SECTION II

LIVESTOCK FEEDING, BREEDING AND MANAGEMENT TRIALS

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SECTION II

DRYLOT WINTERING OF PREGNANT BEEF COWS SUPPLEMENTED WITH EITHER A 12% CRUDE PROTEIN HEAT PROCESSED MOLASSES BLOCK OR DRY ROLLED BARLEY

By
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INTRODUCTION:

Beef cows wintered in North Dakota are commonly fed a limited amount of locally grown roughage and grain to reduce wintering feed costs, which are one of the major expenses in a cow-calf enterprise.

When good quality feed is adequate, cows can usually be wintered without additional energy or protein supplementation. However, when forage supplies are short due to drought or other natural disasters, or when straw and other low quality feeds are used in the ration, it generally becomes necessary to feed supplemental protein and/or energy to meet the nutrient requirements of the cow and the growing fetus. When supplementation is necessary, the livestock producer has a wide array of supplements to select from. These include: feed grains processed on the farm, and commercial fortified grain based range cake, feed blocks, liquid molasses supplements, and large controlled release heat processed molasses blocks, which have recently become popular among livestock producers.

Beet molasses, a by-product of sugar beet processing, contains more TDN than cane molasses (79 vs 72% for ruminants) and more crude protein (8.5 vs 5.8%) (NRC, 1984). The crude protein difference is due in part to processing additives used in sugar extraction from sugar beets, but the invert sugar levels of beet and cane molasses are very comparable making the feeding value of cane and beet molasses essentially the same (Shirley, 1986). The feed manufacturing industry uses molasses extensively, as an appetizer, to reduce dust, as a pelleting binder, as an energy source, and to stimulate rumen microbial activity. Plain molasses has been fed in open troughs to ruminants, but most commonly has been used as a liquid feed carrier for protein, vitamins, and minerals. Liquid feeding has lost popularity under range and drylot conditions because it requires specialized equipment for transporting, unloading, and feeding. The crystal-line blend of molasses sugars found in the 12% protein heat processed molasses block (12% HPM Block) have been developed through a dehydration process that produces a fortified molasses supplement that is high in dry matter, weather resistant, and convenient to feed without specialized equipment.

The 12% HPM Block being evaluated in this study is a blend of beet molasses solids, all natural protein, minerals and vitamins. It is designed to be self fed to beef cattle and is promoted to improve roughage utilization, produce stronger, healthier calves, improve hair coats, and requires minimum labor to feed.

In the present investigation, the 12% HPM Block was evaluated under drylot wintering conditions where nutrient intake was restricted to NRC recommendations (NRC, 1986) plus a 10% increase to compensate for North Dakota winters. Objectives of the study are to document the nutritional value of the 12% HPM Block based on body weight and condition score changes during the wintering period. In addition, calf birth weight, calf survival, and economics of supplementation we compared to unsupplemented control cows and cows supplemented with dry rolled barley.

PROCEDURE:

Ninety crossbred Angus x Hereford and Hereford cows averaging 1230 pounds were randomly allotted to one of three treatments in a completely randomized design. **Treatment one** served as the nonsupplemented control group. **Treatment two** received the 12% HPM Block free choice and **treatment three** received dry rolled barley as energy supplements. Cows were divided within treatments into five replicates of six cows each making a total of thirty cows in each treatment. Allottment criteria included each cow's 1988 Most Probable Producing Ability (MPPA) value, weight, age, and condition score.

Cows in each treatment were fed corn silage, wheat straw, alfalfa, phosphorous supplement from sodium phosphate, trace mineral salt and vitamins A, D, and E (Table 1). To measure the nutritional value of each supplement type, the rations were formulated to contain the same nutrient density as the basal ration plus the added energy and protein available from each of the supplements. The complete mixed rations used were blended with an Arts-Way, 800-A, Silo-Mix wagon equipped with and electronic scale. The 12% HPM Blocks were weighed before placement into each lot and the empty containers were weighed back. The blocks were weighed weekly to monitor consumption. It was found that free choice access to the block by cows that were on a limited intake ration resulted in consumption beyond the .5 to 1 pound per day level that is recommended. Therefore, access to the block was restricted to four hours per day. Then, based on the amount of molasses block dry matter consumed, the amount of barley supplement intake was adjusted to equal the intake of the 12% HPM Block.

Body weight change due to supplement type was obtained by measuring the difference between each cow's starting weight and her weight 12–16 hours after calving. After weighing and processing of the calf was completed, the cow-calf pair was transferred to post calving pastures.

Body condition score was used to estimate changes in external fat cover. Each cow was scored twice during the study. The first score was taken at the start of the study, and the second was made as each cow and calf were processed after calving using a scoring system of 1 to 9, where a cow scoring "1" was considered emaciated, "5" average, and "9" obese.

Statistical analysis was conducted with MSUSTAT (version 4.10). Using MSUSTAT, cow weight gains, body condition score, and calf birth weight data were subjected to a one-way analysis of variance, and significance of differences between treatment means were determined by the Student's test.

RESULTS AND DISCUSSION:

Ninety crossbred Angus x Hereford and Hereford cows were used in a winter supplementation study to evaluate the nutritional value of an experimental 12% heat processed molasses block (12% HPM Block) when compared to un supplemented control cows and cows supplemented with dry rolled barley.

The percent dry matter composition of the control and experimental diets are shown in Table 1, and weights, gains, condition score, calf survival and feed consumption are shown in Table 2. Total dry matter consumption for cows fed the control diet was 22.8 pounds/day, and those cows that received either the 12% HPM Block or dry rolled barley consumed 24.3 pounds of dry matter per day. Since the cows in this study were wintered on restricted intake diets, no attempt was made to evaluate supplementation effects on total dry matter intake. To document differences in nutritional value of the two supplements, daily dry matter intake of 12% HPM Block and dry rolled barley were held nearly constant at 1.35 and 1.32 pounds /head, respectively, which in the case of the 12% HPM Block, was approximately .5 pound more than label recommendations.

Body weight change and condition score were used to document the nutritional value of the 12% HPM Block and dry rolled barley as wintering supplements. When compared to control cows, which lost the average 34.7 pounds/head during the wintering period, cows supplemented with the 12% HPM Block lost 1.5 pounds/head. Those cows that received dry rolled barley gained 15.6 pounds/head. Statistically, cows supplemented with dry rolled barley gained significantly more ($P < .01$) than cows receiving the control diet. However, when cow gains between the 12% HPM Block and dry rolled barley supplemented groups were analyzed, no statistical difference was measured. Therefore, supplementation with the 12% HPM Block resulted in gains that were equal to both the barley supplemented and control cows.

