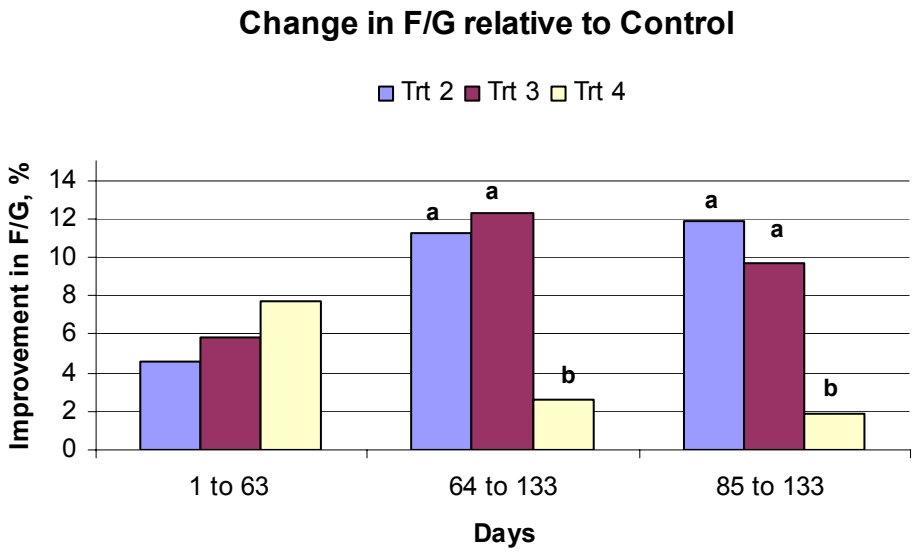

Figure 2. The effect of implants on improvement in F/G relative to cattle which were not implanted. Treatment 1 = control; Treatment 2 = 3 doses 8 mg E_2 and 40 mg TBA ; Treatment 3 = 2 doses 12 mg E_2 and 60 mg TBA; Treatment 4 = 24 mg E_2 and 120 mg TBA. [a, b] Means in the same group without a common superscript differ ($P < 0.10$).

Implanting increased ($P < 0.05$) carcass weight an average of 33 lb (Table 5). Treatments 3 and 4 had an increased ($P < 0.05$) ribeye area compared to control. Yield Grade and marbling score were not affected by treatment ($P > 0.15$) while KPH fat tended ($P < 0.10$) to be lower for treatment 2. Two important points should be made when the effects of implants on Quality Grades are considered for this study. The first being that these cattle had exceptionally high overall Quality Grades and the marbling response to implants seen in this experiment may not be typical of all cattle. Secondly, this experiment was designed to target anabolic activity when caloric intake was not limited. When adaptation to diet does not occur prior to implanting, outcomes may be different.

Table 5: Cumulative Steer Performance and Carcass Characteristics by Treatment[a]

	Treatment				
	1	2	3	4	SEM
133 d Cumulative					
Adjusted end wt[b]	1233[d]	1283[e]	1289[e]	1285[e]	8.69
ADG, lb	3.13[d]	3.49[e]	3.52[e]	3.45[e]	0.06
DMI, lb	22.51[b]	23.45[cd]	22.70[bc]	23.87[d]	0.33
F/G	7.19[d]	6.73[ef]	6.46[f]	6.93[de]	0.12
Hot carcass wt, lb	771[d]	802[e]	806[e]	803[e]	7.53
Dress, %	60.84[de]	60.42[d]	61.09[e]	60.41[d]	0.002
Ribeye area, in^2	12.70[d]	13.00[de]	13.36[e]	13.30[e]	0.19
Ribfat depth, in	0.49	0.47	0.52	0.55	0.02
KPH, %	1.95	1.70	1.84	1.76	0.007
Marbling score[c]	6.41	6.17	6.31	6.16	0.16
Yield Grade	2.99	2.91	2.96	3.03	0.07
Choice or better, %	91.1	90.7	87.2	82.2	

[a]Least squares means.
[b]Calculated as hot carcass wt ÷ 0.625.
[c]$Small^0 = 5$; $Modest^0 = 6$.
[d,e,f]Means in the same row without a common superscript differ ($P < 0.05$).

Cost of Gain Comparison Between Cattle Finished at Opportunities Farm in South Dakota and Cattle Finished in Kansas[1]

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BEEF 2006 - 04

Summary

Cost of gain is an important factor in determining the profit or loss of feeder cattle. For comparison of cost of gain between cattle finished in Southeast South Dakota and cattle finished in Southwest Kansas closeouts of cattle fed at the Opportunities Farm near Lennox, SD were compared with information published by Kansas State University in the monthly Focus on Feedlots. Cattle feeders in the Midwest, including South Dakota, are competitive with cattle feeders in other regions of the United States due to this regions lower ration costs and cost of gain.

Introduction

The predominant cattle feeding regions in the United States are located in the states of Texas, Kansas, Nebraska, Colorado, and Iowa. The Midwest and Northern Great Plains have a competitive advantage to the primary cattle feeding regions because of the price of commodities. There can be a $0.60 advantage for buying a bushel of corn in South Dakota compared to Texas or Kansas. Though feed conversions are generally better in the Southern cattle feeding regions compared with South Dakota, the cost of commodities and cattle type can result in lower costs of gain for cattle finished in South Dakota.

Opportunities Farm was developed as a production-scale teaching classroom and outreach laboratory. There are three unique cattle feeding facilities located at Opportunities Farm, all of which are common to cattle feeding operations in South Dakota. The facilities were designed to allow comparisons of feedlot performance among facilities. We used the closeout information generated from cattle finished in the facilities at Opportunities Farm with closeout information reported by Hale (2006) from Kansas feedyards to demonstrate differences in cost of gain between southeastern SD and west Kansas.

Materials and Methods

There have been 2,068 head of cattle finished as matched sets at Opportunities Farm. A matched set was considered as a group of approximately 240 head of cattle that were sorted three ways. Each sorted group of cattle was allocated to one pen in each of the three facilities. Cattle have been marketed from Opportunities Farm since June 2004; however, there have not been any cattle marketed during the third quarter (July to September) of 2004 or 2005. All cattle information from Opportunities Farm has been entered into a feedlot tracking computer program to generate cost of gain for each matched set of cattle. Cost of gain includes a feed markup ($8/ton) and yardage ($0.25/head/day). The body weights (BW) used were pay weights (BW at purchase and at the slaughter facility).

Using the information available in Focus on Feedlots (Hale, 2006), closeouts from Opportunities Farm were compared with closeouts from nine Kansas feedyards. Closeout data from Opportunities Farm were the pooled closeouts from the three facilities. Only closeouts from steers reported by Hale (2006) were used in this comparison. The closeouts were summarized by quarter.

Results and Discussion

Closeout information from Opportunities Farm and Hale (2006) are listed in Table 1. From this simple comparison there are a few noticeable differences in the values presented. As expected, the number of cattle represented in the means in Table 1 is vastly greater from the Kansas reports. Final BW were heavier, ADG

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was greater, F/G was poorer, and death loss was lower for cattle finished at Opportunities Farm compared to cattle fed in five Kansas feedyards reported by Hale (2006). Though F/G were poorer for cattle finished in South Dakota, cost of gain was lower for every quarter where closeout information was available.

Implications

Though this was only a comparison of closeout information from a limited number of cattle fed at Opportunities Farm, it demonstrates that due to the cost of feedstuffs, cattle feeders in South Dakota can compete with cattle feeders located in the primary cattle feeding regions of the United States.

Literature Cited

Hale, R. 2006. Kansas Feedlot Performance and Feed Cost Summary: Focus on Feedlots. Available: http://www.asi.k-state.edu/DesktopDefault.aspx?tabindex=53&tabid=302. Accessed July 3, 2006.

Table 1. Comparison costs of gain from cattle finished in South Dakota[a] and Kansas[b] from April 2004 to June 2006

	Quarter 1		Quarter 2		Quarter 3		Quarter 4	
Item	Opps Farm in SD	KS	Opps Farm in SD	KS	Opps Farm in SD	KS	Opps Farm in SD	KS
Number of Cattle finished	218	21,799	1,362	56,377	–	34,144	488	22,765
Days on feed	146	153	138	165	–	148	138	141
Final BW, lb	1,486	1,265	1,331	1,244	–	1,312	1,339	1,320
ADG, lb	3.43	3.21	3.76	3.11	–	3.55	3.42	3.63
Feed:Gain	8.50	6.30	6.46	5.98	–	5.87	7.26	5.99
Death loss, %	0.91	1.30	0.51	2.28	–	0.95	0.63	0.79
Cost of gain, $/cwt					–			
Mean	49.24	54.58	41.88	54.80	–	53.91	50.86	53.92
Minimum	–	51.98	–	51.08	–	50.15	–	52.16
Maximum	–	57.23	–	59.77	–	57.31	–	56.10

[a] Opportunities Farm near Lennox, SD.
[b] Summary of nine feedyards in west Kansas (Hale, 2006).

Association of Leptin Gene Markers with Carcass Traits in Beef Cattle[1]

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BEEF 2006 – 05

Summary

The objective of this study was to evaluate four genetic markers on the leptin gene for association with carcass traits in three crossbred families. Three half-sib families were developed from crossbred sires. Families 1, 2, and 3 comprised 26, 21, and 66 offspring, respectively (n = 113). The genetic background of the sires, dams, and offspring was 1/3 Angus, 1/3 Hereford, 1/3 Simmental. Carcass traits collected were finished weight, hot carcass weight (HCW), marbling score, Quality Grade, Longissimus muscle area (LMA), rib fat, Yield Grade, and percent kidney, pelvic, and heart fat (KPH). The four markers analyzed were located on the exon 2, exon 3, and promoter region of the leptin gene. There was an association of marbling score with leptin exon 3 ($P < 0.05$), and ability to grade choice with leptin exon 2 ($P < 0.05$), exon 3 ($P < 0.001$), and promoter ($P < 0.01$) in family 2. Family 2 also displayed allelic effects for ability to grade choice ($P < 0.01$) with leptin exon 3 and promoter. Family 3 showed an association between leptin exon 2 ($P < 0.05$) and marbling score. No association was detected ($P > 0.05$) on family 1.

Introduction

The leptin gene is a candidate gene for association with carcass traits as the leptin protein has been shown to affect various metabolic activities. Leptin is a protein that is secreted by white adipocytes and has receptors located in many types of cells throughout the body. Leptin has been shown to contribute to intake regulation as well as energy balance, including energy expenditure, in humans and rodents. Therefore, this gene may also be of use in advancing efficiency of production, carcass quality, and overall health in livestock selection applications. (Houseknecht et al., 1998)

Associations of a marker in exon 2 of the leptin gene with carcass traits were previously observed in calves produced at the South Dakota State University Beef Breeding Unit, Brookings, SD from 1995 to 1999. Cows arising from a two-breed rotational system involving crosses of Angus x Hereford, Simmental x Hereford, and Tarentaise x Hereford breed types were mated to rotational type or terminal Charolais sires. The calves produced were either two- or three-breed crosses. Significant association was found between genotype and marbling score (P = 0.02) when adjusted for slaughter age, HCW, and back fat. Suggestive relationships were noted for back fat, KPH, and percent cutability. (Bierman, 2001; Bierman et al., 2003)

The objective of this study was to determine association between carcass traits and four leptin gene markers, including the marker previously found to be associated with marbling score in the same herd.

Materials and Methods

A reference population of 162 offspring born from 2001 to 2004 from three sires was developed at the South Dakota State University Beef Breeding Unit, Brookings, SD. The three sires and all offspring were comprised of 1/3 Angus, 1/3 Hereford, and 1/3 Simmental genetic material. The offspring and mated dams of each sire were identified as families 1, 2, and 3. Family 1 corresponds to sire 988083, family 2 corresponds to sire 999114, and family 3 corresponds to sire 988042.

Cattle were weaned at approximately 185 days of age. Following weaning, cattle were fed a corn based diet consisting of 12.5% crude protein and 94.2 Mcal/cwt NE_m for about 110 days. Harvest criteria included an average ultrasound determined rib fat measurement of

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0.30 inches and average finished weight of at least 1,000 pounds for the group.

Cattle were marketed to Tyson Fresh Meats, Dakota City, NE or PM Beef, Windom, MN. Animal identification numbers were matched to plant carcass identification numbers at the time of harvest for cross-referencing pre- and post-mortem phenotypes. Phenotypic data was collected for finished weights and post-mortem measures of HCW, marbling score, Quality Grade, LMA, rib fat, percent KPH, and Yield Grade. Finished weight was determined just prior to harvest, while HCW was determined at the time of harvest. Carcasses were chilled for at least 24 hours prior to collection of the additional carcass data. LMA and rib fat measures were taken by South Dakota State University personnel, while marbling score, Quality Grade, percent KPH, and Yield Grade were determined by a USDA grader.

Whole blood was collected from each calf by jugular or tail vein venapuncture at weaning and again at 5 to 6 months into the feeding period. Samples of about 10 ml were collected in evacuated tubes with 15% EDTA. Blood was stored at 4°C for no more than 24 hours prior to buffy coat (white blood cell) extraction by centrifugation. DNA was extracted from the isolated buffy coats using a saturated salt DNA extraction procedure (Miller et al., 1988).

The four markers analyzed were located on the exon 2, exon 3, and promoter regions of the leptin gene. The primers used are noted in Table 1.

Table 1. Primers for leptin gene markers

Marker name	Primers	Annealing temperature	Reference
Leptin exon 2	Forward 5'-CTGTATCGATTCCTGTGGCTTTGG-3' Reverse 3'-GCGTGTGTGAGATGTCATTGATCC-3'	60°C	Fitzsimmons and Schmutz, 1999
Leptin exon 3	Forward 5'-CCCTCTCTCCCACTGAGCTC-3' Reverse 5'-TAAAGGATGCCCACATAGGC-3'	63°C	Konfortov et al., 1999
Leptin promoter	Forward 5'-AGGCAGGATGTTTAGTCGCAGCAT-3' Reverse 5'-TGTGAGCTGGAAAGAACGGA-3'	60°C	(designed for this study)

The marker on exon 2 was previously described by Bierman and in 2001 and 2003. The markers on exon 3 and promoter were detected by DNA sequencing of the three herd sires on an ABI 3730 DNA Analyzer (Hitachi, Ltd.) at the Nevada Genomics Center. Sequences were aligned and compared using Sequencher 4.6 software (Gene Codes Corporation, 2006). Single nucleotide polymorphisms (SNPs) were detected on the exon 3 and promoter regions of the leptin gene and restriction enzymes were selected based on the sequences of DNA nucleotides surrounding the SNPs. A guanine-adenine (GA) deletion marker was detected on the leptin promoter region, and was heterozygous in sires 1 and 3. Genotyping of the SNP markers was conducted by restriction fragment length polymorphism (RFLP) polymerase chain reaction (PCR) with visualization by electrophoresis on 3% agarose gels with ethidium bromide staining. Genotyping of the GA deletion marker was completed by PCR amplification with incorporated fluorescent dye. PCR products were sent to the Iowa State University Genomics Facility for testing. Returned gel files were aligned and genotyped using GeneMarker 1.5 (SoftGenetics LLC, 2006). Assigned genotypes were verified against sire and dam genotypes, with those not in agreement excluded from the analysis (excluded $n = 49$).

Statistical analysis of associations between the gene markers and phenotypic traits was conducted using General Linear Model (GLM) procedure of SAS (SAS Institute Inc., 2001). Differences in sex, year, age at finishing, and the specific marker were accounted for in the model, with age at finishing used as the adjustment factor. Representative *P*-values and Least-squares means were determined.

Results and Discussion

A total of 113 offspring, from families 1 ($n = 26$), 2 ($n = 21$), and 3 ($n = 66$), were included in the analysis of genotypic and allelic effects on carcass traits. The SNP marker on leptin exon 2 was genotyped and analyzed in all three

families, as all three sires were heterozygous for the marker. The SNP markers on leptin exon 3 and leptin promoter were genotyped and analyzed only in family 2, as they were informative only for the sire of that family. Tables 2 through 4 show the genotypic and allelic effects of the leptin gene markers with carcass traits where significance ($P < 0.05$) was detected.

