1992

1992 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

Department of Animal and Range Sciences

1992

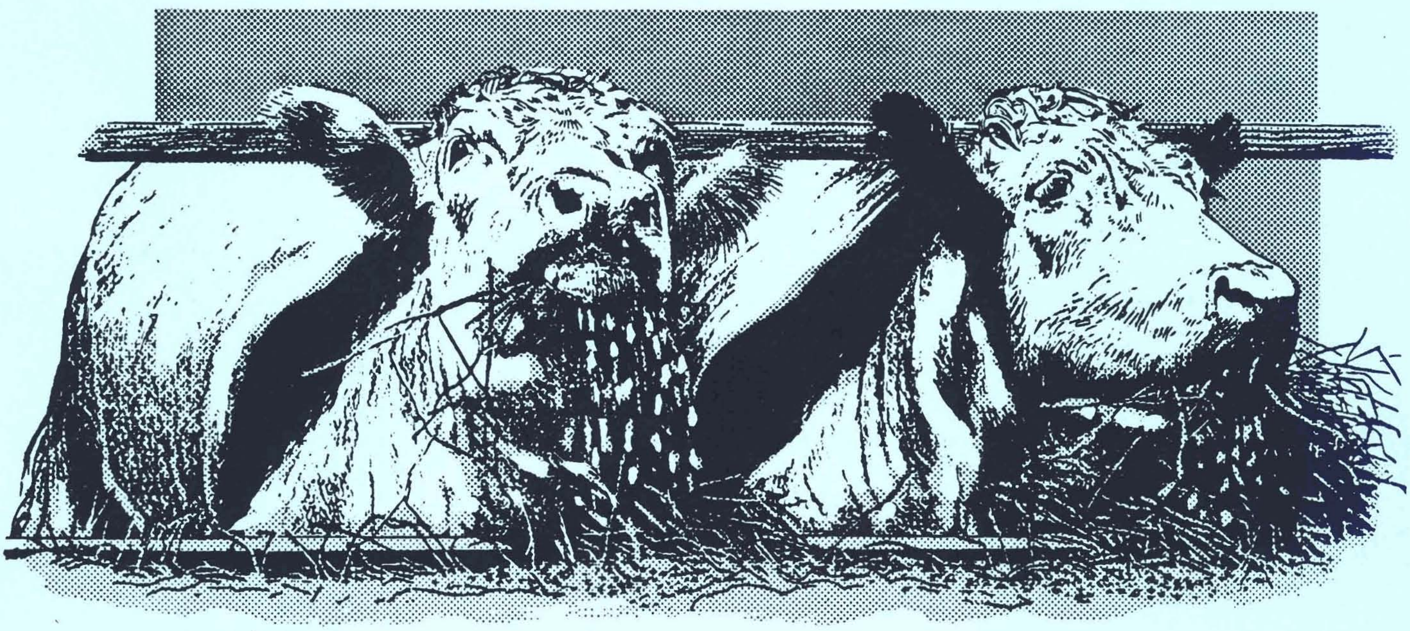
Agricultural Experiment Station

South Dakota

Cooperative Extension Service

Beef Report

South Dakota State University, Brookings



The faculty members of the **Animal and Range Sciences Department** are always ready to answer your questions. Our Brookings phone number is (605) 688-5166. Staff members in Rapid City (RC) can be reached at (605) 394-2236. Please feel free to give any one of us a call.

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August 1992

Dear Beef Producer:

Here is the 1992 version of the Beef Report. I hope you find the research reports interesting and beneficial to you.

South Dakota's rank in the nation is 9th in total cattle, 5th in beef cows, 10th in cattle on feed, and 8th in feeder cattle and calves. South Dakota herds contain 4.5% of the United States total beef cow population. Nationally, we are definitely a leading beef cattle state.

Economically, the beef industry's impact in South Dakota is even greater. When direct, indirect, and induced economic effects are measured, the beef industry is a $6 billion contributor to South Dakota's economy. The largest, nonagriculture industry is the medical industry at $1.7 billion. Beef cattle are definitely the biggest single industry in South Dakota. However, we export 69% of our calf crop. There is great potential to retain calves in the state. You will see in the Beef Report an update on the retained ownership project as well as a report of our experience retaining ownership. A further component of the retained ownership project is a comparison of feeding the same set of cattle in Brookings versus Lubbock, Texas. This information will add to our knowledge on retaining South Dakota calves in South Dakota.

We want our research to answer your questions and needs. We need your input. If you have ideas or interests, contact the research faculty directly or talk to the beef extension specialists. We hope that when you are in the Brookings, Philip, Buffalo, or Beresford areas, you will stop at the experiment stations and look around to see what is going on.

Sincerely,

James R. Males
Head, Department of Animal and
Range Sciences

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SDSU

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August 1992

Dear Beef Cattle Industry Friends:

Thank you for examining the 1992 South Dakota Beef Report. The report summarizes the results of beef cattle related research that was conducted at South Dakota State University during the past year. Beef cattle production is South Dakota's number one industry. I hope you will find that the results contained in this book contribute to the profitability of your beef cattle production or agri-business enterprise.

Some of the results reported in this report have immediate application for your farm, ranch, or agri-business. Other studies are more basic in nature. New discoveries are made with these projects that hopefully will help improve the financial well-being of your business in the future.

We enjoy visiting with you concerning your production or business problems. Fully discussing these problems generally turns them into opportunities. Please feel free to call us concerning these opportunities. Also, make certain you explore all your local sources of information. People helping people will continue to make the beef industry thrive in South Dakota.

Have a save, enjoyable, profitable year. I hope to see you at some of our future meetings.

Sincerely,

John J. Wagner
Extension Ruminant Nutrition Specialist

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INTERPRETING EXPERIMENTAL RESULTS

D.M. Marshall[1]
Department of Animal and Range Sciences
CATTLE 92-1

A typical experimental format involves evaluating the response caused by application of different treatments to experimental subjects (animals, carcasses, pens, pastures, etc.). The effect of a given treatment might be evaluated by comparison to a control group or to one or more other treatment groups. However, a problem with animal research (and other types as well) is that variation not due to treatments often exists among experimental subjects.

For example, suppose that animals receiving ration A grow faster than animals receiving ration B. Was the observed difference in growth rates actually due to differences in the rations or to other factors (i.e., genetics, age, sex, etc.) or some of each? Statistical analyses evaluate the amount of variation between treatment groups relative to the amount of variation within treatment groups. In addition, variation caused by factors other than treatments can sometimes be eliminated by the statistical analysis.

The statement "the difference was statistically significant (P = .05)" indicates the probability of a difference of that magnitude occurring from chance rather than from the research treatment is about 5%.

A correlation coefficient provides an indication of the relationship between two factors and can range from -1 to +1. A strong, positive correlation (close to 1) indicates that as one factor increases the other factor tends to increase, also. For example, several studies have shown a positive correlation between cow milk yield and calf weaning weight. A strong negative correlation (close to -1) indicates that as one factor increases the other factor tends to decrease. A correlation near zero indicates the two factors are unrelated.

Several of the reports in this publication refer to least squares means. In balanced experimental designs, least squares means are often the same as the simple raw means. However, when numbers of experimental subjects are not evenly distributed across treatments, adjustments to the means are needed. Appropriate adjustments are made by least squares procedures. In addition, least squares means are sometimes adjusted for extraneous sources of variation through a so-called analysis of variance.

Means (averages), correlations and other statistics presented in research results are sometimes followed by $\pm$ some figure known as the standard error. The standard error provides an indication of the possible error with which the statistic was measured. The size of the standard error of a treatment mean depends on the animal to animal variation within a treatment group and on the number of animals in the group.

All other factors being equal, the greater the number of animals and(or) replications per treatment, the smaller the difference required to achieve a given value for probability of significance. Stated another way, increasing the number of animals or replications increases the likelihood of detecting differences due to treatments when such differences do indeed exist.

Several of the research reports in this publication contain statistical terminology. Although such terms might be unfamiliar to some readers, the statistical analyses allow for more appropriate interpretation of results and make the reports more useful.

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[1]Associate Professor.

CHAPS SUMMARY FOR SOUTH DAKOTA 1991

D.L. Boggs[1]
Department of Animal and Range Sciences
CATTLE 92-2

Summary

Calving distribution and calf performance data were summarized from the CHAPS (Cow Herd Appraisal of Performance Software) analyses of 61 South Dakota cow herds. CHAPS uses beef cow weaning weight records to calculate adjusted 205-day weights and ratios, keep lifetime production records on cows, calculate Most Probable Producing Ability estimates for cows, produce a sire summary and analyze production according to cow age and 21-day calving periods. The 1991 summary represents 6,196 cows for an average of 102 cows per herd. The herds ranged in size from 19 to 277 head. The average midpoint of the calving season for these herds was April 9. The average actual birth and weaning weights were 78.8 and 507.0 lb, respectively, with the average age at weaning 205.3 days. Overall, 82.8% of the females calved by day 42 of their respective calving seasons, although there was considerable disparity in the percent calved by day 42 between the HIGH and LOW (92.9 vs 69.7%) calving distribution herds. This difference is important since actual weaning weights declined 35 to 60 lb for each 21 days later that calves were born. In addition to these data for the state summary, CHAPS provides valuable information for making within herd selection and management decisions.

(Key Words: Cow-Calf, Performance Records.)

Introduction

A computer program for evaluating cow herd productivity was acquired in 1989 by the SDSU Extension Service and placed in most of the county extension offices. The program is called CHAPS which stands for Cow Herd Appraisal of Performance Software. CHAPS uses standard beef cow weaning weight records to adjust weaning weights and calculate 205-day ratios. In addition, the program keeps lifetime production records on cows, calculates MPPA (Most Probable Producing Ability) for cows, produces a sire summary and analyzes birth dates and weaning weights to give a calving distribution and production analysis by cow age and 21-day calving periods. CHAPS records are summarized to develop a state database to provide producers a basis for comparative analysis of their herds' productivity.

This 1991 CHAPS summary for South Dakota represents 6,196 cows from 61 herds throughout the state. The average herd size was 102 cows with a range of 19 to 277 head. Several interesting trends are apparent in the data. Data of particular interest in the summary were the percentage of calves born in 21-day segments of the calving season. Calving distribution provides an excellent indication of reproductive performance and provides a producer a tool to utilize in troubleshooting reproduction, nutrition and management problems within the various age groups of cows in the herd. CHAPS determines the start of the first 21-day period by using the date when the second 3-year-old or older cow calves. Any cows or heifers calving ahead of that date are considered Early. The calving distribution and performance of the 21 herds with the highest percentage calved by the end of the first 21 days (HIGH) are compared to the 20 herds with the lowest percentage calved by the end of the first 21 days (LOW).

Results and Discussion

1. The age distribution of the cows in the summary appears in Table 1. In these herds, 16.9% were first calf 2-year-olds and approximately 45.4% from 5 to 9 years of age. In these herds, 41.5%

[1]Extension Beef Specialist, Associate Professor.

Table 1. Number and percentage of cows by age in 1990 CHAPS summary

Age of cow, yr	Number of cows	% of total	Weaning weight
2	1050	16.9	468
3	825	13.3	473
4	702	11.3	507
5-9	2813	45.4	513
10 and over	832	13.0	491

were under 5 years and 13.0% were 10 years or older. The average cow age was approximately 5.7 years. As expected, actual weaning weights were highest for the 5- to 9-year-old age group.

2. The average start of the calving season for the mature cow herd was March 15. The average midpoint of the calving season for these herds was April 9. The average actual birth and weaning weights for these calves were 78.8 and 507.4 lb, respectively. The averages for age at weaning, weight per day of age at weaning, and adjusted weaning weight were 205.3 days, 2.49 lb/day and 530 lb, respectively. Actual weaning weights became progressively lighter by 35 to 50 lb for each 21 days later that calves were born (Table 2). Note that the HIGH distribution herds averaged 20 lb more at weaning than the LOW distribution herds due to the higher percentage of calves born early in the calving season.

3. In these herds, nearly 83% of the females were calved by the end of the second 21-day period and over 94% were calved by the end of the third 21-day period (Table 2).

4. The calving distribution within age group (Table 3) shows that about a quarter of the 2-year-olds were calved ahead of the mature cows, with the HIGH distribution herds calving 36.4% EARLY versus 15.6% for the LOW herds. There was even greater disparity between the HIGH and LOW groups in the cumulative percentages of 3- and 4-year-old cows calving within the 21-day calving periods. For example, at the end of the second 21-day period, 89.7% of the 3-year-olds in the HIGH herds had calved compared to only 68.7% in the LOW herds. This trend continues for the 4-year-old cows (92.2 vs 59.7) and indicates difficulty in getting 2- and 3-year-olds among the LOW distribution herds to rebreed and a real need for improvement in nutrition and management of these young females. The data also show the value of calving first-calf, 2-year-olds early to allow more time for rebreeding.

5. CHAPS provides valuable information to individual producers as well as the South Dakota beef industry. If you are interested in enrolling your herd in CHAPS, contact your county extension agent or the extension beef specialists at SDSU.

Table 2. Percentage of cows calving and average actual weaning weight by 21-day calving period for all cows and for high and low calving distribution groups

21-day period	All cows %	All cows Weight	HIGH %	HIGH Weight	LOW %	LOW Weight
Early	5.6	532	8.0	526	3.5	540
1st	47.0	529	63.2	527	29.4	533
2nd	30.2	494	21.7	488	36.8	499
3rd	11.6	443	5.3	431	19.7	454
4th	3.3	394	.8	385	6.9	414
Late	1.7	354	.6	368	3.4	360
Average wt		501		512		492
Avg calving date	April 9		April 5		April 13	
Avg start date for calving cows	March 15		March 20		March 10	

Table 3. Average cumulative percentage calved by 21-day calving periods within age group for all cows and high and low calving distribution groups

Age	Group	% of each age group: Early	1st	2nd	3rd	4th
2	All	27.6	70.4	88.6	96.2	98.9
	HIGH	36.4	81.8	94.8	98.3	99.0
	LOW	15.6	52.9	79.9	91.4	97.4
3	All	1.6	49.8	81.8	94.2	98.3
	HIGH	2.0	62.6	89.7	98.5	99.5
	LOW	1.3	30.9	68.7	87.9	96.4
4	All	1.7	47.9	75.9	92.2	97.3
	HIGH	2.6	71.2	92.2	97.4	97.4
	LOW	2.0	26.4	59.7	85.1	95.9
5-9	All	.9	49.7	84.6	95.2	98.2
	HIGH	1.1	70.6	94.5	99.2	99.8
	LOW	1.2	30.5	72.4	90.4	96.4
10 and over	All	1.6	49.3	79.6	95.7	98.7
	HIGH	2.1	69.5	91.8	97.9	99.6
	LOW	2.1	29.3	62.7	92.3	97.6

IN VITRO ANALYSIS OF DROUGHT STRESSED, CHOPPED SUNFLOWER HEADS AS A PROTEIN SUPPLEMENT FOR CATTLE GRAZING CORN CROP RESIDUES

D.U. Thomson[1] and R.H. Pritchard[2]
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CATTLE 92-3

Summary

The suitability of drought stressed, chopped sunflower heads as an energy and crude protein supplement to low quality forages was evaluated using in vitro fermentation techniques. Sources of supplemental crude protein used in comparisons were drought stressed, chopped sunflower heads, soybean meal, soybeans, and urea. These crude protein sources were added to cornstalks to produce substrates containing 6, 8, 10, 12, and 15% crude protein. Observed fermentable dry matter was higher than the estimated fermentable dry matters, indicating positive associative effects of crude protein level. Similar differences in observed and estimated fermentable dry matters occurred among soybean meal, soybean, and urea treatment means with the drought stressed, chopped sunflower treatment mean being more erratic and lower. Ether extract content of drought stressed, chopped sunflower heads may limit their use as a protein and energy supplement.

(Key Words: Cornstalks, Sunflowers, Fermentation, In Vitro.)

Introduction

Supplemental crude protein is required for cattle fed low quality forages. The choice of a supplement is very important. Supplements must adequately compliment the forages being used and must be available at a reasonable cost. By-product feeds can often fulfill this role.

During drought, yield and quality of sunflowers are compromised and cash market value declines. The damaged sunflowers do contain high levels of crude protein and energy that may make them suitable to use as a supplement for beef cattle fed low quality forages.

The objective of this experiment was to compare single stage, in vitro fermentability of cornstalks supplemented with drought stressed, chopped sunflower heads with more traditional sources of supplemental crude protein.

Materials and Methods

Crude protein supplements, chopped sunflower heads, soybean meal, soybeans, or urea, were substituted for cornstalks to produce substrates containing 6, 8, 10, 12, and 15% crude protein except for the cornstalk only treatment which was 4.64% crude protein. A .5-gram sample of substrates (Table 1) represented the desired amounts of cornstalks and protein source to arrive at the targeted percentages of crude protein.

Two ruminally fistulated cattle were fed cornstalks ad libitum and 1 lb of soybean meal per head daily for 28 days before being used as ruminal liquor donors. Ruminal liquor used for in vitro fermentations was sampled 6 hours after feed delivery.

The ruminal contents sample was first blended under CO_2 for 5 minutes and strained through two layers of cheese cloth. The liquor was then mixed with McDougall's artificial saliva containing no urea at 1:3 (vol:vol). Thirty-five ml of the liquor-buffer solution was added to each substrate.

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[1]Graduate Research Assistant.
[2]Associate Professor.

Table 1. Composition of fermentation substrates

Crude protein level	Base substrate	%	Crude protein source	%
6	Cornstalks	91.77	Chopped sunflower heads	8.22
8	Cornstalks	79.67	Chopped sunflower heads	20.33
10	cornstalks	67.57	Chopped sunflower heads	32.43
12	Cornstalks	55.47	Chopped sunflower heads	44.53
15	Cornstalks	37.32	Chopped sunflower heads	62.67
6	Cornstalks	96.91	Soybean meal	3.09
8	Cornstalks	92.36	Soybean meal	7.64
10	Cornstalks	87.81	Soybean meal	12.19
12	Cornstalks	83.27	Soybean meal	16.73
15	Cornstalks	76.44	Soybean meal	23.56
6	Cornstalks	96.32	Soybeans	3.68
8	Cornstalks	90.91	Soybeans	9.09
10	Cornstalks	85.51	Soybeans	14.49
12	Cornstalks	80.10	Soybeans	19.90
15	Cornstalks	71.98	Soybeans	28.02
6	Cornstalks	99.53	Urea	.47
8	Cornstalks	98.83	Urea	1.17
10	Cornstalks	98.13	Urea	1.87
12	Cornstalks	97.43	Urea	2.57
15	Cornstalks	96.38	Urea	3.61
4.64	Cornstalks	100.00	None	0.00

Following a 48-hour fermentation at 39 °C, the samples were removed from the water bath and centrifuged at 3000 x g for 10 minutes. The supernatant was aspirated and discarded. The tube and residue were dried for 8 hours in an oven at 60 °C and then reweighed. All fermentable dry matter determinations were completed in triplicate. Fermentable dry matter was determined on a dry weight basis as: Fermentable dry matter, % = (1-[(original sample - residue)/original sample]) x 100. Feedstuffs were analyzed for crude protein and drought stressed, chopped sunflower heads were analyzed for acid detergent fiber, neutral detergent fiber, ether extract, and ash content.

Data were analyzed by procedures appropriate for a 4 (source) x 5 (% CP) factorial arrangement of treatments using the GLM procedures of SAS. Response curves for increasing crude protein percentage were tested using the repeated option for linear, quadratic, and cubic effects. The mean separation test used for crude protein source effects was Duncan's New Multiple Range Test.

Results and Discussion

The chemical composition of drought stressed, chopped sunflower heads indicates the uniqueness of this feedstuffs (Table 2). The relatively high protein and fat content make it a promising source of supplemental crude protein and energy. Soybean meal contained a higher amount of fermentable dry matter than other sources followed by soybeans and drought stressed, chopped sunflower heads (Table 3).

Table 2. Chemical composition of drought stressed, chopped sunflowers

Item	Percent DM basis
Dry matter	94.50
Crude protein	21.17
Ether extract	14.72
Acid detergent fiber	24.93
Neutral detergent fiber	28.35
Ash content	6.77
Total digestible nutrients	65.42

Table 3. Crude protein and fermentable dry matter of substrates[a]

Item	Percent crude protein	Ferment-able DM
Drought stressed, chopped sunflower heads	21.17	50.70[b]
Soybean meal	49.62	74.90[c]
Soybeans	42.67	61.80[d]
Urea	201.00	-
Cornstalks	4.64	<31.05[e]

[a] Percentage, dry matter basis.
[b,c,d,e] Means within columns with similar letters do not differ (P<.05).

Mean fermentable dry matter across CP levels was highest for soybean meal (Table 4). Drought stressed, chopped sunflower heads were similar to soybeans with urea producing the lowest fermentable dry matter values.

Estimated fermentable dry matter values were calculated from observed fermentable dry matter values determined for each substrate fermented alone (Table 3). Estimated fermentable dry matter differed among crude protein sources (Table 4).