Condition score, measured at the start of the study and as each cow calved, fluctuated as body weight changed as shown in Table 2. External fat cover in the unsupplemented control cows was significantly less than either of the supplemented groups ($P < .01$). Cows supplemented with barley possessed slightly better condition than those receiving the 12% HPM Block but the difference was not significant, indicating that the effective change on external fat cover was similar for both supplements.

There was no difference in calf birth weight or survival between treatments.

Wintering economics was evaluated for each of the supplement types. Feed ingredient costs used per unit of dry matter, and the processing charge are shown in Table 1. Daily feed consumption, and feeding economics are shown in Table 2. When compared to the control cows, supplementing with dry rolled barley cost an additional $11.00 per cow, while supplementing with 12% HPM Block cost an additional $25.09 per cow. When compared to the barley supplemented cows, using the 12% HPM Block cost an additional $14.09 per cow.

In conclusion, supplementation with the 12% protein HPM Blocks resulted in nearly equal animal response when compared to supplementation with dry rolled barley. Whether animal performance would be improved by continuous access, instead of limited access, to the 12% HPM Block was not addressed in this trial, but remains a question for further study.

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Table 1. Ingredient cost/pound and ration percent dry matter composition.

	Int'l Feed No.	Ingredient cost / lb.	Control	12 % HPM Block	Barley
Corn Silage	3-02-819	.0400	52.4	49.5	49.4
Wheat Straw	1-05-175	.0250	15.2	14.4	14.3
Alfalfa Hay	1-00-071	.0550	20.4	19.2	19.5
Alfalfa Cubes	1-00-059	.0550	11.1	10.3	10.4
12% HPM Block		.1990		5.8	
Barley	4-00-549	.0479			5.4
Sodium Phosphate	6-04-287	.4306	.50	.41	.48
T. Min. Salt 1/		.0650	.4	.41	.41
Vit. A, D, & E 2/		.4534	.028		.026
Ration Processing		.0125			

1/ Trace mineral salt contained: NaCl, 98.6%; Mg, .35%; Zn, .35%; Mn, .026%; Fe, .21%; Cu, .03%; I, .011%; Co, .011%

2/ Vitamin A, D, & E additive contained: vitamin A, 5,000,000 USP units/lb.; vitamin D_3, 1,000,000 USP units/lb.; vitamin E, 500 USP units/lb.

Table 2. Mean weights, gains, condition score, calf birth weight, feed consumption and feeding economics for cows supplemented during wintering with either a 12% HPM Block or dry rolled barley

Treatments:	Control	12% HPM Block	Dry Rolled Barley	SE1/
Gains:				
No. Head	30	30	30	
Days Fed	85.3	86.6	87.7	
Starting wt., lbs.	1231.2	1232.0	1226.0	
Post calving wt., lbs.	1196.5	1230.5	1241.6	
Net gain or loss, lbs. 2/	-34.7^{a}	-1.5^{a}b	15.6^{b}	10.55
LSD: 45.6 lbs.				
Condition Score:				
Initial score	5.28	5.38	5.22	
Post calving score	4.75	5.38	5.38	
Score change 2/	$-.53^{a}$	0.0^{b}	$.16^{b}$	.44
LSD: .30				
Birth Weight:	96.8	94.2	96.2	2.2
LSD: 9.6 lbs.				
Daily Feed Consumption/Head:				
Corn Silage	11.9	12.07	12.00	
Wheat Straw	3.5	3.51	3.48	
Alfalfa	4.65	4.69	4.74	
Alfalfa Cubes	2.52	2.50	2.51	
12% HPM Block		1.35		
Barley			1.32	
Sod. tripoly phosphate	.114	.10	.118	
Trace Min. Salt	.099	.10	.10	
Vitamin A, D, & E	.006		.006	
Total Feed/hd./da., lbs.	22.79	24.31	24.27	
Feeding Economics/Head:				
Feed / hd., lbs.	1947.0	2108.0	2130.0	
Feed cost / cwt., $	5.71	6.47	5.74	
Feed cost / hd., $	111.21	136.30	122.21	
Feed cost / hd. / da., $	1.30	1.57	1.39	
1/ Standard error for mean.				
2/ Values with unlike superscripts differ significantly (P .01)				

IVOMEC^R AND A TOTALAN^R/WARBEX^R COMBINATION COMPARED FOR PARSITE CONTROL IN BACKGROUNDED FEEDLOT HEIFERS

By

D. G. Landblom and J. L. Nelson

INTRODUCTION:

Livestock producers are encouraged through media advertisements to include routine treatments for internal and external parasites as part of their animal health programs. These advertisements always promise a profitable return per dollar invested when used as directed. However, it is questionable whether the promoters claims hold true for all situations and locations. Invomec^R, isolated from the fermentation of Streptomyces avermitilis, and Totalon^R, which is a systemic pour-on formulation of the compound levamisole, are two new worming products that have been highly promoted.

Ivomec, a revolutionary new compound, is a broad spectrum parasiticide that controls gastrointestinal roundworms, lungworms, grubs, lice, and mange mites that cause scabies in cattle. Totalon, a new formulation of the old compound levamisole, does not possess the broad spectrum of Ivomec, but does control gastrointestinal roundworms and lungworms. Warbex, also a reliable systemic pour-on that has been available for many years, controls grubs and lice. When Warbex is used in combination with Totalon the spectrum of parasiticide coverage is nearly as broad as that of Ivomec with the exception of scabies mites, which are not controlled.

Several research investigations using a variety of anthelmentics have been conducted at this station and at other locations in North Dakota and have resulted in no advantage for routine worming (Anderson, 1987, Andrews et al., 1984 Landblom and Nelson, 1985, Landblom et al., 1985a and Stromberg, 1984). Ivomec, however, has been tested in cow/calf pairs in cooperator herds and a significant increase in calf weaning weight was reported (Wohlgemuth et al., 1987). In addition to the encouraging results reported by Wohlgemuth (1987) with Ivomec, it has been suggested by some parasitologists that Ivomec may also possess an unidentified growth promoting property as well as its ability to control parasites, particularly the fourth state larvae of Ostertagia ostertagi.

The purpose of this investigation is to evaluate the efficacy, and growth and feed efficiency, potential growth promoting effects, and to document the economics of using a single treatment of Ivomec when compared to a Totalon/Warbex combination treatment in background heifer calves.