Table 2. Leptin exon 2 genotypic effects on carcass phenotypes in families 2 and 3

	Family 2						
	CC [a]		CR [a]		RR [a]		
Trait	*n*	LS Mean	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	6	1091	10	1072	5	1060	0.7906
HCW, lb	6	642	10	611	5	654	0.1219
Marbling score [b]	6	369	10	339	5	345	0.4426
Choice [c]	6	0.83	10	0.10	5	0.20	0.0165
LMA, in^2	6	12.7	10	12.4	5	12.9	0.8330
Fat, in	.	.	.	.	.	.	.
YG [d]	6	1.95	10	1.64	5	1.80	0.4180
KPH, %	6	2.25	10	2.06	5	2.25	0.7772
	Family 3						
	CC [a]		CR [a]		RR [a]		
Trait	*n*	LS Mean	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	14	1072	29	1061	24	1088	0.4497
HCW, lb	14	650	28	653	23	647	0.9300
Marbling score [b]	12	379	28	425	24	385	0.0151
Choice [c]	14	0.47	29	0.56	24	0.53	0.8925
LMA, in^2	12	12.3	26	12.2	24	12.8	0.4270
Fat, in	10	0.40	17	0.48	14	0.47	0.2534
YG [d]	12	2.20	26	2.23	22	2.24	0.9855
KPH, %	8	2.31	23	2.68	20	2.45	0.0674

[a] genotype; [b] slight = 300-399, small = 400-499; [c] choice = 1, not choice = 0; [d] USDA 1, 2, 3, 4, 5

Table 3. Leptin exon 3 and promoter genotypic effects on carcass phenotypes in family 2

	Leptin exon 3						
	CC [a]		CT [a]		TT [a]		
Trait	*n*	LS Mean	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	2	1015	11	1082	8	1070	0.5064
HCW, lb	2	660	11	619	8	627	0.3809
Marbling score [b]	2	398	11	323	8	364	0.0233
Choice [c]	2	0.50	11	0.00	8	0.75	0.0005
LMA, in^2	2	12.8	11	12.4	8	12.8	0.8583
Fat, in	.	.	.	.	.	.	.
YG [d]	2	2.10	11	1.57	8	1.87	0.1425
KPH, %	2	2.54	11	2.03	8	2.16	0.4603
	Leptin promoter						
	AA [a]		AG [a]		GG [a]		
Trait	*n*	LS Mean	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	.	.	12	1059	9	1085	0.4067
HCW, lb	.	.	12	624	9	631	0.6521
Marbling score [b]	.	.	12	334	9	357	0.2274
Choice [c]	.	.	12	0.08	9	0.67	0.0024
LMA, in^2	.	.	12	12.4	9	12.8	0.3976
Fat, in	.	.	.	.	.	.	.
YG [d]	.	.	12	1.70	9	1.74	0.7991
KPH, %	.	.	12	2.17	9	2.08	0.6893

[a] genotype; [b] slight = 300-399, small = 400-499; [c] choice = 1, not choice = 0; [d] USDA 1, 2, 3, 4, 5

Table 4. Leptin exon 3 and promoter allelic effects on carcass phenotypes in family 2

	Leptin exon 3				
	C [a]		T [a]		
Trait	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	9	1015	8	1022	0.8303
HCW, lb	9	610	8	608	0.9377
Marbling score [b]	9	356	8	377	0.3330
Choice [c]	9	0.11	8	0.75	0.0068
LMA, in^2	9	11.9	8	12.3	0.5276
Fat, in	.	.	.	.	.
YG [d]	9	1.82	8	1.99	0.4112
KPH, %	9	2.32	8	2.26	0.8069
	Leptin promoter				
	A [a]		G [a]		
Trait	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	12	1059	9	1085	0.4067
HCW, lb	12	624	9	631	0.6521
Marbling score [b]	12	334	9	357	0.2274
Choice [c]	12	0.11	9	0.75	0.0024
LMA, in^2	12	12.4	9	12.8	0.3976
Fat, in	.	.	.	.	.
YG [d]	12	1.70	9	1.74	0.7991
KPH, %	12	2.17	9	2.08	0.6893

[a] base substitution; [b] slight = 300-399, small = 400-499; [c] choice = 1, not choice = 0; [d] USDA 1, 2, 3, 4, 5

Only 2 offspring from family 2 had rib fat data, so analysis of that trait was not possible. The leptin promoter AA genotype was not present in the offspring from family 2, though a small number of dams were genotyped AA.

Of the traits analyzed, marbling score and ability to grade choice showed the greatest association with the four leptin markers. Family 2 exhibited significant genotypic effects for marbling score for leptin exon 3 ($P < 0.05$), and ability to grade choice for leptin exon 2 ($P < 0.05$), exon 3 ($P < 0.001$), and promoter ($P < 0.01$). Family 2 also displayed significant allelic effects for ability to grade choice ($P < 0.01$) for leptin exon 3 and promoter. Family 3 showed a significant association between genotype and marbling score for leptin exon 2 ($P < 0.05$). Family 1 had a significant association of the leptin promoter GA deletion marker with Yield Grade ($P < 0.05$). No associations between the markers and finished weight, HCW, LMA, rib fat, and percent KPH were detected.

The results of this study are supportive of the previous studies (Bierman, 2001; Bierman et al., 2003) conducted with the same population at the South Dakota State University Beef Breeding Unit, Brookings, SD, for an association of significance between genotype for the marker on leptin exon 2 and marbling score. However, comparison of least square means for each genotype was not consistent between families. Significant association with marbling score and ability to grade choice, were observed for all four markers analyzed by genotype. Significant association with ability to grade choice was noted in leptin exon 3 and leptin promoter when analyzed by sire allele.

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Association of Microsatellite Markers on Bovine Chromosomes 5 and 6 with Carcass Traits[1]

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Summary

The objective of this study was to identify chromosomal regions associated with phenotypic variation in carcass traits in three crossbred families. Three half-sib families were developed from crossbred sires. Families 1, 2, and 3 comprised 29, 25, and 77 offspring, respectively (n = 131). The genetic background of the sires, dams, and offspring was 1/3 Angus, 1/3 Hereford, 1/3 Simmental. Carcass traits collected were finished weight, hot carcass weight (HCW), marbling score, Quality Grade, Longissimus muscle area (LMA), rib fat, percent kidney pelvic, and heart fat (KPH), and Yield Grade. Microsatellite markers on chromosomes 5 and 6 were selected based on their relative position. Markers used on chromosome 5 were BM6026, RM103, BM321, RM084, BMS1216, BM315, and BM597. Markers used on chromosome 6 were ILSTS093, ILSTS090, BM1329, BMS518, ILSTS035, BM8124, and BMC4203. Individual marker analysis was conducted because homozygosity of the bulls for some markers hindered interval mapping. Family 1 exhibited allelic affects for finished weight, hot carcass weight, and marbling score on chromosome 5. Markers RM103 and BM321 were associated with finished ($P < 0.01$) and carcass ($P < 0.05$) weights. An association with marbling score was identified with BM6026 ($P < 0.05$), RM103 ($P < 0.01$), and BM321 ($P < 0.01$). On chromosome 6, BMC4203 was associated with Longissimus muscle area in family 1 ($P < 0.05$) and family 2 ($P < 0.001$). No association was detected ($P > 0.05$) on family 3.

Introduction

LMA has been identified as an economically important trait, as the Longissimus dorsi is located in the most valuable carcass regions and is used to calculate USDA Yield Grade and total retail product yield (Tatum, 1997). LMA was correlated with a QTL on chromosome 6 in the Belgian Blue X MARC III sired cattle (Casas et al., 2000). The identification of a QTL for LMA on chromosome 6 was supported by a study involving Brahma X Hereford sired cattle (Casas et al., 2003). In the same study, another QTL for the same trait was located on chromosome 5 with significance (Casas et al., 2003).

LMA was selected as the trait of interest for this study, leading to the selection of microsatellite markers on bovine chromosomes 5 and 6. The objective was to identify chromosomal regions associated with phenotypic variation in carcass traits in three crossbred half-sib families.

Materials and Methods

A reference population of 162 offspring born from 2001 to 2004 from three sires was developed at the South Dakota State University Beef Breeding Unit, Brookings, SD. The three sires and all offspring were comprised of 1/3 Angus, 1/3 Hereford, and 1/3 Simmental genetic material. The offspring and mated dams of each sire were identified as families 1, 2, and 3. Family 1 corresponds to sire 988083, family 2 corresponds to sire 999114, and family 3 corresponds to sire 988042.

Cattle were weaned at approximately 185 days of age. Following weaning, cattle were fed a corn based diet consisting of 12.5% crude protein and 94.2 Mcal/cwt NE_m for about 110 days. Harvest criteria included an average ultrasound determined rib fat measurement of 0.30 inches and average finished weight of at least 1,000 pounds for the group.

Cattle were marketed to Tyson Fresh Meats, Dakota City, NE or PM Beef, Windom, MN. Animal identification numbers were matched to plant carcass identification numbers at the time of harvest for cross-referencing pre- and post-mortem phenotypes. Phenotypic data was

[1] This project was funded by the SD Ag Experiment Station
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collected for finished weights and post-mortem measures of HCW, marbling score, Quality Grade, LMA, rib fat, percent KPH, and Yield Grade. Finished weight was determined just prior to harvest, while HCW was determined at the time of harvest. Carcasses were chilled for at least 24 hours prior to collection of the additional carcass data. LMA and rib fat measures were taken by South Dakota State University personnel, while marbling score, Quality Grade, percent KPH, and Yield Grade were determined by a USDA grader.

Whole blood was collected from each calf by jugular or tail vein venapuncture at weaning and again at 5 to 6 months into the feeding period. Samples of about 10 ml were collected in evacuated tubes with 15% EDTA. Blood was stored at 4°C for no more than 24 hours prior to buffy coat (white blood cell) extraction by centrifugation. DNA was extracted from the isolated buffy coats using a saturated salt DNA extraction procedure (Miller et al., 1988).

Seven microsatellite markers were selected on each of the two chromosomes, approximately 20 cM apart. Markers used on chromosome 5 were BM6026, RM103, BM321, RM084, BMS1216, BM315, and BM597. Markers used on chromosome 6 were ILSTS093, ILSTS090, BM1329, BMS518, ILSTS035, BM8124, and BMC4203. Genotyping was completed by polymerase chain reaction (PCR) amplification of the microsatellite markers with incorporated radioactive phosphorus (^{32}P). PCR products were loaded on 8% polyacrylamide gels for electrophoresis. Electrophoresed gels were fixed to blot paper and dried in a gel dryer, prior to being placed on autoradiography film in radiography cassettes. Films were exposed for two days and then developed. Films were read over a transluminator, and genotypes were determined independently by two researchers and reconciled or excluded from analysis. Assigned genotypes were also verified against sire and dam genotypes, with those not in agreement excluded from the analysis (excluded $n = 31$).

Statistical analysis of associations between the gene markers and phenotypic traits was conducted using the General Linear Model (GLM) procedure of SAS (SAS Institute Inc., 2001). Individual marker analysis was conducted because homozygosity of the sires for some markers inhibited interval mapping. Differences in sex, year, age at finishing, and the specific marker were accounted for in the model, with age at finishing used as the adjustment factor. Representative *P*-values and Least-squares means were determined.

Results and Discussion

A total of 131 offspring from families 1 ($n = 29$), 2 ($n = 25$), and 3 ($n = 77$), were included in the analysis of allelic affects on carcass traits. Informative markers for family 1 were BM6026, RM103, BM321, BMS1216, and BM315 on chromosome 5, and ILSTS093, ILSTS090, BMS518, ILSTS035, and BMC4203 on chromosome 6. Informative markers for family 2 were BM321, RM084, and BM597 on chromosome 5, and ILSTS090, BM1329, and BMC4203 on chromosome 6. Informative markers for family 3 were BM6026, RM103, BM321, RM084, and BM315 on chromosome 5, and ILSTS093, BM8124, and BMC4203 on chromosome 6.

Significant associations between sire allele and phenotype were shown for finished weight, HCW, marbling score, and LMA. Tables 1 and 2 exhibit the associations between the markers and carcass traits where significance ($P < 0.05$) was detected.

Table 1. BM6026, RM103, and BM321 allelic effects on carcass phenotypes in family 1

BM6026

	Sire allele 1		Sire allele 2		
Trait	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	14	996	8	924	0.1765
HCW, lb	14	613	8	578	0.3199
Marbling score [a]	14	427	8	355	0.0124
Choice [b]	14	0.71	8	0.43	0.1481
LMA, in^2	14	12.7	8	12.2	0.3344
Fat, in	13	0.32	8	0.26	0.3054
YG [c]	12	1.75	8	1.58	0.5109
KPH, %	13	2.55	5	2.73	0.3316

RM103

	Sire allele 1		Sire allele 2		
Trait	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	12	960	11	1074	0.0063
HCW, lb	12	602	11	677	0.0119
Marbling score [a]	12	372	11	451	0.0040
Choice [b]	12	0.47	11	0.77	0.1222
LMA, in^2	12	12.7	11	13.3	0.2034
Fat, in	12	0.33	11	0.42	0.0895
YG [c]	10	1.35	10	1.49	0.5386
KPH, %	9	2.34	10	2.56	0.1668

BM321

	Sire allele 1		Sire allele 2		
Trait	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	7	1092	6	912	0.0072
HCW, lb	7	682	6	564	0.0144
Marbling score [a]	7	477	6	361	0.0061
Choice [b]	7	0.74	6	0.42	0.2617
LMA, in^2	7	14.0	6	12.6	0.0780
Fat, in	7	0.38	6	0.24	0.0657
YG [c]	6	1.54	5	1.37	0.6851
KPH, %	6	2.38	3	1.95	0.0849

[a] slight = 300-399, small = 400-499; [b] choice = 1, not choice = 0; [c] USDA 1, 2, 3, 4, 5

Table 2. BMC4203 allelic effects on carcass phenotypes in families 1 and 2

	Family 1					Family 2				
	Sire allele 1		Sire allele 2			Sire allele 1		Sire allele 2		
Trait	*n*	LS Mean	*n*	LS Mean	*P*-value	*n*	LS Mean	*n*	LS Mean	*P*-value
Finished weight, lb	9	960	8	1016	0.3155	7	1022	10	1043	0.6534
HCW, lb	9	596	8	629	0.4045	7	596	10	638	0.1033
Marbling score [a]	9	387	8	391	0.9029	7	365	10	364	0.9813
Choice [b]	9	0.61	8	0.72	0.6755	7	0.29	10	0.40	0.3130
LMA, in^2	9	11.7	8	13.1	0.0359	7	9.8	10	12.1	0.0004
Fat, in	9	0.29	7	0.35	0.5196	.	.	.	.	.
YG [c]	9	1.94	7	1.47	0.1613	7	2.27	10	1.94	0.1782
KPH, %	7	2.38	7	2.43	0.7753	7	2.76	10	2.36	0.0662

[a] slight = 300-399, small = 400-499; [b] choice = 1, not choice = 0; [c] USDA 1, 2, 3, 4, 5

Only 2 offspring from family 2 had rib fat data, so analysis of that trait was not possible. Family 1 exhibited allelic affects for finished weight, HCW, and marbling score on chromosome 5. Markers RM103 and BM321 were associated with finished ($P < 0.01$) and carcass ($P < 0.05$) weights. An association with marbling score was identified with BM6026 ($P < 0.05$), RM103 ($P < 0.01$), and BM321 ($P < 0.01$). BMS1216 showed an association with rib fat in family 1 ($P < 0.05$). On chromosome 6, BMC4203 was associated with LMA in family 1 ($P < 0.05$) and family 2 ($P < 0.001$). No significant association between sire alleles and phenotypes were detected ($P > 0.05$) on family 3. Quality Grade, rib fat, percent KPH, and Yield Grade were not found to be associated with any of the markers in any of the families analyzed.

Implications

The markers found to be significantly associated with carcass traits could be utilized in MAS applications. The consistency of the results of this study with other studies indicates that these microsatellite markers may be useful for assessing a wide variety of populations with varying characteristics. Based on the results for the informative markers identified, further exploration in an attempt to make interval mapping possible is warranted.

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Evaluation of Reproduction and Blood Metabolites in Beef Heifers Fed Dried Distillers Grains Plus Solubles and Soybean Hulls During Late Gestation[1]

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Summary

Dried distillers grains plus solubles (DDGS) contain a significant amount of both undegradable intake protein and fat, which have both been shown to increase reproductive performance when supplemented to heifers during gestation. The mechanisms leading to enhanced reproduction when fat or UIP are supplemented have not been fully defined. The objective of this experiment was to evaluate DDGS or soybean hulls (SBH) fed during the last trimester of gestation on circulating concentrations of growth hormone (GH) and insulin-like growth factor-I (IGF-I) and reproductive efficiency. Ninety-five crossbred heifers were grouped by expected calving date, BW, BCS, and randomly assigned to DDGS or SBH (n = 6 pens per treatment). Diets were formulated to be isoenergetic and meet the nutrient requirements at d 240 of gestation. Diets were limit fed during the last trimester of gestation until parturition. Blood samples were collected prior to calving and once per week for 4 weeks following calving . Treatment had no effect on circulating concentrations of GH or IGF-I. Time influenced both GH and IGF-I. Circulating concentrations of GH were elevated at calving and decreased by 4 d after calving. Circulating concentrations of IGF-I rose for the first 2 d following calving and then decreased through d 6. At the start of the breeding season there was no difference between DDGS and SBH in the percent of heifers that had initiated estrous cycles (74% and 70%, respectively). There was a tendency for more DDGS treated heifers to become pregnant during a 64 d natural service breeding season compared to SBH treated heifers (92% vs 80%, respectively). There was no difference in the distribution of pregnancies throughout the breeding season between treatments. In summary, DDGS and SBH fed during the last trimester of pregnancy to heifers resulted in similar patterns of circulating concentrations of GH and IGF, but DDGS treated heifers tended to have improved pregnancy rates during a defined breeding season.