The percentage fermentable dry matter observed (Table 4) was higher than the estimated fermentable dry matter, in most cases indicative of a positive associate effect of crude protein supplementation. Differences between observed and estimated fermentable dry matters among crude protein sources were similar except for drought stressed, chopped sunflower heads. Associative effects from drought stressed, chopped sunflower heads were lower (P<.05), more erratic than for other crude protein sources. The ether extract of the 15% crude protein drought stressed, chopped sunflower head substrate was calculated to be 9.2%, which is high enough to depress fiber digestion. One would also expect to see soybeans cause a similar depression in fermentable dry matter due to increased levels of fat but lower substitution rates for soybeans limited ether extract to a maximum of 6.5%. Ether extract content of drought stressed, chopped sunflower heads may limit their use as a source of supplemental crude protein and energy.

Table 4. Estimated fermentable dry matter for treatments

Source	CP, %	Observed FDM, %[abc]	Estimated FDM, %	Difference[c]
Chopped sunflower heads	6	30.00	32.66	-2.66
Chopped sunflower heads	8	38.35	35.04	3.31
Chopped sunflower heads	10	41.91	37.42	4.49
Chopped sunflower heads	12	49.91	39.80	10.11
Chopped sunflower heads	15	45.53	43.36	2.17
	Mean	41.14[d]	37.69[d]	3.45[d]
Soybean meal	6	34.58	32.40	2.18
Soybean meal	8	41.29	34.40	6.89
Soybean meal	10	44.68	36.39	12.29
Soybean meal	12	48.61	38.38	10.23
Soybean meal	15	51.38	41.38	10.00
	Mean	44.11[e]	36.59[e]	7.52[e]
Soybeans	6	31.11	32.18	-1.07
Soybeans	8	37.59	33.85	3.74
Soybeans	10	44.12	35.51	8.61
Soybeans	12	45.88	37.17	8.71
Soybeans	15	48.22	39.67	8.55
	Mean	41.39[d]	35.68[f]	5.71[e]
Urea	6	31.15	31.37	-.22
Urea	8	39.48	31.37	8.11
Urea	10	38.90	31.37	7.53
Urea	12	41.18	31.37	9.81
Urea	15	38.50	31.37	7.13
	Mean	37.84[f]	31.37[g]	6.47[e]

[a] Fermentable dry matter.
[b] Source x level (P<.01).
[c] Quadratic response within source (P<.05).
[d,e,f,g] Means within columns with similar letters do not differ (P<.05).

EFFECTS OF LEVEL OF CONCENTRATE AND FORAGE AVAILABILITY ON THE PERFORMANCE OF BEEF COWS GRAZING WINTER RANGE[1]

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CATTLE 92-4

Summary

Two winter grazing trials were conducted on consecutive years to determine the effect of level of concentrate supplement and amount of forage available on performance of cows grazing dormant winter range. Simmental x Angus cows were fed concentrate supplements containing combinations of corn and soybean meal at either high, medium or low levels. Supplements were formulated to provide .7 lb of crude protein during year 1 and .51 lb of rumen degradable crude protein in year 2. Two pastures with differing amounts of available forage were grazed each year. In year 1, the amount of available forage had a greater effect on body weight and condition score change than did level of concentrate fed. Cows receiving higher levels of supplement actually gained less weight. The interaction between level of supplement and amount of available forage showed higher levels of concentrate supplement may be more detrimental when amount of available forage is limited. The amount of available forage was considerably greater in both pastures the second year with cows gaining more weight on the high available forage pasture. Cows receiving higher levels of concentrate supplement gained more weight and body condition than those receiving lower levels of supplement. There was no interaction between forage availability and level of concentrate in year 2.

(Key Words: Beef Cattle, Winter Grazing, Supplement, Forage Availability.)

Introduction

Typically, protein is considered the most limiting nutrient in low quality forages such as native winter range. Research has shown that protein supplementation will decrease winter weight and condition score losses by improving intake and digestibility of mature, low protein forages. Recent research also suggests that supplements with high levels of starch may be detrimental to cow performance. It has been thought by some that the advantage of feeding higher levels of concentrate supplement may depend on the amount of forage available to be grazed. The objective of this study was to determine the effect of level of concentrate supplement and forage availability on the performance of dry, pregnant cows.

Materials and Methods

A winter grazing study using 120 (year 1) and 126 (year 2) pregnant Simmental x Angus cows grazing native winter range was replicated over 2 years at the SDSU Range and Livestock Research Station near Cottonwood. Cows were allotted by age and weight to three soybean meal-corn supplement treatments (Tables 1 and 2) and grazed on a pasture of either high or low forage availability during January and February. Concentrate supplements were balanced to provide .7 lb of crude protein in year 1 and .51 lb of rumen degradable crude protein in year 2 (Table 2). In year 1, 1.91, 4.88, and 7.85 lb of dry matter per cow were fed for the low, medium, and high levels of concentrate supplements, respectively. Amount of concentrate

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[1]Thanks expressed to Terry Foppe, AAFAB Composition Analysis Laboratory Inc., 1318 Duff Drive, Fort Collins, CO, 80524, for species composition analysis of esophageal samples.
[2]Graduate Research Assistant.
[3]Associate Professor.

Table 1. Supplemental treatments[a]

Item	Low	Medium	High
	Year 1		
Soybean meal	87.43	14.55	-
Corn	-	73.57	87.90
Dicalcium phosphate	5.23	1.23	.25
Potassium chloride	6.81	3.07	2.17
Molasses	.52	5.97	7.77
Bentonite	-	1.84	1.91
	Year 1		
Soybean meal	81.16	21.27	8.44
Corn	-	71.16	86.42
Dicalcium phosphate	6.22	1.17	.09
Potassium chloride	9.88	3.86	2.56
Molasses	2.50	2.51	2.51

[a] Percentage on a dry matter basis.

Table 2. Composition of daily supplemental intake per cow

Item	Low	Medium	High
	Year 1		
Dry matter, lb	1.91	4.88	7.85
Crude protein, lb	.70	.70	.70
Rumen degradable protein, lb[a]	.60	.38	.24
Metabolizable energy, Mcal[b]	2.31	6.70	10.92
Calcium, lb	.030	.022	.014
Phosphorus, lb	.029	.027	.027
Potassium, lb	.101	.124	.156
	Year 2		
Dry matter, lb	1.67	4.93	7.92
Crude protein, lb	.69	.94	1.09
Rumen degradable protein, lb[a]	.51	.51	.51
Metabolizable energy, Mcal[b]	1.93	6.69	11.29
Calcium, lb	.027	.019	.007
Phosphorus, lb	.030	.030	.029
Potassium, lb	.110	.140	.166

[a] Calculated from NRC ruminant nitrogen usage tables.
[b] Calculated from NRC feed tables.

supplement per cow per day fed in year 2 was 1.67, 4.93, and 7.92 lb, respectively, for the low, medium and high levels of supplements (Table 2). Supplements were fed in pelleted form (3/8 in. diameter) and were balanced to exceed NRC requirements for calcium, phosphorus, and potassium (Table 2).

The two pastures used in the study were dominated by western wheatgrass (Table 3). The low available forage pasture (270 acres) was grazed for 3,684 animal unit days during November just prior to both trials to create a difference in quantity of available forage. The high available forage pasture (351 acres) had not been grazed since the previous April in either year. Estimates of forage standing crop were made on November 29 and 30 in year 1 and on December 21 in year 2. Forage was estimated on 50 plots (.25 m^2) in each pasture at each sampling period. Plots were located using stratified random sampling based on range site. Fifteen of the 100 total plots estimated at each sampling period were also clipped by hand, sorted by species, oven dried (60 °C), and weighed. The relationship between estimated forage standing crop and actual values was determined using linear regression, and all unclipped estimates were calibrated using those equations.

From early December to early February, cows were gathered every morning, sorted into treatment groups, and bunk fed their respective diets. At the beginning and end of the trial, cows were weighed in the morning on two consecutive days after overnight removal from feed and water. Initial and final cow weights were the average of the two consecutive weights. Condition scores (1 to 9, 1 = extremely emaciated) were assigned by two technicians at the beginning and end of the trial. Cows were bred to either Angus or Simmental bulls and had mean calving dates of February 27 and March 26 for first calf heifers and mature cows, respectively. Data from three cows that calved prior to the end of the trial were deleted in year 2.

In early January of each year, forage samples were collected with four esophageally fistulated steers that grazed with the cows. The four steers were grazed together on each pasture for two consecutive days. Steers were allowed to graze with screened collection bags for 25 minutes after morning supplementation was completed. Extrusa samples were frozen, lyophilized and ground for later analysis. Ground samples were microhistologically analyzed for forage composition and analyzed for chemical composition (Table 4). Hand

Table 3. Availability of predominant grass species[a]

Item	Low		High	
	Year 1			
Western wheatgrass	270.6	(30.9)	491.8	(46.6)
Japanese brome	78.9	(8.5)	54.9	(9.7)
Shortgrasses[b]	112.3	(7.8)	99.3	(24.8)
Total	461.8		646.0	
	Year 2			
Western wheatgrass	870.8	(76.6)	1141.6	(125.6)
Japanese brome	20.2	(9.0)	22.8	(8.0)
Shortgrasses[b]	334.8	(27.9)	313.4	(37.9)
Total	1225.8		1477.8	

[a] Expressed in lb/acre.
[b] Undifferentiated mixture of buffalograss and blue grama.

Table 4. Composition of forage samples collected in early January 1991 and 1992

	Forage available			
	Year 1		Year 2	
Item	Low	High	Low	High
Esophageal samples, % species composition by weight[a]				
Western wheatgrass	96.63 (.94)	94.05 (.86)	98.79 (.57)	98.68 (.68)
Japanese brome	2.15 (.63)	1.19 (.58)	.00 (.10)	.29 (.12)
Other grasses	1.22[c] (.84)	4.76[d] (.78)	1.21 (.55)	1.03 (.65)
Esophageal samples, % organic matter basis[ab]				
Crude protein	3.73[c] (.17)	5.45[d] (.16)	4.68 (.31)	4.93 (.38)
Acid detergent fiber	57.56[c] (.71)	53.54[d] (.65)	53.51[e] (.29)	52.48[f] (.35)
Neutral detergent fiber	82.57 (.85)	80.76 (.78)	82.83 (.53)	83.50 (.65)
Acid detergent lignin	8.21[g] (.49)	6.87[h] (.45)	5.35 (.22)	5.22 (.27)
Clipped samples, % organic matter basis				
Crude protein	3.79	5.04	3.57	3.68
Acid detergent fiber	49.86	47.83	54.36	54.23
Neutral detergent fiber	80.38	77.35	83.77	84.35
Acid detergent lignin	4.90	5.17	4.93	4.67
Clipped samples, % dry matter basis				
Calcium	.26	.31	.34	.30
Phosphorus	.07	.10	.05	.05
Potassium	.19	.22	.24	.18
Ash	5.42	5.69	6.91	7.37

[a] Least squares means followed by standard errors.
[b] Uncorrected for salivary contamination.
[c,d] Means within year with uncommon superscripts differ (P<.05).
[e,f] Means within year with uncommon superscripts differ (P=.06).
[g,h] Means within year with uncommon superscripts differ (P=.07).

clipped samples similar to cow diets were also taken at this time (Table 4).

Data were analyzed by the GLM procedure of SAS with treatment means separated by the PDIFF option.

Results and Discussion

Greater precipitation during the growing season in year 2 (Figure 1) caused the large difference in the amount of forage available between years (Table 3). Western wheatgrass was the predominant species of grass consumed with lesser amounts of Japanese brome, buffalograss, blue grama and sideoats grama being consumed (Table 4). Esophageal sampling in year 1 indicated that cattle grazing the high forage pasture selected forage that was higher (P=.001) in crude protein and lower in acid detergent fiber (P=.002) and lignin (P=.07; Table 4). Clipped samples also indicated that higher quality forage was available to cattle grazing the pasture with more forage available (Table 4). In year 2, cattle grazing the low available forage pasture selected forage higher (P=.06) in acid detergent fiber (Table 4), but other indicators of forage quality were similar. Clipped samples also indicated that forage in the high and low available forage pastures was similar (Table 4). The difference in

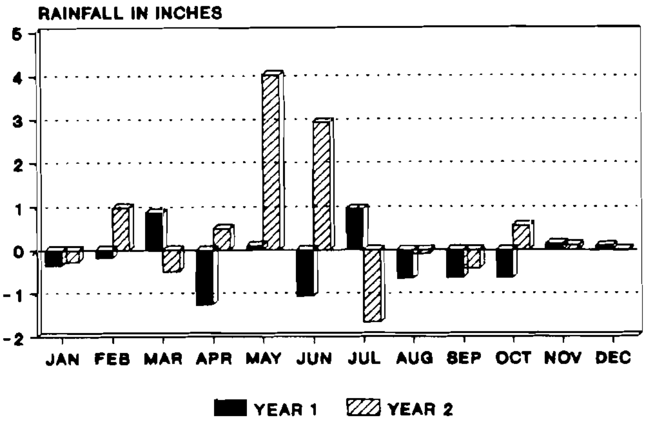

Figure 1. Year 1 and year 2 deviation from long term average precipitation at SDSU Range and Livestock Research Station near Cottonwood.

available forage during the first year caused cows on the low forage pasture to be less selective in their forage consumption, resulting in a lower quality diet than cows on the high forage pasture. During the second year when the amount of forage in both pastures was much higher, the quality of forage consumed in the low and high forage pasture was more similar.

In year 1, the amount of available forage had a greater effect on cow performance than did the level of concentrate supplement (Table 5). Cows grazing the high available forage pasture gained 51.5 lb more (P<.001) than cows grazing the low forage pasture. This difference in weight gain was probably due to cows on the high forage pasture being able to select a higher quality diet than cows on the low forage pasture (Table 4). Cows fed higher levels of supplement actually gained less weight (P<.001) and lost more condition score (P<.01; Table 5). In other words, cows gained less weight as the amount of corn per day in the concentrate supplement increased. Similar research conducted at the Gudmundsen Sandhills Laboratory near Whitman, Nebraska, found that cows grazing native winter range exhibited greater weight loss when additional energy was supplemented in the form of ear corn as compared to feeding a protein supplement without ear corn. The Nebraska results and results from several other research projects indicate that increasing levels of starch in the diet cause negative effects on digestibility and intake of mature forage. The interaction between amount of forage and level of concentrate for weight change (P=.10) and condition score change (P=.07) the first year shows that increasing the level of concentrate was more detrimental to cow performance on the low forage pasture (Table 6).

In the second year, cows grazing the high available forage pasture gained only 11.1 lb more (P=.04) than cows grazing the low forage pasture (Table 5). Increasing the level of concentrate supplement resulted in increased weight gains and body condition scores. Cows receiving the high level of supplement gained 25 more pounds (P=.001) and more body condition (P=.001) than cows receiving the medium level of supplement and 38.4 more pounds (P=.001) and more body condition (P=.001) than cows receiving the low level of supplement (Table 5). There was no interaction between amount of available forage and level of concentrate for weight change and body condition change in the second year. Greater weight gains by all groups in the second year may have been due to adverse weather prior to the start of the trial causing cows to weigh less and have less body condition at the beginning of the trial.

Numerous research trials have demonstrated that providing a small amount of an all natural protein supplement to cows consuming mature, low protein forages will increase forage digestibility and forage consumption. The results from the first year of this study indicate that providing additional energy in the form of a high starch supplement, like corn, will not improve cow weight change but may in fact be detrimental. In some cases it has been thought that, when the amount of available forage is limited, feeding a higher amount of a concentrate supplement is beneficial. But in the first year of this study, even when the amount of forage available to be grazed was lower, increasing the amount of supplement caused cows to gain less weight and lose more body condition. Results from year 2 seem to contradict the earlier year's results. Cows receiving higher levels of supplement gained more weight and body condition during the second year.

These results suggest that benefits from feeding a high level of concentrate supplement may depend on the amount of forage available to be grazed. In year 1 when amount of available forage was lower and cows

Table 5. Cow performance[a]

Item	Level of supplement: Low	Medium	High	Available forage: Low	High
			Year 1		
No. cows	40	40	40	60	60
Initial wt, lb	1089 (15.4)	1089 (15.8)	1084 (15.7)	1094 (13.5)	1080 (14.5)
Initial condition score, 1-9	5.5 (.11)	5.6 (.11)	5.6 (.11)	5.6 (.10)	5.6 (.10)
Wt change, lb	57.2[b] (5.0)	46.0[c] (5.1)	27.5[d] (5.1)	17.8[b] (4.4)	69.4[c] (4.7)
Condition score change	.0[b] (.09)	.0[b] (.09)	-.3[c] (.09)	-.2[b] (.08)	.1[c] (.08)
			Year 2		
No. cows	41	42	40	60	63
Initial wt, lb	1074 (16.5)	1076 (19.0)	1080 (19.0)	1074 (16.9)	1079 (16.8)
Initial condition score, 1-9	5.1 (.07)	5.1 (.08)	5.1 (.08)	5.1 (.07)	5.1 (.07)
Wt change, lb	61.9[b] (6.4)	75.3[c] (7.0)	100.3[d] (7.4)	73.7[b] (6.6)	84.7[c] (6.5)
Condition score change	-.2[b] (.06)	-.1[c] (.07)	.2[d] (.07)	0 (.07)	0 (.07)

[a] Least squares means followed by standard errors.
[b,c,d] Means within main effect with uncommon superscripts differ ($P<.05$).

were less able to select a high quality diet, high levels of concentrate supplement high in starch were detrimental to cow performance. Since supplements from year 1 were formulated on an equal crude protein basis, the possibility exists for a rumen degradable crude protein deficiency in cows fed the medium and high levels of supplements. This may have occurred due to the lower rumen degradability of crude protein in corn and may have contributed to lower weight gains and body condition losses. In year 2, when the amount of forage available was not limiting the selectivity of the cows and supplements contained similar amounts of rumen degradable crude protein, increasing the level of concentrate supplement high in starch improved cow weight gains and body condition. In years when forage is abundant, we would expect cow weight change to be greater and high levels of supplement for additional weight gain may not be necessary. Supplementation is more likely needed when the amount of forage available is limited. In this case, additional energy supplemented in the form of grain can actually be detrimental.

Future studies are planned to determine how forage conditions affect the optimum level of supplementation. With the information available, it is still advisable that the major goal of supplementing cows grazing dormant winter range should be to provide a high protein, all natural supplement to increase digestibility and consumption of forage. Providing additional energy in the form of grain for additional weight gains is probably not advisable even when forage is limited.

Table 6. Cow performance for the interaction of supplement treatment and forage availability[a]

Forage available	Low			High		
Level of supplement	Low	Medium	High	Low	Medium	High
			Year 1			
No. cows	20	20	20	20	20	20
Initial weight, lb	1095 (19.1)	1098 (20.3)	1089 (19.8)	1082 (20.8)	1080 (20.0)	1078 (20.4)
Initial condition score, 1-9	5.5 (.14)	5.7 (.15)	5.6 (.14)	5.6 (.15)	5.4 (.14)	5.7 (.15)
Weight change, lb	38.4[d] (6.18)	15.8[c] (6.55)	-1.1[b] (6.38)	75.9[f] (6.72)	76.2[f] (6.47)	55.9[e] (6.58)
Condition score change	.0[cd] (.11)	-.2[bc] (.12)	-.5[b] (.11)	.0[cd] (.12)	.2[d] (.12)	-.1[cd] (9.12)
			Year 2			
No. cows	20	21	19	21	21	21
Initial weight, lb	1064 (20.0)	1080 (22.2)	1079 (22.9)	1083 (20.3)	1073 (22.0)	1082 (21.7)
Initial condition score, 1-9	5.0 (.09)	5.1 (.10)	5.0 (.10)	5.1 (.09)	5.1 (.10)	5.1 (.10)
Weight change, lb	61.8[b] (7.8)	66.6[b] (8.7)	92.6[c] (9.0)	62.0[b] (7.9)	84.1[c] (8.6)	108.0[d] (8.5)
Condition score change	-.2[b] (.08)	.0[b] (.09)	.2[c] (.09)	-.2[b] (.08)	-.1[b] (.09)	.2[c] (.08)

[a] Least squares means followed by standard errors.

[b,c,d,e,f] Means in a row with uncommon superscripts differ ($P<.05$).

EFFECT OF SOURCE AND LEVEL OF SUPPLEMENTAL PROTEIN ON PERFORMANCE OF POSTPARTUM RANGE COWS

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CATTLE 92-5

Summary

Two postpartum grazing trials were conducted from early March to mid May in consecutive years to determine the effects of supplemental rumen escape protein on the performance of spring calving beef cows grazing native range. Simmental x Angus cows were allotted within 7 to 14 days of calving to three supplement treatments formulated to provide equal amounts of energy from corn, soybean meal, and a combination of blood meal and corn gluten meal. Cows supplemented with corn lost more weight than cows supplemented with soybean meal. Supplemental escape protein did not improve weight gains over the soybean meal supplement. Supplemental treatments did not affect cow body condition, percentage of cows cycling, or calf performance. Results from this trial indicated that supplemental escape protein did not improve cow performance over that of a more rumen degradable protein source such as soybean meal.