PROCEDURE:

Ninety crossbred Charolais X Angus X Hereford heifer calves weighing approximately 600 pounds, and raised at the Dickinson Experiment Station, were randomly allotted in a 2x3x3 factorial arrangement. The heifers were treated with either Ivomec or a Totalon/Warbex combination and were compared to untreated controls. Each treatment group was further subdivided into light, medium, and heavyweight classes to sort out potential interactions between year, weight, class, and worming treatment. The starting weight class groupings were as follows: Light – 560 pounds, medium – 610 pounds, and heavyweight – 648 pounds.

Before the investigation began, all calves in each treatment were fecal sampled to determine the baseline level of worm egg and coccidia oocyst shedding, and worm species distribution. Each treatment was further fecal sampled at each 28-day weight period during the study.

Heifer calves treated with the Totalon/Warbex combination received 2.5 cc. of Totalon per 110 pounds of body weight, which was poured along the midline of the back according to the manufacturers recommendations. The Warbex was also poured along the midline of the back but at the rate of 3 oz. / head. Ivomec treated heifers were injected subcutaneously with 1 cc. for each 110 pounds of body weight. Dosage rate was calculated using the average weight of the calves in each weight class. The control calves did not receive wormer, but did receive Warbex to control lice during the first year. Treatment was not necessary the second year.

In addition to the worming treatments, the heifers were given a 7-way Clostridium booster vaccination, and had been previously double vaccinated with a killed bacterin for IBR, and PI_3.

Feed ingredients used and ration nutrient analysis for diets fed during each year of the study are shown in Table 1. Drought conditions in 1988 required adjustments in the type of hay used during the second year, but did not result in appreciable changes in nutrient density. In addition to the change in hay type, 200 mg / head of Rumensin[R] supplement was added to avoid potential bloat problems. Complete mixed rations were used that were blended in an Arts-Way, 800-A, Silo-Mix mixing wagon equipped with an electronic scale. When feed bunks were filled, all pens received an equally uniform portion from each batch mixed to minimize potential mixing variables between batches.

RESULTS AND DISCUSSION:

This experiment was initiated in 1988 and repeated in 1989 to increase confidence in the results obtained during the first year of the study. Each heifer calf was fecal sampled before worming treatments were administered. A large variation in worm and coccidia oocyst shedding was measured between years, as shown in Table 3. In contrast to 1988, when worm egg shedding ranged from 15 to 34 epg of feces, egg shedding in 1989 was nearly zero in all calves for the following common genuses: Ostertagis, Nematodirus, Cooperia, Trichuris, Oesophagostomum, Haemonchus, and Trichostrongylus. Coccidia oocyst shedding follow the same pattern as worm egg shedding, and ranged from 567 to 1233 epg of feces during the first year followed by a range of 24 to 78 epg of feces the second year.

The large yearly variation in worm egg and coccidia oocyst shedding was related to the level of parasite infestation, and was brought on by the drought of 1988. Extremely dry conditions interrupted larvae development. Normally, worm eggs hatch shortly after they are passed in the feces and become infective within approximately five days. When conditions are unfavorable, such as during the 1988 drought, the embryonated eggs remain dormant until a moist microenvironment becomes reestablished. Reestablishment of a proper microenvironment for larvae to become infective never occurred during the 1988 grazing season.

Heifer backgrounding gain and feed efficiency are shown in Table 2. Initially, the weight gain data were analyzed as a 2x3x3 factorial arrangement to test for main effects and interactions between year x weight class, year x treatment, weight class x treatment, and year x weight class x treatment. Finding no interaction differences, the data were combined and subjected to a one-way analysis of variance using the microcomputer statistical package MSUSTAT (version 4.10). Compared to the control heifers treated with a Totalon/Warbex combination gain 4.8 pounds more per head, and those treated with Ivomec gained 10.3 pounds more per head. While there was a trend toward better gains by using Ivomec, the 10.3-pound difference was not significant (P .01). There was also no difference in feed efficiency between treatments. Based on these data, it is not possible to pin point any effect on animal performance from an unidentified growth factor as has been suggested by some parasitologists.

A partial marketing analysis has been developed and is included in Table 2. In this model heifer calves were purchased at $83.00/cwt and sold at $73.50/cwt. After feed cost, feeder calf expense, and parasite treatment costs were deducted from gross returns, net returns differed very little. When compared to the control heifers, treating with the Totalon/Warbex combinations returned $1.19 more per head, which is $2.16 less than the cost of treatment.

In conclusion, these data show that both types of anthelmentics effectively reduced worm egg shedding to very low levels, but had no effect on coccidia oocyst shedding. The data also points out that even though there was a large variation in egg shedding between years, there was no difference in gain performance between years, treatments or weight classes, and that net returns were not great enough to offset the cost of treatment. Finally, it is apparent that the level of parasitism encountered either year was not of sufficient magnitude to cause a depression in animal performance.

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Table 1. As fed complete mixed backgrounding rations fed each year comparing Ivomec and Totalon/Warbex combination.

	Percent (As Fed)	
Ingredients:	**1988**	**1989**
Corn Silage	35.1	45.3
Mixed Hay	28.0	----
Alfalfa	9.76	16.1
Barley	26.7	36.9
Dicalcium phosphate	.17	.31
Trace mineral salt	.17	.31
Vitamin A, D, & E	.038	-------
Rumensin 600 supplement	-------	1.09
	100.28%	100.01%
Nutrient Analysis:		
Crude Protein		
As Fed	7.65%	8.63%
Moisture Free	11.10%	13.80%
Calcium		
As Fed	0.47%	0.31%
Moisture Free	0.68%	0.49%
Phosphorus		
As Fed	0.28%	0.22%
Moisture Free	0.41%	0.35%
Ration Dry Matter	68.90%	62.50%

Table 2. Mean backgrounding gain performance, feed efficiency, feeding economics, and marketing analysis among heifers treated with either Ivomec or a Totalon/Warbex combination.