Introduction

Prepartum nutrition has a major effect on postpartum reproduction. Supplementation with fat and/or undegradable intake protein (UIP) may provide a nutritional mechanism to optimize reproduction in young beef cows. Pregnant heifers supplemented with UIP (Patterson et al., 2002) or fat (Bellows et al., 2001), had increased pregnancy rates without differences in BW or body condition score (BCS), however the mechanism by which either fat or UIP supplementation function to enhance reproduction has yet to be fully elucidated. Dried distillers grains plus solubles (DDGS) contain both UIP (up to 60% of the CP) and fat (12 %), and are an economical and readily available feedstuff in many areas of the United States.

Changes in insulin-like growth factor-I (IGF-I) and the components of the IGF system have been demonstrated to influence reproductive function (Zulu et al., 2002). Subsequently, under nutrition of beef cows caused decreased circulating concentrations of IGF-I and prolonged the postpartum anestrous period (Roberts et al., 1997). We hypothesized the effects of increased fat and UIP to enhance reproductive function may be associated with

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altering the somatotropic axis in well fed pregnant beef heifers. Therefore, our objective was to evaluate the effects of DDGS (increased UIP and fat) or soybean hulls (low fat and UIP) during the last trimester of gestation on circulating concentrations of growth hormone (GH) and IGF-I and subsequent reproductive efficiency.

Materials and Methods

Ninety-five crossbred pregnant beef heifers were allotted to one of two prepartum dietary treatments (**DDGS or SBH**). The heifers were blocked by previous heifer development strategy and stratified by expected calving date, BW, and BCS. Heifers were randomly allotted to one of twelve dry-lot pens at the SDSU Cottonwood Research Station. Diets were limit fed and consisted of similar amounts of grass hay (8.90 lb/hd/d) plus a supplement (0.69 lb/hd/d) formulated for each respective diet and either DDGS (6.80 lb/hd/d) or SBH (7.60 lb/hd/d). Dietary treatments were applied from the mean gestation of 190 d until parturition, for a mean dietary treatment application of 96 d. Both DDGS and SBH diets were formulated to offer similar amounts of energy and to meet or exceed the degradable intake protein (DIP) requirement for an 1120 lb heifer at the mean day of gestation during dietary treatment application of 240 d (Table 1; NRC Model, 1996).

Table 1. Nutrient composition, intake, and modeled balances of prepartum diets containing either dried distillers grains plus solubles (DDGS) or soybean hulls (SBH) fed to beef heifers during the last trimester of gestation.

Diet Nutrient Composition[a]	DDGS[b]	SBH[b]
Ether extract, %[c]	6.7	3.08
CP, %[c]	17.2	12.0
DIP, % of CP[d,e]	59.4	80.3
ADF, %[c]	24.5	40.1
NEm, Mcal/lb[d]	0.74	0.70
IVDMD, %[c]	63.4	68.9
Nutrient Intake[a]		
DM Intake, lb[c]	16.4	17.2
Nem, Mcal/d[d]	12.1	12.0
CP, lb/d[c]	2.82	2.06
DIP, lb/d[d]	1.68	1.65
MP, lb/d[d]	1.87	1.29
Modeled Nutrient Balance[a]		
NEm, Mcal/d[d]	0.2	0.1
CP balance, lb/d[c]	1.22	0.46
DIP balance, lb/d[d]	0.18	0.14
MP balance, lb/d[d]	0.67	0.09

[a] DM basis.
[b] Formulated using NRC computer model (1996) to be isocaloric and adequate in DIP and meet nutrient requirements of 1120 lb heifer at 240 d of gestation.
[c] Based on assayed values for individual feed ingredients
[d] Based on tabular values for individual feed ingredients
[e] Degradable intake protein
[f] Invitro dry matter disappearance

Following parturition heifers were removed from treatment diets, placed on pasture and managed as one group until July. In July lactating heifers were grouped by treatment and previous development and split into four pastures. Heifer BW and BCS was measured using a 9 point scale (1=emaciated; 9 = obese) by half score increments and the average of two individual trained scorers, at the start of the feeding period, just prior to parturition, and monthly until weaning. Calving ease score was recorded at parturition. Calf BW were measured at birth and monthly until weaning. Cows were exposed to bulls for a 64 d natural service breeding season. On d 5 of the breeding season all cows received an injection of prostaglandin $F_{2\alpha}$ (25mg as 5mL of ProstaMate i.m., IVX Animal Health, St. Joseph, MO). Pregnancy was detected by transrectal ultrasonography 86 d and 117 d following the start of the breeding season.

Blood samples were collected by jugular venipuncture into 10 mL Vacutainer tubes on d 71 of the feeding period (1 week prior to start of calving) and weekly for 4 weeks following calving for determination of plasma concentrations of GH and IGF-I. Blood samples were also collected 7 d prior to the start of the breeding season and 11 d later (d 5 of the breeding season) for analysis of progesterone (P4) concentrations. Animals were determined to be cycling at the start of the breeding season if P4 concentrations were $\geq$ 1ng/mL in 1 of the 2 samples. Animals were determined to be anestrous if P4 concentrations were < 1ng/mL in both samples.

Mean BW and BCS were compared using GLM procedure of SAS for a randomized complete block with treatment x block as the error term and pen as the experimental unit. Cyclicity and pregnancy rate were analyzed by Chi-square analysis using the frequency procedure of SAS. Pregnancy distribution was analyzed by analysis of repeated measures of categorical data, and concentrations of GH and IGF-I were analyzed by repeated measures using the Mixed procedure of SAS. Cows that had lost calves prior to the start of the breeding season were omitted from pregnancy and cycling data.

Results and Discussion

There were no differences between DDGS or SBH treated heifers in initial (*P* = 0.56; *P* = 0.34), calving (*P* = 0.60; *P* = 0.36), or weaning (*P* = 0.40; *P* = 0.14) BW or BCS (Table 2). All heifers maintained a BCS of ≥5.5 from intiation of the feeding period until weaning. Furthermore, there was no difference between treatment in calving ease (*P* = 0.90), calf birth weight (*P* = 0.48), calf ADG (*P* = 0.90) or weaning weight (*P* = 0.70; Table 3).

Table 2. Effect of dried distillers grains plus solubles (DDGS) and soybean hull (SBH) dietary treatments on heifer BW and BCS at the start of the feeding period, at calving, and at weaning.

Body weight, lb	DDGS	SBH	SEM[a]	*P*-Value
Initial	1116	1120	1.2	0.56
Calving[b]	1162	1153	4.2	0.60
Weaning	1147	1169	19.0	0.40
Body condition score[c]				
Initial	5.96	5.89	0.04	0.34
Calving[d]	5.95	5.84	0.07	0.36
Weaning	5.70	5.47	0.06	0.14

[a] Standard error of the mean
[b] Body weight was measured within 24 h after parturition
[c] Body condition is the average of two trained individual scorers using half scores on a 9 point scale (1 = emaciated; 9 = obese)
[d] Just prior to parturition

Table 3. Effects of dried distillers grains plus solubles (DDGS) and soybean hull (SBH) on calving ease and calf birth weight, weaning weight, and ADG

Item	DDGS	SBH	SEM[a]	*P*-Value
Calving Ease[b]	1.23	1.21	0.13	0.90
Body weight, lb				
Birth	86	86	1.43	0.48
Weaning[c]	441	437	12.13	0.70
ADG, lb	2.09	2.09	0.04	0.90

[a] Standard error of the mean
[b] 1= no assistance 2= easy pull 3= hard pull requiring calf jack 4= caesarian section 5= malpresentation
[c] The mean age at weaning was 167 d

There was no effect of treatment (*P* = 0.51) or treatment x time (*P* = 0.99), but there was an effect of time (*P* = 0.002) on circulating concentrations of GH (Figure 1). Circulating concentrations of GH were elevated at calving (14.4 ± 1.5 ng/mL) and decreased by d 4 after calving (9.0 + 1.6 ng/mL). Periparturient plasma GH concentrations in beef cattle have been shown to rise around parturition and subsequently decline during early lactation for cows in excellent to moderate nutritional status at parturition (Lalman et al., 2000). Lactation increases the energy demand for cows. In addition to the demand of lactation, first calf heifers also have an energy demand for growth. One of the functions of GH is to stimulate mobilization of fat stores, which may help to alleviate physiological energy deficiencies in periparturient animals.

In the current study there was no effect of treatment (*P* = 0.18) or treatment x time (*P* = 0.63), but there was an effect of time (*P* < 0.001) on circulating concentrations of IGF-I (Figure 2). Concentrations of IGF-I rose for the first 2 d following parturition (57.1 ± 5.2 ng/mL) and then decreased through d 6 (30.5 ± 5.6 ng/mL). This is consistent with the function of GH on the somatotropic axis; under conditions of adequate nutrient intake GH also functions to cause a subsequent rise in hepatic IGF-I secretion in beef cows (Lalman et al., 2000).

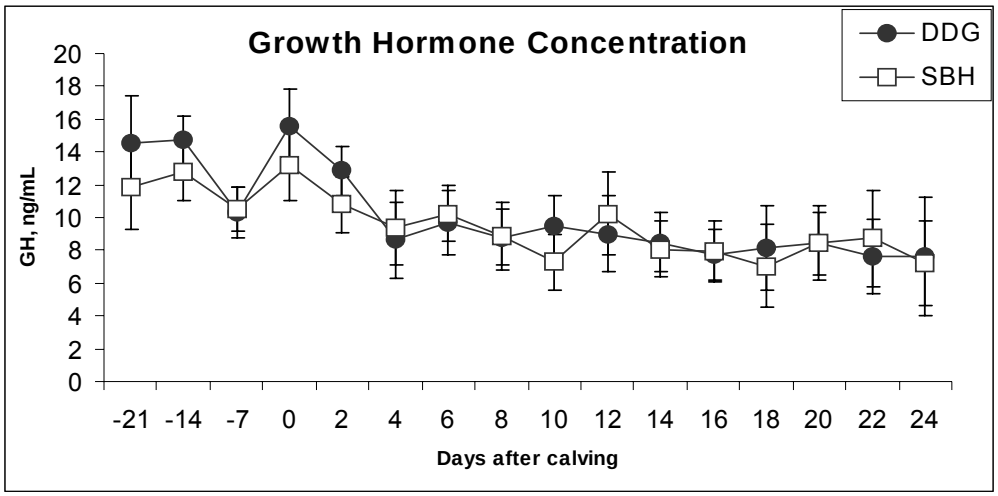

Figure 1. Circulating concentrations of growth hormone by day in pre- and postpartum dried distillers grains plus solubles (DDGS) and soybean hull (SBH)supplemented beef heifers. (Treatment *P* =0.51; Time *P* = 0.002; Treatment * Time *P* = 1.0)

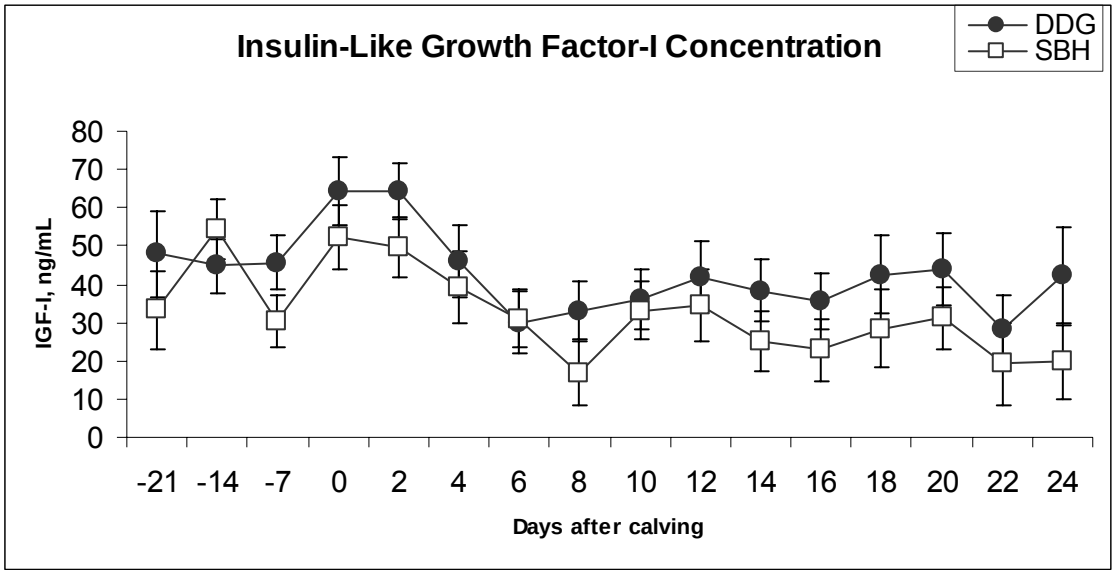

Figure 2. Circulating concentrations of insulin-like growth factor-I by day in pre- and postpartum dried distillers grains plus solubeles (DDGS) and soybean hull (SBH) supplemented beef heifers. (Treatment *P* = 0.18; Time *P* = < 0.001; Treatment * Time *P* = 0.63)

At the start of the breeding season there was no difference (*P* = 0.75) between DDGS and SBH in the percentage of heifers that had initiated estrous cycles (Figure 3, 74% and 70%, respectively). In addition, there was no difference (*P* = 0.30) in the distribution of pregnancies (Figure 4) during the breeding season between treatments. However, there was a tendency (*P* = 0.11) for more DDGS treated heifers to become pregnant during a 64 d natural service breeding season compared to SBH treated heifers (Figure 3; 92% vs 80%, respectively).

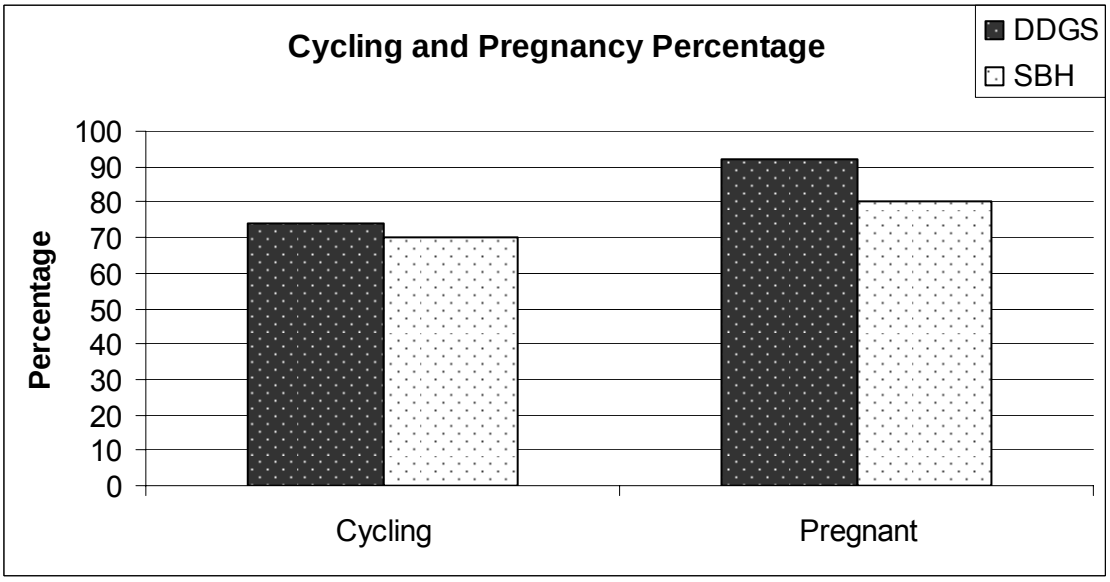

Figure 3. Percentage of dried distillers grains plus solubles (DDGS) and soybean hull (SBH) treated heifers cycling at the start of the breeding season and percentage pregnant following a 64 d breeding season. (DDGS n=44; SBH n=38; Cycling *P* = 0.75; Pregnant *P* = 0.11)

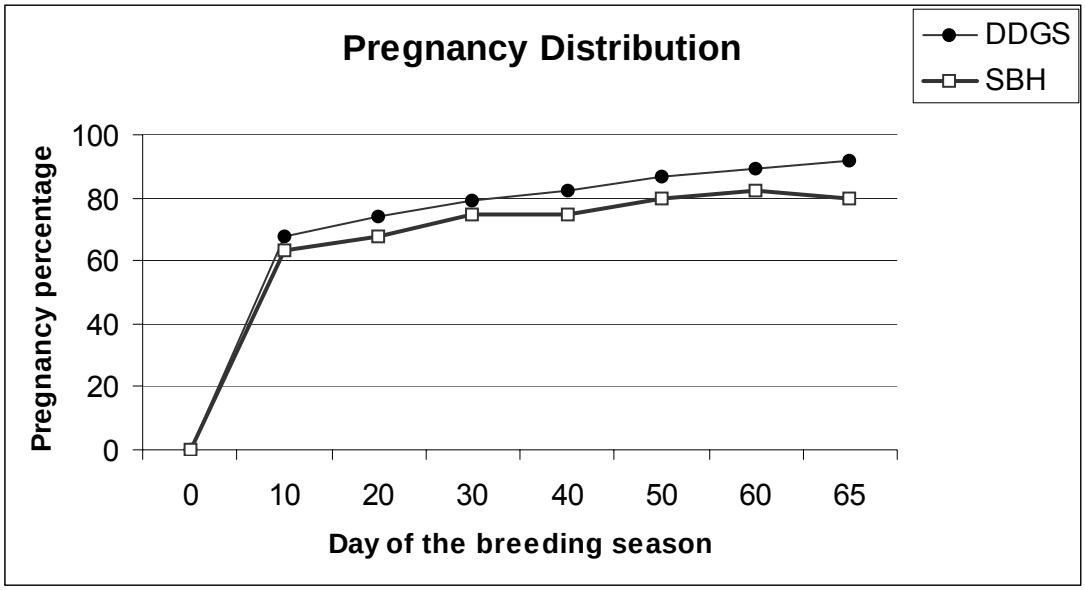

Figure 4. Pregnancy distribution for dried distillers grains plus solubeles (DDGS) and soybean hull (SBH) treated heifers during a 64 d natural service breeding season. (Treatment $P = 0.26$; Time $P < 0.001$; Treatment*Time $P = 0.98$)

Conclusion

In conclusion, both DDGS and SBH caused similar effects to postpartum heifer performance, calving ease, and calf performance, therefore, both can be effectively fed during the last trimester of gestation to replace hay in limit-fed heifer diets. Although there where no detectable differences in circulating concentrations of GH and IGF-I and no difference in the number of heifers cycling at the start of the breeding season or in the pregnancy distribution, DDGS treated heifers tended ($P = 0.11$) to have a greater pregnancy rate than SBH treated heifers. Therefore, fat and/or UIP sources fed in the last trimester of gestation have the potential to positively impact subsequent reproductive performance in well maintained beef heifers.