(Key Words: Beef Cattle, Postpartum, Escape Protein, Protein Supplementation.)

Introduction

The period from early lactation to rebreeding is a very critical time for cows. At this time, protein and energy requirements are at their highest level of the year. Therefore, postpartum cows may need some form of supplementation in order to meet the extra nutritional requirements. This is especially true if they have high milking abilities, are extremely thin, or if they are 2-year-old cows.

Recent research has focused on different supplementation schemes involving the use of escape protein which is low in rumen degradability. The protein which reaches the small intestine for absorption is composed of microbial crude protein and feed protein which escapes ruminal degradation. When protein requirements are high, as in the case of a lactating beef cow, microbial crude protein may not meet the cow's metabolizable protein requirements. By providing a less rumen degradable (or escape) protein, the total amount of metabolizable protein available to the small intestine can be increased. Others have reported that supplemental escape protein has improved cow weight gains, milk production and decreased the interval between calving and first estrus. Research in Nebraska has suggested that cows grazing lush green forages such as smooth brome may benefit from supplemental protein that is low in rumen degradability. The objective of this study was to determine the effect of escape protein supplementation on the performance of lactating cows grazing native range in the spring.

Materials and Methods

Two postpartum grazing trials conducted in consecutive years involved lactating Simmental x Angus crossbred cows grazing native range from early March to mid-May were conducted at the SDSU Range and Livestock Research Station near Cottonwood. Dietary treatments (Table 1) included a corn-based supplement (Corn), a soybean meal based supplement (SBM), and a supplement which provided a higher level of rumen undegradable protein (Escape). The Escape supplement provided equal amounts of rumen undegradable protein from blood meal and corn gluten

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Table 1. Supplemental treatments[a]

	Escape	SBM	Corn
	First Year		
Corn	26.4	-	82.7
Soybean meal	-	90.0	-
Blood meal	19.8	-	-
Corn gluten meal	39.3	-	-
Molasses	5.6	5.6	5.4
Dicalcium phosphate	5.9	4.4	6.1
Potassium chloride	3.0	-	2.9
Sodium sulfate	-	-	2.9
	Second Year		
Corn	26.5	-	82.8
Soybean meal	-	90.0	-
Blood meal	19.5	-	-
Corn gluten meal	39.3	-	-
Molasses	5.5	5.5	5.6
Dicalcium phosphate	5.9	4.5	6.0
Potassium chloride	2.9	-	2.8
Sodium sulfate	-	-	2.8

[a] Percentage on a dry matter basis.

meal (Table 2). The Escape and SBM treatments provided 1.35 lb of crude protein per day to meet cow requirements not provided by grass (Table 2). The Corn treatment was formulated to provide equal amounts of energy to the Escape and SBM treatments (Table 2). All supplement treatments were balanced to supply equal daily amounts of calcium, phosphorus, potassium, and sulfur exceeding NRC (1984) requirements. They were gathered every morning, sorted into treatment groups and bunk fed their respective supplements in pellet form (3/8 inch diameter). Cows were grazed on a native pasture composed primarily of western wheatgrass.

Ninety-six and 103 cows were used in the study in the spring of 1991 and 1992. First calf heifers and cows were bred to either Angus or Simmental bulls to begin calving on February 15 and March 15 respectively. Within 7 to 14 days of calving, cows were allotted by age of cow, calving date, and sex of calf. Initial cow weights were taken in the morning after overnight removal from feed and water. Weights taken in early April and mid-May were the averages of weights taken in the morning after two consecutive days after overnight removal from feed and water. Condition scores (1 to 9, 1 = extremely emaciated) were assigned by two trained technicians in early April and mid May.

Blood samples were taken via jugular venipuncture 10 days apart in early May and early June to determine the number of cows cycling. Blood samples were analyzed for serum progesterone levels by radioimmunoassay. Cows having serum progesterone levels greater than 1 ng/ml were considered cycling. The breeding season began on June 6 with 6 days of estrus detection and artificial insemination. Remaining cows were then injected with prostaglandin. Estrus detection and artificial insemination continued for 6 more days. Cows were than exposed to bulls for 48 days.

Table 2. Composition of daily supplemental intake per cow

	Escape	SBM	Corn
	First Year		
Dry matter, lb	3.03	3.19	3.13
Crude protein, lb	1.34	1.35	.24
Rumen undegradable protein, lb[a]	.92	.42	.17
NE_m, Mcal[b]	2.72	2.82	2.76
Calcium, lb	.06	.05	.04
Phosphorus, lb	.05	.05	.04
Potassium, lb	.06	.08	.07
	Second Year		
Dry matter, lb	2.72	2.91	2.85
Crude protein, lb	1.35	1.35	.26
Rumen undegradable protein, lb[a]	.82	.38	.15
NE_m, Mcal[b]	2.44	2.79	2.74
Calcium, lb	.05	.05	.05
Phosphorus, lb	.05	.05	.05
Potassium, lb	.06	.07	.07

[a] Calculated from NRC Ruminant Nitrogen Usage (1985) values.
[b] Calculated from NRC (1984) values.

Conception date was calculated from calving date the following year, assuming a 283-day gestation period. Cow cycling rate and pregnancy rate were analyzed by the Chi-square analysis of SAS. Other performance data was analyzed by the GLM procedure of SAS with treatment means separated by the PDIFF option.

Results and Discussion

Cows supplemented with Corn lost more weight ($P<.05$) than cows supplemented with SBM (Table 3). The Escape supplement did not improve weight gains over the SBM treatment. Cow body condition scores and milk production as reflected by calf weight gains and weaning weights (year 1) were not affected by supplement treatment. Supplement treatment did not affect pregnancy rate, conception date or the percentage of cows cycling in early May and early June or during the first 12 days of the breeding season (Table 3). Based on cow weight change, protein seems to be limiting for lactating beef cows grazing native range in the spring. Contrary to other reported research, feeding an escape protein provided no additional benefit in cow weight gains or improvement in percentage of cows cycling or other measures of reproductive performance for lactating beef cows grazing native range in the spring.

Table 3. Cow and calf performance[a]

	Escape		SBM		Corn	
Initial weight, lb	1000	(17.0)	972	(17.6)	988	(15.3)
Cow average daily gain, lb/day						
Calving to mid-May	-.08[bc]	(.17)	.04[c]	(.18)	-.35[b]	(.15)
Initial condition score	4.6	(.08)	4.5	(.09)	4.6	(.08)
Condition score change	.2	(.08)	.2	(.08)	.1	(.07)
	Reproductive Performance (Year 1)					
Number of cows	30		34		33	
Cows cycling in May, %	26.7		35.3		21.2	
Cows cycling in June, %	73.3		82.4		72.7	
Cows artificially inseminated, %	83.3		76.5		87.9	
Cows pregnant, %	96.7		94.1		90.9	
Conception date	June 19 (2.3)		June 18 (2.6)		June 20 (2.0)	
	Reproductive Performance (Year 2)					
Number of cows	34		35		34	
Cows cycling in May, %	29.4		34.3		38.2	
Cows cycling in June, %	55.9		68.6		67.7	
Cows artificially inseminated, %	61.8		65.7		61.8	
Calf average daily gain, lb/day						
Birth to mid-May	2.0	(.07)	1.9	(.07)	1.9	(.06)
Weaning weight, lb[d]	572	(10.7)	574	(13.0)	567	(9.1)

[a] Least squares means followed by standard errors.
[b,c] Means within a row with uncommon superscripts differ (P<.05).
[d] Data from first year only.

BREEDING SYSTEM EFFECTS ON PRODUCTION EFFICIENCY THROUGH WEANING-PRELIMINARY RESULTS

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Summary

Preliminary results are presented on production efficiency for a comparison of two-breed rotational crossbreeding to the terminal phase of a rotational-terminal combination system with Charolais as the terminal sire breed. The breeding system comparisons were made within each of three types of dam: Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford. The two breeding systems had similar average values for dam size, condition score, and feed ME through weaning. Results indicate an increase for terminal matings compared to rotational matings in terms of weaning weight and efficiency ratio (calf weaning weight/dam and calf feed ME) within the Angus x Hereford group, while the effect of breeding system was nonsignificant within the other two dam types.

(Key Words: Beef Cattle, Breeding System, Production Efficiency.)

Introduction

Crossbreeding allows the potential for 1) making quick and dramatic genetic change within a herd, 2) utilization of heterosis, and 3) genetic complementarity. Rotational crossbreeding systems take advantage of heterosis and have the desirable feature of producing replacement females within the system. In herds that are large enough to support an additional breeding group, a terminal mating phase can be invoked in addition to the rotation. Such rotational-terminal combination systems are sometimes called rotaterminal systems. Replacement females are retained from the rotational phase but not from the terminal phase of the rotaterminal system. Terminal matings have the most potential for genetic complementarity by allowing the use of specialized breed types. That is, the genetic makeup of dams can include breeds that excel in maternal traits, while the sire excels in growth and carcass traits.

To justify the additional complications required to maintain a rotaterminal breeding system compared to a rotational system, there must be an improvement in performance to weaning or a premium on the price of feeder calves based on expected improved feedlot performance or carcass value. Two-breed rotations have been developed and maintained for a number of years in the SDSU beef breeding research herd. A terminal phase has been added in recent years. An adequate evaluation of breeding systems requires that the cow-calf, postweaning-feedlot, and carcass-packing segments of production are included. The objective of the present paper is to present preliminary information on the comparison of rotational versus terminal matings for cow-calf production in a drylot management system. Postweaning and carcass information will be presented in the future as it becomes available.

Materials and Methods

Three different two-breed rotations--Simmental x Hereford, Angus x Hereford, and Tarentaise x Hereford--have been developed at the Antelope Range Livestock Station in northwestern South Dakota. [Note: Hereford and Polled Hereford are referred to interchangeably. The breed composition of many cows in this herd include both types.] Within a two-breed rotation, cows of low percentage Hereford are mated to Polled Hereford bulls, while cows of high percentage Hereford are mated to the bulls of the other breed used in the

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rotation. In other words, the cow is mated to a bull of the breed other than that of her own sire.

For the present study, a portion of the dams continue to be mated within their respective rotation, while another portion have been mated to Charolais bulls in a terminal cross. The full array of matings are shown in Table 1. The Simmental x Hereford and Angus x Hereford rotations have been in place a number of years, so that there are no longer any first-cross (F1) cows remaining. The Tarentaise x Hereford rotation was established more recently, and includes a number of F1 cows. For purposes of analyses in this paper, the F1 cows have been grouped with the Tarentaise x Hereford cows of low percentage Hereford.

A sample of cows from each mating type were transported to a drylot in Brookings with facilities for feeding cows individually. Cows entered the drylot study one week after weaning in October, 1990, and remained there through weaning in October, 1991. Calves were born primarily in March and April. A total of 64 cow-calf pairs completed the 360-day test.

Initial feed levels offered to cows were based on NRC (1984) guidelines, and so initial differences between cows varied with cow weight. Cow weights and visual condition scores were monitored at 4-week intervals. Feed levels were adjusted at 4-week intervals in an attempt to minimize differences in condition score among cows, with a target score of 5 to 6 on a scale of 1 through 9. The cow precalving diet consisted of chopped hay and pelleted hay, while corn grain was added during lactation. The metabolizable energy (ME) content of each feedstuff was estimated from NRC (1984). Cumulative ME was calculated for nonlactation and lactation, and then calving date was included in the statistical model. Therefore, the values for nonlactating ME and lactating ME are adjusted to the overall average lengths of those respective periods (158 and 202 days for nonlactation and lactation, respectively). Calf weaning weight and efficiency ratio (calf weaning weight/dam and calf feed ME) are also adjusted to the overall average calf weaning age.

Table 1. Sire and dam breeds used in rotational and terminal matings

Dam breed[a]	Sire breed: Rotational	Sire breed: Terminal
SHS	Polled Hereford	Charolais
HSH	Simmental	Charolais
AHA	Polled Hereford	Charolais
HAH	Angus	Charolais
THT	Polled Hereford	Charolais
HTH	Tarentaise	Charolais

[a] SHS = Simmental x Hereford dams sired by Simmental, HSH = Simmental x Hereford dams sired by Polled Hereford, AHA = Angus x Hereford dams sired by Angus, HAH = Angus x Hereford dams sired by Polled Hereford, THT = Tarentaise x Hereford dams sired by Tarentaise, and HTH = Tarentaise x Hereford dams sired by Polled Hereford.

Results and Discussion

The objective of the present paper is to compare rotational versus terminal matings for each of the three dam types. Differences between rotational versus terminal matings reflect 1) differences in additive genetic effects of Charolais versus the two breeds in the dam rotation, and 2) additional individual heterosis for terminal matings compared to rotational matings. Also of interest is the extent to which rotational versus terminal comparisons vary across dam types (i.e., dam type x breeding system interaction). Discussion regarding dam type as a main effect, while of interest, will be limited in this paper.

Average levels of performance are presented by dam type and breeding system in Table 2. The breeding system comparison was not significant for any of the measures of dam size, condition score, or feed ME. When averaged across dam types, calf birth weights were 11.3 lb heavier in terminal matings than in rotational matings. The difference was especially large for the Angus x Hereford group (17.4 lb). No significant difference in calving difficulty between breeding systems was observed among these cows which ranged from five to ten years of age.

The dam type x breeding system interaction was significant only for calf weaning weight and the efficiency ratio. The Angus x Hereford group seemed to benefit most from the terminal breeding phase. Average weaning weight and efficiency ratio were significantly higher for terminal matings than for rotational matings within the Angus x Hereford group, while the breeding system comparison was nonsignificant for the other two dam types.

These results should be regarded as preliminary in two respects. First, a second set of animals (1992 calf crop) are currently under evaluation to provide additional observations for the data set. Secondly, calf postweaning feedlot performance and carcass traits will be evaluated on both calf crops. This additional information should provide a more comprehensive evaluation of breeding system effects on total system efficiency. It should also be noted that reproductive performance was not evaluated for this paper.

It should be noted that only mature cows were evaluated in this study. The large effect of terminal matings on birth weight within the Angus x Hereford group, and to a lessor extent within Tarentaise x Hereford, illustrates the need for caution regarding bull type when consideration is given to dam age. The impact of larger calf birth weights on calving difficulty is likely to be much greater in first-calf heifers in particular. In this particular herd, presently heifers are bred to Angus or Red Angus bulls with low predicted genetic values for birth weight. Females are not exposed to terminal-sire matings until their second breeding year or later.

Table 2. Average performance in drylot by dam type and breeding system

Dam type	Simmental x Hereford			Angus x Hereford			Tarentaise x Hereford			Avg SE	Avg difference Ter-Rot
Breeding system[a]	Rot	Ter	Diff.	Rot	Ter	Diff.	Rot	Ter	Diff.		
Number dam-calf pairs	7	13		9	13		14	8			
<u>Dam traits</u>											
Avg precalving wt, lb	1264	1290	ns	1265	1242	ns	1165	1178	ns	30.9	5.8
Avg lactating wt, lb	1203	1224	ns	1226	1173	ns	1129	1131	ns	30.6	-10.1
Overall avg wt, lb	1226	1249	ns	1241	1198	ns	1143	1148	ns	30.5	-5.2
Avg precalving condition score[b]	4.8	5.0	ns	5.4	5.6	ns	4.9	4.9	ns	.165	.11
Avg lactating condition score[b]	4.5	4.7	ns	5.6	5.5	ns	4.8	4.8	ns	.162	.03
Overall avg condition score[b]	4.6	4.8	ns	5.5	5.5	ns	4.9	4.8	ns	.158	.07
Precalving ME, Mcal	2879	2902	ns	2810	2774	ns	2699	2747	ns	49.5	12.0
Lactating ME, Mcal	5912	5885	ns	5468	5444	ns	5626	5672	ns	79.4	-1.6
Total cow ME, Mcal	8791	8787	ns	8278	8219	ns	8325	8419	ns	118.8	10.2
<u>Calf traits</u>											
Birth wt, lb	104.8	111.7	ns	93.5	110.9	**	100.5	110.0	+	3.82	11.3**
Creep ME, Mcal	335.1	339.9	ns	358.0	365.9	ns	351.5	342.0	ns	25.0	1.1
Weaning wt, lb	556.6	558.7	ns	472.5	531.2	**	542.8	541.4	ns	14.7	19.7
<u>Dam-calf traits</u>											
Total ME, Mcal	9125	9127	ns	8636	8583	ns	8674	8754	ns	120.2	9.4
Calf weaning wt/total ME, lb/Mcal	.0609	.0612	ns	.0546	.0620	**	.0619	.0625	ns	.00157	.0028*

[a] Rot = two-breed rotation; Ter = rotaterminal system with two-breed rotational cows mated to Charolais bulls.

[b] Based on a scale of 1 (thinnest) through 9 (fattest).

[ns] Nonsignificant, +P<.10, *P<.05, **P<.01.

IMPLANT COMBINATIONS AND REIMPLANTING STRATEGIES FOR YEARLING STEERS FED HIGH CONCENTRATE DIETS

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Summary

Crossbred yearling steers were used to determine the relative efficacy of specific anabolic implant combinations and sequences on feedlot performance and carcass traits. Steers were fed a high concentrate finishing diet for 112 days. Implanting was done on days 1 and 42 of the feeding period. Implanting improved ($P<.05$) average daily gain (ADG) 22% and feed efficiency 15%. Implant treatment generally increased dry matter intake. Implanting increased ($P<.05$) the rib eye area of carcasses 6.5% and tended to cause a reduction in percentage choice carcasses. The percentage of abscessed implants ranged from <1% to 10%, depending on the type of implant used even though implant needles were disinfected between each use.

(Key Words: Implants, Steers, Feedlot.)

Introduction

The additive effects of trenbolone acetate and estradiol based implants have created many options for implanting feedlot cattle. The combination, sequences, and timing of implant use that produce optimum results are unclear. The implant strategies that will maximize performance will significantly reduce quality grades of beef carcasses. Carcass quality grade is highest in nonimplanted cattle, but production efficiencies are low.

We know that reimplant programs improve gains over a 120-day feeding period. There is also substantial evidence that implanting within 60 days of slaughter lowers quality grades. As a compromise between these two concerns, it may be beneficial to reimplant 120-day cattle after 40 days on feed. The general classes of implants available to use in these situations are estradiol, zeralonone and trenbolone acetate. This study was designed to determine whether specific implant combinations and sequences of use would be more suitable as an optimum program in yearling steers.

Materials and Methods

Crossbred yearling steers (262 head) were assembled during late April and May of 1991. As groups of steers arrived, they were ear tagged and treated for parasites with Levamisole[4] and XPAR[4] according to label directions. The receiving diet was 50% wheat straw and 50% ground hay. A pelleted protein supplement (44% crude protein) containing 9,900 IU vitamin A per pound was fed at a rate of 1 lb per head per day.

Initial weights were taken on two consecutive days. Intake was restricted to 10 lb of receiving diet, and water was withheld after 5 p.m. the day before each initial weight determination. Allotment to pen and treatment was based on the first weight taken such that breed type and weight were balanced across 30 pens of 8 head each. Implants were administered when the second initial weight was measured.

An abrupt switch to the finishing diet (Table 1) occurred on the day of the second initial weight determination. During the first week, dry matter intake

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Table 1. Finishing diets

Item	Percentage[a]
Hay	10.00
Whole shelled corn[b]	41.34
High moisture corn	41.34
Liquid supplement[c]	3.59
Soybean meal, 44%[d]	3.28
Calcium carbonate	.18
Potassium chloride	.27

[a] Percentage dry matter basis.
[b] Decreased to 40.340% after 77 days.
[c] Contained the following (DMB) DM 70%, CP 28.5%, Ca 10.1%, P 1.0%, K 4.4%, NaCl 11.15%, vitamin A 51,865 IU/lb, vitamin D 12,965 IU/lb, vitamin E 27 IU/lb, and monensin 730 g/T.
[d] Increased to 4.28% after 77 days.

was started at 14.4 pounds per head per day which is slightly above maintenance. Intake was increased every third day until cattle were fed to appetite. Appetite was established based on morning bunk conditions. Steers were fed once daily starting at 7 a.m. except on weigh days, when feeding started at 9 a.m.

Implant treatments each applied to five pens (40 head) included the following:

Treatment	Day 0	Day 42
1	0	0
2	Synovex-S[5]	Synovex-S + Finaplix-S[6]
3	36 mg Ralgro[4]	Synovex-S + Finaplix-S
4	36 mg Ralgro	36 mg Ralgro + Finaplix-S
5	36 mg Ralgro	72 mg Ralgro + Finaplix-S
6	72 mg Ralgro	72 mg Ralgro + Finaplix-S

Implant integrity was determined 28 days after each implanting. Exudative implant sites were exposed and swabbed for microbial culture. Culture work was done by Dr. D. W. Miskimmins of the SDSU Animal Disease and Diagnostic Laboratory. Implant sites were scored as 0 = no reaction, 1 = some firm swelling, 2 = warm, swollen, soft, 3 = draining abscess, and 4 = scarring or other evidence of previous drainage.