	Control	Totalon/ Warbex	Ivomec	SE 1/
Gain Performance:				
No. Head	30	30	30	
Days Fed	112	112	112	
Initial Wt., lbs.	599.0	601.2	601.9	
Final Wt., lbs.	855.5	862.5	868.7	
Gain, lbs.	256.5	261.3	266.8	
ADG, lbs. 2/	2.29	2.33	2.38	.1089
LSD: 45 lbs. / day				
Feed Efficiency:				
Feed /head, lbs.	3196.0	3216.0	3284.0	
Feed/head/day, lbs.	28.5	28.7	29.3	
Feed/lbs. of gain, lbs.	12.4	12.3	12.3	
Feeding Economics:				
Feed Cost/head, $	120.40	121.61	123.62	
Feed Cost/day, $	1.08	1.09	1.10	
Feed Cost/lb. of gain $	.4635	.4678	.4583	
Feed Cost/cwt. Of gain $	45.36	46.78	45.83	
Marketing Analysis:				
Gross Return ($89.80/cwt) $	628.79	633.93	638.49	
Partial Expenses:				
Heifer Cost ($80.00/cwt.) $	497.17	499.00	499.58	
Feed Cost/Head, $	120.40	121.61	123.62	
Parasite Treatment Cost:				
Warbex, $	.47	.47		
Totalon, $		2.27		
Ivomec, $			3.35	
Total Expenses	618.04	623.35	626.55	
Net gain or loss, $	10.75	10.58	11.94	
Net return difference, $		-.17	1.19	
1/ Standard error for mean.				
2/ Gains did not differ significantly (P. 01).				

Table 3. **Mean pre and post treatment effects on worm egg and coccidia Oocyst egg shedding. 1988 & 1989**

Year & Month Sampled	Control	Totalon/Warbex	Ivomec
	Worm Egg Shedding, epg		
1988			
Pretreatment (December)	32.0	23.7	14.7
January	51.0	0.5	2.7
February	32.0	0.4	3.3
March	40.0	1.2	2.5
April	21.0	3.8	2.3
1989			
Pretreatment (December)	0.8	0.8	4.4
December	0.0	0.0	0.0
January	0.0	0.4	0.0
February	0.8	0.0	0.8
March	0.0	0.0	0.0
	Coccidia Oocyst Shedding, epg		
1988			
Pretreatment (December)	633.0	1233.0	567.0
January	141.0	143.0	83.0
February	117.0	37.0	25.0
March	173.0	151.0	94.0
April	35.0	51.0	35.0
1989			
Pretreatment (December)	76.0	24.0	78.8
December	0.0	0.7	0.0
January	0.0	0.0	0.0
February	0.0	0.0	0.0
March	0.0	0.0	0.7

EFFECT OF ARTIFICIAL FIBER ON FEEDLOT PERFORMANCE OF STEERS FED A HIGH BARLEY DIET

By
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INTRODUCTION:

The benefit of feeding high levels of barley to feedlot cattle has been well documented by Dinusson et al, (1962). However, feeding high grain diets to feedlot cattle for extended periods of time often results in digestive disorders such as chronic acidosis, rumenitis, parakeratosis and liver abscesses. These disorders often result in reduced cattle performance particularly towards the end of the feeding period. Acidosis is caused by the inability of the animal to adequately buffer the large quantity of acid produced in rumen during the fermentation of grains. Rumenitis and parakeratosis result from an excessively acid rumen environment and lack of physical abrasion normally provided by hay or other fiberous feeds. During rumenitis, the rumen wall loses it integrity thus allowing entry of bacteria into the animals body. These bacteria eventually cause liver abscesses which reduce cattle performance and carcass value.

The objective of this trial is to document the effects of placing artificial fiber (plastic pot scrubbers) into the rumen of steers fed an all barley diet.

The plastic pot scrubbers have been reported to improve both daily gains and feed efficiency of steers fed a 100% high moisture corn diet by Ohio Animal Scientist, Dr. Steve Loerch (1981).

EXPERIMENTAL PROCEDURE:

On November 10, 1988, thirty-six crossbred steers with an average weight of 650-700 pounds were started on a feedlot performance trial scheduled to run for a minimum of 100 days. The steers were blocked into three weight groups and randomly assigned within blocks to: a pot scrubber treatment of an all barley ration plus artificial fiber, or a control treatment of 85% barley plus corn silage.

Rations were formulated to promote gains of 3 pounds per head per day using a computer program developed by the University of Minnesota and are shown in Table 1a. Actual feed consumed is shown in Table 1b.

Both rations were supplemented with monensin sodium (Rumensin^R), sodium bicarbonate, minerals and vitamins. All steers received a Compudose ear implant and were treated with Lysoff^R for louse control. They had been vaccinated for common feedlot diseases using a 3-way (Triangle 3) and a 7-way (Electroid 7) vaccine prior to the start of the trial.

During the first 29 days, the steers were fed increasing levels of barley. On December 9, the 18 head of treatment steers were dosed with eight plastic pot scrubbers per steer. The Tuffy^R brand scrubbers were compressed into an approximately 1 inch diameter x 4 inch long cylinder, wrapped with masking tape and placed in the rumen through the esophagus using a speculum and a wooden dowel rod. The scrubbers were coated with mineral oil to make them easier for the steers to swallow. The steers were housed in 32’x64’ outdoor pens equipped with a slotted fence windbreak on the north and west sides. Each pen was equipped with an automatic waterer and 16 feet of concrete feed bunk.

Feed was prepared using a roller mill to dry roll the barley and a mixing wagon equipped with electronic scales. Feed was available continuously in the bunks and fresh feed was added every 3-5 days. Stale, rejected feed was removed on a regular basis and subtracted from the total amount fed. Initial and final steer weights were calculated as the average of two day weights, with the interim weights taken at 28 day intervals. At the conclusion of the trial, the steers were hauled approximately 25 miles to Dickinson, ND and sold at auction. The performance data were analyzed by AOV procedures for a completely randomized design using the MSUSTAT computer program developed at Montana State University.

Results of this trial are summarized in Tables 2 and 3. Two steers from the treatment group were lost due to acute bloat on February 9, and February 16. An autopsy indicated that in the second case, a pot scrubber had been responsible for the bloat condition by physically blocking the elimination of rumen gas.

Except for the two cases of bloat, the steers remained in good health throughout the trial.

Feed efficiency appeared to be improved by approximately 15% on all the barley plus pot scrubber ration. Cost of feeding varied from $40.38 to $53.16/cwt gain depending on whether or not a $25/T processing charge was added to the ration. Without the processing charge, the cost per cwt of gain was 36 cents more using the pot scrubbers ($40.74 vs $40.38). However, with the added charge for processing the advantage of $1.59 favors the pot scrubbers treatment, $51.75 vs $53.16

It appears from this preliminary work, that the "pot scrubber" idea is valid and produced results similar to the Ohio study.

Future work needs to determine the minimum number of pot scrubbers necessary to maintain a healthy rumen. Also, feed intake could be enhanced and labor reduced if a well designed self-feeder were used. This would minimize waste and keep the feed fresher, more palatable. The feeding of tempered or steam rolled barley might help minimize the incidence of bloat but would increase the cost of processing feed.