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Effects of Standing Estrus and Concentrations of Estradiol on Uterine pH[1]

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BEEF 2006 – 08

Summary

Research has demonstrated that cows that are in estrus within 24 h of fixed-time AI had elevated concentrations of estradiol and greater pregnancy rates compared to cows that are not in estrus. Our objective was to determine if estradiol and/or estrus had an effect on uterine pH during a fixed-time AI protocol. Non-lactating beef cows (n = 20) were treated with the CO-Synch protocol (100µg GnRH on d -9; 25 mg PG on d -2; and 100µg GnRH on d 0). Half (n = 10) the cows received an injection of estradiol cypionate (ECP; 1mg) 12 h following PG. Cows detected in standing estrus within 24 h of the second GnRH injection were considered to be in standing estrus. Cows treated with ECP had greater concentrations of estradiol compared to non-treated cows (8.3 ± 0.7 and 5.2 ± 0.7 PG/mL, respectively), and a treatment by time interaction influenced concentrations of estradiol. All cows had similar concentrations of estradiol at time of ECP, but ECP treated cows had elevated concentrations of estradiol following the second GnRH injection compared to control cows. Treatment, time, and treatment by estrus by time influenced uterine pH. All cows had a similar uterine pH 12 h after ECP, but control cows that did not exhibit estrus had a higher uterine pH compared to control cows that did exhibit estrus and ECP cows that exhibited estrus at time of the second GnRH injection, the time insemination would occur (pH 7.0 ± 0.1, 6.7 ± 0.1, 6.8 ± 0.1, respectively). ECP cows not exhibiting estrus were intermediate (6.8 ± 0.1). All cows had a similar uterine pH from 24 h after time of insemination through ovulation. In summary, ECP treatment elevated concentrations of estradiol and lowered uterine pH to a level similar to the uterine pH of control cows that exhibited estrus within 24 h of when insemination would occur.

Introduction

Several fixed-time insemination protocols utilize an injection of gonadotropin releasing hormone (GnRH) on d -9, an injection of Prostaglandin $F_{2\alpha}$ (PG) on d -2, and a second injection of GnRH at the time of insemination (d 0). Previous research has shown animals in standing estrus within 24 h of fixed-time artificial insemination (TAI) had higher pregnancy rates compared to animals not in standing estrus (Perry et al., 2004, Perry et al., 2005). Furthermore, animals in standing estrus have elevated preovulatory concentrations of estradiol 36 h prior to when insemination would occur in a fixed time insemination protocol, and administering 1mg of Estradiol Cypionate (ECP) 12 h post PG increased concentrations of estradiol similar to animals in standing estrus (Perry and Perry, 2006). Animals in standing estrus (elevated preovulatory concentrations of estradiol) had a lower uterine pH compared to animals not in standing estrus (Elrod and Butler, 1993; Perry and Perry, 2006). Therefore, the objective of this experiment was to determine if estradiol and/or estrus had an effect on uterine pH during a fixed-time AI protocol.

Material and Methods

Experimental Design

Twenty cycling beef cows were synchronized with the CO-Synch protocol [GnRH (100 μg as 2 mL of OvaCyst i.m., IVX animal Health, St. Joseph MO) on day -9, PG (25 mg as 5 mL of ProstaMate i.m., IVX animal Health, St. Joseph, MO) on day -2, and on day 0 GnRH (100 μg, OvaCyst, i.m.)]. On day -2 an injection of 1 mg of ECP was administered to half of the animals (i.m. in 1 mL Sesame seed oil) 12 h after

[1] This project was funded by the SD Ag Experiment Station. We would like to express our thanks to T. Glaus, and C. Moret for help with this project, IVX Animal Health for prostaglandin and GnRH, and Western Point, Inc. for Estrus Alert.
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[3] Research Assistant
[4] Assistant Professor

administration of PG. Control animals received a 1 mL injection of Sesame seed oil.

Transrectal Ultrasonography and Uterine pH

Uterine pH was determined in all animals on day -2 at time of the ECP injection, and 24, 48, 72 and 96 h after the PG injection. Uterine pH was determined by inserting a sterile, plastic infusion pipette through the cervix and into the uterus. Once the infusion pipette was in place, a flexible pH electrode (1.4 mm in diameter; Microelectrodes, Bedford, NH) was extended into the uterine body. A reference electrode was inserted into the vagina of the animals and both probes were left in place until a stable pH reading was obtained. Ovaries of all animals were examined by transrectal ultrasonography to record follicular development using an Aloka 500V ultrasound with a 7.5 MHz transrectal linear probe. All follicles (≥ 8 mm) were recorded on day -2, at time of PG administration, and on day 0, at time of GnRH administration. At 48 h after the second GnRH injection, ovaries were examined to determine if ovulation had occurred. Ovulation was defined by the disappearance of a dominant follicle.

Blood Collection, Estrus Detection, and Radioimmunoassays

Blood samples were collected at the time uterine pH was determined on d -1, 0, 1, and 2 to determine circulating concentrations of estradiol. Blood samples were collected via venipuncture of the tail vein into 10-mL vacutainer tubes and allowed to clot at room temperature for 1 h before being placed in a 4°C refrigerator for 24 h. Samples were centrifuged (1200 x *g*) for 30 min. Serum was collected and stored at -20°C until radioimmunoassays (RIA) were performed. Circulating concentrations of estradiol were analyzed in all serum samples by RIA (Perry et al., 2004). Standing estrus was detected in all cows by visual observations or with the aid of Estrus Alert Patches (Western Point, Inc, Merrifield, MN).

Statistical Analysis

Differences in uterine pH and circulating concentrations of estradiol-17β were determined by analysis of variance for repeated measures in SAS (Proc Mixed, Littell et al., 1998).

Results and Discussion

Cows treated with ECP had greater ($P < 0.01$) concentrations of estradiol compared to non-treated cows (8.3 ± 0.7 and 5.2 ± 0.7 pg/mL, respectively). A treatment by time interaction ($P < 0.01$) influenced concentrations of estradiol (Figure 1). All cows had similar ($P > 0.15$) concentrations of estradiol at time of ECP administration, but ECP treated cows had elevated ($P < 0.02$) concentrations of estradiol following the second GnRH injection compared to control cows. This is similar to previous reports where administering 1 mg of ECP 36 h prior to the second GnRH injection resulted in preovulatory concentrations of estradiol similar to animals that spontaneously initiated standing estrus (Perry and Perry, 2006). In all animals concentrations of estradiol diminished after the second GnRH injection.

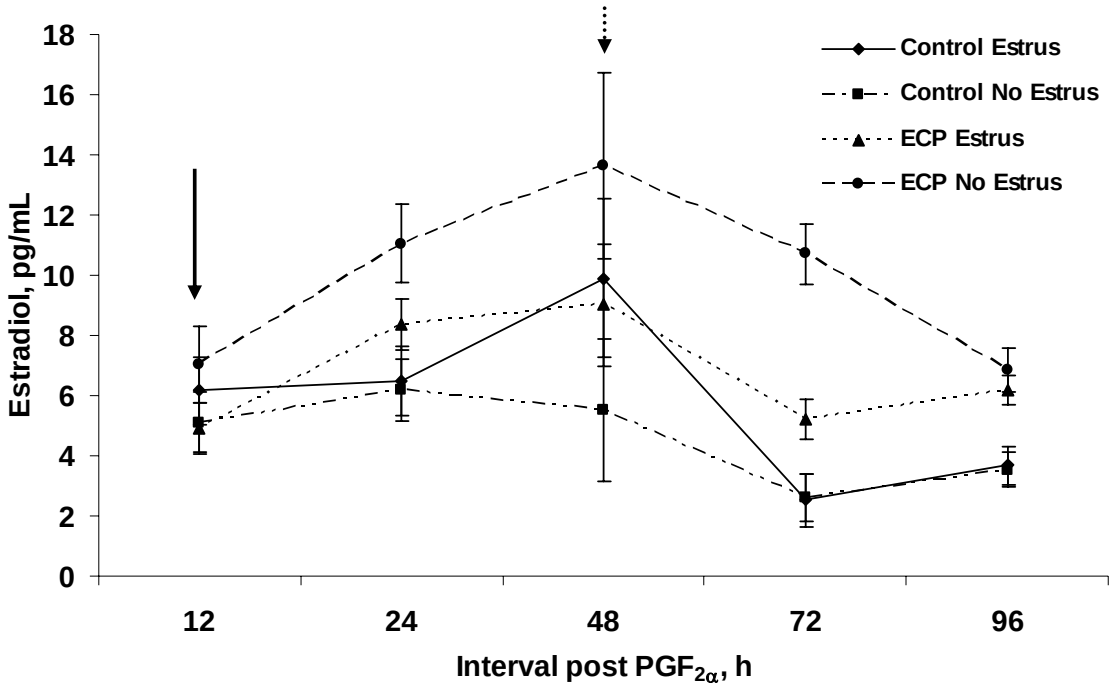

Figure 1. Circulating concentrations of estradiol for cows detected in standing estrus within 24 h of the second GnRH injection and cows administered ECP during the CO-Synch protocol. Estradiol Cypionate (solid arrow) was administered 12 h following the PG injection. Gonadotrophin Releasing Hormone (dashed arrow) was administered 48 h after the PG injection and at the time that insemination would occur.

Treatment (P = 0.01) and time (P < 0.01) both had a significant effect on uterine pH while treatment by estrus by time (P = 0.065) tended to effect uterine pH (Figure 2). Control cows that did not exhibit estrus had a higher uterine pH compared to ECP cows that did not exhibit estrus (P = 0.03) at time of ECP administration, but all cows had a similar uterine pH (P > 0.19) 12 h after ECP. Control cows that did not exhibit estrus had a higher uterine pH compared to control cows that did exhibit estrus (P < 0.01) and ECP cows that exhibited estrus (P = 0.05) at time of the second GnRH injection, the time insemination would occur (7.0 $\pm$ 0.1, 6.7 $\pm$ 0.1, 6.8 $\pm$ 0.1, respectively). ECP cows not exhibiting estrus were intermediate (6.8 $\pm$ 0.1). All cows tended to have a similar uterine pH beginning 24 h after the second GnRH injection through ovulation (P > 0.06). This is consistent with previous research where uterine pH is lower in animals that are in standing estrus compared to animals not in standing estrus (Elrod and Butler,1993; Perry and Perry 2006). However, concentrations of estradiol had no linear (P > 0.21) or quadratic (P > 0.21) relationship with uterine pH.

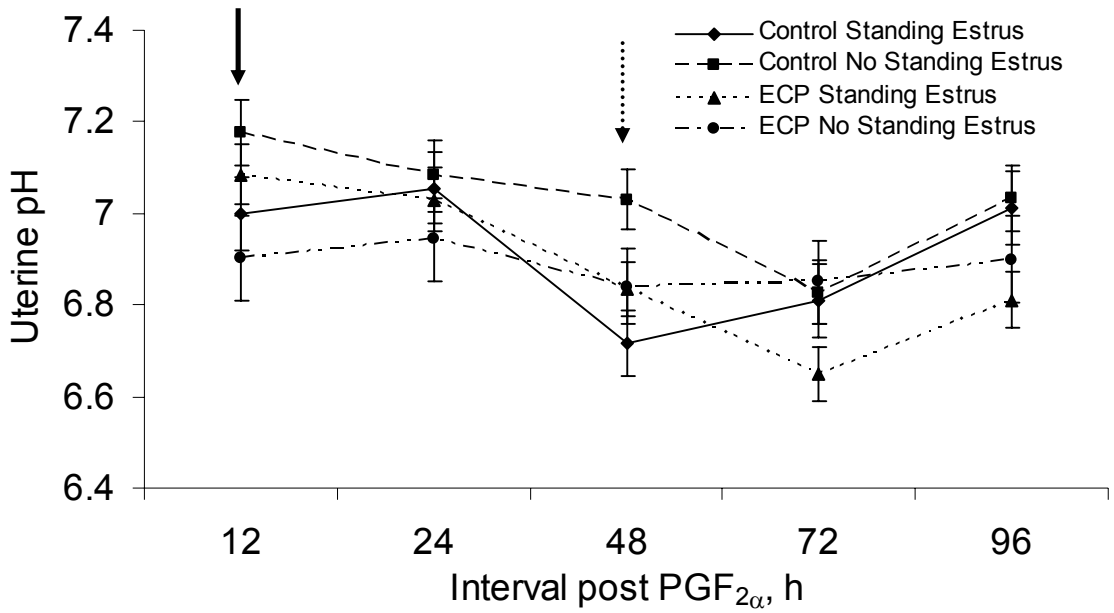

Figure 2. Effect of ECP and standing estrus on uterine pH for cows detected in standing estrus within 24 h of the second GnRH injection and cows administered ECP during the CO-Synch protocol. Estradiol Cypionate (solid arrow) was administered 12 h following the PG injection. Gonadotrophin Releasing Hormone (dashed arrow) was administered 48 h after the PG injection and at the time that insemination would occur.

In summary, ECP treatment not only elevated circulating concentrations of estradiol but also lowered uterine pH to level similar to the uterine pH of animals who spontaneously exhibit standing estrus within 24 h of a fixed time artificial insemination.

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Effect of an Injection of GnRH at Time of Insemination Following Detection in Standing Estrus on Beef Cow and Heifer Pregnancy Rates[1]

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BEEF 2006 - 09

Summary

An injection of GnRH at the initiation of standing estrus has been reported to increase pregnancy and circulating concentrations of progesterone in repeat breeder dairy cows, cows that have normal estrous cycles but will not conceive. The objective of this study was to determine the effect of administering an injection of GnRH at time of insemination on subsequent concentrations of progesterone and conception rates in beef cattle that have exhibited standing estrus. Eighty-two beef heifers at 2 locations were synchronized with the Select Synch-CIDR protocol (n = 42) or the 14-19 MGA protocol (n = 40) and AI was performed following detection in standing estrus by qualified personnel. At location 1, blood samples were collected on d 2, 4, 6, 10, 15, and 18 after insemination. Heifers that were pregnant had elevated concentrations of progesterone on day 18 compared to nonpregnant heifers. Among heifers, conception rates were 71% and 59% for GnRH treated and control, respectively, and were not different between treatments. Two hundred and thirty-six postpartum beef cows at 2 locations were synchronized with the Select Synch-CIDR protocol, and AI was performed following detection in standing estrus by qualified personnel. Among cows conception rates were 70% and 70% for GnRH treated and control, respectively and were not different between treatments. Overall conception rates were 70% and 67% for GnRH treated and control, respectively, and were not different between treatments. In summary, injection of GnRH at time of insemination did not influence subsequent concentrations of progesterone and had no influence on conception rates in beef cattle that had exhibited standing estrus.