Feed deliveries were monitored daily. Diet ingredients were subjected to chemical analysis weekly. The crude protein content of corn and hay declined during the course of the study. To raise dietary crude protein, soybean meal (1%) was substituted for an equal amount of dietary dry whole shelled corn. Diet composition prior to and after 78 days is shown in Table 2.

Table 2. Diet analysis[a]

Item	Days 1 to 77	Days 78 to 112
Dry matter, %	83.7 $\pm$ .22	81.0 $\pm$ .10
Crude protein, %	11.5 $\pm$ .19	11.6 $\pm$ .08
NDF, %	14.8 $\pm$ .08	15.5 $\pm$ .05
ADF, %	6.6 $\pm$ .09	7.1 $\pm$ .07
Ash, %	3.4 $\pm$ .09	3.2 $\pm$ .07

[a] All values except dry matter on DM basis.

[5] Syntex Corporation, Des Moines, IA.
[6] Hoechst Roussel, Somerville, NJ.

Steers were weighed in the morning after 28, 42, 98, 111, and 112 days on feed. Water was withheld for 12 hours prior to weighing on day 42. Intake was restricted to 50% of ad libitum and water was withheld for 12 hours the day prior to the 111- and 112-day weights. These weights (days 111 and 112) were used as final weights.

After the day 112 weights, steers were fed similarly to the previous 2 days. After feed was cleaned up, steers were shipped 70 miles to IBP, Luverne, MN, where they stood overnight with access to water. Overall transit shrink was 2.6% of final weights and was used to calculate cumulative performance data. Steers were slaughtered the next morning after shipment. Hot carcass weight was recorded. Twenty-four hours after slaughter, carcasses were available for grading. Rib eye area and rib fat were measured. The federal grader on duty estimated percent kidney, pelvic and heart fat and identified marbling to the nearest one-third marbling score. One grader made all subjective estimates. Carcasses were presented to the grader in a completely random sequence.

The data were statistically evaluated using procedures for a completely random design. Mean separations were accomplished using Duncan's New Multiple Range Test as an option in the GLM procedure of SAS. Percentage choice data were tested by Chi square analysis. No specific treatment contrasts for percentage choice were made. One individual was identified as a heifer and removed form the study on day 2. Two carcasses were missed during measurements of rib fat thickness and rib eye area. The experimental units for feedlot performance and carcass data were pen means and individual carcasses, respectively.

Results and Discussion

The original intent was to evaluate implant combinations and reimplant programs for steers requiring 120 days on feed. The excellent steer performance caused us to reduce time on feed to 112 days. Implanting increased ($P<.001$) cumulative ADG over controls by 22% (Table 3). Among groups receiving implants, the variation in cumulative ADG was only 5% from lowest to highest mean value. No differences in ADG were detected.

Some treatment differences in steer performance occurred that cannot be explained. These differences occurred between treatments 3, 4, and 5 which all received the same implant treatment during the initial 42-day feeding period. Through 42 days, steers in treatment 5 had lower ADG than steers in treatments 3 and 4, although they were treated similarly. Gain during the following 70 days was similar among all implanted groups. Reviewing individual steer performance, there were no obvious problems to explain this response. Steers on treatment 4 tended to consume more feed than steers on treatments 3 and 5 in each phase of the study.

Carcass weights and fat thicknesses were appropriate for today's market standards (Table 4). Implanting increased ($P<.001$) carcass weight. Fat thickness differed ($P<.05$) among treatments, but no relationship to implants used could be identified. Rib eye area increased ($P<.001$) with implanting as would be expected. Marbling scores were lower ($P<.05$) for treatment 5 which was the group that tended to have lower ADG. The 62.5% choice for control cattle is typical for the mixed, colored steers used in this study. Chi square analysis indicated no differences in percentage choice due to implanting, but all implanted groups had numerically fewer choice cattle than the controls. There was an 70-day time span from last implanting to slaughter and still a 10 point decline in percentage choice carcasses in implanted treatments was observed. This reduction in percentage choice has been consistent across our studies in recent years.

The incidence of abnormal implant sites is noted in Table 5. These data should be reviewed with the knowledge that implant needles were disinfected between each use. Chi square analysis indicates that there were treatment effects at day 28 ($P<.10$) and day 70 ($P<.05$), although the high frequency of zero observations may make the test invalid. There was a 10% abscess rate for Finaplix-S and 5% for 72 mg Ralgro implants. Synovex and 36 mg Ralgro abscess problems were nominal. Cultures were obtainable from Synovex and Finaplix implant sites. *Actinomyces pyrogenes* was the most commonly identified organism in these sites (Table 6).

Table 3. Feedlot performance responses to implant treatments

Treatment	1	2	3	4	5	6	
Day 0 implant	Control	SYN	36 mg	36 mg	36 mg	72 mg	
Day 42 implant	Control	SYN/FIN	SYN/FIN	36/FIN	72/FIN	72/FIN	SEM
Initial weight	742	741	744	744	745	741	2.1
Day 1 to 42							
Weight (day 42)	901^{a}	904^{ab}	917^{ab}	924^{b}	898^{a}	909^{ab}	6.1
ADG	3.80^{ab}	3.88^{abc}	4.13^{bc}	4.27^{c}	3.65^{a}	4.01^{abc}	.138
DMI	18.75^{ab}	18.24^{a}	18.90^{ab}	19.55^{b}	18.25^{a}	18.72^{ab}	.340
F/G	4.94^{ab}	4.73^{ab}	4.59^{a}	4.58^{a}	5.04^{b}	4.68^{ab}	.116
Day 43 to 112							
Weight (day 112)	1106^{a}	1181^{b}	1193^{b}	1192^{b}	1172^{b}	1185^{b}	9.6
ADG	2.56^{a}	3.46^{b}	3.44^{b}	3.35^{b}	3.42^{b}	3.45^{b}	.120
DMI	21.24^{a}	22.39^{b}	22.48^{bc}	23.44^{c}	22.56^{bc}	22.52^{bc}	.309
F/G	8.33^{a}	6.49^{b}	6.56^{b}	7.00^{b}	6.63^{b}	6.56^{b}	.210
Day 1 to 112							
Weight[a]	1077^{a}	1151^{b}	1162^{b}	1161^{b}	1141^{b}	1154^{b}	9.4
ADG	3.00^{a}	3.65^{b}	3.73^{b}	3.72^{b}	3.54^{b}	3.69^{b}	.086
DMI	22.20^{a}	22.83^{ab}	23.14^{b}	24.07^{c}	22.96^{ab}	23.11^{b}	.259
F/G	7.42^{a}	6.27^{b}	6.22^{b}	6.47^{b}	6.49^{b}	6.27^{b}	.134

[a] Based on 2.6% final weight shrink.
[b,c] Means without common superscripts differ ($P<.05$).

Table 4. Effect of implant treatment on carcass traits

Treatment	1	2	3	4	5	6	SEM
Carcass wt, lb	672^{b}	715^{c}	727^{c}	724^{c}	713^{c}	719^{c}	7.69
Dressing percent	62.5	62.2	62.6	62.4	62.5	62.3	.214
Rib fat, in.	.46^{bc}	.43^{bc}	.40^{b}	.45^{bc}	.40^{b}	.48^{c}	.022
Rib eye area, $in.^2$	11.84^{b}	12.54^{c}	12.87^{c}	12.45^{c}	12.87^{c}	12.33^{bc}	.178
KPH	1.80	1.65	1.63	1.68	1.63	1.71	.070
Yield grade	2.77^{b}	2.61^{bc}	2.46^{c}	2.74^{b}	2.42^{c}	2.82^{b}	.091
Marbling score[a]	4.75^{c}	4.50^{bc}	4.44^{bc}	4.56^{bc}	4.35^{b}	4.50^{bc}	.109
Choice, %	62.5	47.5	50.0	52.5	45.0	53.9	

[a] 4.00 = Slight^{o}, 5.00 = Small^{o}.
[b,c] Means without common superscripts differ ($P<.05$).
[d] Increased to 4.28% after 77 days.

Table 5. Implant score frequencies by type of implant[a]

	Implant			
Score	35 mg Ralgro	72 mg Ralgro	Synovex-S	Finaplix-S
Day 28				
0	119	36	38	-
1	0	1	0	-
2	1	2	0	-
3	0	0	0	-
4	0	0	2	-
Day 70				
0	40	74	79	178
1	0	4	0	17
2	0	0	1	3
3	0	0	0	0
4	0	0	0	0

[a] One steer in treatment 5, 72 mg + Finaplix, was diagnosed as unimplanted at day 70.

Table 6. Microbial cultures of infected implant sites

Calf	Implant	Organism
557	Finaplix-S	*Actinomyces pyrogenes*
442	Finaplix-S	*Actinomyces pyrogenes*
662	Finaplix-S	α *hemolytic streptococci*
570	Synovex-S	*Actinomyces pyrogenes*
579	Synovex-S	*Actinomyces pyrogenes*
540	Synovex-S	*Staphylococcus aureus*

No definitive differences between implant combinations and reimplanting strategies were evident from these data. Each implant treatment used lowered production costs compared to feeding nonimplanted cattle. We have known for many years that implants reduce marbling in beef carcasses and that response appears in this data set. Larger data sets will be necessary to determine if specific implant strategies will have a lesser negative effect on carcass quality than other strategies.

COMBINATION OF SYNOVEX-S[1] AND FINAPLIX-S[2] FOR YEARLING STEERS

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CATTLE 92-8

Summary

Two hundred seventy-seven crossbred yearling steers (719 lb) were utilized in a 3-year study to determine the effect of combinations of Synovex-S and Finaplix-S on daily gain and carcass merit. Treatments included no implant (C), implanted with Synovex-S on day 1 and Synovex-S on about day 60 (SS), and implanted with Synovex-S on day 1 and the combination of Synovex-S and Finaplix-S on about day 60 (SSF). In year 1, all steers were slaughtered after 124 days on feed. In year 2, steers were slaughtered after 120, 134, or 148 days on feed. In year 3, steers were slaughtered after 121, 140, or 156 days on feed. Implanting increased ($P<.001$) average daily gain by 19.9% (4.00 vs 3.34 lb per head daily). Cattle implanted with the combination of Synovex-S and Finaplix-S gained weight more rapidly ($P<.05$) than cattle implanted only with Synovex-S (4.08 vs 3.93 lb per head daily). Implanted steers had heavier ($P<.01$) hot carcass weights, larger rib eye areas ($P<.01$), lower ($P<.05$) marbling scores, and more ($P<.01$) fat over the 12th rib than nonimplanted steers. There were no significant differences in any of the carcass traits between implants. Percentage choice carcasses were 76.6, 73.0, and 75.2 for the C, SS, and SSF treatments, respectively. One time use of the combination of Finaplix-S and Synovex-S with a minimum of 60 days prior to slaughter did not reduce carcass marbling score or quality grade.

(Key Words: Estradiol, Trenbolone Acetate, Steers, Carcass Quality.)

Introduction

Finaplix-S was approved for use in feedlot steers in 1987. When used as the sole implant, performance appears to be increased slightly as compared to nonimplanted controls. Using Finaplix-S in combination with an estrogenic implant has resulted in significant improvements in performance of feedlot cattle and has become a common practice in the commercial cattle feeding industry.

Several reports have indicated that the percentage of cattle grading choice is reduced when the combination of Finaplix-S and an estrogenic implant is used. Depending upon when and how the cattle are sold, reduced propensity to grade choice would have serious economic consequences for cattle feeders. It has been proposed that the negative effects of Finaplix-S on quality grade can be lessened if the combination is administered once with 60 to 90 days prior to slaughter.

The objective of this research was to investigate the effect of Finaplix-S in combination with Synovex-S on average daily gain and carcass merit in yearling steers.

Materials and Methods

Crossbred yearling steers that had been grazing summer pastures at the Range and Livestock Research Station located near Philip, SD, were used in a 3-year study to investigate the impact of Finaplix-S in combination with Synovex-S on feedlot average daily gain and carcass merit. Treatments used included a

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[1]Product of Syntex Animal Health, West Des Moines, IA.
[2]Product of Hoescht Roussel, Sommerville, NJ.
[3]Associate Professor.

nonimplant negative control (C), implanted with Synovex-S on day 1 and approximately day 60 (SS), and Synovex-S on day 1 and the combination of Synovex-S and Finaplix-S on approximately day 60 (SSF). Table 1 displays the treatments and numbers of cattle used in each year of the study.

Data from 1989 and 1990 appeared in previous issues of this report (CATTLE 90-10 and 91-15, respectively). Details of how the studies were completed and how the data were collected for the first 2 years of the study may be found in those reports. In year 3 of the study, 133 steers were transported to a commercial feedlot[4] located near Kimball, SD, and weighed and processed following overnight withdrawal of feed and water. All cattle were then fed in a common pen. Diets fed to the steers are shown in Table 2. Steers were adjusted to the finishing diet by feeding diet 1 for 10 days and diet 2 for 7 days.

Table 1. Number of observations for each implant treatment

	Number of cattle			
Treatment	1989	1990	1991	Total
Control	17	30	45	93
Synovex-Synovex	18	30	45	93
Synovex-combination	18	30	43	91

Table 2. Composition of diets fed to steers in year 3

	Diet		
Ingredient[a]	1	2	Finish
Cracked corn	33.15	43.92	68.78
Alfalfa hay	9.00	3.00	-
Mixed silage[b]	54.21	49.11	26.37
Mineral supplement	.19	.19	.19
Supplement[c]	3.45	3.78	4.66
Nutrient composition[d]			
Dry matter, %	57.59	60.07	71.74
Crude protein, %	12.79	12.33	12.40
Calcium, %	.76	.64	.55
Phosphorus, %	.35	.36	.37
NE_m, Mcal/cwt	82.98	88.18	94.59
NE_g, Mcal/cwt	51.00	56.00	62.23

[a] Percentage as fed.
[b] Approximate composition: Corn 33.33%, cane 33.33%, and alfalfa 33.33%.
[c] Sup-R-Lix, Purina Mills, Inc., St. Louis, MO.
[d] Dry matter basis.

[4] R and L Feedyard, Kimball, SD.

Approximately 15 randomly selected steers from each treatment were slaughtered after 121, 140, or 156 days on feed. Days on feed were 124 for all steers in year 1 and 120, 134, or 148 in year 2. Final weight used to compute performance data was calculated by dividing hot carcass weight by the mean dressing percentage for each slaughter date. Carcass data were collected 24 hours postslaughter. The USDA grader called marbling scores and estimated kidney, heart and pelvic fat. Rib fat was measured with a steel probe and rib eye area was measured with a grid. Carcass regrades were not considered in the analysis.

Data were analyzed according to analysis of variance procedures for a completely randomized design. Data from years 2 and 3, that included multiple slaughter dates, were used to test for treatment x day and treatment x day x year interactions. These were not significant. Consequently, data from all 3 years were pooled for the final analysis of variance. Differences in percentage choice carcasses were tested by Chi-square analysis procedures. Means were separated using orthogonal contrasts. Comparisons of interest were (1) C vs SS and SSF and (2) SS vs SSF.

Results and Discussion

Table 3 shows average daily gain and the initial and final weights for the steers. Implanting improved ($P<.001$) average daily gain (3.93 and 4.08 vs 3.34 lb per head daily for SS and SSF vs C, respectively). Steers implanted with SSF gained faster ($P<.05$) than steers implanted with SS (4.08 vs 3.93 lb per head daily).

Table 4 shows carcass data for steers. Implanting increased ($P<.01$) hot carcass weight (HCW), fat thickness, and rib eye area. However, if rib eye area is expressed on a per cwt of carcass basis, no increase in muscularity was apparent. Implanting also reduced ($P<.05$) marbling score by 3.2%. This reduction did not correspond to a significant reduction in the percentage choice carcasses. Approximately 75% of the steers on all treatments graded choice. There were no differences detected for any carcass traits between the SS and SSF treatments.

Analysis of these data showed that each day on feed corresponded to .0064 units of marbling ($P<.05$) and that marbling scores were .175 units lower for implanted cattle. We can, therefore, estimate that 27 additional days on feed would be required for implanted cattle to achieve similar marbling scores as nonimplanted cattle. Each day on feed resulted in a 1.6976 lb increase in hot carcass ($P<.0001$). Implanted steers fed for an additional 27 days would be projected to produce carcasses that are 46 lb heavier at a similar marbling score. On a live basis, cattle would have to be about 74 lb heavier, assuming a 62.5% yield.

Finaplix-S used in combination with Synovex-S can improve average daily gain without depressing carcass quality grade when compared to using only Synovex-S. These steers were implanted only once with the combination and 60 to 96 days remained between implanting and slaughter. Proper use of these products can enhance feedlot profitability.

Table 3. Effect of implant combination on weight gain

	Treatment		
Item	Control	Synovex	Combination
Initial wt, lb	788	794	790
Final wt, lb[a]	1238	1321	1336
Avg daily gain, lb/head[ab]	3.34	3.93	4.08

[a] Implant vs control ($P<.001$).
[b] Synovex vs combination ($P<.05$).

Table 4. Effect of implant combination on carcass characteristics

	Treatment		
Item	Control	Synovex	Combination
Hot carcass wt, lb[a]	772	824	833
Fat thickness, in.[a]	.47	.53	.56
Rib eye area, in,^{2}[a]	12.80	13.36	13.54
Muscling[b]	1.66	1.63	1.63
Yield grade	3.03	3.16	3.23
Marbling score[c]	5.43	5.28	5.23
Percent choice	76.6	73.0	75.2

[a] Implant vs control ($P<.01$).
[b] Rib eye area + hot carcass weight (cwt).
[c] Implant vs control ($P<.05$).

OPTIMUM MONENSIN LEVELS IN RECEIVING DIETS FOR NEWLY WEANED CALVES

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CATTLE 92-9

Summary

This research addressed the effects of dietary monensin on the performance and health of steer calves weaned and shipped directly to the feedlot. Feedlot receiving diets were based on corn silage and contained 0, 10, 20, or 30 g/ton monensin. Calves were allowed ad libitum access to feed for 85 days to determine the effects of monensin level on dry matter intake, average daily gain, and fecal shedding of coccidia oocysts. Higher levels of monensin caused decreases ($P<.05$) in dry matter intake during the initial feeding period. Gains were not affected by monensin during this period and as a result feed efficiency was improved ($P<.05$) when diets contained 20 or 30 g of monensin per ton. Cumulative 85-day feedlot performance was not affected by treatment. Over 90% of all calves were shedding coccidia oocyst when they arrived in the feedlot. The number of calves shedding oocysts was consistently reduced by monensin after 18 days postweaning.

(Key Words: Calves, Monensin, Coccidiosis.)

Introduction

Coccidiosis infection is prevalent in feedlot cattle and left uncontrolled can be a costly disorder reducing feedlot performance and calf resistance to secondary infection. Several products are available to feedlot operators for the control of coccidia. Decoquinate, Amprolium, sulfa drugs, and ionophores can be used in effective control/treatment programs. These are chemically distinct compounds. Suggested uses and label clearances vary significantly.

Ionophores are the one class of compounds mentioned above that are typically used throughout the feeding period to improve feed efficiency and average daily gain. If they can be used to control coccidia in the initial feedlot receiving period, feed management (especially supplements) could be simplified. The ionophore monensin is approved as a coccidiostat and may contribute in this scenario. The concern is that dietary levels of monensin high enough to inhibit coccidia may adversely affect feed intake and gains unless a low dosage adaptation period is followed. Feeding low levels of monensin during adaptation is probably not an effective dosage to control coccidia.

Newly weaned and shipped feeder calves typically consume limited amounts of feed (<1.5% body weight) during the first week in the feedlot. If monensin was included in this feed at 20 g per ton, the average daily monensin during the first week would be 150 mg for 500-lb calves. This would be a suitable dosage to use for adaptation to the monensin. In this scenario calves are adapting to the feedlot and monensin simultaneously. If adaptation to monensin is a function of its concentration rather than the daily dosage, unacceptably low feed intakes may occur. This experiment was designed to evaluate the effect of monensin dosage when fed on a gram per ton basis on dry matter intake and coccidia oocyst shedding in newly received feeder calves.

Materials and Methods

On November 5, 1991, 269 steer calves were weaned from cows in western South Dakota and shipped approximately 375 miles to the SDSU research feedlot at Brookings. Calves were unloaded at 3 a.m.

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and allowed access to hay and water until processing was started at 8 a.m. Processing included obtaining individual body weight, ear tagging, vaccination for IBR, BVD, PI_3, H. somnus, BRSV[3] and 7-way clostridia sp.[3]. All calves received Ivomec[4] as per label dosage for body weight.

After processing, 160 calves from the original group were randomly allotted to 20 pens of 8 head and allowed access to long hay, water and the control diet (Table 1). At 2 p.m., fecal samples were collected from each calf for coccidia infection screening. This fecal sample was identified as day 0. Sorting to pens and treatments was done on day 2 in the feedlot. Diets containing monensin were first fed on day 3, which was 53 hours after arrival at the feedlot. Monensin dosages were formulated to provide 0, 10, 20, or 30 grams per ton (air dry basis) in the complete diet.