Also, a device is needed that will compress the pot scrubbers into a neat "bolus" what would be small and easily placed in the rumen.

SUMMARY:

Steers fed an all barley ration and given eight plastic "pot scrubbers" intra-rumenally as a source of artificial fiber had similar gain but were 15% more feed efficient than steers fed a comparable diet but with corn silage providing the bulk or roughage.

Feed intake and feedlot health appeared normal throughout the trial, however, two steers with the pot scrubbers died of acute bloat.

Additional work is needed to better evaluate the use of pot scrubbers in high barley rations, but they appear to have promise as a source of artificial fiber.

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Table 1A Calculated Rations For The Artificial Fiber Trial.

	Pot Scrubber Treatment	Control
Ingredient	**Percent**	**Percent**
Barley	95.6	82.8
Corn Silage	----	13.8
Limestone	1.5	0.93
Sodium Bicarbonate	0.75	0.68
RM600 1/	2.00	1.80
Vitamin A, D, & E 2/	0.07	0.06
Total	**100%**	**100%**
Estimated		
Dry Matter	88.5	81.1
TDN	79.8	79.1
Crude Protein	13.1	12.8

1/ GTA RM600 provides 1200 grams of monensin sodium per ton.

2/ GTA Quin ADE proves 5 million I.U. Vitamin A, 1million I.U. Vitamin D_3, and 500 I.U. Vitamin D per pound.

Table 1B. Actual Pounds of Feed Fed During the Trial

	Pot Scrubber Percent	Control
First 29 Days **November 10 – December 9**		
Average Pounds Feed/Day (as fed)		
Barley	13.2	14.4
Alfalfa	6.0	6.3
Corn Silage	20.9	17.2
Salt	0.12	0.13
Di Calcium Phosphate	0.12	0.13
RM600	0.24	0.27
Total	**40.58**	**38.43**
Last 81 Days **December 9 – February 28**		
Average Pounds Feed/Day (as fed)		
Barley	15.6	15.9
Alfalfa	----	-----
Corn Silage	----	8.1
Salt	0.08	0.09
Di Calcium Phosphate	----	----
RM600	0.33	0.38
Limestone ($CaCO_3$)	0.16	0.19
Sodium Bicarbonate ($NaCO_2$)	0.26	0.10
Vitamins	0.012	0.013
Total	**16.44**	**24.8**
110 Day Total **November 10 – February 28**		
Average Pound Feed/Day (as fed)		
Barley	14.95	15.5
Alfalfa	1.59	1.67
Corn Silage	5.53	10.25
Salt	0.09	0.10
Di Calcium Phosphate	0.03	0.034
RM600	0.31	0.35
Limestone ($CaCO_3$)	0.12	0.14
Sodium Bicarbonate ($NaCO_2$)	0.19	0.08
Vitamins	0.008	0.009
Total	**22.82**	**28.13**

Table 2. Effects of the "Pot Scrubbers: on Feedlot Performance

	Pot Scrubber Treatment	Control
Number Fed	16	18
Days on Feed	110	110
Total Animal Days	1760	1980
Initial Weight		
Total	11,028	12,348
Average	689.3	686
Final Weight	15,664	17,849
Average	979	991.6
Weight Gain		
Total	4,636	5,501
Average	289.7	305.6
Difference 1/		+ 15.9
Average Daily Gain	2.63	2.78
1/ No significant difference in gains. Standard Error for Mean – 13.5; Least Sig Difference – 38.89; Significance Level .05		

Table 3. Effects of the "Pot Scrubbers" on Feed Efficiency and Economics

	Pot Scrubber Treatment	Control
Total Pounds Feed (as fed)	40,155	56,233
Pounds Feed/Steer	2,150	3,124
Pounds Feed/Steer/Day	22.82	28.40
Pounds Feed/Cwt Gain	8.66	10.22
Difference %	(-) 15%	
Total Cost of Feed		
Without Processing $	1,830.89	2,221.53
With Processing $	2,332.83	2,924.39
Cost of Feed/Head		
Without Processing	114.43	123.42
With Processing	145.80	162.47
Cost of Pot Scrubbers		
8 @ $.45	3.60	
Feed Cost/Cwt Gain		
Without Processing	40.74	40.38
With Processing	51.57	53.16

BROOD COW EFFICIENCY MANAGEMENT STUDY
PROGRESS REPORT II

By
D. G. Landblom, J. L. Nelson, L. Manske, and P. Sjursen

INTRODUCTION:

In the cow-calf business, calf weaning weight, nutrient requirements of the cow and the overall cost of production are parameters affected by a cow's level of milk production, body condition, and mature body weight. Several investigations have been conducted to measure the interrelationship of cow size, maintenance requirements and calf weaning weight. They clearly show that energy requirements for maintenance are dependent on cow weight, and that as mature cow weight increases calf weaning weight also increases (Klosterman et al., 1968; Urick et al., 1971; Jeffrey and Berg, 1972; Miguel et al., 1972; Benyshek and Marlowe, 1973; Turner et al., 1974; NRC, 1984; Rode and Bowden, 1987).

Weaning weight can be raised by increasing mature body weight, increasing milking ability, or through a combination of both factors. Although selection for increased milk production among beef breeds results in heavier calves at weaning, infusing dairy blood into the beef herd is a more rapid method for increasing milk production (Cundiff, 1970). However, it is also associated with poorer reproductive performance when post partum energy levels are inadequate (McGinty and Frerichs, 1971; Halloway et al., 1975, and Wyatt et al., 1977).

Lactation status not only affects maintenance energy requirements which are higher for cows of high milk production potential per unit of body weight than cows with low milk production potential (Ferrell and Jenkins, 1982), but it also increases forage intake of free ranging beef cows. Kronberg et al., (1986) found that the forage intake of lactating Hereford and Simmental x Hereford cross cows was 23% and 39% more, respectively, than their non-lactating counterparts.

Since rebreeding success, which is dependent on gestation and post partum lactation energy levels, and range carrying capacity contribute heavily to the overall cost of production, this brood cow efficiency management study is designed to document the energy necessary to support rebreeding success, to identify the range ecosystem impact of cow types that are diverse with respect to body weight and milking ability, and to establish an economic model for each experimental breed type. Within the investigation there are three major relationships of importance: **1)** the relationship between nutrition and reproduction, **2)** the relationship between nutrition and total beef production, and **3)** the relationship between grazing intensity and its effect on species composition and plant density change.