Introduction

Previous research has indicated that an injection of GnRH at time of insemination following detection in standing estrus increased (Schels and Mostafawi, 1978; Nakao etal 1983) or had no effect on first service conception rates (Stevenson et al., 1984) among dairy cows. However, pregnancy rates among repeat breeder dairy cows have consistently been increased by an injection of GnRH at time of insemination {Mee et al., 1993; Stevenson et al., 1984). Progesterone during the subsequent estrous cycle is required for the survival of the embryo/fetus, and cows with elevated concentrations of progesterone earlier in the subsequent estrous cycle had embryos that were more advanced developmentally, and were capable of inhibiting the PGF_2 release on day 16 after insemination. However, results have been mixed on the effect of an injection of GnRH at time of insemination on circulating concentrations of progesterone during the subsequent estrous cycle. The previous studies have focused mainly on lactating dairy cows, and little is known about the influence of an injection of GnRH at time of insemination following detection in standing estrus among beef heifers and cows. The objective of this study was to evaluate the effect of administering an injection of GnRH at time of insemination in beef cows and heifers that had exhibited standing estrus on circulating concentrations of progesterone and first service conception rates.

Materials and Methods

Eighty-two beef heifers at two locations were synchronized, and artificial insemination (AI) was performed following detection in standing estrus by qualified personnel. At location 1, 42 heifers were synchronized with the Select Synch plus Controlled Internal Drug Releasing device (CIDR) protocol. On d 0 an injection of GnRH (100 μg as 2 mL of Ovasynch i.m.; IVX, St. Joseph, Missouri) and a CIDR was placed into

[1] This project was funded by the SD Ag Experiment Station. We would like to express our thanks to A. Drew, W. Kruse, B. Larson, J. Nelson, B. Perry, K. Vanderwal and R. Zastrow for help with this project and IVX Animal Health for prostaglandin and GnRH.
[2] Assistant Professor

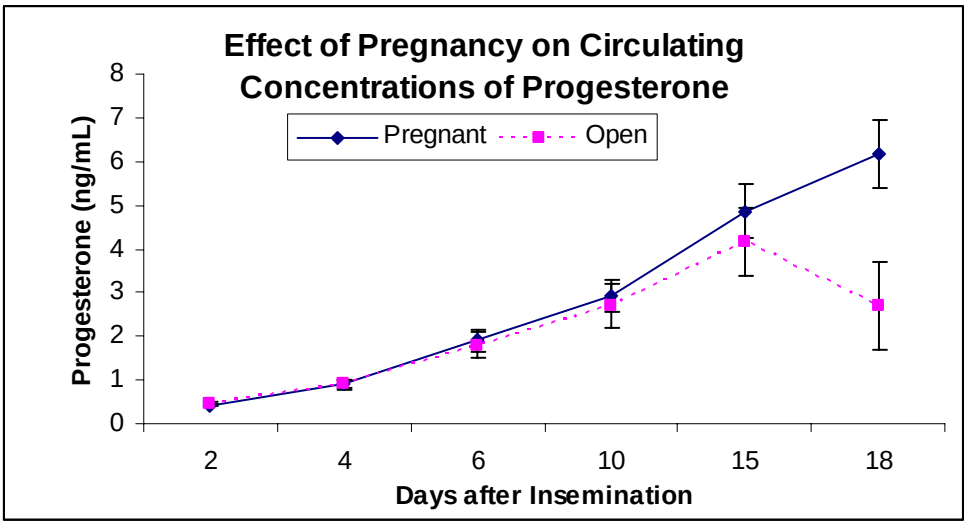
the vagina. On d 7 $PGF_{2\alpha}$ (25 mg as 5 mL of Prostamate i.m., IVX, St. Joseph, Missouri) was injected and the CIDR was removed. Thirty-three heifers were inseminated following detection in standing estrus during a 72 h estrus detection period. At location 2, 40 heifers were synchronized with the 14-19 MGA protocol [MGA was fed at 0.5 $mg \cdot hd^{-1} \cdot d^{-1}$ for 14 d, and 19 d after MGA withdrawal an injection of $PGF_{2\alpha}$ (25 mg as 5 mL of Prostamate) was administered]. Thirth-five heifers were inseminated following detection in standing estrus during the 72 h estrus detection period. Blood samples were collected from heifers at location 1 by venipuncture of the jugular vein into 10 mL Vacutainer tubes on d 2, 4, 6, 10, 15, and 18 after insemination. Serum was harvested and stored at -20°C until analyzed.

Two hundred and thirty-six postpartum beef cows at two locations were synchronized with the Select Synch plus CIDR protocol as previously described (location 2 n = 58 and location 3 n = 192) and AI was performed following detection in standing estrus by qualified personnel. At location 2, 52 cows were inseminated following detection in standing estrus during the estrus detection period, and at location 3, 175 cows were inseminated following detection in standing estrus during the estrus detection period.

Effects of treatment and pregnancy on circulating concentrations of progesterone were analyzed by analysis of variance for repeated measures in SAS by PROC MIXED. Effect of treatment on first-service conception rates and final pregnancy rates were determined by chi-square analysis in PROC FREQ of SAS.

Results and Discussion

Pregnancy significantly influenced subsequent concentrations of progesterone. Heifers that were pregnant had elevated concentrations of progesterone on d 18 of the subsequent estrous cycle compared to nonpregnant heifers (Figure 1; $P < 0.01$). There was a tendency for GnRH at time of insemination to influence circulating concentrations of progesterone during the subsequent estrous cycle (Figure 2; $P = 0.18$). Concentrations of progesterone tended to be greater in control heifers compared to GnRH treated heifers on d 6 ($P = 0.08$), 10 ($P = 0.068$), and 15 ($P = 0.106$).



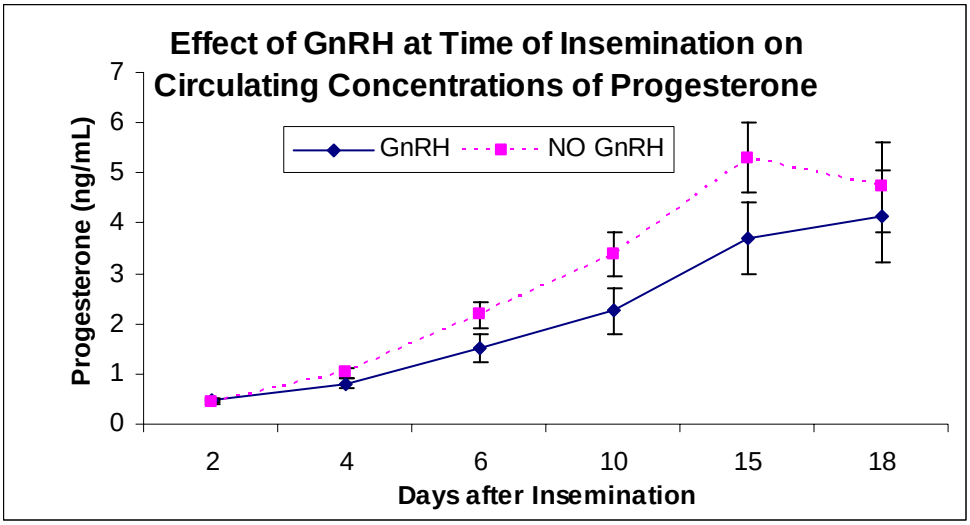


Figure 2. Effect of administering an injection of GnRH at time of insemination following detection in standing estrus on circulating concentrations of progesterone.

Among heifers, first service conception rates at location 1 were 63% (10/16) and 65% (11/17) for GnRH treated and control, respectively, and there was no difference between treatments (*P* = 0.89). At location 2, first service conception rates were 78% (14/18) and 53% (9/17) for GnRH treated and control, respectively, and there was no difference between treatments (*P* = 0.12). When locations were combined there was no difference (*P* = 0.31) between GnRH treated and control heifers in first service conception rates [71% (24/34) and 59% (24/34), respectively; Figure 3].

Among cows, first service conception rates at location 2 were 61% (17/28) and 58% (14/24) for GnRH treated and control, respectively, and there was no difference between treatments (*P* = 0.86). At location 3, first service conception rates were 74% (59/80) and 73% (69/95) for GnRH treated and control, respectively, and there was no difference between treatments (*P* = 0.87). When locations were combined there was no difference (*P* = 0.92) between GnRH treated and control cows in first service conception rates [70% (76/108) and 70% (83/119), respectively; Figure 3].

When heifers and cows were combined, overall first service conception rates were 70% (100/142) and 67% (103/153) for GnRH treated and control animals, respectively, with no difference detected between treatments (*P* = 0.57; Figure 3).

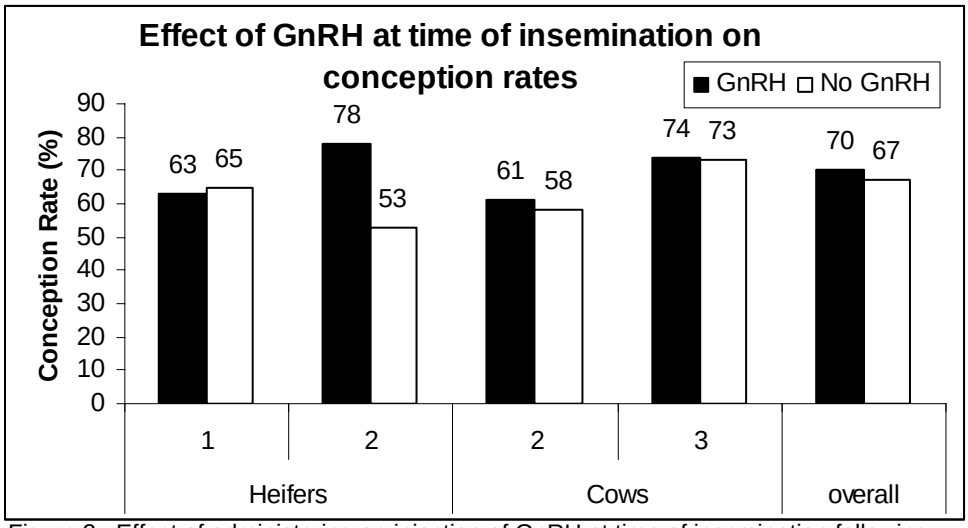


Figure 3. Effect of administering an injection of GnRH at time of insemination following detection in standing estrus on conception rates.

There was no improvement in first service conception rates among heifers or cows by administering an injection of GnRH at time of insemination in the present study. Standing estrus is induced by estradiol acting upon the hypothalamus in the absence of progesterone. Secretion of estradiol by the ovulatory follicle is thought to be responsible for priming the pituitary to release LH. The initiation of standing estrus, the peak in plasma estradiol, and the release of the ovulatory surge of LH all occur at approximately the same time. Pituitary responsiveness to GnRH is greatest near estrus but before the spontaneous surge has been initiated. Thus, administration of exogenous GnRH at estrus and prior to the spontaneous LH surge should result in an LH surge of greater magnitude, but administration of GnRH at time of insemination (approximately 12 h after the initiation of standing estrus) may not result in a greater surge of LH.

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Predicting Forage Production, Stocking Rate, and Beef Production in Eastern South Dakota: A Case Study[1]

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BEEF 2006 - 10

Introduction

In the summer of 1999, the Hand and Hyde County Bootstraps group met to form a working group to better understand "Management Intensive" Grazing (MIG) systems. From this working group of ranchers and state and federal agency personnel, evolved a goal to establish six demonstration sites in South Dakota (Figure 1). In 2000, the first demonstration site was established by Jim Faulstich near Highmore, SD in Hyde County. This site is a 320 acre pasture dominated by native mixed-grass prairie vegetation with some introduced species such as smooth bromegrass, Kentucky bluegrass, and crested wheatgrass. The pasture was fenced into 21 paddocks and water was developed using aboveground pipeline. Cattle weights, forage biomass, forage utilization, and climate data were measured. This report summarizes the first six years of the study and provides some predictive tools for forage production, stocking rate, and beef production based on climate data.

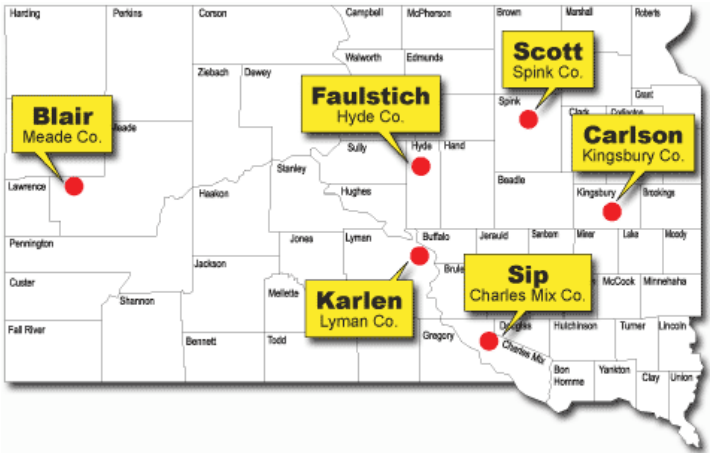

Figure 1. South Dakota Grassland Coalition managed intensive grazing demonstration sites.

[1] This project was funded by the SD Grassland Coalition.
[2] Assistant Professor

Data Collection

Animal Performance. The pasture was stocked with Red Angus x South Devon cross bred heifers during the summers of 2000 to 2005. Animal performance data during the first six years of the demonstration study are listed in Table 1. In 2002 and 2004, the stocking rate was reduced to compensate for dry conditions. The average number of grazing days supported by the MIG pasture was 124 days. Gain per animal and average daily gain (ADG) was quite consistent except in 2005 for unknown reasons. Gain per acre averaged 38.5 lb/acre over the six years and varied due to yearly stocking rate and ADG differences.

Table 1. Animal performance statistics for the Faulstich MIG demonstration site from 2000 to 2005 near Highmore, South Dakota.

	Year					
Item	2000	2001	2002	2003	2004	2005
Area grazed, acres	313.7	313.7	313.7	313.7	288.5	313.7
Stocking rate, AUM/acre	1.17	1.18	0.79	0.96	0.53	1.15
Grazing season, days	119	118	111	132	127	135
Number of heifers	100	109	76	71	38	86
Initial weight, lb	848	784	822	886	874	890
Final weight, lb	1007	943	949	1035	1024	980
Gain per animal, lb	159	159	127	149	150	90
Average daily gain, lb	1.34	1.34	1.15	1.34	1.35	0.67
Gain per acre, lb/acre	50.7	55.2	30.8	33.7	19.8	24.7

Forage Biomass. Forage biomass estimated before cattle grazed each paddock averaged 2200 lb/acre, but varied considerably each year (Table 2). Forage biomass after cattle grazed each paddock was 1200 lb/acre resulting in an average utilization of 42%. The average number of days spent grazing each paddock was 4 days. Due to dry conditions, forage growth was less in 2002 and 2004 which resulted in longer grazing periods per paddock. Grazing periods per paddock were shorter in 2001 due to good forage growing conditions.

Table 2. Average forage biomass before and after grazing, utilization, and average grazing days per paddock for the Faulstich MIG demonstration site from 2000 to 2005 near Highmore, South Dakota.

	Year					
Item	2000	2001	2002	2003	2004	2005
Average forage biomass before grazing, lb/acre	2500	3900	1200	1700	1500	2500
Average forage biomass after grazing, lb/acre	1400	1800	800	900	900	1600
Average utilization, %	44	54	33	47	40	36
Average time in paddock, days	2.8	2.2	5.0	3.2	6.6	4.5

Weather. Precipitation data for 2000 through 2005 and the historic 30 year average are shown in Table 3. Considerable variation existed in the monthly total precipitation each year. Drought conditions exhibited in the 2002 and 2004 forage biomass (Table 2) is in large part due to the amount of April precipitation (Table 3). Spring and summer total precipitation masks the effects of the importance of April precipitation. For example, in 2004, average forage biomass before grazing was 1500 lb/acre even though spring precipitation (April-June) was above the 30 year average (Table 3).

Table 3. April through August, spring, summer, and season total precipitation from 2000 to 2005 and the 30 year average for the Faulstich MIG demonstration site near Highmore, South Dakota.

	Year						
Month	2000	2001	2002	2003	2004	2005	Average
April	2.59	4.68	0.85	2.02	0.08	1.18	2.32
May	4.02	2.66	1.06	2.35	4.57	2.20	3.37
June	0.84	2.04	0.95	3.75	4.98	5.14	3.19
July	2.23	0.30	1.92	1.72	2.28	1.10	3.25
August	0.53	0.30	4.92	1.22	2.36	0.58	2.97
Spring (April-June)	7.45	9.38	2.86	8.12	9.63	8.52	8.88
Summer (July-August)	2.76	0.60	6.84	2.94	4.64	1.68	6.22
Season total	10.21	9.98	9.70	11.04	14.27	10.20	15.10

Predictive Tools

Regression equations using monthly total precipitation to predict average forage biomass before grazing, stocking rate and beef gain per acre were evaluated. April precipitation had the greatest ability to adequately predict forage biomass (Fig. 2). These results are extremely valuable since typical pasture turnout dates are late-April to early May in eastern South Dakota.

Producers in this region can measure April precipitation and determine the average forage biomass before grazing.