Table 1. Basal receiving diet formulation

Item	% dry matter basis
Corn silage	74.94
Wheat straw	15.00
Soybean meal, 44%[a]	9.21
Limestone[a]	.55
Trace mineralized salt[ab]	.30

[a] Included as a pelleted supplement. Supplements contained 0 g/cwt, 37.2 g/cwt, 74.4 g/cwt, or 111.6 g/cwt Rumensin-60, and 8.95 x 10^5 IU/lb vitamin A.
[b] Contains 97% NaCl, .007% I, .24% Mn, .24% Fe, .05% Mg, .032% Cu, .011% Co, .032% Zn, and .5% Ca.

Initial feed deliveries were limited to 3.7 lb dry matter daily on day 1 and day 2 to avoid wasting feed. Steers were consuming 9.5 lb of feed by day 7. This slow acceptance of feed is typical in this yard when starting range calves with no previous exposure to harvested feeds. Feed ingredients were sampled weekly and analyzed for dry matter, crude protein, acid detergent fiber, neutral detergent fiber and ash content. Actual diet composition data are shown in Table 2. Monensin assays were conducted by Elanco[5].

Fecal sampling was repeated twice each week for the initial 4-week period on feed and again at 56 and 82 days. In each instance, rectal grab sampling was performed in the early afternoon. Cattle were weighed initially and after 29, 57, 85, and 86 days on test. The day 85 and 86 weights were used as final weights. To normalize fill, dry matter intake was restricted to 7.35 lb the day before each of these final weights and water was withheld for 12 hours prior to weighing.

During the course of the experiment, six steers were removed for health reasons. Respiratory virus infections were the primary cause of illness. Booster vaccinations for IBR, BVD, PI_3 and H. somnus were administered on December 11, 1991, to aid in disease control.

The statistical analyses used were appropriate for a completely random design experiment with replication. Feedlot performance was summarized using pen as the experimental unit. Individual steers were considered the experimental unit for fecal oocyst data. Means separation tests were completed by orthogonal contrast. To evaluate the level of coccidia problems, the frequency of calves shedding oocysts was tested by Chi square analysis. Fecal oocyst counts were categorized as 0, 1 to 99, 100 to 499 and 500 or greater for this analysis.

Results

The calves used in this study were on open prairie and exposed to a severe winter storm 8 days prior to weaning. They were exhausted, emaciated and showed signs of snow burn upon arrival at the feedlot. This stress undoubtedly contributed to the relatively

[3]Beecham Laboratories, Bristol, TN.
[4]MSDAGVET, Rahway, NJ.
[5]Elanco, Indianapolis, IN.

Table 2. Diet nutrient analysis[a]

Item	Treatment[b] 0	10	20	30	SEM
Dry matter	48.42	48.42	48.45	48.48	1.08
Crude protein	11.22	11.23	11.29	11.33	.037
Neutral detergent fiber	46.0	45.2	45.2	45.2	1.26
Acid detergent fiber	25.9	25.9	25.9	25.9	.65
Ash	6.31	6.33	6.33	6.33	.13

[a] All values except dry matter on dry matter basis; n = 13.
[b] Monensin, grams per ton diet, air dry basis.

high mortality (2.5%) experienced during the experiment. Historically, the receiving death loss in these calves has been <1%. The benefit of this situation was that it would tend to heighten coccidiosis problems.

Dry matter intake during the first week on feed was 1.4% body weight and could be considered typical under these conditions. Weekly dry matter intake increased steadily through 35 days and then plateaued. Monensin dosage did affect dry matter intake during the initial 3 weeks in the feedlot (Table 3). Cumulative dry matter intake during the initial 29-day period was also lower when monensin was fed (Table 4). Gains were similar during this period and efficiency of feed utilization improved accordingly. Cumulative performance variables (85 days) were not affected by monensin dosage.

No acute coccidiosis problems developed during this experiment, although over 90% of the calves were shedding oocysts upon arrival at the feedlot. Monensin reduced oocyst shedding at day 9 (P<.20), day 12 (P<.001), day 18 (P<.001), day 26 (P<.20), and day 82 (P<.05; Table 5). More monensin treated cattle were shedding oocysts on day 16 than control cattle (P<.10). This was evident only in the 10 and 30 g per ton treatments. It appears that monensin began to consistently lower oocyst shedding at day 18, which is 15 days after monensin was first fed and continued through the 82-day sampling period (Table 5). Some oocyst shedding occurred in all treatments on day 82,

Table 3. Weekly dry matter intake summary[a]

Item	Treatment[b] 0	10	20	30	SEM
1 to 7 days[c]	7.27	7.30	7.17	7.26	.172
8 to 14 days[d]	10.57	10.24	8.71	9.16	.265
15 to 21 days[c]	12.24	12.22	11.42	11.68	.288
22 to 28 day	13.26	13.45	12.97	12.85	.400
29 to 35 days	15.75	16.27	15.06	15.34	.361
36 to 42 days	15.69	15.52	15.07	15.40	.412

[a] Pounds per head per day.
[b] Monensin, grams per ton diet, air dry basis.
[c] 10 vs 20 and 30 (P<.10).
[d] Control vs others (P<.01); 10 vs 20 and 30 (P<.01).

Table 4. 85-day feedlot performance summary

Item	Treatment[a] 0	10	20	30	SEM
Initial wt, lb[bc]	501	505	508	507	1.9
Days 1 to 29					
Body weight, day 29[cd]	573	577	581	583	3.1
Avg daily gain, lb	2.50	2.46	2.52	2.68	.099
Dry matter intake, lb[cef]	10.63	10.60	9.89	10.07	.184
Feed/gain, lb[ef]	4.29	4.33	3.93	3.77	.049
Gain/feed, lb/cwt[df]	23.5	23.2	25.5	26.7	.93
Days 30 to 57					
Body weight, day 57	657	665	661	665	5.2
Avg daily gain, lb	3.01	3.15	2.85	2.91	.126
Dry matter intake, lb	16.69	16.81	15.92	16.50	.441
Feed/gain, lb	5.58	5.36	5.65	5.68	.250
Gain/feed, lb/cwt	18.06	18.76	17.87	17.74	.780
Days 1 to 85					
Body weight, day 85	680	684	685	688	5.8
Avg daily gain, lb	2.11	2.10	2.08	2.15	.066
Dry matter intake, lb	14.30	14.21	13.34	14.04	.303
Feed/gain, lb	6.84	6.78	6.41	6.54	.187
Gain/feed, lb/cwt	14.7	14.8	15.6	15.3	.43

[a] Monensin, grams per ton, air dry basis.
[b] Linear, quadratic ($P<.10$).
[c] Control vs others ($P<.05$).
[d] Linear ($P<.05$).
[e] Linear ($P<.01$).
[f] 10 vs 20 and 30 ($P<.05$).

indicating no treatment completely arrested the coccidia problem. There is insufficient information available to determine if this continued oocyst shedding is typical when feeding ionophores. The 85-day monensin intakes averaged 74, 156, and 230 mg per head which may be too low to provide complete control of coccidia organisms.

The result of this experiment should not be interpreted to mean that all calves can be started on feeds containing 30 g monensin per ton. Other research has shown that cattle consuming normal amounts of feed require an adaptation to monensin. However, range calves that do not readily consume feed upon entering the feedlot can be fed a diet containing 30 g monensin per ton. Adaptation to monensin apparently occurs nearly as rapidly as adaptation to the feedlot environment.

Table 5. Frequency of calves shedding oocysts

Sample day[b]	Oocyst[c] counts	Treatment[a] 0	10	20	30
		Percentage of calves			
0	0	3	8	3	6
	1 to 99	83	61	85	77
	100 to 499	11	18	8	17
	500 +	3	13	5	0
2	0	18	10	8	11
	1 to 99	76	73	77	76
	100 to 499	3	13	13	11
	500 +	3	5	3	3
5	0	14	10	18	9
	1 to 99	71	77	65	80
	100 to 499	11	10	18	3
	500 +	3	3	0	9
9	0	46	72	67	70
	1 to 99	51	28	31	30
	100 to 499	0	0	3	0
	500 +	3	0	0	0
12[d]	0	50	90	85	76
	1 to 99	50	10	15	14
	100 to 499	0	0	0	0
	500 +	0	0	0	0
16[e]	0	81	72	95	75
	1 to 99	19	28	5	25
	100 to 499	0	0	0	0
	500 +	0	0	0	0
18[d]	0	81	100	98	97
	1 to 99	19	0	2	3
	100 to 499	0	0	0	0
	500 +	0	0	0	0
23	0	76	93	88	92
	1 to 99	22	8	13	8
	100 to 499	0	0	0	0
	500 +	1	0	0	0
26	0	79	92	95	89
	1 to 99	21	8	5	11
	100 to 499	0	0	0	0
	500 +	0	0	0	0
54	0	84	88	98	92
	1 to 99	16	12	2	8
	100 to 499	0	0	0	0
	500 +	0	0	0	0
82[d]	0	69	81	100	89
	1 to 99	25	16	0	11
	100 to 499	2	1	0	0
	500 +	0	0	0	0

[a] Monensin, grams per ton.
[b] Days in the feedlot.
[c] Counts per gram fresh feces.
[d] $P<.05$.
[e] $P<.10$.

LIMITING INTAKE OF FINISHING DIETS BY RESTRICTING ACCESS TIME TO FEED AND THE INTERACTION WITH MONENSIN

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CATTLE 92-10

Summary

One hundred seventy-six yearling steers were randomly allotted to 16 pens and fed ad libitum or restricted amounts of finishing diets with or without monensin. Intake of the restricted cattle was limited by allowing only 6 to 7 hours access time to feed per day. All cattle were fed once daily. Monensin and restricting access time reduced feed intake by 5.6% and 7.9% (P<.01), respectively. Intake tended to be lowest for restricted cattle fed monensin (P=.13). Intake of restricted cattle as a percent of ad libitum intake varied greatly during the study. This may have contributed to the 7% reduction in daily gain of the restricted-monensin fed cattle and the fact that only nonsignificant trends toward improved feed efficiency due to intake restriction were found (P=.13). Factors affecting rate of feed intake must be considered if limited access time is to be used successfully to improve feed efficiency.

(Key Words: Yearling Steers, Limit-Feeding, Access Time, Monensin.)

Introduction

Although high grain diets are usually fed ad libitum to finishing cattle, a 5 to 10% restriction of feed intake below ad libitum has been shown in some studies to improve feed efficiency without affecting daily gain. Such a restriction offers additional advantages of improved bunk management, reduced day to day fluctuation of intake, and improved feed inventory control.

Despite potential benefits, limit-feeding of finishing diets has not been adopted for two reasons. First, results among studies have been variable. An understanding of the biological mechanisms involved will be needed before consistency can be achieved across a variety of feeding situations. Second, there is as yet no practical method for determining the appropriate intake. The response appears to be dependent on a narrow range of restriction between 5 and 10%. This has generally been achieved by pair-feeding with ad libitum controls, which is impractical in commercial feedlots.

The objective of this study was to determine if limiting access time to a high concentrate finishing diet was an effective way to achieve a small restriction of intake (7% below ad libitum) and, as a result, improve feed efficiency. The role of an ionophore, monensin, in the limit feeding response was also evaluated.

Materials and Methods

One hundred seventy-six yearling, crossbred steers were randomly allotted to 16 pens and fed ad libitum or restricted amounts of feed daily with or without monensin. Ad libitum cattle had unlimited access to feed throughout the study. Finishing diet intake of the restricted group was limited by afternoon bunk checking such that the last of the day's feed was consumed between 4 and 5 p.m. This provided 6 to 7 hours of access to feed and was considered appropriate to achieve an approximate 7% reduction in intake based on previous studies at this facility. The finishing diets were formulated such that absolute intakes of protein, calcium, phosphorus, potassium, supplemental trace minerals, vitamin A, tylosin and monensin (depending on treatment) would be the same across treatments (Table 1), assuming 7% lower intake

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Table 1. Experimental diet composition (dry matter basis)

Ingredient	Diets[a]						
		Step up				Finishing	
	Receiving	1	2	3	4	Ad lib	Restr
	Percent						
Rolled corn	32.5	54.9	62.8	70.3	77.8	84.8	82.7
Alfalfa hay	24.0	37.9	30.0	22.5	7.5	-	-
Brome hay	39.0	-	-	-	-	-	-
OMB[b]	-	-	-	-	7.5	8.0	8.0
Molasses	2.0	4.0	4.0	4.0	4.0	4.0	4.0
Soybean meal	-	-	-	-	-	-	1.8
Dicalcium phosphate	.3	.2	.2	.2	.2	.2	.3
Limestone	1.1	1.2	1.2	1.2	1.2	1.2	1.2
Potassium chloride	.6	.5	.5	.5	.5	.5	.6
Trace mineral salt[c]	.5	.5	.5	.5	.5	.5	.5
Urea	-	.8	.8	.8	.8	.8	.9

[a] Vitamin A fed at 50,000 IU/day. Cattle on ionophore treatments were fed monensin at 295 mg/day and tylosin at 90 mg/day. Other cattle were fed tylosin only.
[b] Oat mill by-product. Approximately 80% oat hulls.
[c] Trace mineral salt contained 97% NaCl, .007% I, .24% Mn, .24% Fe, .05% Mg, .032% Cu, .11% Co, .032% Zn, and .5% Ca.

for restricted cattle (desired level of restriction). The diets were fed once per day.

The cattle were vaccinated (IBR, BVD, BRSV, Lepto, 7-way clostridial), treated with Ivermectin, implanted with Synovex-S, and ear tagged upon arrival at the feedlot. They were weighed on and off test after a 16-hour removal of feed and water. Interim 28-day weights were taken after a 16-hour removal of water only.

The data were analyzed as a 2 x 2 factorial design with intake and ionophore levels as main effects. Daily gain, carcass weight, and dressing percentage were analyzed with the individual animal as the experimental unit and initial and slaughter weights as covariates for gain and carcass data, respectively. Intake and feed efficiency analyses were based on pen observations.

Results and Discussion

Feedlot performance is presented in Table 2. As expected, restricting the access time to feed reduced dry matter intake ($P<.01$). The reduction amounted to 7.9% from day 29 through day 126. Ad libitum feeding of the step-up diets during period 1 resulted in a smaller overall reduction for the entire study of 6.5%. The main effect of feeding monensin also reduced intake of the finishing diets by 5.6% ($P<.01$). The interaction of access time and monensin approached significance ($P=.13$) as the effect of restricted access time tended to be greater when monensin was fed (11.2% vs 4.7%). However, degree of restriction was not consistent throughout the study (Table 3). It ranged from 86 to 92% and 91 to 101% of ad libitum for monensin and nonmonensin fed cattle, respectively.

Table 2. Feedlot performance of yearling steers fed finishing diets ad libitum or restricted with or without monensin

Item	Monensin		No monensin		SE
	Ad libitum	Restricted	Ad libitum	Restricted	
No. steers	43	44	44	44	
Initial weight, lb	797	800	797	803	6.8
Final weight, lb[ce]	1232	1201	1227	1231	7.9
Dry matter intake, lb/day					
1-28 days	16.6	16.4	16.5	16.5	.09
29-126 days[ac]	20.6	18.3	21.1	20.1	.38
1-126 days[ac]	19.7	17.9	20.1	19.3	.31
Weight gain, lb/day					
1-28 days	2.83	2.74	2.79	2.68	.11
29-126 days[df]	3.65	3.31	3.59	3.61	.07
1-126 days[ce]	3.47	3.18	3.41	3.40	.06
Feed:gain					
1-28 days	5.86	6.02	5.99	6.17	.260
29-126 days	5.65	5.54	5.91	5.57	.138
1-126 days	5.69	5.63	5.91	5.67	.123

[a] Monensin (P<.01).
[b] Monensin (P<.05).
[c] Restriction (P<.01).
[d] Restriction (P<.05).
[e] Monensin x restriction (P<.05).
[f] Monensin x restriction (P<.01).

Table 3. Dry matter intake of restricted cattle as a percent of ad libitum[a]

Period	Monensin +	Monensin -
	%	%
1-28 days	99	100
29-56 days	86	91
57-84 days	91	92
85-112 days	88	98
113-126 days	92	101
1-126 days	91	96

[a] Restriction begun with initial feeding of the finishing diet on day 26.

An interaction between access time and monensin was found for daily gain between day 29 and day 126 ($P<.01$) as well as overall ($P<.05$). This resulted from 8.5% lower daily gain for cattle fed the restricted diet containing monensin compared to the other treatments. Feed efficiency, on the other hand, only approached significance for the same period ($P=.13$). Dressing percentage of the cattle at slaughter did not differ due to treatment ($P>.10$), indicating that adjustments of daily gain to compensate for level of intake effects on gut fill were unnecessary in this study.

It is obvious from the data in Table 3 that achieving a specific degree of daily intake restriction by limiting access time to feed was, at best, only partially successful. Monensin tended to increase the effect of access time restriction. It is well known that monensin can reduce palatability of feeds and rate of consumption. It appears that this results in greater access time needed to achieve the same degree of restriction as in cattle not fed monensin. Although the overall restriction for the monensin-fed cattle was within the desired range of 5 to 10%, it was substantially greater during the second and fourth weigh periods. This likely contributed to the lower daily gain for this treatment. The greater restriction coincided with daily high temperatures that averaged 4 to 7 °F above those of the other periods. When exposed to hot weather, cattle tend to eat less during the day and more in early morning and late evening. The feeding pattern imposed on the restricted cattle in this study did not permit such a behavioral change and factors that decrease eating rate would have accentuated heat stress effects on performance.

While feed efficiency tended to improve with restricted intake, the differences were small and inconclusive. This may have been due to the variability in degree of restriction imposed during the study. However, even a conservative interpretation of the data, that feed efficiency did not differ, would suggest that either maintenance requirements were reduced or energy was more efficiently used for growth by restricted, monensin-fed cattle, since feed efficiency did not suffer in spite of lower daily gain. In other words, improved energy utilization offset the "dilution of maintenance" advantage of the other treatments with greater daily gains.

In conclusion, in order to be an effective means of restricting high concentrate finishing diet intake, access time should be determined for specific feeding situations. Factors that affect rate of intake, such as the feeding of monensin, will affect the degree of restriction and, therefore, the response to limit feeding. Other factors that should, perhaps, be taken into account would include the occurrence of high ambient temperatures (heat stress), ionophore type, and grain content of the diet.

EFFECT OF STRAW AND NEWSPAPER BEDDING ON COLD SEASON FEEDLOT PERFORMANCE IN TWO HOUSING SYSTEMS

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CATTLE 92-11

Summary

Two hundred seventy-three crossbred steer calves were fed until slaughter (November through May, 189 days) in either semi-confinement (partial overhead shelter, 88 sq. ft. per steer, concrete pen surface) or conventional open lots (windbreak, 448 sq. ft. per steer, dirt surface with mound). Within each housing system, cattle were provided with no bedding or bedding in the form of oat straw or shredded newspaper. Bedding was provided in amounts necessary to maintain a relatively dry, manure-free area large enough for all cattle to lay down at the same time. There were no interactions between housing systems or bedding treatments (P>.10). Feed intake did not differ (P>.10) between treatments at any time during the study. On the other hand, overall (day 1 through 189) daily gain was 8.6% greater for steers fed in semi-confinement pens compared to open lots (P<.001). Bedding also improved overall gain by 8.3% (P<.001) compared to no bedding, with newspaper generally being as effective as straw. Similar benefits of housing and bedding were evident in feed efficiency as well. Housing and bedding improved overall feed efficiency 8.2% and 6.8%, respectively (P<.001). Less newspaper than straw was used in this study (232 vs 266 lb per 100 head per day) and break-even values were $141.88 and $114.21 per ton, respectively. Both housing and bedding improved feedlot performance, with bedding being as effective in open lots containing mounds as on concrete. Newspaper can be an effective replacement for more conventional bedding materials.

(Key Words: Steer Calves, Housing, Bedding, Straw, Newspaper.)

Introduction

It is commonly accepted that providing cattle with bedding during cold weather and(or) when pens are muddy improves feedlot performance. The impact of bedding on performance is dependent on several factors, including the effective temperature and amount of mud to which the cattle are exposed. These factors can be altered by protection from wind and the use of concrete pen surfaces or mounds. It could, therefore, be expected that the benefits of bedding would differ between housing systems. Additionally, a variety of materials are available for use as bedding. Not all are equally effective due to differences in physical characteristics such as absorbency. Discarded newspaper will become more plentiful as recycling becomes mandatory in the future and has potential as bedding material.

The objectives of this study were 1) to determine if the use of bedding was as effective in improving performance of cattle fed fall through late spring in mounded, open lots as in semi-confinement on concrete and 2) to determine if shredded newspaper was as effective a bedding material as straw in the feedlot.

Materials and Methods

Two hundred seventy-three crossbred steer calves were randomly allotted to nine semi-confinement and 16 conventional, open lot pens, resulting in 9 and 12 steers per pen, respectively. The semi-confinement pens were 16 x 50 ft. with the feed bunk and 16 ft. of pen length covered by a shed open to the south. The pens were surfaced with concrete and provided 1.7 ft.