Breed combination used were selected according to their expected mature body weight and lactation potential, and are being bred to Charolais sires in a terminal crossing system. The Hereford breed serves as the foundation and control breed in the following breeding scheme:

Cow Breed	x	Sire Breed	=	Calf Breed
Hereford Control		Hereford		Hereford
Hereford		Charolais		Char. x Hereford
Angus x Hereford		Charolais		Char. x Ang. x Heref.
Milking Shorthorn x Angus x Hereford		Charolais		Char. x M-Shorthorn x Angus x Hereford
Simmental x Hereford		Charolais		Char. x Simmental x Hereford

There are two principle phases in the investigation: a drylot wintering phase and a summer grazing phase on native range. During the wintering phase each breeds gestation and lactation dry matter intake is being monitored and adjusted to levels that will promote optimum rebreeding efficiency.

On native range, forage disappearance is being measured to identify differences in range carrying capacity for the various cow types. The range is being further investigated to determine the impact of each cow type on the range ecosystem by monitoring the changing effects of grazing on plant species composition and plant density. Since several years of data are needed to identify changes in the range community, only the milking ability estimates, weight gains, and weaning weights obtained on native range will be reported with the drylot data in this progress report.

PROCEDURE:

In 1986, the initial breed groups were fed long crested wheatgrass hay ad libitum and one pound of dry rolled barley per head daily during the gestation phase. As each cow calved she and her calf were weighed and transferred to postcalving lots where they were allowed free choice access to the complete mixed lactation ration shown in Table 1. Measured intake of feed was discontinued on May 21st when the groups were moved to spring pasture. Exposure to fertile Charolais bulls began on June 1st and ended on July 31st.

In 1987, the cows grazed crop aftermath until December 14, 1986, when they were moved into drylot and started on the silage based gestation rations shown in Table 2. The groups were maintained on the rations for a one-week adjustment period before being weighed on two consecutive days. Weights for the two consecutive weighings were averaged and the gestation phase was started on December 22, 1986. As each cow calved, she and her calf were weighed and transferred to a separate cow lots reserved for each breed after calving, and started on the complete mixed lactation ration shown in Table 2. The groups were maintained on these rations until they were turned out on crested wheatgrass spring pasture April 30, 1987. The previous year, 30 percent of the MS x A x H cows were open at the end of the breeding season. Therefore, in 1987 eight pounds of dry rolled barley was fed per head during the first heat cycle of breeding to the high lactation Milking Shorthorn and Simmental cross cow groups. Fertility tested Charolais bulls were with the cow groups from June 1st to August 1st.

In 1988, the groups were handled in much the same way as in 1987, but didn't graze crop aftermath as long. They were adjusted to the silage based gestation rations shown in Table 3, and weighed on trial December 15, 1987. A longer drylot lactation period was needed in 1988 because of the drought. Below normal spring precipitation and above normal temperatures combined to reduce crested wheatgrass growth substantially. The cow groups were turned out on crested wheatgrass on May 27, 1988 when suitable growth was attained. Feeding of eight pounds of dry rolled barley supplement to the high lactation groups (MS x A x H and S x H) began on May 27th also. Fertility tested Charolais bulls were with all groups from June 1st until August 15th. The breeding season was extended two additional weeks because of the prolonged high temperatures experienced during June and July.

The experiment began in1986 with an unequal number of cows in each breed group that were properly bred to Charolais. In all subsequent years the herds are being maintained at ten cows. Replacements for cows that have had to be removed from the study have been very limited. Replacements are being made at two specific times during the production year. Cows that lose calves anytime before the start of the breeding season on June 1st are replaced with comparable pair from a reserve gene pool. These cows that are examined for pregnancy and identified as open at weaning are replaced with a comparable bred cow from the reserve pool when the winter feeding period is started.

Dry matter intake during gestation has been regulated based on body weight measurements taken biweekly. The breed groups are fed to gain approximately two pounds daily during the last trimester of pregnancy so that they will have a net gain after calving ranging between .2 and .4 tenths of a pound per day. The (H) and (A x H) groups are fed 22 pounds of dry matter as a basal ration, and the (MS x A x H) and (S x H) groups are fed 24 pounds of dry matter as a basal ration. Adjustments to the basal dry matter intake levels are made upward or downward based upon body weight changes at each biweekly weighing, and are further adjusted for cold weather according to the following schedule: 15°F (no adjustment), 0°F (+9%), -15°F (+18%), and -30°F (+27%)

Efficiency in beef production is calculated as the feed energy input per unit of beef produced, where energy input is expressed in terms of megacalories per kilogram of liveweight. In this study, efficiency is being measured in megacalories per pound of liveweight weaned and is obtained by charting the total calculated digestive energy consumed against the pounds of calf weaned from all exposed cows. Additional measurements include: **1)** pre and post calving gain, **2)** gestation and lactation dry matter feed consumption, **3)** wintering economics, **4)** milking ability estimates obtained at selected dates during the grazing season, and **5)** animal weight gains obtained during the grazing season.

Milk production is estimated using the weigh-suckle-weigh method (Neville, 1962) in June, August, and October of each year, which correspond to the varying stages of pasture maturity in the northern Great Plains.

Statistical analysis was conducted with MSUSTAT (version 4.10). Using MSUSTAT, the data was subjected to a one-way analysis of variance, and the significance of differences between treatment means were determined by the Student's test.

RESULTS AND DISCUSSION:

Three of seven production cycles scheduled for this long term investigation have been completed. Within each production cycle, two specific periods are measured in detail which include a drylot wintering period and a summer grazing period on native range. Data associated with forage production, plant density and species composition changes, and the effect of cow type on range carrying capacity will not be reported on at this time, but will be summarized in future progress reports. Drylot wintering begins in mid December after the cow types have completed grazing crop aftermath, and continues until approximately mid May when the breed groups are turned out on crested wheatgrass pasture. Starting and completion dates have varied each spring and fall in response to seasonal precipitation and its effect on grazable forage. The summer grazing period on native range begins the third week of June each year, and is completed when pastures are sufficiently grazed based on clipping appraisals.