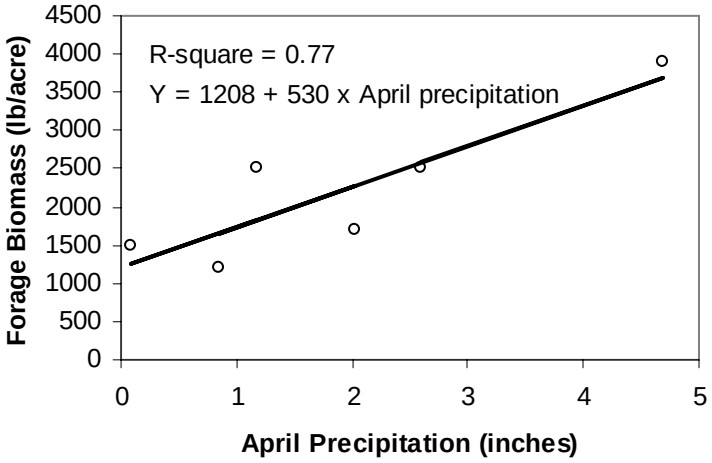

Figure 2. Relationship between average forage biomass before grazing and April monthly total precipitation for the Faulstich MIG demonstration site near Highmore, South Dakota.

Summer stocking rates can be estimated in two ways. The relationship between the actual stocking rate and predicted stocking rate using April precipitation is presented in Fig. 3. Also, stocking rate can be calculated from the predicted forage biomass estimate. For example, the dotted line in Fig. 3 is a calculated estimate of stocking rate based on the forage prediction equation (Fig. 2) and multiplying by 35% harvest efficiency and dividing 750 lb (monthly dry matter intake of forage per 1000 lb animal unit). Notice the calculated estimate over predicts the stocking rate when April precipitation is greater than 4.5 inches compared to the actual stocking rate (Fig. 3).

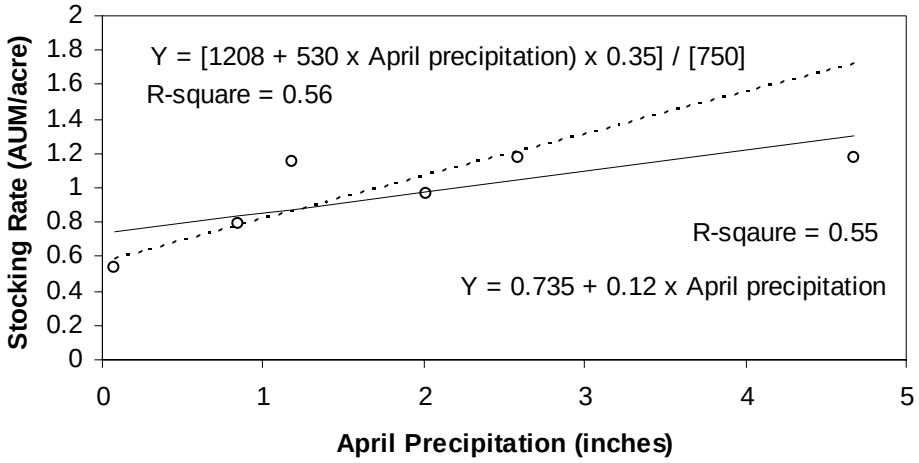

Figure 3. Relationship between actual stocking rate (open circles) and predicted stocking rate using April precipitation (solid line) and calculated stocking rate based on predicted forage production (dotted line) for the Faulstich MIG demonstration site near Highmore, South Dakota.

Finally, beef production per acre was adequately estimated using April precipitation (Fig. 4). Determining the net profit or loss of stocker enterprises can be estimated before the grazing season has started.

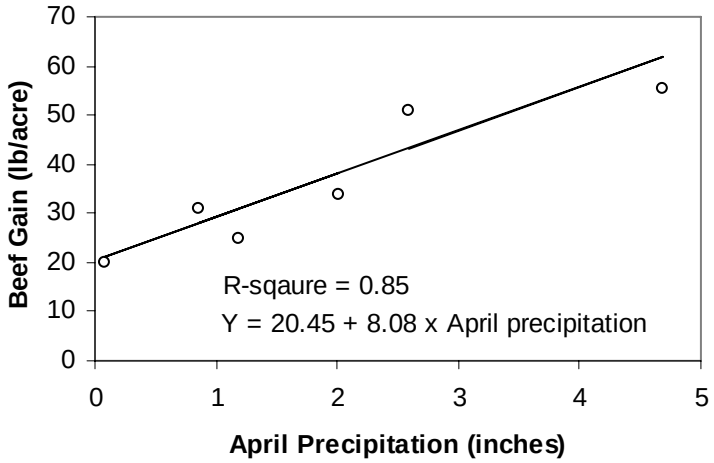

Figure 4. Relationship between beef gain per acre and April monthly total precipitation for the Faulstich MIG demonstration site near Highmore, South Dakota.

Rye and Turnips to Extend the Grazing Season for Weaned Calves[1]

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BEEF 2006 –11

Summary

As part of a series of studies to determine the feasibility of short season crops to extend the grazing season for weaned calves, planting date studies and a grazing trial were conducted near Brookings, SD. Small plots of turnips were seeded with a no-till drill into oat stubble on Aug 1 and 15 in year 1. In year 2, rye and turnips were seeded on July 20, Aug 1, and Aug 15. Based on forage yield, planting these crops on or before August 1 in eastern South Dakota is recommended. In late September of year 3, 44 weaned heifers were allotted by weight to graze rye or rye + turnips for 63 d. Following the grazing study all heifers were fed and managed as one group until the following April. During the grazing study, heifers grazing rye + turnips gained 0.4 lb less per day than heifers grazing rye. From the end of the grazing study to April the rye + turnips group gained 0.2 lb more per day than the heifers that had grazed rye. This resulted in a similar mean weight in April. Under the conditions of this study, short season crops such as rye or turnips are a feasible source of forage for grazing weaned calves.

Introduction

Extending the grazing season for weaned calves and cows has potential to reduce labor and costs for development of replacement heifers or back grounding calves. To produce high quality forage for calves after weaning, short season crops such as turnips, rye and other small grains have been seeded after other crops have been harvested in late summer or early fall. This is part of a series of studies to determine the feasibility of using short season crops to extend the grazing season for weaned calves (Pruitt et al, 2005).

Materials and Methods

Planting Date Studies

In the summer of 2003 (Exp. I), a small plot study was conducted near Brookings, SD to determine the effect of summer planting date on yield of turnips for fall grazing. Turnips was seeded to small plots (6 ft x 50 ft) on two planting dates (Aug 1 and Aug 15) using a no-till drill into oat stubble. The variety 'Purple Top White Globe' turnip was seeded at 4.5 lb/acre. The field was top dressed with urea (46-0-0) at the rate of 75 lb N/acre after the first planting date. The experiment was arranged as randomized complete block design with four replications. Yield estimates were made on two harvest dates (Oct 15 and Nov 1) by hand clipping 3.28-ft length of the inner 4 rows. Samples were dried in a forced air oven at 140^{o}F for 72 hr and weighed.

In the summer of 2004 (Exp. II), the small plot study was repeated except that an earlier planting date was added and rye was included in the comparison. Rye and turnips were seeded to small plots (6 ft x 50 ft) on three planting dates (July 20, Aug 1, and Aug 15) using a no-till drill into oat stubble. The variety 'Dakold' rye was seeded at 75 lb/acre and the variety 'Purple Top White Globe' turnip was seeded at 4.5 lb/acre. The field was top dressed with urea (46-0-0) at the rate of 75 lb N/acre after the first planting date. The experiment was arranged as split-plot, with four replications; planting date served as the whole-plot and species as the subplot. Yield estimates were made on three harvest dates (Oct 1, Nov 1, and Dec 1) by hand clipping 3.28-ft length of the inner 4 rows. Samples were dried in a forced air oven at 140^{o}F for 72 hr and weighed.

Grazing Study

In the summer of 2005, a 40 acre field of oat stubble near Brookings, SD was split into two fields; one field seeded with 80 lb/acre of

[1] This project was funded by the SD Ag Experiment Station.
[2] Assistant Professor
[3] Professor

'Dakold' rye and the other seeded with 40 lb/acre 'Dakold' rye + 2 lb/acre 'Purple Top White Globe' turnips using a no-till drill on July 27. Each field was top dressed with urea (46-0-0) at the rate of 50 lb N/acre on July 30. The rye and rye + turnips established well and were ready for grazing by late-September. Turnips dominated the rye + turnips pasture. Rye and turnip plants were sampled on October 6, frozen and later analyzed for CP, NDF, ADF and ash.

Forty four heifer calves were allotted by breed and weight to 2 grazing treatments starting on September 27, 1 wk after they had been fenceline weaned on pasture. Heifers were penned away from feed and water overnight prior to being weighed at the beginning and end of the 63 d grazing period. After the grazing period, all heifers were fed and managed as one group until weighed again on April 20.

Results and Discussion

Planting Date Studies

Highest yields for turnips were recorded for the July 20 planting date compared to either August planting date (Table 1). Rye had similar yield at either the July 20 or August 1 planting date, but was greater than the August 15 planting date. In 2003, forage yield of turnips was 90% less for the Aug 15 planting date compared to the August 1 planting date. In 2004 the forage yields for turnips decreased by 47% from August 1 to the August 15 planting date (Table 1). The lower yield at the August 15 planting date in 2003 and 2004 was likely a result of late-summer accumulated precipitation. Accumulated precipitation by August 1 was similar for 2003 and 2004, but late-September precipitation was 3.2 inches greater in 2004 than 2003 (Fig. 1). The greater forage yield for turnips at the July 20 planting date (Table 1) is attributed to the favorable moisture conditions that existed by the timely precipitation prior to planting (Fig. 1). It is unclear why forage yield of rye at the July 20 planting date was not greater than the August 1 planting date. Perhaps rye did not germinate as quickly as the turnips did to take advantage of the moisture that existed prior to planting. To ensure maximum forage yields of small grains such as rye or Brassica species such as turnips for fall grazing, planting on or before August 1 is recommended. Oats, winter wheat, and spring wheat are typically harvested between July 15 and August 15 in eastern South Dakota, making them a desirable crop to follow with rye or turnips for grazing. Nitrogen fertilizer in the range of 50 to 75 lb/acre is recommended to ensure adequate yields for fall growth (Koch and Karakaya, 1998).

Table 1. Forage yield of rye and turnips.

	Planting date 2003		Planting date 2004		
Species	1-Aug	15-Aug	20-Jul	1-Aug	15-Aug
	---------- lb/ac ----------		---------- lb/ac --------		
Rye	-	-	1985[c]	1988[c]	1234[d]
Turnip	3960[a]	390[b]	5268[a]	3940[b]	2101[c]

SE = 188.5, means followed by similar letter within a year are not significantly different (P > 0.05).

Grazing Study

Table 2 shows the nutrient composition of both rye and turnips. Both are relatively high in crude protein. The low NDF content of the turnips agrees with values reported by Smart et al. (2004). Heifers consumed both the turnip tops and bulbs. They did not appear to selectively graze the tops, as some people have observed.

Table 2. Composition of rye and turnips in grazing study[a]

	Dry matter basis			
	% CP	% NDF	% ADF	% ASH
Rye	18.0	40.8	21.3	12.8
Turnip tops	23.5	14.9	13.2	19.3
Turnip bulbs	13.9	13.7	11.8	10.2

[a]samples collected on 10/6/2005

Heifers grazing the turnips + rye gained 0.4 lb less per day (P<0.01) during the grazing period than the heifers grazing ryegrass (Table 3). A possible explanation for this lower ADG could be the low NDF of the turnips. Although no disease symptoms were observed during the trial, Wikse and Gates (1987) reported potential occurrence of polioenchephalomalacia (PEM), pulmonary emphysema, bloat and hemolytic anemia for cattle grazing Brassicas (plants in the turnip family).

The heifers in this trial gained 0.2 lb more per day (P=0.03) from the end of the grazing period to the following April. This resulted in similar mean weight in April for both groups. For development of replacement heifers the lower weight gain during the grazing period would not be expected to influence future productivity as long as they compensated prior to the breeding season the following spring
.

Table 3. Performance of heifers.

	Rye	Turnips + Rye	SE	P=
No. of heifers	22	22		
Average initial age	191	194	5	0.71
Weight, lb				
initial, 9/27	514	512	14	0.90
end of grazing period, 11/29	617	589	16	0.24
yearling weight, 4/20	924	924	20	0.99
Average daily gain, lb				
63 day grazing period	1.63	1.23	0.06	<.001
end of grazing to April	2.16	2.36	0.06	0.03
initial to April	2.00	2.01	0.05	0.83

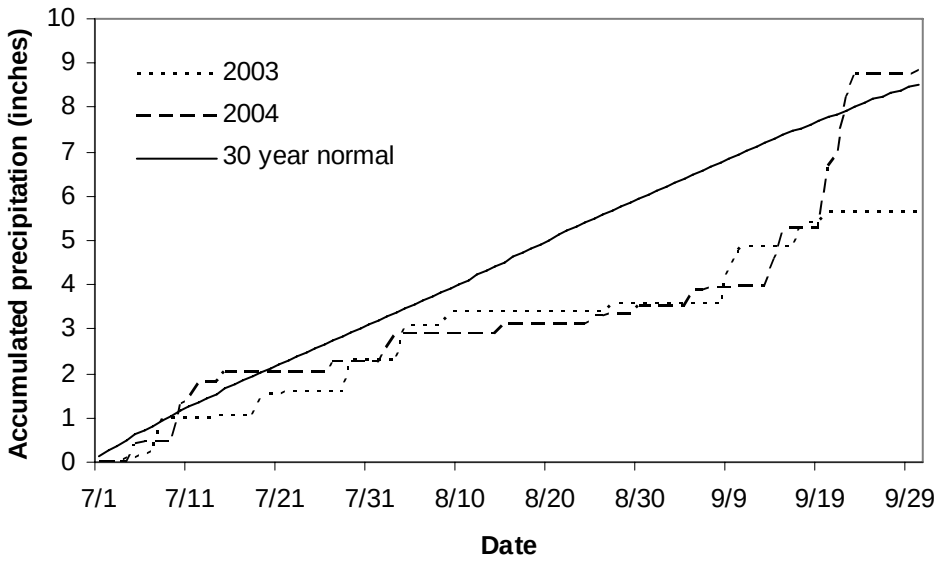

Figure 1. Accumulated precipitation for July-September in 2003 (dotted line), 2004 (dashed line), and 30 year normal (solid line).

Implications

Short season crops such as rye or turnips planted on or before August 1 can provide forage for fall grazing by spring born calves after weaning. Under the conditions of this study calves grazing rye could be expected to gain more than calves grazing rye + turnips.

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North Central Water Quality Survey[1]

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BEEF 2006 – 12

Summary

This survey was conducted to determine the water quality in north central South Dakota. Twenty-one water sources from 16 different livestock operations were surveyed for this project. The water sources included five runoff-fed dugouts, 6 spring-fed dugouts, 4 deep wells (> 1000 ft), 3 medium-depth wells (100 to 500 ft) and 3 shallow wells (< 100 ft). Each water sample was initially tested with a hand-held Hanna Dist WP4 electroconductivity (EC) meter and the readings were recorded. Samples were then shipped to Servi-Tech Laboratories in Hastings, NE, where they were tested for EC, total dissolved solids (TDS), hardness, pH, calcium (Ca), chloride (Cl), magnesium (Mg), potassium (K), sulfate (SO_4), sulfate-sulfur (SO_4-S), and sodium (Na). Water quality indicators and mineral concentrations were not different over time when analyzed across all water sources or within each water source independently. Water from runoff-fed dugouts was lower ($P < 0.05$) in pH than water from spring-fed dugouts or wells. Well water contained greater ($P < 0.05$) concentrations of Cl than water from either runoff-fed or spring-fed dugouts. Potassium concentrations were greater ($P < 0.05$) in water from runoff-fed dugouts than in water from spring-fed dugouts or well water. Estimation of water quality without testing is highly inaccurate and variable. Livestock producers should obtain water samples for determination of water quality and adjust management to account for poor-quality water sources.

Introduction

Water quality is a major concern for livestock operations in South Dakota. For most livestock operations, poor-quality water is that which contains high concentrations of sulfates. High-sulfate water is common in certain regions of western South Dakota, but has also been identified sporadically in eastern South Dakota. This survey was conducted to determine the water quality in north central South Dakota.

Materials and Methods

Twenty-one water sources from 16 different livestock operations were surveyed for this project. Producers were asked to cost share in the project at a rate of $5.00 per sample and provide information and access to the water sources in question. The water sources included five runoff-fed dugouts, 6 spring-fed dugouts, 4 deep wells (> 1000 ft), 3 medium-depth wells (100 to 500 ft) and 3 shallow wells (< 100 ft). Sampling dates were on or near May 24, July 8, August 24, October 4, 2005. Dugout samples were collected on each of the dates listed above and well water samples were sampled twice, once at the initial sampling date and again on the final sampling date. Each water sample was initially tested with a hand-held Hanna Dist WP4 electroconductivity (EC) meter and the readings were recorded. Samples were then shipped to Servi-Tech Laboratories in Hastings, NE, where they were tested for EC, total dissolved solids (TDS), hardness, pH, calcium (Ca), chloride (Cl), magnesium (Mg), potassium (K), sulfate (SO_4), sulfate-sulfur (SO_4-S), and sodium (Na). Data were analyzed using the GLM and MIXED procedures of SAS.