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of bunk space per steer. The conventional, open lot dimensions were 48 x 112 ft. with a well packed dirt surface and contained a mound and adjacent windbreak approximately 30 ft. behind the feed bunk. Bunk space was 1.8 ft. per steer. A shelter belt protected the open lots on the north and west sides. Bedding was provided as necessary to provide a relatively dry, manure-free area large enough for all of the steers in a pen to lay down at one time. As a result, new bedding was added every 3 to 10 days, depending on conditions, at a rate that averaged 266 and 232 lb per 100 head per day for straw and newspaper, respectively. Semi-confinement pens were cleaned at 2- to 3-week intervals and the feed apron and surrounding area of the open lots was cleaned after 117 and 161 days on feed. Air temperature and wind speed were recorded hourly by weather instrumentation located in an unprotected area approximately 600 ft. south of the feedlot.

The cattle were vaccinated (IBR, BVD, Lepto, 7-way clostridial), treated with Ivermectin[3], implanted with Ralgro[4], and ear tagged upon arrival at the feedlot. They were reimplanted with Synovex-S[5] after 82 days on test. Weights on and off test were taken after a 16-hour removal from feed and water. Interim 28-day weights were taken after a 16-hour removal of water only. Two diets were fed during the study (Table 1). The first was an 80% concentrate diet which was limit-fed during the first 82 days on test. The second was a more typical 90% concentrate diet fed ad libitum for the remainder of the study. No step-up diets were fed. Switches between the receiving diet (50% concentrate, fed prior to the on-test weight) and limit-fed grower and finisher diets were made by limiting initial intake of the new diet to maintain a constant net energy intake and then gradually increasing to the desired level.

Data were analyzed as a completely random design with a 2 x 3 factorial arrangement of treatments. Comparisons of open lot vs semi-confinement, bedding vs no bedding, and straw vs newspaper were made using orthogonal contrasts.

Results and Discussion

Feedlot performance data for this study are presented in Table 2. No interactions between housing system and bedding were found for the variables tested, indicating that the provision of bedding had the same kind and magnitude of effect on the cattle kept in semi-confinement as on those in the open lots.

The grower diet was fed across treatments at a level set to achieve a specific rate of gain and, as a result, dry matter intakes were not different from 1 through 82 days on test ($P>.10$). Intakes were also similar among treatments when fed the finishing diet ad libitum ($P>.10$). Overall dry matter intake (1 through 189 days on test), of course, reflected these results ($P>.10$).

Semi-confinement housing improved daily gain consistently throughout the study compared to open lots with mounds and windbreaks ($P>.001$). The advantage was .25 lb per day during both the growing and finishing phases. Feed dry matter required per pound of gain (feed:gain) was reduced by .44 and .55 lb during the growing and finishing phases, respectively ($P<.001$). Improvements in gain and feed:gain resulted in semi-confinement cattle weighing 15 lb more at slaughter than open lot fed cattle ($P<.001$).

The provision of bedding (straw or shredded newspaper) increased daily gain by .37 and .24 lb per day compared to no bedding during the finishing phase and overall ($P<.001$). Bedding effect only approached significance ($P=.12$) during the growing phase. The reason for this is unknown but may be related to the fact that cattle without bedding appeared to carry more mud, resulting in an overestimate of daily gain. This was apparently not the case with finishing and overall

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[3]IVOMEC, MSD AGVET, Rahway, NJ, 90965.
[4]Pitman-Moore, Inc., Mundelein, IL, 60060.
[5]Syntex Animal Health, Des Moines, IA, 50303.

Table 1. Diets fed to steers during the growing and finishing phases of the study (dry matter basis)

Ingredient	Diets: Limit-fed grower	Diets: Finisher
	Percent	
Rolled corn	65.3	83.2
Corn distillers grain (wet)	11.5	3.6
Brome hay	20.0	10.0
Limestone	1.6	1.6
Potassium chloride	.4	.5
Urea	.5	.5
Trace mineral salt[a]	.6	.5
Premix[b]	.1	.1

[a] Trace mineral salt contained 97% NaCl, .007% I, .24% Mn, .24% Fe, .05% Mg, .032% Cu, .11% Co., .032% Zn, and .5% Ca.
[b] Provided vitamin A at 50,000 IU/day, monensin at 295 mg/day, and tylosin at 90 mg/day.

gains, since pen conditions were dry at the time of slaughter and dressing percentages did not differ (P>.10). However, gain of cattle bedded with newspaper was equal to those with straw during the finishing phase and overall. Feed:gain reflected the same effects of bedding as did daily gain. Feed:gain was .71 and .42 lb lower for bedded cattle during the finishing phase and overall, respectively, than for nonbedded cattle (P<.001). As with daily gain, straw tended to improve feed:gain during the growing phase, but newspaper did not, resulting in a bedding effect that only approached significance (P=.12).

The benefits of providing bedding and the additional shelter from wind and precipitation in semi-confinement were substantial in this study. However, the impact on performance that can be expected will naturally vary with environmental conditions. Air temperatures were relatively mild during the study, averaging 33 °F. This is 5 °F warmer than long-term, historical averages. With temperatures frequently near or above 32 °F, precipitation in the form of rain and sleet occurred on several occasions and resulted in unusually poor feeding conditions. Benefits of bedding and additional housing may be less in environmental conditions more typical for this region. However, this study does illustrate the sizable negative impact the environment can have on feedlot cattle performance and the potential for modifying it. The lack of an interaction between bedding and housing system also suggests that access to mounds and protection from the wind, while beneficial, are not adequate by themselves to offset this negative impact. Hair coats of cattle receiving bedding were obviously drier and carried less mud than nonbedded cattle throughout much of the study. Dry, clean hair coats provide better insulation and reduce cold stress and maintenance energy requirements.

Less shredded newspaper was used to achieve the same overall effect of straw. This has been found in other studies as well and may be due to the fact that newspaper is about 2.5 times as absorbent as straw. Based on the usage rates in this study and

Table 2. Feedlot performance of steers fed in two housing systems with three types of bedding[a]

Item	Bedding				Housing		
	None	Straw	News-paper	SE	Open lot	Confine-ment	SE
No. steers	99	99	75		192	81	
Initial wt, lb	584	585	582	5.5	588	579	4.4
Final wt, lb[ab]	1079	1121	1118	8.8	1099	1114	7.0
Dry matter intake, lb/day							
1 to 82 days	14.2	14.2	14.2	.03	14.3	14.2	.02
83 to 189 days	21.2	21.7	21.4	.21	21.5	21.4	.17
1 to 189 days	18.2	18.5	18.3	.13	18.3	18.3	.10
Daily gain, lb/day							
1 to 82 days[cd]	2.83	2.96	2.85	.046	2.76	3.01	.037
83 to 189 days[bc]	2.91	3.25	3.32	.056	3.03	3.28	.045
1 to 189 days[bc]	2.88	3.12	3.12	.031	2.91	3.16	.025
Feed:gain							
1 to 82 days[cd]	5.05	4.82	5.01	.081	5.18	4.74	.065
83 to 189 days[bc]	7.32	6.72	6.47	.123	7.11	6.56	.100
1 to 189 days[bc]	6.33	5.93	5.88	.057	6.31	5.79	.046

[a] Least squares means.
[b] No bedding vs bedding ($P<.001$).
[c] Housing ($P<.001$).
[d] Straw vs newspaper ($P=.12$).

assumptions about feed, cattle and yardage costs[6], straw and shredded newspaper had break-even values of $114.21 and $141.88 per ton, respectively. If straw and shredded newspaper had been purchased for $60 per ton, their use would have returned $13.63 and $17.95 per head above bedding cost.

In conclusion, both housing and bedding improved feedlot performance, with bedding being as effective in open lots containing mounds as on concrete. Newspaper can be an effective replacement for more conventional bedding materials.

[6]Assumes $1.03 purchase price for calves, $76.50 fed cattle price, $84.30/ton feed cost, and $.15 per day yardage.

EFFECT OF BULL EXPOSURE ON REPRODUCTIVE PERFORMANCE OF FIRST-CALF HEIFERS BRED BY NATURAL SERVICE

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CATTLE 92-12

Summary

Ninety-four spring calving, first-calf heifers were allotted to one of two treatment groups, control or bull exposed, to study the effect of bull exposure early postpartum on rebreeding performance when bred by natural service. Bull exposure early postpartum had no effect on pregnancy rate. However, bull exposure unexpectedly increased the subsequent calving interval by 9 days ($P<.05$) and delayed the average calving date by 7 days ($P<.05$). Under the conditions of this study in which heifers were in condition score 5 or better at calving and bred by natural service, bull exposure early postpartum did not improve reproductive performance.

(Key Words: Bull Exposure, Calving Interval, Reproductive Performance, First-calf Heifers.)

Introduction

Bull exposure has been shown to reduce the interval from calving to first estrus by 15 to 20 days and increase the percentage cycling prior to breeding. If these effects result in a shorter calving interval, subsequent calf weaning weights should be increased by having older calves at weaning. For this reason the economics of bull exposure could be favorable. Unfortunately, few studies have presented production endpoints suitable for calculating economic return. To further confuse the economics of bull exposure, condition score of the female, and method of breeding (natural service or synchronization and artificial insemination) can influence the biological response to bull exposure.

This study was conducted to evaluate the effect of bull exposure on reproductive performance of first-calf heifers when rebred by natural service.

Materials and Methods

This trial was conducted on a commercial ranch in southwestern South Dakota in the spring of 1991. Ninety-four spring calving, crossbred, first-calf heifers with an average calving date of March 1 were allotted by calving date to either a control or bull exposed treatment. Treatment groups were maintained in separate pastures with no audio or visual contact. Heifers were fed alfalfa/grass hay free choice, 2 lb of a 14% protein pellet and 5 lb of ear corn after calving.

A total of 48 heifers were exposed to two, epididectomized, yearling Angus bulls within 2 weeks of calving. Epididectomized bulls were removed on April 30 and the treatment groups were co-mingled at this time. Four yearling Angus bulls were turned in on June 4 for a 60-day breeding season.

A total of four heifers were removed from the study due to one abortion, one did not return from summer pasture, and two were lost from ranch records. Thus, 45 head per treatment were available for data analysis. Calving interval was calculated as the number of days between the first and second calving date. No attempt was made to measure the interval from calving to first estrus.

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[1]Assistant Professor.
[2]Associate Professor.
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Results and Discussion

The effect of bull exposure on reproductive performance is shown in Table 1. Bull exposure had no effect on pregnancy rate. However, bull exposure unexpectedly increased the subsequent calving interval by 9 days (P<.05) and thus delayed the average calving date by 7 days (P<.05). These results are difficult to interpret because bull exposure has not had a negative effect on reproduction in previous studies.

These results, combined with results of previous studies, suggest several factors interact to moderate the biological response to bull exposure. For example, both SDSU and Nebraska research have documented diminishing effects of bull exposure when the experimental cattle were in good body condition. The average condition score of 5.1 for this experiment suggests that cattle adequately nourished may not have a positive response to bull exposure. Furthermore, in this study, treatment groups were co-mingled some 35 days before the breeding season began and rebred by natural service. Either of these practices could have induced cycling activity in some noncycling heifers and could have skewed the data in favor of the controls. This would be in contrast to results obtained from trials in which estrus synchronization and artificial insemination were utilized to rebreed the cattle. In a synchronization program, the females may not be exposed to bulls at any time, which would eliminate any bull stimulus. Thus, exposure to sterile bulls could be of economic benefit in this situation.

In summary, under the conditions of this study in which first-calf heifers in condition score 5 or greater at calving were rebred by natural service, bull exposure early postpartum was not economically advantageous.

Table 1. Effect of bull exposure on rebreeding performance of first-calf heifers

Item	Treatment		SE
	Control	Bull exposed	
Condition score at calving[a]	5.1	5.1	
Pregnancy rate, %	91 (41/45)	91 (41/45)	
Calving interval, days	386[b]	395[c]	2.80
Avg calving date, 1992	3/22[b]	3/29[c]	2.00

[a] 1 = emaciated to 9 = obese.
[b,c] Means with unlike superscripts differ (P<.05).

EFFECT OF LUTYLASE OR BOVILENE ON CONCEPTION RATE TO ARTIFICIAL INSEMINATION OF HEIFERS

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Summary

Calving records from 306 two-year-old heifers were used to compare the effect of Lutylase or Bovilene on first-service conception rate as part of an estrus synchronization and artificial insemination program. There was no difference (P=.91) between products in the percentage of heifers conceiving to artificial insemination following estrus synchronization.

(Key Words: Lutylase, Bovilene, Prostaglandin, Synchronization.)

Introduction

Pharmaceutical advancements have resulted in the clearance of three prostaglandin products for estrus synchronization of beef cattle. These include a natural preparation, trade name Lutylase[3], and two synthetic preparations, trade names Bovilene[4] and Estrumate[5]. Currently, there is considerable opinion but little research data comparing prostaglandin products for estrus synchronization and artificial insemination. The objective of this field research was to compare the effectiveness of Lutylase or Bovilene for estrus synchronization and artificial insemination for replacement heifers.

The effect of Lutylase or Bovilene on estrus synchronization response was reported in South Dakota Beef Report 91-19. The effect of Lutylase or Bovilene on first-service conception rate is reported herein.

Materials and Materials

A total of 533 yearling heifers were synchronized with MGA[6] and prostaglandin injection at three locations. Beginning 33 days prior to the start of breeding, heifers were fed .5 mg per head per day of MGA for 14 consecutive days. Seventeen (17) days after the last day of MGA feeding, heifers were injected with either Bovilene or Lutylase according to label directions. Specifically, either 5 cc of Lutylase were injected into the muscle or 2 cc of Bovilene were injected under the hide (subcutaneous). Heifers within a location were allotted to prostaglandin treatment according to birth date when possible. Heifers were subdivided into five injection groups within the three locations. Injection groups 1 to 3 were managed on one ranch, group 4 on a second ranch, and group 5 heifers were managed at the SDSU Range and Livestock Research Station near Philip.

Heifers were artificially inseminated if they came into estrus within 5 days of injection. A heifer was inseminated approximately 12 hours after being first detected in estrus.

Only heifers with 1992 calving dates were included in the statistical analysis of first-service conception rate. Attrition from the study occurred due to being open in the fall of 1991, aborting before calving, or a pregnant heifer was sold and calving date was not recorded. Calving dates were available for 141 heifers injected with Bovilene and 165 heifers

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[3]The Upjohn Company, Kalamazoo, MI.
[4]Syntex Animal Health, Des Moines, IA.
[5]Haver, Shawnee, KS.
[6]Melengestrol acetate, The Upjohn Company, Kalamazoo, MI.

injected with Lutylase. Gestation length was calculated from the date of insemination. Heifers with a gestation length of 291 days or less were considered to have conceived to artificial insemination.

Independent variables included in preliminary statistical models evaluating first-service conception rate included prostaglandin treatment, injection group, and the treatment x group interaction. The treatment x group interaction was not significant and was therefore dropped from the final analysis.

Results and Discussion

Prostaglandin treatment had no effect (P=.91) on first-service conception rate. Conception rates were 75.8% for Lutylase and 76.3% for Bovilene. Although these values represent a biased estimate of first-service conception rate due to the loss of heifers from the study, the relative difference between products is an accurate evaluation. Attrition from the study occurred at random and was equal between products.

Based on the heat detection data reported previously and the conception data reported herein, it would appear that the choice between Lutylase and Bovilene should be based on economics and operator preference in giving intramuscular or subcutaneous injections, as no biological differences were noted.

Appreciation is expressed to Ed and Rich Blair, Blair Ranches, Sturgis; Reuben and Connee Quinn, Quinn Cow Company, Pine Ridge; and to Ron Haigh, Range and Livestock Research Station, Philip, for supplying cattle and to representatives of The Upjohn Company and Syntex Animal Health for supplying prostaglandin product.

AN UPDATE ON RETAINED OWNERSHIP: CASE STUDY OF CALVES BORN AT THE ANTELOPE RANGE LIVESTOCK STATION

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CATTLE 92-14

Summary

An update to a previous report on the case history of retained ownership in the Antelope Range Livestock Station herd is provided. Calves born in 1990 and 1991 were placed in a custom feedlot following weaning and the profitability of postweaning feedlot performance was estimated. Retaining ownership through slaughter, as opposed to selling calves at weaning, resulted in additional estimated profits of $51.27 and $107.82 per head (excluding interest on calf) for the 1990-born and 1991-born calf crops, respectively.

(Key Words: Retained Ownership, Economics.)

Introduction

Ownership through slaughter has been retained of a portion of each calf crop since 1985 from the SDSU Antelope Range Livestock Station. A previous report (Marshall and Wagner, 1990) presented results from the first five years, during which profits from weaning to slaughter ranged from $1.82 per head in the worst year to $215.41 in the best year (excluding interest on calf value). The objective of this report is to provide an update of our experiences with retaining ownership from weaning through slaughter for calf crops born in 1990 and 1991.

Materials and Methods

This study includes two years of information from crossbred calves of several breed combinations born at the Antelope Range Livestock Station in northwestern South Dakota. Calves were born primarily in March and April and were weaned in October at an average age of about 7 months. Within two to three weeks after weaning, calves were transported to a commercial custom feedlot where they remained until slaughter. Ownership was retained through slaughter on 101 steers and 25 heifers from the 1990-born calf crop and on 57 steers and 27 heifers from the 1991-born calf crop.

Energy levels were increased quite rapidly after entry into the feedlot. Calves were slaughtered on two dates (4 weeks apart) each year, with a random half of each breed-sex combination included in each slaughter group. The time period from feedlot entry to slaughter was 196 and 224 days for the two respective slaughter groups for 1990-born calves and 185 and 212 days for 1991-born calves. Slaughter age generally ranged from 13 to 15.5 months.

Average values for days in the feedlot, final live weight, and percent choice or prime carcasses were calculated from the calves that finished their respective feeding period, whereas other average values in Table 1 also take into account the performance of calves that died or were prematurely removed from the feedlot. Similarly, in Table 2, slaughter calf price represents only those calves that finished their respective feeding period, whereas all figures expressed on a per-head basis are based on the number of calves entering the feedlot.

Calf price at feedlot entry (Table 2) is the assumed average price for which the calves could have been sold at weaning time if ownership had not been retained. Estimated calf value at feedlot entry is the assumed calf entry price multiplied by the average weight of calves entering the feedlot. Initial shrunk weight averaged 532 and 548 lb for calves born in 1990

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and 1991, respectively. Performance and costs during the period from weaning to feedlot entry were not directly taken into consideration but should be reflected in calf value at feedlot entry. Feedlot charges reflects the actual payment to the feedlot for feed, lot charges, medication and veterinary expenses. The line labeled trucking/marketing takes into account trucking from the feedlot to the slaughter plant, insurance and the $1 check-off deduction. Trucking from the ranch to the feedlot was not taken into account on the assumption this expense would also have occurred if the calves had been sold at weaning.

Estimated gross profit during the postweaning feedlot period was computed as slaughter sales minus the assumed value of calves at feedlot entry minus feedlot expenses minus trucking/marketing expenses. Estimated net profit was computed as estimated gross profit minus interest costs on feedlot expenses. No interest cost was charged for the value of calves at feedlot entry.

Results and Discussion

While interpreting the information presented, keep in mind that the objective was to estimate only the profit (or loss) that accrued during the postweaning feedlot period. This is profit (or loss) over and above that which would have been attained if the calves had been marketed soon after weaning in the fall. Costs and revenues associated with the cow herd (i.e., preweaning profit factors) were not considered. With other factors held constant, a lower price of calves at feedlot entry results in larger postweaning profits but lower cow-calf phase profits. The difference between two calf crops in postweaning profits is, in general, not indicative of the difference in cow-calf profitability.

Numbers of calves retained and their average performance values for both calf crops are presented in Table 1. The death loss for both years combined was 6 of 210 or 2.86%. Reduced salvage values were received for one 1990-born calf and two 1991-born calves which were removed from the feedlot early. Although statistically meaningful comparisons between calf crops cannot be made, the 1991-born calves appeared to have performed somewhat better than the 1990-born calves. The genetic makeup of the two calf crops is assumed to have been quite similar. The difference between years in performance could possibly have been due in part to relatively milder weather during the winter of 1991-92. For the five previous calf crops of this herd, daily gain averaged 3.20 lb/day (Marshall and Wagner, 1990).

Relative profitability from weaning through slaughter is presented in Table 2. The 1990-born calves returned an estimated net profit of $51.27 per head. A relatively higher estimated net profit of $107.82 was realized for the 1991-born calf crop, reflecting improved performance, reduced death loss, and especially, reduced value of calves at feedlot entry compared to the previous calf crop. Again, the reader is reminded that these figures give no indication as to the relative profitability of the cow-calf (preweaning) phase of production. Marshall and Wagner (1990) reported positive postweaning net profits for each of the five previous calf crops of this herd. However, there was considerable variation across years, ranging from $1.83 to $215.41 per head.

As mentioned previously, no interest cost was assumed for the value of calves entering the feedlot. Thus, the estimated net profit figures in Table 2 can be interpreted as dollar return on investment, where the investment is the calf value at feedlot entry. If interest costs for the opportunity loss associated with not selling at weaning were deducted, then the estimated net profit figures would be reduced accordingly.