The Nutrient Requirements of Beef Cattle (1984) handbook currently recommends that dry pregnant mature beef cows weighing approximately 1100 pounds should consume 21.0 pounds of dry matter that contains 53.2% TDN, and it further recommends that 1200 pound cows in the same stage of pregnancy consume 22.3 pounds of dry matter containing 52.9% TDN. Beef cows wintered under the more adverse conditions of the northern Great Plains require additional dry matter intake above NRC recommendations. Using the nearly all roughage diets shown in Tables 1, 2, and 3, the cow types in this investigation have been fed 13% to 15% more dry matter daily. Although the differences are not large as shown in Table 4, the dry matter increase being used has not maintained equal post calving weight among all breeds. Average daily gain after calving has been - .20 (H), .10 (MSxAxH) -.18 (AxH), and .14 for the (SxH) group, which falls short of the net gestation gain after calving goal of .2 to .4 tenths of a pound. These differences were not statistically significant (P .01).

During a short 47 to 53 day drylot lactation period after calving the cow types have been fed ad libitum in preparation for the upcoming breeding season. Dry matter intake has ranged from 27.9 pounds among the (H) cows to 34.2 pounds among the (SxH) cows. Estimations of lactation potential are shown in Table 7. During the early part of the breeding season in June, milking ability has been estimated using weigh-suckle-weigh methods to range from a low of 13.3 pounds of milk from the (H) cows to a high of 18.7 pounds/day from the dairy x beef (MSxAxH) cows. The short term elevated plane of nutrition being used after calving, which is approximately 30% above NRC recommended levels, is designed as a specific short term allocation to put the cow types in a gaining condition before being turned out on crested wheatgrass pasture. Once on the pasture, the heavier milking MSxAxH and SxH cows are being given eight pounds of barley per head daily during the first breeding cycle. Efforts to maintain dry matter intake levels within acceptable limits without overfeeding have resulted in some reproductive failures within all cow types. However, the largest number of open cows has been in the (H-Control) group. Weaning percentages and the pounds of calf weaned per cow exposed are summarized in Table 5. Weaning percentages for the respective breeds have been 85.7% (H-Control), 89.3% (MSxAxH), 92.6% (H), 92.6% (SxH), and 92.9% for the (AxH) cows. The impact of reproductive failure is further reflected in the pounds of calf weaned per cow exposed, which has been 454.2 pound for (H-Control), 522.4 pounds for (H), 544.8 pounds for (MSxAxH), 554.7 pounds for (AxH), and 563.8 pounds for the (SxH) group. Statistically, the pounds of calf weaned per cow exposed in the (H-Control) group is the only weight that differs significantly from the other breed types (P .05).

Efficiency is being measured by charting the calculated megacalories of digestible energy (DE) consumed against the pounds of calf weaned per cow exposed. When compared to the straightbred Hereford control cows, the (H) cows consumed 1.1% less DE, the AxH cows 9.7% more. Digestible energy consumption per pound of calf weaned from exposed cows is 8.88 Mcal for (AxH), 8.99 Mcal for (H), 9.16 Mcal for (MsxAxH), 9.24 Mcal for (SxH), and 10.08 Mcal for the (H-Control) group. How does this measurement of efficiency compute in terms of dollars and cents to beef cattle producers raising cash crop calves from cow types typical of the ones being used in this investigation? To answer this question, a partial economic model has been developed and is shown in Table 6. Direct cost for feed and processing that have been incurred are shown as wintering expenses. The wintering expense shown does not include cost for other variable and fixed costs that a producer would normally incur. Gross return was determined by multiplying the actual average weaning weight, and the Dickinson, North Dakota, average market value within each weight class during the September – December 1988 period. Net returns computed were $8,360.97 for the (H-Control), $9,490.35 for the (SxH), $9,524.53 for the (MSxAxH), $9,563.10 for the (H), and $9,876.12 for the AxH group. At this time in the investigation, a difference of $1,515.15 exists between the most efficient (AxH) cows, and the least efficient (H-Control) cows. When the other cow types are compared to the AxH cows, much smaller net return differences exist. Returns were $313.02, $351.59, and $385.77 dollars less for the (H), (MSxAxH), and (SxH) cow types, respectively.

Cow and calf gains on native pasture are summarized in Table 8. The heavier milking cow types (AxH, SxH, and MSxAxH) gained the slowest during the summer on native range, but their calves, as a group, gained the fastest. Three year mean gains for the respective cow types were 57 pounds for the (H-Control), 56 pounds for the (H), 41 pounds for the (AxH), 32 pounds for the (MSxAxH), and 27 pounds for the (SxH) cows. Straightbred Hereford control calves and the Charolais x Hereford crossbred calves nursing Hereford dams gained less than calves nursing the other cow types, but the difference was not significant. Calf gains from each of the cow types on native pasture were 244 pounds for the (H-Control), 247 pounds for the (H), 265 pounds for the(AxH), 275 pounds for the (MSxAxH) cows.

Although trends are developing in this long term brood cow efficiency management study, a considerable amount of data remains to be collected before a final analysis can be conducted, and conclusions drawn. In future progress reports the influence of grazing and its effect on range carrying capacity, plant density, and species composition changes will be merged with the data that are already available to produce a measurement of profitability.

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Table 1. Ration Dry Matter Composition and Ingredient Cost Per Pound of Dry Matter. 1986.

	Int'l Feed Number	Dry Matter Ration %	Dry Matter Cost/Pound
Gestation:			
Crested Wheatgrass Hay	2-05-424	96.3	.025
Dry Rolled Barley	4-00-535	3.7	.037
Feeding Charge		________	.0025
		100.00	
Crude Protein: 9.6%			
Calcium: .38%			
Phosphorous: .27%			
Minerals Were Fed Free Choice			
Lactation:			
Alfalfa	1-00-071	19.1	.0222
Crested Wheatgrass Hay	2-05-424	21.4	.025
Corn Silage	3-02-822	39.8	.01944
Dry Rolled Barley	4-00-535	13.1	.037
Sunflower Meal		5.9	.0584
Trace Mineral Salt	6-04-152	.35	.064
Dicalcium Phosphate	6-01-080	.35	.191
Processing		________	.0125
		100.00	
Crude Protein: 11.0 %			
Calcium: .54%			
Phosphorous: .38%			

Table 2. Ration Dry Matter Composition and Ingredient Cost Per Pound of Dry Matter. 1987.