Results and Discussion

Water quality indicators or mineral concentrations were not different over time when analyzed across all water sources or within each

[1] This project was funded by the North Central Region Sustainable Agriculture Research and Education program and the South Dakota Cooperative Extension Service.
[2] Extension Livestock Educator
[3] Associate Professor, Extension Beef Specialist

water source independently. As such, only the main effect of source is presented in Tables 1 and 2. With the exception of pH, water quality indicators were not different between water sources. Water from runoff-fed dugouts was lower ($P < 0.05$) in pH than water from spring-fed dugouts or wells. Well water contained greater ($P < 0.05$) concentrations of Cl than water from either runoff-fed or spring-fed dugouts. Potassium concentrations were greater ($P < 0.05$) in water from runoff-fed dugouts than in water from spring-fed dugouts or well water

.

Table 1. Water quality indicators for water from different sources

Item	Runoff-fed dugout	Spring-fed dugout	Well	SEM
Number of locations	4	6	11	
Number of samples per location	4	4	2	
Handheld electroconductivity, mmho/cm[a]	0.88	1.75	1.99	0.20
Lab electroconductivity, mmho/cm	0.93	1.91	2.09	0.21
Total dissolved solids, ppm[b]	698	1432	1347	230
Hardness, mg $CaCO_3$/L	414	722	536	84
pH	7.76[c]	8.00[d]	7.87[d]	0.04

[a]mmho/cm = millimhos per centimeter

[b]ppm = parts per million.

[c,d]Means within a row lacking common superscripts differ ($P < 0.05$).

Table 2. Mineral concentrations in water from different sources

Item	Runoff-fed dugout	Spring-fed dugout	Well	SEM
	---------- ppm[a] ----------			
Number of locations	4	6	11	
Number of samples per location	4	4	2	
Calcium	78	110	143	11
Chloride	22[b]	84[b]	201[c]	22
Magnesium	53	108	43	16
Potassium	22[b]	15[c]	12[c]	1
Sodium	76	256	326	52
Sulfate	347	849	568	168

[a]ppm = parts per million.

[b,c]Means within a row lacking common superscripts differ ($P < 0.05$).

Many of the parameters tested did not change over time and were not affected by water source. This is perhaps not unexpected given the relatively small sample size and high degree of variability. Analysis of a larger sample might help elucidate indicators or trends to aid in prediction of water quality. In the mean time, livestock producers, managers, nutritionists, and veterinarians should be cautious in making assumptions on water quality. Testing the quality of the water directly is, without question, the most

accurate means of determining water quality.

Implications

Due to the variability in the quality of water within various sources, the lack of a clear correlation between water source and water quality, and the lack of clear patterns relative to changes in water quality following environmental events, it is recommended that water be tested prior to utilization by livestock. A simple hand held EC meter can be utilized as a screening tool to determine if further testing may be necessary. All county extension offices in South Dakota have an EC meter available to help screen livestock water at no charge to the producer.

If a high EC reading occurs (> 2000), it is recommended that further testing be conducted to determine the cause for the high EC reading.

Frequency of testing is up to the discretion of the producer. However, it is suggested that an test be conducted at the start of the grazing season to determine initial water quality. That test may also be suggestive of the need for further or more frequent testing. Subsequent testing may be necessary depending on environmental conditions. Also, if producers notice a change in animal health – cattle that are gaunt or cattle that are at the dugout but refuse to drink – it may be an indication of a water quality issue and testing is needed.

Effect of Supplementing Distillers Grain or Corn on Performance of Cows Grazing Spring Pasture during the Breeding Season[1]

Tyler A. Melroe[2], Richard J. Pruitt[3], George A. Perry[4], Jeffrey A. Clapper[5], and Heather A. Werner[6]
Department of Animal and Range Sciences

BEEF 2006 - 13

Summary

In a 2 yr study 180 lactating cows (2 to 10 yr old) grazing pastures dominated by smooth bromegrass and Kentucky bluegrass near Brookings, SD received 3 supplemental treatments for 48 d beginning in mid May. Cows received 4.6 lb DM of dried distillers grains with solubles (DDGS), 4.3 lb corn DM, or no supplement daily, starting approximately 14 d prior to the start of the breeding season. Cows were bled weekly for 5 wk beginning 1 wk prior to the beginning of the treatment period. Serum was analyzed for progesterone concentration to determine the onset of cyclicity. While supplemented cows did tend to have higher ADG than cows that received no supplement, supplementation did not improve any measure of reproduction. Calf growth rate was not affected by supplementation. The results were similar when only 2 and 3 yr olds were included in the analysis. Under the conditions of this study, it is not beneficial to supplement cows with DDGS or corn to improve cow reproductive performance or calf performance.

Introduction

Grazed forage in the spring is typically high in crude protein (CP) but the high rumen degradability of the CP may result in inadequate metabolizable protein for lactating cows (Blasi et al., 1991). Anderson et al. (1988) reported improved performance in yearling steers supplemented with undegradable intake protein (UIP) grazing fresh forages. Wiley et al. (1991) reported heifers consuming diets that were isonitrogenous and isoenergetic had a greater percentage cycling prior to the breeding season and conceiving in the first 21 d of the breeding season when greater levels of UIP were fed. Blasi et al. (1991) found that cows grazing smooth brome grass supplemented with UIP produced more milk resulting in higher calf growth rate. Expansion of ethanol production has led to abundant supplies of distillers co-products. These products are high in CP with increased rumen escape value. The objective of this research was to determine the effect of supplementing cows grazing spring pasture with DDGS or corn on cow and calf performance.

Materials and Methods

Angus and Simmental x Angus cows (2 to 10 yr old; 2004, n=87; 2005, n=93) were allotted by age (2, 3, and 4 yr or older), breed, and calving date to one of three treatments. Cows grazing pastures dominated by smooth bromegrass and Kentucky bluegrass (Table 1), fertilized with 75 lb/acre N and 17 lb/acre P received 1) dried distillers grains with solubles (DDGS) at 4.6 lb DM/hd daily, 2) corn at 4.3 lb DM/hd daily, or 3) no supplement (Table 2).

Table 1. Forage composition, dry matter basis.[a]

	Year 1	Year 2	SE
Crude protein, %	14.8	17.0	0.5
NDF, %	55.2	54.3	0.6
ADF, %	28.6	28.7	0.4
EE, %	2.3	3.0	0.1
Ash, %	9.7	10.0	0.3

[a] average of weekly samples

[1] This project was funded by the SD Corn Utilization Council, the SD Ag Experiment Station, and Bill and Rita Larson. The authors wish to thank Kevin VanderWal and Anna Drew for managing the cattle involved in this study and for their assistance in data collection.
[2]Graduate Student
[3]Professor
[4] Assistant Professor
[5] Associate Professor
[6] Undergraduate Student

Table 2. Supplements.

	Year 1		Year 2	
	Corn	DDGS	Corn	DDGS
Corn, lb DM	4.31		4.27	
DDGS, lb DM		4.61		4.61
CP, lb/d	0.38	1.38	0.37	1.41
UIP, lb/d[a]	0.20	0.76	0.21	0.74
EE, lb/d	0.15	0.49	0.15	0.56
NEm., Mcal/d[a]	4.39	4.57	4.35	4.57

[a] based on NEm and RU values from NRC, 2000.

To eliminate differences associated with pasture effects, cows were rotated through 11 paddocks. Each treatment group was moved every third day just prior to feeding at approximately 0930.

At the beginning of each trial cows were weighed on 2 consecutive days following an overnight shrink away from feed and water. This procedure was repeated upon completion of the supplementation period, and again at weaning. Body condition scores (BCS) were recorded by the same two trained technicians, with determination of BCS reported as an average of the two estimates with 1 being extremely thin and 9 being extremely obese (Pruitt and Momont, 1988). Calf weights were determined on each of the above occasions as the average of 2 weights on consecutive days.

Beginning 1 wk prior to the start of supplementation, blood samples were collected weekly for 5 wk by jugular venipuncture. Blood was stored at 4°C for 24 h, and centrifuged at 1,200 x *g* for 30 min. Serum was harvested and stored at -20°C until analyzed. Samples were analyzed for progesterone by radioimmunoassay. Cows were considered cycling when they met 1 of 3 criteria: 1) progesterone > 1 ng/ml serum for two consecutive weeks; 2) progesterone > 1 ng/ml serum followed by standing estrus within 2 wk; or 3) standing estrus. All cows were injected with prostaglandin $F2_{\alpha}$ at the beginning of the breeding season and artificially inseminated 12 h after visual estrus detection. All cows not previously inseminated were re-administered prostaglandin $F2_{\alpha}$ 7 d after the first injection. Estrus detection and artificial insemination continued for 44 d. Cows were then exposed to bulls for 33 d in year 1 and 22 d in year 2. Pregnancy was determined by transrectal ultrasonography. Conception date was determined by a combination of transrectal ultrasonography, breeding records, and subsequent calving date.

Forage samples were collected weekly starting in mid-May and ending in early July by clipping samples at approximately 10 cm above ground level. Samples were frozen at -20°C following collection until further analysis could be performed. Forage samples were freeze dried, ground, and analyzed for CP, NDF, ADF, EE and ash.

Statistical analysis

Cow weight, average daily gain, BCS, and days from calving to cyclicity, and conception were analyzed using PROC GLM of SAS (SAS Institute, Cary, NC). Independent variables in the statistical model included supplement treatment, year, and cow age group (2, 3 and 4 yr and older). Treatment x year served as the error term. Means were separated by the PDIFF option of SAS.

Reproductive performance expressed as percentages were analyzed using PROC GENMOD of SAS. Independent variables were treatment, year, and cow age group.

Analysis one included all cows. Since young, thin cows are more likely to show a reproductive response to treatments, a second analysis was conducted with only 2 and 3 yr old cows.

Calf weights and average daily gain were analyzed using PROC GLM of SAS with treatment, year, cow age group, and calf sex serving as independent variables. Treatment x year was used as the error term to test

treatment effects. Means were separated using the PDIFF option of SAS.

Results and Discussion

ADG tended (P = 0.09) to be higher for cows receiving supplement (Table 3). Cows consuming DDGS or corn gained at similar rates during the supplementation period. Since gain for the DDGS and corn groups were similar, the response to supplementation suggests an effect of energy rather than a response to crude protein or UIP.

Table 3. Performance of all cows.

	DDGS	SE	Corn	SE	No Supplement	SE	P=
No. of females	60		60		60		
Weight, lb							
Start	1225	6	1217	6	1223	6	0.65
End	1339	9	1326	9	1314	9	0.35
Weaning	1365	6	1361	6	1345	6	0.22
Cow ADG from initial weight, lb							
Supplementation Period	2.02[a]	0.06	1.93[ab]	0.06	1.62[b]	0.06	0.07
Start to weaning	1.12	0.04	1.15	0.04	0.97	0.04	0.12
End to weaning	0.39	0.08	0.52	0.08	0.45	0.08	0.60
Condition score							
Start	5.9	0.0	5.8	0.0	6.0	0.0	0.09
End	6.2	0.1	6.2	0.1	6.2	0.1	0.96
Weaning	6.1	0.0	6.1	0.0	6.1	0.0	0.57

[a,b] Means without a common superscript differ (P < 0.07).

Supplementation did not improve reproductive performance (Table 4) or calf ADG (Table 5). Wiley et al. (1991) reported greater weight gain and shorter postpartum interval for first calf heifers receiving supplemental protein postpartum in the form of rumen undegradable protein compared to rumen degradable protein. Milk production and calf gain was not affected by protein source. The base diet in their study was medium quality grass hay (10.1% CP, 55% NDF)

Table 4. Reproductive performance of all cows.

	DDGS	SE	Corn	SE	No Supplement	SE	*P*=
No. of females	60		60		60		
Cycling by beginning of breeding season, %	48.3		53.3		48.3		0.76
Cycling by day 21 of the breeding season, %	98.3		98.3		98.3		1.00
Calving to cycling, d	80.2	0.9	78.6	0.9	79.7	0.9	0.57
Conception in first 21 d of breeding season, %	53.3		63.3		65.0		0.37
Calving to conception, d	97.2	1.5	96.4	1.5	97.1	1.5	0.92
% Pregnant	96.7		93.3		96.7		0.60

Table 5. Calf performance from all cows

	DDGS	SE	Corn	SE	No Supplement	SE	*P*=
No. of Calves	60		60		60		
Weight, lb							
Start	245	3	238	3	241	3	0.39
End	396	4	380	4	387	4	0.17
Weaning	578	6	557	6	573	6	0.22
Calf ADG from initial weight, lb							
Supplementation period	2.68	0.03	2.50	0.03	2.58	0.03	0.12
Start to weaning	2.65	0.03	2.54	0.03	2.64	0.03	0.25
End to weaning	2.64	0.04	2.56	0.04	2.68	0.04	0.31

Typically 2 and 3 yr old females will be thinner at the beginning of the breeding season, have longer postpartum intervals and are more likely to respond to management affecting reproductive performance. In this study, the percentage of cows cycling at the beginning of the breeding season were 25.0, 46.2 and 72.2% for cows 2, 3 and 4 and older ($P < 0.001$). If the supplement treatments were going to affect reproduction, the effect would most likely be observed in young cows. Results for 2 and 3 yr old cows are presented in tables 6 through 8. Young cows receiving supplement gained more ($P = 0.05$) than cows receiving no supplement. Reproductive performance and calf gains were not improved by supplementation (Table 7). Although the added gain from supplementation did not translate to improved reproductive performance in this study, in other situations where young cows are extremely thin the added weight gain could impact reproductive performance.

Table 6. Performance of 2 and 3 year old cows.

	DDGS	SE	Corn	SE	No Supplement	SE	P=
No. of females	36		36		36		
Weight, lb							
Start	1136	8	1128	8	1146	8	0.47
End	1244	7	1238	7	1237	7	0.72
Weaning	1275	6	1287	6	1280	6	0.52
Cow ADG from initial weight, lb							
Supplementation period	1.93[a]	0.04	1.95[a]	0.04	1.61[b]	0.04	0.05
Start to weaning	1.21	0.05	1.27	0.05	1.08	0.05	0.22
End to weaning	0.58	0.06	0.70	0.06	0.63	0.06	0.49
Condition score							
Start	5.8	0.1	5.6	0.1	5.8	0.1	0.46
End	6.0	0.1	6.0	0.1	6.0	0.1	0.96
Weaning	6.0	0.1	6.0	0.1	6.0	0.1	0.92

[a,b] Means without a common superscript differ ($P < 0.05$)

Table 7. Reproductive performance of 2 and 3 yr old cows.

	DDGS	SE	Corn	SE	No Supplement	SE	*P* =
No. of females	36		36		36		
Cycling by beginning of breeding season, %	33.3		41.7		30.6		0.50
Cycling by day 21 of the breeding season, %	100.0		97.2		97.2		0.44
Calving to cycling, d	82.7	1.1	82.8	1.1	85.0	1.1	0.42
Conception in first 21 d of breeding season, %	50.0		69.4		66.7		0.19
Calving to conception, d	101.4[a]	0.1	100.3[b]	0.1	100.4[b]	0.1	0.01
% Pregnant	97.2		94.4		94.4		0.80

[a,b] Means without common superscript differ ($P < 0.01$)

Table 8. Performance of calves from 2 and 3 yr old cows.

	DDGS	SE	Corn	SE	No Supplement	SE	*P* =
No. of Calves	36		36		36		
Weight, lb							
Start	239	4	238	4	239	4	0.98
End	385	7	379	7	385	7	0.82
Weaning	561	8	552	8	566	8	0.54
Calf ADG from initial weight, lb							
Supplementation period	2.57	0.05	2.49	0.05	2.55	0.05	0.62
Start to weaning	2.57	0.03	2.50	0.03	2.60	0.03	0.29
End to weaning	2.55	0.02	2.50	0.02	2.63	0.02	0.07

Implications

Under the conditions of this study, it is not beneficial to supplement cows with DDGS or corn to improve cow reproductive performance or calf performance. Supplementation of extremely thin cows to improve weight gain has potential to increase reproductive performance.

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SDSU Cow/Calf Teaching and Research Unit

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BEEF 2006 - 14

Summary

The SDSU Cow Calf Teaching & Research Unit (CCU) provides cattle and facilities for numerous Animal Science and Range Science classes and a variety of research projects. The CCU also provides cattle for the SDSU Little International, Block & Bridle activities, numerous judging team workouts, and other activities that bring potential students to the SDSU campus. Kevin VanderWal and Anna Drew, along with part time student employees, manage the herd and assist with beef cattle activities throughout the year.

Faculty members that have conducted or contributed to research in recent years include: Dick Pruitt, George Perry, Sandy Smart, Jeff Clapper, Bill Epperson, and Vance Owens. Recent studies have included: fenceline weaning, control of estrus and ovulation, supplementation of cows during the breeding season, extending the grazing season with small grain pasture and interseeding legumes in grass pastures.