It has been profitable in general over the last seven calf crops to retain ownership of calves through slaughter in this particular herd, although the magnitude of profits have varied considerably across years. Market factors over which the producer has little or no control have tended to fluctuate much more than performance factors, contributing to the risk of retaining ownership. It might be possible to manage some of the risk through forward contracting and(or) futures markets. The decision to participate in retained ownership must be made by each individual, after carefully considering factors such as risk tolerance, financing, price outlook for cattle and feed, and identification of a feedlot.

Literature Cited

Marshall, D. M. and J. J. Wagner. 1990. A five-year case history of retained ownership. SD Agr. Exp. Sta. Beef Report CATTLE 90-15:57.

Table 1. Feedlot performance of steers and heifers

	Year of calf birth	
	1990	1991
No. calves started	126	84
Death loss, head	4	2
No. calves sold early	1	2
No. calves finished	121	80
Days in feedlot[a]	210.3	198.4
Avg daily gain, lb/day	2.98	3.25
Final live weight, lb[a]	1160	1197
Avg feed intake, lb/day	22.6	25.6
Percent choice or prime carcasses[a]	64.5	58.8
Cost of gain, $/lb[b]	.434	.397
Cost/head/day, $[b]	1.29	1.29

[a] Based entirely on calves that finished.
[b] No interest costs are included.

Table 2. Economic performance of steers and heifers in feedlot

	Year of calf birth	
	1990	1991
Estimated calf price at feedlot entry, $/cwt	98.00	90.00
Slaughter price, $/cwt[a]	76.86	75.77
Slaughter value, $/head	861.65	876.39
Feedlot charges, $/head	265.84	252.46
Trucking/marketing, $/head	12.85	13.18
Estimated calf value at feedlot entry, $/head	521.50	493.23
Estimated gross profit, $/head[b]	61.46	117.52
Estimated net profit, $/head[c]	51.27	107.82

[a] Slaughter price is based only on calves that finished. All other figures are based on all calves.
[b] No interest costs are included.
[c] Interest costs for feedlot charges are included.

SOUTH DAKOTA RETAINED OWNERSHIP DEMONSTRATION

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Summary

Four hundred nineteen steer calves representing 57 cow-calf producers were consigned to a custom feedlot in mid-October. Cattle were fed in one of three pens. One pen of calves was fed a starter program for 20 days followed by a moderate roughage growing diet for 84 days before they were switched to a high energy finishing diet (TWO). The other two pens were fed a starter program for 20 days followed by a moderate roughage growing diet for 14 days before they were switched to a high energy finishing diet. Cattle were sorted into one of these two pens on the basis of whether they had been exposed to feed (AFED, either weaned or creep fed) prior to feedlot arrival or not exposed to feed (ANFED). The TWO calves weighed 500 lb initially, gained 2.80 lb per head daily, and averaged 1047 lb at slaughter after an average of 196 days on feed. Average cost of gain and profitability were $58.27 per cwt and -$28.74 per head, respectively. The AFED and ANFED calves weighed 539 and 554 lb initially, gained 3.04 and 3.08 lb per head daily, and averaged 1116 and 1136 lb at slaughter after an average of 190 and 189 days on feed, respectively. Average cost of gain and profitability were $55.40 and $56.32 per cwt and $23.57 and $33.20 per head, respectively. When data from years 1 and 2 were combined, average daily gain, dressing percentage, quality grade, and cost of gain were related to profitability and accounted for 79.6% of the variation in profitability.

(Key Words: Retained Ownership, Feedlot Performance, Feedlot Profitability.)

Introduction

Retained ownership of feeder calves has been shown to consistently improve profitability of cow-calf operations through either an increase in net returns per cow or through minimizing losses in some years. Average profits in 1990-91 for cattle enrolled in the South Dakota Retained Ownership Demonstration were $38.75 and $16.69 per head for an accelerated finishing and two-phase growing and finishing programs, respectively. The range in profitability for all 69 groups of 5 steers was from -$56.57 to $131.36. An understanding of factors influencing the profitability of retained ownership is essential in order to successfully use retained ownership as a market alternative.

The overall objective of this multi-year program is to evaluate retained ownership as a marketing alternative for cow-calf producers. This report summarizes data from the second year of the project.

Materials and Methods

Fifty-seven cow-calf producers consigned 84 groups of five steer calves to a custom feedlot[7] in mid-October of 1991. One hundred sixty calves arrived at the lot the evening prior to processing and were

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[6]Jerauld County Extension Agent.
[7]R and L Feedyard, Kimball, SD.

allowed access to water overnight. The remaining calves were processed upon arrival.

Processing procedures included weighing, measuring hip height and determining initial fat thickness with an ultrasound instrument. All calves were treated with Ivomec[8] to control parasites and implanted with Synovex-S[9]. They received 7-way clostridial bacterin and were vaccinated for IBR, BVD, PI_9, BRSV and Hemophilus somnus. Appropriate boosters were given on day 21 in the lot.

Following processing, calves were separated into one of three pens. Cattle in one pen were fed according to a traditional two phase growing and finishing program (TWO). Cattle in the other two pens were fed according to an accelerated finishing program. Cattle were sorted into one of these two pens on the basis of whether they had been exposed to feed (AFED, either weaned or creep fed) prior to feedlot arrival or not exposed to feed (ANFED).

All three groups were fed long stem alfalfa-grass hay and a commercial receiving feed[10]. Over a several day period as cattle became accustomed to eating at the bunk, a growing ration (Table 1) gradually replaced the hay for the TWO calves, while a winter finishing ration (Table 1) gradually replaced the hay for the AFED and ANFED calves. The commercial receiving feed was increased until the calves were eating about 3% of their body weight (about 16 lb per head daily). At this point, an additional growing ration or winter finishing ration gradually replaced the receiving feed for the TWO and accelerated calves, respectively.

On day 12 in the feedlot, a storm system moved through. Over an inch of rain followed by freezing rain and snow completely soaked the calves and the feedlot. Cattle in the AFED and ANFED pens went off feed during the storm. In order to minimize digestive upsets and reduce stress on the cattle, a growing ration was fed in place of the winter finisher. Once intakes and the weather was stable, cattle were stepped up through a series of intermediate rations until the cattle were back to the winter finisher.

Fifty-five calves were fed the growing diet until day 104. Then, they were stepped up to the final finishing diet (Table 1). Calves in the accelerated pens were fed the winter finishing until mid-February. Then they were switched to the final finisher until slaughter.

Since all cattle were fed in one of three pens, individual feed bills were calculated from performance data according to equations published by the National Research Council. Cattle were weighed approximately every 6 weeks. Ration energy density was calculated for each feeding program from the average performance for each pen. An estimate of individual intake was calculated for each calf using calf weight, daily gain and ration energy density.

Feed, yardage, and veterinary bills were financed through a commercial bank[11]. Death loss was shared by all participants. Producers were sent periodic progress reports and copies of their feed bills. Each group of five cattle were slaughtered when three steers from the group appeared to reach .4 inch of fat over the 12th rib.

Results and Discussion

A wide variety of cattle types were represented in the program. Straightbreds or crosses of the following breeds were consigned: Amerifax, Angus, Beefalo, Charolais, Chianina, Continental, Galloway, Gelbvieh, Hereford, Holstein, Jersey, Limousin, Maine Anjou, Murray Grey, Red Angus, Rx3[12], Salers, Shorthorn, Simmental and Tarentaise.

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[8]Product of MSDAGVET, Rahway, NJ.
[9]Product of Syntex Animal Health, West Des Moines, IA.
[10]Pre-Con, product of Purina Mills, Inc., St. Louis, MO.
[11]Tri-County State Bank, Kimball, SD.
[12]A composite breed of Red Angus, Hereford and Red Holstein.

Table 1. Composition of diets fed to steers

Item	Diet: Grower	Winter finisher	Final finisher
Ingredient[a]			
Mixed silage[b]	54.87	32.32	26.37
Alfalfa hay	12.00	-	-
Cracked corn	29.67	63.08	68.78
Supplement[c]	3.28	4.41	4.66
Mineral	.19	.19	.19
Nutrient[d]			
Crude protein, %	12.99	12.30	12.40
NE_m, Mcal/cwt	80.91	93.57	94.59
NE_g, Mcal/cwt	49.00	61.23	62.23
Calcium, %	.81	.56	.55
Phosphorus, %	.34	.37	.37
Vitamin A, IU/lb	4613	3323	3246
Rumensin, g/ton	20	22.5	22.7

[a] Percentage, as fed.
[b] Approximate as fed composition: corn 33.3%, cane 33.3%, and alfalfa 33.3%.
[c] Sup-R-Lix, Purina Mills, Inc.
[d] Dry matter basis.

Initial weight, hip height and fat thickness are displayed in Table 2. Generally, cattle placed in the accelerated program pens were taller (P<.0001) at the hip and heavier (P<.001) than calves placed in the two-phase program. There were a few smaller framed, lighter calves in all pens. Steers in the ANFED pen were heavier (P<.05) and carried slightly more condition (P<.0001) than steers in the AFED pen.

Feedlot performance information is shown in Table 3. Cattle were weighed full the day prior to slaughter. Slaughter weight for each steer was computed by applying a 4% pencil shrink to this full weight. Slaughter weight was greater (P<.0001) for steers on the accelerated program as compared with steers on the two-phase program (1116 and 1136 vs 1047 lb, respectively). Average daily gain was also greater (P<.0001) for accelerated steers than for two-phase steers (3.04 and 3.08 vs 2.80 lb per head daily). Accelerated steers were fed fewer days (P<.01) than two-phase steers (190 and 189 vs 196 days for AFED, ANFED vs TWO, respectively).

Actual average dry matter intake was 19.68 and 20.06 lb per head daily for the AFED and ANFED steers, respectively. Two-phase steers consumed an average of 20.43 lb dry matter per head daily. Feed to gain ratio was 6.47, 6.51 and 7.29 lb dry matter per pound gain for the AFED, ANFED and TWO steers, respectively.

Table 4 shows carcass data collected for the steers. Carcasses of two-phase cattle were lighter (P<.0001) than carcasses of accelerated calves. Dressing percentage (P<.001), rib eye area (P<.10) and marbling scores (P<.01) were lower for two-phase cattle than for accelerated calves. Accelerated calves that were previously exposed to feed had lighter (P<.01) carcasses and lower dressing percentages (P<.001), backfat thickness (P<.0001), and yield grades

Table 2. Initial weight, hip height, and fat thickness of program steers

	Weight, lb	Height, in.	Fat thickness, in.
Accelerated, fed			
Average	539	44.00	.042
Range	346-720	39.50-49.00	.00-.12
Standard deviation	68	1.96	.02
Range (5 head)	391-654	40.40-48.00	.012-.076
Accelerated, not fed			
Average	554	44.24	.057
Range	370-786	39.50-50.00	.02-.16
Standard deviation	76	1.92	.03
Range (5 head)	450-745	41.65-48.20	.032-.12
Two phase			
Average	500	41.79	.052
Range	382-576	38.50-45.00	.04-.12
Standard deviation	37	1.63	.02
Range (5 head)	452-532	39.15-43.85	.04-.072

Table 3. Feedlot performance of program steers

	Slaughter wt, lb	ADG, lb	Days fed
Accelerated, fed			
Average	1116	3.04	190
Range	804-1398	1.88-4.00	166-215
Standard deviation	106	.35	15
Range (5 head)	945-1334	2.66-3.40	166-215
Accelerated, not fed			
Average	1136	3.08	189
Range	849-1386	1.54-4.06	166-215
Standard deviation	107	.39	18
Range (5 head)	978-1284	2.60-3.47	166-215
Two phase			
Average	1047	2.80	196
Range	918-1179	2.25-3.48	189-215
Standard deviation	64	.29	12
Range (5 head)	996-1122	2.50-3.10	189-215

Table 4. Carcass data for steers

Pen	Hot carcass wt, lb	Dressing percent	Fat thickness, in.	Rib eye area, in.^{2}	Kidney, heart and pelvic fat, %	Calculated yield grade, units	Marbling score[a], units	Percent choice
Accelerated, fed								
Average	710	63.55	.41	12.33	2.32	2.75	4.67	36.4
Range	464-916	57.68-70.26	.10-.80	8.7-18.6	1.00-3.50	.49-4.16	3.00-6.20	
Standard deviation	78	2.13	.14	1.84	.55	.67	.51	
Range (5 head)	572-847	60.46-68.08	.26-.61	9.66-15.80	1.40-2.90	1.60-3.49	3.96-5.48	0-100
Accelerated, not fed								
Average	731	64.29	.49	12.32	2.47	3.06	4.73	40.1
Range	553-928	60.00-68.81	.10-1.10	8.80-16.00	1.00-3.50	1.48-5.06	3.00-7.00	
Standard deviation	74	1.73	.17	1.45	.55	.67	.56	
Range (5 head)	608-851	62.06-66.25	.30-.74	10.00-14.45	1.50-3.10	2.08-3.81	4.16-5.44	0-100
Two phase program								
Average	659	62.93	.46	11.88	2.57	2.87	4.49	18.5
Range	583-747	59.59-66.16	.20-.80	9.6-15.4	2.00-3.50	1.46-4.32	3.50-5.50	
Standard deviation	40	1.47	.13	1.20	.41	.64	.42	
Range (5 head)	616-702	61.17-64.36	.35-.55	11.06-12.88	2.10-2.90	2.31-3.26	4.08-4.84	0-60

[a] 3.00 = Traces^{o}, 4.00 = Slight^{o}, 5.00 = Small^{o}, 6.00 = Modest^{o}, 7.00 = Moderate^{o} and 8.00 = Slightly abundant^{o}.

(P<.0001) than nonfeed exposed, accelerated calves. Percentage choice carcasses for the AFED, ANFED and TWO calves were 36.4, 40.1 and 18.5, respectively.

Although there appears to be differences in cattle performance and carcass characteristics between the three pens of cattle, these differences may not be due to the different feeding programs. Cattle were not randomly assigned to each pen. Therefore, initial weight, hip height, genetic make-up and other factors of the pens were different.

Table 5 shows the feeding period costs for the cattle. Feed and yardage expenses were greater for the two-phase cattle due to additional time on feed. Marketing expenses included insurance, check-off and weighing charges. Fifteen steers died during the project. Four of these deaths were from Hemophilus somnus, two were from bloat and nine were due to respiratory infections of unknown origin. Seven of the deaths were from each accelerated pen and one from the two-phase pen. However, all participants shared death loss equally.

Feed cost of gain and total cost of gain are expressed on a pay weight to pay weight basis and were similar for both accelerated pens of cattle. Feed cost of gain was slightly higher for the two-phase calves. Initial pay weight was assumed to be 4% greater than initial weight obtained at the feedyard. The weight obtained the day prior to slaughter less the 4% pencil shrink was assumed to equal finished pay weight. Break-even sale price was $75.62, $75.78, and $78.15 per cwt for the AFED, ANFED and TWO calves, respectively.

Table 6 shows the initial value, sale value and profitability of the program steers. Initial price was computed by using numerous sale barn reports for the last 3 weeks in October 1991 and regressing price on pay weight (Figure 1). The equation predicting price was Price ($/cwt) = 163.3314 - .1806 x weight (lb) + .000107 x weight $(lb)^2$. One thousand three hundred fifty-four observations were used in the regression. The coefficient of determination (R^2) was .7097. No attempt was made to adjust the initial prices for breed type, frame size, initial condition or location.

All cattle were sold on a grade and yield basis. Average carcass price was slightly higher for the accelerated calves than for the two-phase calves because a higher proportion of the accelerated calves graded choice. The base choice carcass price and the select discount were $125 and $2, $126 and $2, $122 and $3 and $125 and $6 for cattle slaughtered after 166 (March 31), 180 (April 14), 189 (April 23) and 215 days (May 19) on feed.

Profits excluding calf interest and trucking to the lot were $23.57, $33.20, and -$28.74 per head, respectively, for the AFED, ANFED and TWO calves. Interest on the calf should be accounted for when evaluating retained ownership profitability. If opportunity interest on the calf was 7%, interest charges and profitability would have been $19.52 and $4.03, $19.80 and $13.36, and $19.21 and -$47.96 per head for the AFED, ANFED and TWO calves, respectively. Another way to examine profitability and calf interest is to calculate an annual return on investing the calf in a retained ownership program. Annual return on investment (initial calf value) was 8.31, 11.67 and -10.61% for the AFED, ANFED and TWO calves, respectively.

The range in cattle profitability between groups of five head within each feeding program was tremendous. There were 74 groups of cattle in the accelerated program. Profitability of these groups ranged from -$53.01 to $98.55 per head. Sixty-two of the groups made a profit. Only 12 groups lost money. Only one group of calves out of a total of eleven made a profit in the two-phase program. Profitability ranged from -$63.72 to $2.94 per head.

Another way to express retained ownership profitability is to use slaughter value and feedlot costs to back calculate the value of the calves in the fall when they were placed into the feedlot. Accelerated program steers were worth an average of $878.26 at slaughter. Feedlot costs averaged $300.34. Therefore, the average accelerated program calf was worth $577.92 in the fall. Average pay weight in the fall was 568 lb. Thus, accelerated calves were worth $101.75 per cwt in the fall. This represents a premium of about $5.88 per cwt compared with the average market price obtained

Table 5. Feeding period costs[a]

Item	Accelerated, fed	Accelerated, not fed	Two phase
Feed	220.92	224.51	229.69
Yardage	28.50	28.35	29.40
Veterinary	11.96	12.57	10.87
Interest[b]	6.28	6.37	6.35
Trucking[c]	7.73	8.08	6.97
Marketing	1.58	1.59	1.59
Death loss	21.42	21.42	21.42
Total	298.39	302.89	306.29
Feed cost of gain[d], $/cwt	39.88	40.25	43.61
Total cost of gain[d], $/cwt	55.40	56.31	58.27
Break-even sale price, $/cwt	75.62	75.78	78.15

[a] Dollars per head.
[b] Interest on feed, yardage and veterinary expenses only.
[c] Trucking to packing plant only.
[d] Pay weight basis.

Table 6. Profitability of retained ownership steers

	Feeding program		
Item	Accelerated, fed	Accelerated, not fed	Two phase
Initial pay weight, lb	561	577	520
Price, $/cwt	96.23	95.41	98.51
Initial value, $	539.85	550.52	512.25
Hot carcass wt, lb	710	731	659
Price, $/cwt	122.08	122.24	119.70
Sale value, $	866.77	893.57	788.82
Profit, $/head[a]	23.57	33.20	-28.74
Annual return on investment, %	8.31	11.67	-10.61

[a] Excludes calf interest and trucking to the feedlot.

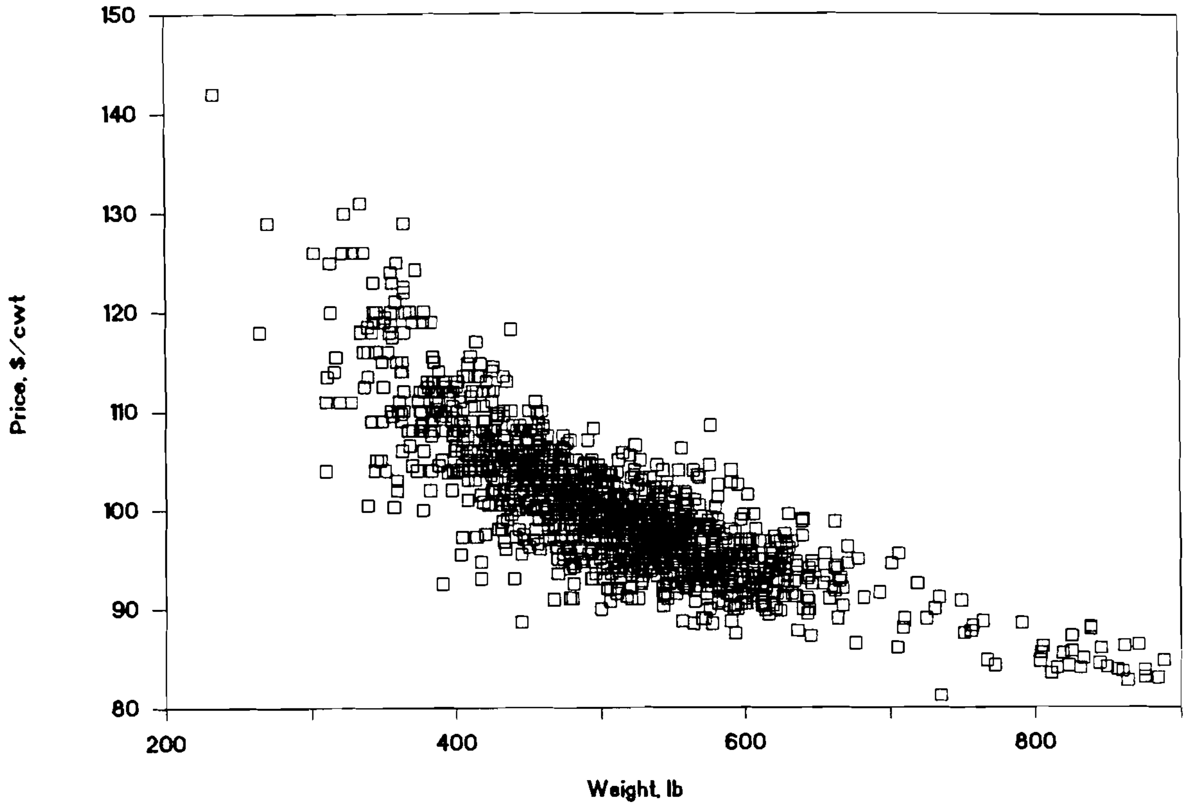

Figure 1. Relationship between price and pay weight.

from Figure 1. Two-phase program steers were worth $788.82 at slaughter, cost $306.29 to feed and had a pay weight of 520 lb in the fall. Thus, they were worth only $92.79 per cwt in the fall. This represents about a $5.72 per cwt discount in the fall compared with the price obtained from Figure 1. In other words on the average, accelerated producers made an additional $5.88 per cwt on their calves by feeding them out. However, two-phase producers lost $5.72 per cwt on their calves by feeding them.