About 150 Angus and SimAngus females are bred each spring, and 110 calve starting in late February. Although it is not feasible to maintain all the breeds that are important to this region, two breeds provide variation for teaching purposes and still allow us to use the herd for research where limiting variation is important.

The goal of our breeding program is to produce bulls that fit into one of the following categories:

1. Calving ease Angus bulls to breed to heifers and cows.
2. High growth Angus bulls (purebred and high percentage) to breed to cows.
3. SimAngus hybrid bulls for a simple crossbreeding system.

Proven sires are used by artificial insemination. The average expected progeny differences for the herd and AI sires used in 2006 are shown in Tables 1 and 2. The EPDs reflect selection for a balance of above average weaning weight, yearling weight, scrotal circumference, and milk EPDs along with below average birth weight. More recently we have placed emphasis on increasing marbling and rib eye area as long as other important production traits are not sacrificed.

In recent years, breed associations in the US have developed economic indexes to simplify selection. EPDs are weighted by their economic value to rank animals on the net profit per head of their progeny compared to the progeny of other animals raised in the same environment. To use the indexes effectively a person would need to know: 1) What traits are included in the index? 2) What production and marketing scenario is the basis of the index?

Table 1. Angus EPDs and indexes for Angus at the CCU (Spring 2006)

	Angus cows	Yearling Angus heifers	Angus AI sires
Expected Progeny Differences			
Birth weight	+1.5	+1.4	+1.5
Weaning weight	+41	+42	+51
Yearling weight	+78	+81	+95
Scrotal circumference	+0.49	+0.63	+0.61
Milk	+23	+23	+27
Intramuscular fat	+0.14	+0.12	+0.27
Rib eye area	+0.18	+0.28	+0.51
Economic indexes			
$Wean Value	+25.49	+25.18	+28.86
$Beef Value	+31.71	+34.59	+45.76

[1] Professor

Table 2. American Simmental Assn. multi-breed EPDs and economic indexes for SimAngus at the CCU (Spring 2006).

	SimAngus cows	Yearling SimAngus heifers	Simmental and SimAngus AI sires
Expected Progeny Differences			
Birth weight	-2.3	-2.8	+1.3
Weaning weight	+21	+20	+37
Yearling weight	+52	+52	+65
Milk	+7	+9	+4
Yield Grade	+0.19	+0.21	-0.01
Marbling	+0.31	+0.29	+0.11
Rib eye area	-0.21	-0.20	+0.27
Economic Indexes			
All Purpose Index	+100	+93	+96
Terminal Index	+62	+67	+64

Average $Wean and $Beef indexes for Angus produced at the CCU are reported in Tables 1 and 4. The American Angus Association uses cost and price data from the previous 3 years to calculate these indexes. The $Wean index includes both income and cost associated with differences in birth weight, weaning weight, milk production, and mature cow size. It does not include a measure of reproduction. In calculating the index it is assumed that replacement heifers are retained and remaining replacement heifers and steer calves are sold at weaning time. The $Beef index includes income and cost associated with feedlot performance and carcass value for animals sold on a value based grid. This index indicates the value of an animal's progeny to the cattle feeder compared to the progeny of other animals.

The average All Purpose Index (API) and Terminal Index (TI) for the SimAngus at the CCU are listed in tables 2 and 5. The American Simmental Association calculates these indexes using income and cost data averaged over the previous five years to weight EPDs according to their economic importance. These indexes are designed to rank animals for differences in net dollars returned per cow exposed.

Calculation of the API includes all EPDs except tenderness. It is based on the assumptions that sires are bred to first calf heifers and mature cows; a portion of their daughters are retained for breeding; steers and remaining heifers are fed for harvest; and carcasses are priced on a value based grid. The API does include a measure of reproduction through use of a stayability EPD. The TI is designed to compare the value of sires that are bred to mature cows with all offspring fed for harvest and with carcasses priced on a value-based grid. Maternal traits are not included in this index.

Each fall about 20 bred females are sold by phone auction. Yearling bulls are sold in a limited auction held in April at the Cow Calf Unit. The major goal of the sale is to provide a learning opportunity for students interested in the beef industry. Students are involved in producing the sale catalog, developing advertising, creating a promotional video, and answering questions from potential customers. Practice in communication, teamwork, and listening to customers is an important part of the process. Selection of sires each year is based heavily on what we learn from our customers on sale day and what has the most value to them.

On April 15, 2006 students from the CCU crew, the Seedstock Merchandising Class and the Block & Bridle Club hosted potential customers. Table 3 shows the sale averages and range in prices. Eighty two percent of the bulls sold to repeat customers. There is more information and pictures from our 2006 sale on the web at: ars.sdstate.edu/facilities/ccu.

Table 3. Performance and sale price of bulls offered in the 2006 SDSU Bull Sale

	Calving ease Angus bulls	Growth Angus bulls	SimAngus bulls
Birth weight, lb[a]	81	92	94
Adj. weaning weight, lb	710	746	699
Adj. yearling weight, lb	1261	1358	1228
Adj. scrotal circumference, cm	38.2	38.2	38.2
Adj. rib fat, in.	0.31	0.34	0.29
Adj. % IMF	4.16	3.95	3.56
Adj. REA, sq. in.	13.8	13.9	13.7
Average sale price	$2,688	$2,833	$2,257
Range in sale price	$2,000-$4000	$2,000-$4,300	$2,000-$2,900

[a] Birth weights for Angus are actual. Birth weights for SimAngus are adjusted to a mature cow basis as calculated by the ASA.

Table 4. Angus EPDs and indexes for Angus bulls in the 2006 SDSU Bull Sale.

	SDSU Calving ease Angus bulls	SDSU Growth Angus bulls	Breed average for non-parent bulls in the AAA database
Expected Progeny Differences			
Birth weight	+1.3	+3.0	+2.3
Weaning weight	+44	+48	+39
Yearling weight	+84	+90	+72
Scrotal circumference	+.35	+.42	+.33
Milk	+27	+25	+19
Intramuscular fat	+.19	+.19	+..11
Rib eye area	+.31	+.29	+.19
Economic indexes			
$Wean Value	+26.55	+24.23	+22.50
$Beef Value	+38.99	+38.95	+29.99

Table 5. American Simmental Association Multi-Breed EPD and indexes for SimAngus bulls in the 2006 SDSU Bull Sale.

	SDSU SimAngus bulls	Average for Simmental hybrids in ASA database	Factors to convert ASA EPDs to an Angus base
Expected Progeny Differences			
Birth weight	-1.9	-.5	+5.8
Weaning weight	+24	+26	+22.6
Yearling weight	+57	+54	+20.8
Milk	+9	+5	+11.9
Yield Grade	+.21	+.11	
Marbling	+.29	+.23	
Rib eye area	-.24	-.16	
Economic Indexes			
All Purpose Index	+95	+89	
Terminal Index	+62	+60	

Opportunities Farm Update

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BEEF 2006 – 15

Summary

Opportunities Farm allows comparisons of different feedlot facilities located on one site for use in teaching and outreach. The three facilities are: 1) bed-pack confinement, 2) dirt-mound open pens, and 3) partially-covered pens. The first cattle were placed in Opportunities Farm in February 2004. There have been 3,023 head of steers and heifers marketed from Opportunities Farm through June 2006.

Introduction

There are multiple feedlot facility designs that presumably aid in managing the weather extremes encountered in the Midwest and Northern Great Plains. Furthermore, management of manure nutrients is an important feature of modern feedlots. There has been renewed interest in cattle feeding in South Dakota which appears to be a continuing trend. Cattle feeding enterprises on farms and ranches may allow multiple generations to be involved with production agriculture. Due to these factors, generating data to evaluate the effect of feedlot facility on cattle performance, economics of cattle feeding, and nutrient management is important for cattle feeders.

Opportunities Farm cattle feeding facilities, constructed during 2003 and 2004, were built as a production-scale classroom and laboratory. This allows student involvement and learning in an environment similar to what they could develop once they have completed college. Additionally, the feedlot facilities allow cattle performance comparisons among three cattle feeding facilities. Facility comparison data that are currently being generated include: 1) cattle performance comparisons; 2) non-feed costs comparisons; and 3) meat quality comparisons.

Feedlot Facility Description

There are three cattle feeding facilities at Opportunities Farm. The three facilities are described as 1) bed-pack confinement (Confinement), 2) dirt-mound open pens (Open), and 3) partially-covered pens (Iowa). Each facility contains four pens and each pen can hold 80 head of cattle (320 head capacity within a facility, 960 total head capacity of the feedlot). Diagrams of the facilities are depicted in Figure 1.

[1] Extension Beef Feedlot Specialist
[2] Distinguished Professor
[3] Manager, Opportunities Farm

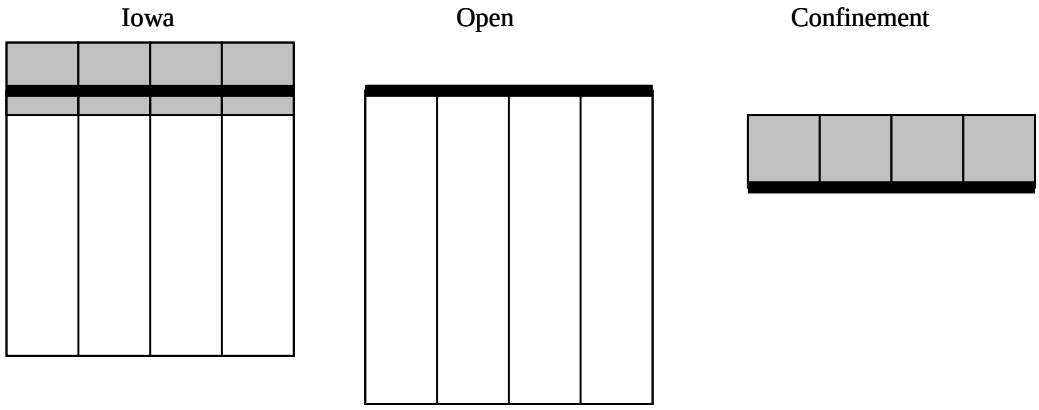


Figure 1. Topographic image of the three feedlot facilities. The bunk line is represented with the thick, black line (▬) and the Partial and Confinement monoslope buildings are represented with the shaded areas (▭).

The facilities were designed for comparison purposes. Thus, each facility has similar bunk space (80 feet/pen; 12 inches/head), and within a facility, similar pen dimensions. Each pen contains a concrete waterer that provides a total of 100 inches of water space/pen (1.25 inches/head). Pen dimensions are listed in Table 1.

Table 1. Dimensions of the three feedlot facilities at the Opportunities Farm

Item	Confinement[a]	Open[a]	Iowa[a]
Building dimensions, feet[b]	360 × 40	–	320 × 35
Pen width, feet	90	80	80
Pen depth, feet	40	275	215
Bunk space, inches/head	12	12	12
Animal space, feet^2/head	45	275	215
Water space, inches/head	1.25	1.25	1.25
Area under roof, feet^2/head	45	–	20

[a] Confinement = bed-pack confinement; Open = dirt-mound open pens; Iowa = partially-covered pens
[b] Dimensions of the entire building that spans the length of four feedlot pens

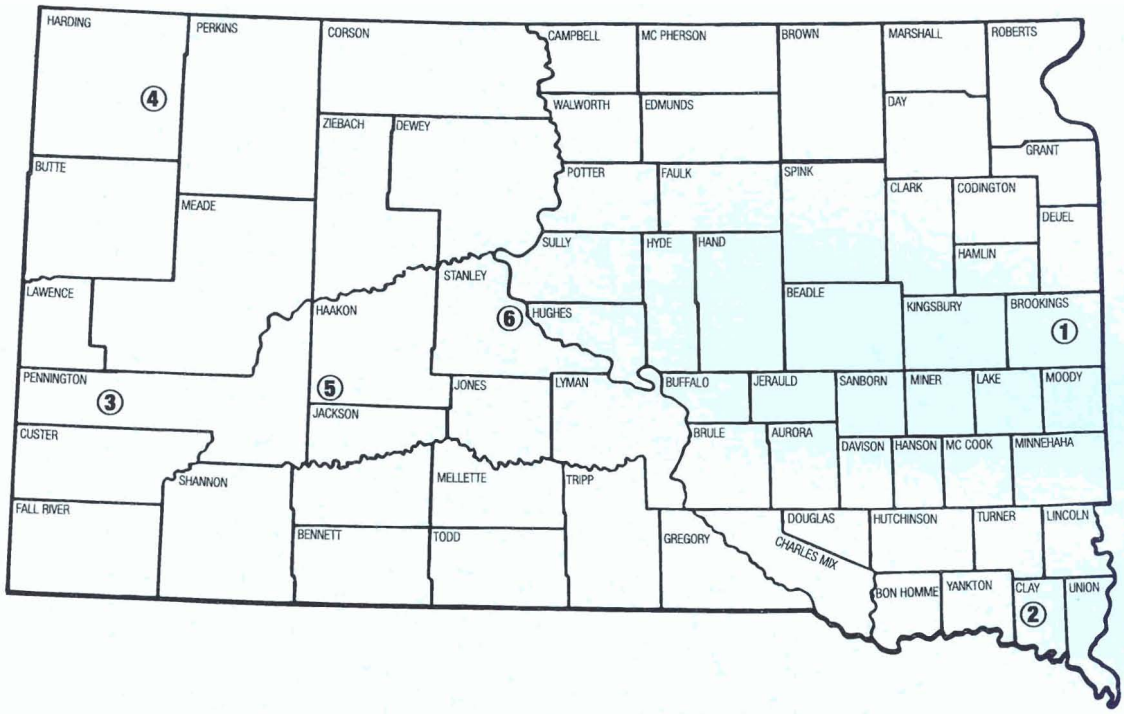
The bed-pack confinement facility is oriented East to West with the bunk line on the South side of the building. The entire facility is covered by a steel-monoslope building that is 360 feet × 40 feet. The slope of the roof is South to North. The height of the South side of the building allows for afternoon sun to reach the back of the building. Each pen is 90 feet wide and 40 feet deep allowing 45 feet^2 per head of pen space. The entire floor surface is concrete with a slight slope towards the center of the pen from both bunk and back of the pen. Waterers are located in the back 1/3 of the pen. The pens are bedded weekly with approximately one ton of corn stover. To clean the pens, cattle are moved through gates located along the bunk line and held in the feed alley while the front 2/3 of the pen is scraped. Bedding is added to the back 1/3 of the pen and is considered the bed-pack.

The dirt-mound open pen bunk line is oriented East to West with the bunk line on the North side of the pens. Each pen is 80 feet wide and 275 feet deep allowing 275 feet^2 per head of pen space. There is a 12 foot concrete-feed apron. The waterers are located 30 ft from the bunk along the fence line. Mounds are located along the fenceline, sloping towards the back-center of

the pen. The slope towards the back of the pen begins approximately 20 feet from the feed apron. At the back of the pen, the mounds are approximately 8 feet high with a slope of 4:1 (one foot drop for every 4 linear feet). Manure from the pens is scraped, piled, and hauled after each pen of cattle is marketed.

The partially-covered pens are oriented similar to the dirt-mounded open pens. Each pen in this facility is 80 feet wide and 215 feet deep allowing 215 feet^2 per head of pen space. There is a monoslope building that covers the feed alley, bunk, waterer, and front 20 feet of the pen. The dimensions of the building are 320 feet $\times$ 35 feet. Waterers are located 10 feet from the bunk, along the fence line. The entire area underneath the building and 12 feet beyond the South end of the building is concrete. Mounds are located along the fenceline, sloping towards the back-center of the pen. At the back of the pen, the mounds are approximately 3 feet high with a slope of 4:1 (one foot drop for every 4 linear feet). Manure from the dirt portion of the pens is scraped, piled, and hauled after each pen of cattle is marketed. Periodically, while cattle are in the pens the area under the roof is cleaned. During the winter, bedding is occasionally added to the area under the roof.

Animal and Range Sciences
Research and Extension Units



1. Brookings: SDSU campus, Agricultural Experiment Station,
   Cooperative Extension Service

2. Beresford: Southeast South Dakota Research Farm
   Beef cattle nutrition
   Swine nutrition and management

3. Rapid City: West River Ag Research and Extension Center
   Research and Extension staff in Animal & Range Sciences,
   Plant Science, Economics, 4-H, and
   Extension administration

4. Buffalo: Antelope Range Livestock Station
   Beef cattle breeding and range beef herd management
   Sheep nutrition, management, and breeding

5. Philip: Range and Livestock Research Station
   Range beef nutrition and herd management
   Range management

6. Ft. Pierre: Hughes-Stanley County Extension Office
   Area beef and 4-H Extension specialists

These research and Extension units are geographically spaced across South Dakota to help solve problems, bring the results of livestock and range research to users, enhance the statewide teaching effectiveness of the Animal & Range Sciences Department staff, and maintain a close and productive relationship with South Dakota producers and the agribusiness community.

The state of South Dakota is our campus, our research lab, our classroom