The range in fall calf values over both feeding programs was from a discount of $11.95 per cwt for one group of five steers up to a premium of $21.99 per cwt for another group of five. Premiums of this magnitude are never applied in the feeder calf market. The only way for cow-calf producers to be fully rewarded for superior genetics is to retain ownership of the calf crop. However, these data also show that there are cattle that should not be fed directly to finish at a custom feedlot. Perhaps these cattle are best suited for high roughage wintering programs followed by grazing in the summer.

Data from year 2 of the project were combined with data collected in 1990-91. Forward selection regression procedures were used to study factors related to profitability. Table 7 summarizes the regression statistics for the model. Average daily gain was the first variable selected into the model predicting profit. It explained 29.01% of the variation in profit. For every .1 lb increase in average daily gain, profit was improved by $6.43 per head. Dressing percentage explained an additional 30.04% of the variation in profit and was the second variable to be selected into the model. A full percentage unit increase in dressing percentage corresponded to a $14.62 increase in profitability. Quality grade was selected third into the model and accounted for an additional 16.14% of the variation. If a carcass graded choice rather than select or lower, profit was improved by $39.94. Total cost of gain came into the model fourth and explained an additional 4.4% of the variation in profit. For each $1.00 per cwt increase in cost of gain, profit was reduced by $2.63 per head. These four variables accounted for 79.6% of the variation in profit and no other variable accounted for more than 4% of the remaining variation in profit. Table 8 further illustrates how gain, dressing percentage, quality grade, and cost of gain impact profit.

Table 7. Summary of regression statistics

Variable	Parameter estimate	Standard error	Probability	Partial R^2
Intercept	-972.40	31.79	.0001	
Average daily gain	64.31	2.57	.0001	.2901
Dressing percentage	14.62	.45	.0001	.3004
Quality grade[a]	39.94	1.75	.0001	.1614
Cost of gain[b].	-2.63	.21	.0001	.0440

[a] 0 = select or lower, 1 = choice or higher.
[b] Total costs excluding calf interest, pay to pay basis.

Table 8. Value of select variables for low, middle and high profit groups

	Profit group		
Variable	Low 1/3	Mid 1/3	High 1/3
Profit, $/head	-29.36	25.87	81.48
Average daily gain, lb	2.73	3.01	3.15
Dressing percent	62.95	63.79	64.93
Percent choice	14.92	38.71	69.35
Cost of gain	56.46	54.09	52.75

The importance of dressing percentage and quality grade is due to the fact that the cattle were sold on a grade and yield basis. Average daily gain is important as it relates to market timing and cost of gain. In year 1, the slaughter market was stronger at the earlier marketing dates than the later. In year 2, the choice carcass market remained relatively stable over all marketing dates. In both years, the choice-select price spread increased throughout the spring and was higher for the later market dates.

Regression procedures were also used to try to predict profitability from the initial data that were available each fall. Variables examined included initial weight, hip height, fat thickness and age; sire breed and dam breed; and whether the calves were creep fed, vaccinated or weaned prior to feedlot arrival. Only 11.5% of the variation in profitability could be explained using this information. In other words, we cannot use these variables to predict in the fall how profitable a retained ownership program will likely be. Factors such as market conditions, feedlot performance, and carcass merit are much more important in determining profitability.

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COMPARISON OF PRODUCTION EFFICIENCIES WHEN CALVES ARE FED IN SOUTH DAKOTA OR TEXAS

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Summary

South Dakota's reputation for harsh winters is frequently cited as a limitation to our competitiveness in cattle feeding. To help quantify the impact of climate on cattle feeding, heifers produced in western South Dakota were fed in eastern South Dakota or in the Texas panhandle. Heifer calves were obtained from two ranches, assembled at SDSU, and sorted into three similar groups. Group 1 remained at the SDSU feedlot, Group 2 was shipped half-way to Texas and returned to SDSU, and Group 3 was sent on to Texas for feeding. These groups allow consideration of climate and transit stress on feedlot performance. Similar diets, health programs, and implants were used at each location. The 144 heifers were started on test November 8, 1991, and slaughtered on May 14 (SD) and May 15, 1992 (TX). Cumulative average daily gain (3.01 lb) was similar among locations. Interim gains differed among locations as weather conditions varied. Heifers consumed 4% more (P<.05) feed and were 4.5% less (P<.05) efficient when fed in South Dakota. Final weights and carcass weights were similar after 188 days on feed. Acute disease problems only occurred in Groups 2 and 3. The lower feed prices in South Dakota and lower costs for trucking and health made feeding more profitable in South Dakota.

(Key Words: Cattle, Feedlot, Climate.)

Introduction

During the last two decades, cattle feeding has become concentrated in the southern high plains. The large increase in numbers of cattle on feed in that region has had a significant impact on the cattle feeding industry of the midwest. Iowa, Illinois and other eastern and central cornbelt states have experienced dramatic reductions in cattle feeding activity. Reducing the number of cattle fed in a region reduces demand for, and consequently the price of feed grains. Supply and packing industry activities decline as well. Iowa economists determined that in the early 1980's each steer fed in the state generated $1,000 in personal income when related industry activities were considered. Accordingly, any reduction in cattle feeding activity has a significant impact on the overall economy of a state or region.

South Dakota has not suffered the significant reduction in numbers of cattle fed other cornbelt states have experienced. Even so, our economy has been affected by prevailing regional trends. The area has experienced a reduction in packers and corn prices suffer from the decline in demand in this region. As a state, we currently export most of the feeder cattle and feed grains we produce. It is important for our economy that we identify factors that will reverse the trend of exporting our feeder calves and grains and the revenues they can generate to the southern high plains. Addressing these concerns before cattle feeding activity falls in South Dakota reflects prudent management. Iowa failed to address these concerns until after their industry collapsed. Now they have lost the infrastructure needed for rebuilding cattle numbers. The sporadic fluctuation in Iowa cattle feeding activity in recent years is indicative of the troubles they face in rebuilding.

The expertise, technological support and financing needed to feed cattle can be made available anywhere in the United States. Industry observers also

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realize that feeder cattle and packers can be moved. Feed supplies and environmental conditions are the factors that have the greatest impact on the competitiveness of cattle feeding. South Dakota has an excellent rating for the quantity and prices of feeds available. Unfortunately, the climate here is considered too harsh to accommodate efficient cattle feeding and this perception is affecting our industry. Much of today's cattle feeding activity is supported by second party investors that typically believe it is too cold to feed cattle in South Dakota. This concern must be addressed if South Dakota will successfully compete for the investment capital necessary for a healthy and growing cattle feeding industry.

Computer simulation modelling indicates that the climate in South Dakota is competitive with the climate in the southern plains. In the model, regional advantages shift as seasons change. During periods when the climate puts South Dakota at a disadvantage to the southern plains, it appears that lower grain prices in South Dakota can offset the costs associated with poorer feed efficiency. These are only projected results and actual production data are needed before arguments promoting cattle feeding in South Dakota can be effectively presented.

The experiment described here makes a direct evaluation of the production efficiencies when South Dakota calves are fed in Brookings, SD, or New Deal, TX. New Deal is in the Texas panhandle region where approximately 4 million head of cattle are on feed. By minimizing genetic, diet and management variation, we can develop a clear picture of the impact of climate in South Dakota on the economics of feeding cattle. This information will be useful to individual producers, corporate feeding operations and financial organizations that are currently discriminating against cattle feeding in our region.

Materials and Methods

Limousin x Angus and Charolais x Angus heifer calves were purchased from two ranches in western South Dakota and assembled at the South Dakota State University research feedlot. Heifers were eartagged, weighed, vaccinated for IBR, BVD, BRSV, H. somnus, PI_3, Clostridia spp and brucellosis; treated for internal and external parasites; and implanted with Synovex-H on November 7, 1991. The following day they were sorted into three groups of 48 head, balancing the ranch of origin and weight distribution in each group. On November 8, all heifers were weighed again and this represented the initial test weight. Group 1 heifers were then placed in 6 pens of 8 heifers at the SDSU feedlot. Group 2 heifers were loaded on a truck and shipped half way to the Texas destination before returning to the SDSU feedlot. Group 3 heifers were loaded on a second truck and shipped to the Texas Tech University research feedlot at New Deal, Texas. Shipment of Group 2 heifers was done to eliminate transit effects from climate comparisons. Transit time was 1,000 miles and took 23 hours for Groups 2 and 3.

Diets were standardized among locations. The receiving diet was fed for 31 days and abruptly switched to the finishing diet on day 32 (Table 1). Except during the step-up periods, feed was provided ad libitum. Individual weights and feed intakes were summarized 31, 60, 88, 116, 146 and 188 days after initial processing. These are represented as Periods 1 through 7 in subsequent discussions. The heifers were fed in pens of 8 head with solid concrete floors at SDSU. The Texas heifers were fed in pens of 6 or 8 head. The flooring was partially slatted concrete. Feeding was done once daily. Heifers were reimplanted with Synovex-H after 116 days.

Final weights were obtained on May 13 in South Dakota and May 14 in Texas. Heifers were slaughtered the day after final weights were obtained and carcass traits were noted for each group.

Data were analyzed as appropriate for a completely random designed experiment. All performance data were evaluated using mean data for each pen replicate. Statistical analysis was conducted using the GLM procedures of SAS. Mean separation tests were made using Duncan's New Multiple Range tests.

Results and Discussion

One heifer from Group 1 died of bloat after 39 days on feed. One heifer from Group 2 died of broncho pneumonia 15 days after initial weights were taken. A second heifer was eventually removed (March 3) from the same pen for apparent chronic lung

Table 1. Feedlot diets used for comparing climatic effects on feedlot performance of heifers

	Diet[a]	
Ingredient	Receiving[b]	Finishing[c]
Alfalfa, %	15.00	-
Corn silage, %	40.00	13.00
Cracked corn, %	32.77	26.22
Whole shelled corn, %	-	50.00
Molasses, %	2.75	2.75
Soybean meal, %[d]	8.88	6.42
Calcium carbonate, %[d]	.25	1.11
Potassium chloride, %[d]		.25
Trace mineralized salt, %[d]	.35	.25
Crude protein, %	13.74	12.00
NE_m, Mcal/cwt	81.4	93.7
NE_G, Mcal/cwt	51.0	62.6

[a] Dry matter basis.
[b] Provided 1,000 IU vitamin A/lb diet.
[c] Provided 1,000 IU vitamin A/lb, 27 g monensin/T and 10 g tylosin/T.
[d] Included as a pelleted supplement containing feed additives (except AS-700).

problems. One heifer was removed from Group 3 for similar reasons.

Heifers shipped 1,000 miles exhibited a 4.6% body weight shrink and all of the chronic or terminal respiratory problems were associated with these groups. The lower initial 31-day average daily gain (ADG) for shipped heifers indicates that they did not fully recover this shrink during the initial month on feed (Table 2). The ADG shown is based on preshipment body weights. If postshipment body weights are used, the ADG during Period 1 was 4.63 and 3.84 ($P<.05$) for Groups 2 and 3, respectively.

During winter months, heifers fed in South Dakota consumed more feed ($P<.05$) than the heifers fed in Texas (Table 2). Interim ADG fluctuated during these periods. Gains were better ($P<.05$) in South Dakota during December but poorer ($P<.05$) in March. Overall, gains were similar between locations and feed efficiency was 4.5% better when cattle were fed in Texas (Table 3). These results are similar to previous computer simulations. It is important to recognize that pen conditions in South Dakota were much poorer than usual in March. The South Dakota pens were concrete, but the manure pack was reduced to a sloppy consistency that could not be cleaned for an extended period of time. As a result, heifers were particularly wet and cold during this period.

In May, conditions became extremely hot in South Dakota and cattle showed signs of heat stress including a decline in feed intake. This caused feed conversion to worsen in Periods 6 and 7 and probably contributed to lower quality grades. Local packers found that cattle were grading 35 to 40% choice during this period.

These results show a slight advantage in biological production efficiencies when cattle are fed in

Table 2. Feedlot performance patterns for heifers fed in South Dakota or Texas

Item	Group 1	Group 2	Group 3
Period 1 November 9 - December 9			
Average daily gain	4.10[a]	3.79[b]	3.06[c]
Dry matter intake	15.07[ab]	14.58[a]	15.50[b]
Feed/gain	3.68[a]	3.86[a]	5.10[b]
Period 2 December 10 - January 6			
Average daily gain	3.92[a]	3.76[a]	2.38[b]
Dry matter intake	17.52[a]	16.63[a]	14.65[b]
Feed/gain	4.53[a]	4.45[a]	6.19[b]
Period 3 January 7 - February 3			
Average daily gain	2.99	3.23	3.45
Dry matter intake	20.61[a]	19.82[ab]	18.10[b]
Feed/gain	7.03[a]	6.21[ab]	5.37[b]
Period 4 February 4 - March 2			
Average daily gain	2.93	2.65	2.47
Dry matter intake	20.67[a]	19.70[a]	17.72[b]
Feed/gain	7.25	7.61	7.41
Period 5 March 3 - March 30			
Average daily gain	2.33[a]	2.56[a]	3.60[b]
Dry matter intake	19.81[a]	19.00[ab]	18.10[b]
Feed/gain	8.82[a]	7.56[a]	5.10[b]
Period 6 March 31 - April 27			
Average daily gain	2.15[a]	2.42[a]	3.30[b]
Dry matter intake	20.73	20.22	20.02
Feed/gain	9.68[a]	8.91[a]	6.24[b]
Period 7 April 28 - May 13			
Average daily gain	2.06	2.57	2.61
Dry matter intake	18.80[a]	19.08[a]	21.15[b]
Feed/gain	9.74	8.18	8.41

[a,b,c] Means without common superscripts differ ($P<.05$).

Table 3. Cumulative effect of shipping and climate on the feedlot performance of heifers

Item	Group 1	Group 2	Group 3
Initial weight, lb	546	550	545
Off-truck weight, lb	-	527	521
Shrink, %	-	4.73	4.45
1-188 day			
Average daily gain, lb	3.01	3.04	3.01
Dry matter intake, lb	18.95[a]	18.31[ab]	17.64[b]
Feed/gain	6.30[a]	6.03[ab]	5.88[b]
Final weight	1109	1118	1107
Carcass weight, lb	674	686	674
Dressing percent	60.8	61.4	60.9
Percent choice	55	50	74
Yield grade 1, %	-	4	-
Yield grade 2, %	38	46	33
Yield grade 3, %	57	48	16
Yield grade 4, %	5	2	-

[a,b] Means without common superscripts differ (P<.05).

Texas. Cattle grew as rapidly in South Dakota but required slightly more feed per pound of gain. Economic efficiency should be considered when making these comparisons. The 4.5% difference in feed/gain could be offset if diets cost 4.5% less in South Dakota. Corn prices are typically 10 to 15% lower in South Dakota than they are in Texas, more than offsetting the cost of poorer feed conversions.

The winter of 1991 was warmer and muddier than typical for eastern South Dakota. Coupled with the hot spring, this may have been the poorest feeding conditions we have experienced in several years. To obtain a truer comparison of environmental effects on competitiveness in cattle feeding, this research should be repeated. The pens used in this study had a concrete base. Most of the cattle pens in the plains states have an earthen base. Both of the facilities used in this research now have earthen pens to simulate a more typical feedlot environment. In pursuing additional climatic data, the use of earthen pens would strengthen the applicability of results.

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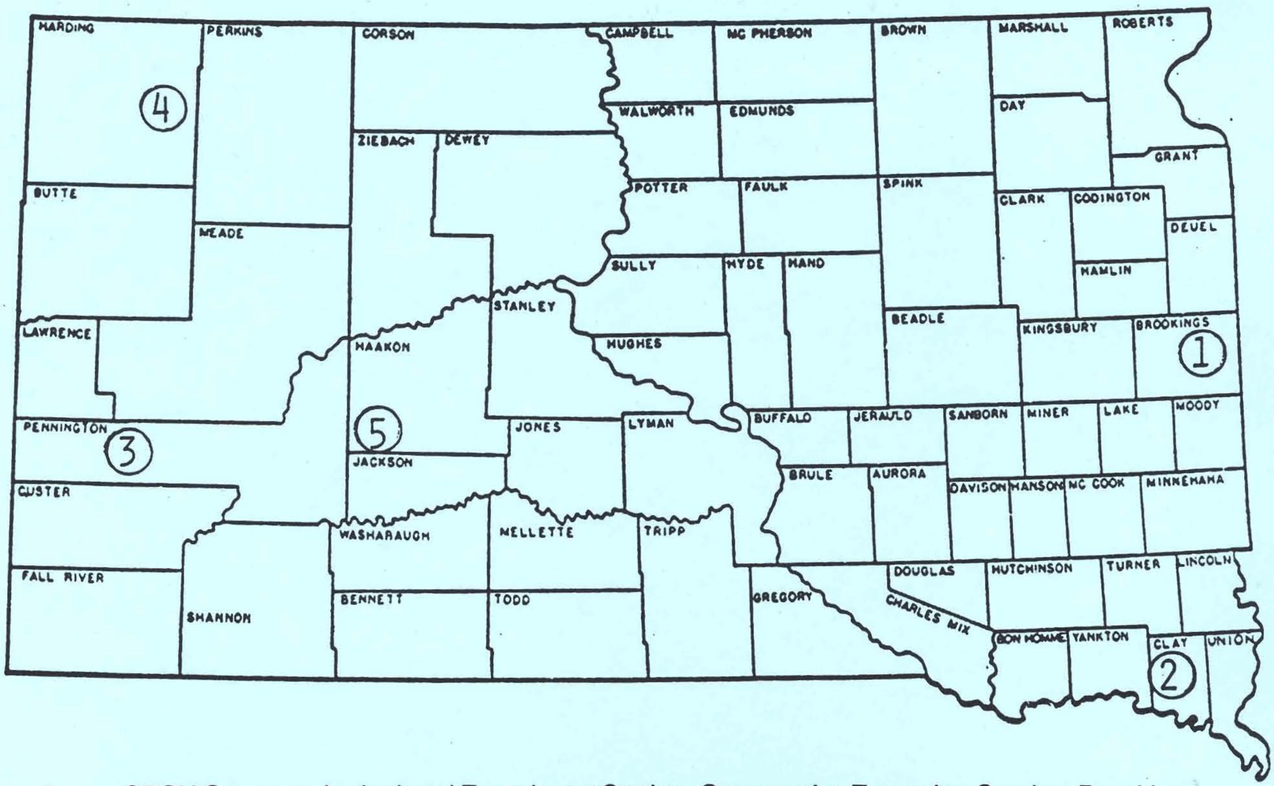
IMC, Pitman-Moore, Inc., Terre Haute, IN
MacKenzie Associates, Roundhill, VA
Merck and Company, MSDAGVET, Rahway, NJ
Purina Mills, Inc., St. Louis, MO
R and L Feedyard, Kimball, SD
Roche Animal Health, Nutley, NJ
Select Sires, Inc., Plain City, OH
Sioux Falls Stockyards, Sioux Falls, SD
Southeast SD Experiment Farm Corporation
SD Beef Cattle Improvement Association
SD Cattlemen's Association
SD Corn Utilization Council
SD Livestock Foundation
SD Stockgrowers Association
SD Veterinary Medical Association
Syntex Animal Health, Des Moines, IA
Tri County State Bank, Kimball, SD
21st Century Genetics, Shawano, WI

ANIMAL AND RANGE SCIENCES
RESEARCH AND EXTENSION UNITS



1. SDSU Campus, Agricultural Experiment Station, Cooperative Extension Service, Brookings.

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

3. West River Agricultural Research and Extension Center, Rapid City
   Professional research and extension staff in Animal and Range Sciences, Plant Science, Economics, 4-H and Extension Administration.

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

5. Range and Livestock Research Station, Philip
   Range beef nutrition * Herd management * Range management.

These research and extension units are geographically located in South Dakota to help solve problems, bring the results of livestock and range research to the user, enhance the statewide teaching effectiveness of the Animal and Range Sciences Department staff and maintain a close and productive relationship with South Dakota producers and our agri-business community.

THE STATE OF SOUTH DAKOTA
IS
OUR CAMPUS * OUR RESEARCH LAB * OUR CLASSROOM

South Dakota State University, Animal and Range Sciences Department