	Int'l Feed Number	Dry Matter Ration %	Dry Matter Cost/Pound
Gestation:			
Corn Silage	3-02-822	59.5	.01944
Oat Hay	1-03-276	39.7	.02108
Trace Mineral Salt	6-04-152	.51	.064
Dicalcium Phosphate	6-01-080	.29	.191
Processing			.0125
		100.00	
Crude Protein: 8.1%			
Calcium: .45%			
Phosphorous: .24%			
Lactation:			
Alfalfa	1-00-071	25.6	.0222
Corn Silage	3-02-822	46.4	.01944
Oat Hay	1-03-276	20.3	.02108
Barley Dist. Dry Grain	5-02-144	2.1	.050
Soybean Oilmeal	5-20-637	3.4	.1139
Trace Mineral Salt	6-04-152	1.1	.064
Dicalcium Phosphate	6-01-080	1.1	.191
Processing			.0125
		100.00	
Crude Protein: 10.7 %			
Calcium: .87%			
Phosphorous: .43%			

Table 3. Ration Dry Matter Composition and Ingredient Cost Per Pound of Dry Matter.

1988.

	Int'l Feed Number	Dry Matter Ration %	Dry Matter Cost/Pound
Gestation:			
Corn Silage	3-02-822	57.9	.01944
Oat Hay	1-03-276	41.3	.02108
Trace Mineral Salt	6-04-152	.4	.064
Dicalcium Phosphate	6-01-080	.4	.191
Processing			.0125
		100.00	
Crude Protein: 8.1%			
Calcium: .48%			
Phosphorous: .26%			
Lactation:			
Alfalfa	1-00-071	24.3	.0222
Corn Silage	3-02-822	48.2	.01944
Oat Hay	1-03-276	20.5	.02108
Soybean Oilmeal	5-20-637	4.8	.1139
Trace Mineral Salt	6-04-152	1.1	.064
Dicalcium Phosphate	6-01-080	1.1	.191
Processing			.0125
		100.00	
Crude Protein: 10.7 %			
Calcium: .85%			
Phosphorous: .44%			

Table 4. Three Year Mean Gestation and Lactation Gain, Dry Matter Feed Consumption and Partial Economics. 1986-1988.

Breed	**(H)**	**(MSxAxH)**	**(AxH)**	**(SxH)**	**SE**
Gestation:					
No. Head	28	30	30	27	
Days Fed	87.2	95.7	86.5	92.4	
Initial Wt., Lbs.	1114	1105	1176	1218	
Calving Wt., Lbs.	1097	1115	1160	1231	
Wt. Change, Lbs. 4/	-17	+10	-16	+13	26.4
ADGain or Loss, Lbs.	-.20	+.10	-.18	+.14	
Gestation Economics:					
DM Feed, Lbs. 4/	2135	2396	2129	2377	137.9
DM Feed/hd/day., Lbs.	24.5	25.0	24.6	25.7	
Feed Cost/lb. of DM, $	.0305	.0307	.0307	.0308	
Feed Cost/hd., $	65.11	73.56	65.36	73.21	
Feed Cost/hd/day, $	.746	.769	.756	.792	
Lactation:					
No. Head	27 1/	29 2/	30	26 3/	
Days Fed	53.4	47.4	54.5	50.1	
Calving Wt., Lbs.	1093	1115	1169	1223	
Spr. Turnout Wt., Lbs.	1181	1187	1255	1294	
Gain, Lbs. 4/	88	72	86	71	29.5
ADG After Calving, Lbs.	1.65	1.52	1.58	1.42	
Lactation Economics:					
DM Feed/Hd., Lbs. 4/	1489	1597	1783	1713	367.6
DM Feed/Hd/Day, Lbs.	27.9	33.7	32.7	34.2	
Feed Cost/Lb. of DM $	.0394	.0394	.0393	.0393	
Feed Cost/Hd., $	58.67	62.92	70.07	67.32	
Feed Cost/Hd/Day, $	1.10	1.33	1.29	1.34	
Combined Water Costs:					
Gestation Cost, $	65.11	73.56	65.36	73.21	
Lactation Cost, $	58.67	62.92	70.07	67.32	
Flushing Feed, $	--	4.10	--	4.10	
Total Average					
Wintering Cost, $	123.78	140.58	135.43	144.63	
1/ One cow removed					
2/ One cow removed					
3/ One cow removed					
4/ Values do not differ significantly					

Table 5. Three Year Mean sumary of Efficiency Among the Various Cow Types. 1986-1988

Breed	**(H-Control)**	**(H)**	**(MSxAxH)**	**(AxH)**	**(SxH)**
No. of Cows Exposed	28	27	28	28	27
No. of Cows Exposed that Weaned a Calf	24	25	25	26	25
% Weaning Calves 1/	85.7	92.6	89.3	92.9	92.6
SE Mean = 7.5					
Total Mcal. Of Dig. Energy Consumed Breed 1/	128147.5	126744.5	139732.8	137902.7	140610.1
SE Mean = 7172					
Total Lbs. of Calf Weaned From Exposed Cows	12717	14104	15253	15532	15222
Lbs. of Calf Weaned/Cow Exposed 2/	454.2^{a}	522.4^{ab}	544.8^{b}	554.7^{b}	563.8^{b}
SE Mean = 14.2					
Dig. Energy/Lb. of Calf Weaned From Exposed Cows, Mcal. 1/	10.08	8.99	9.16	8.88	9.24
SE Mean = 1.2					
1/ Values do not differ significantly					
2/ Values with unlike superscripts differ significantly (P <.05)					

Table 6. **Partial Economic Model Estimating Net Returns From Each of the Cow Types. 1/**

Breed	**Hereford Control**	**Hereford**	**MS x Angus x Hereford**	**Angus x Hereford**	**Simmental x Hereford**
Total Lbs. of Calf Weaned from Exposed Cows	12,717	14,104	15,253	15,532	15,222
Gross Return/Cow Exposed, $	11,826.81	12,905.16	13,460.77	13,668.16	13,395.36
(Mkt. Value/cwt2/	($93.00)	($91.50)	($88.25)	($88.00)	($88.00)
Less Total Wintering Cost, $	-3,465.84	-3,342.06	-3,936.24	-3,792.04	-3,905.01
Net Return $	8,360.97	9,563.10	9,524.53	9,876.12	9,490.35
1/ This partial economic model includes direct costs for feed and processing only. No other variable or fixed costs are included.					
2/ Market value is based on average value within weight class for the September – December, 1988 period at Dickinson, North Dakota.					

Table 7. Three Year Mean Estimates of Milking Ability Expressed in Pounds of Milk. 1986-1988

	June 18	Aug. 30	Oct. 30	Season Mean 1/
Hereford Control	14.4	10.6	6.7	10.6[a]
H	13.3	9.7	6.6	9.9[a]
A x H	14.9	13.1	7.4	11.8[ab]
S x H	17.0	13.7	10.1	13.6[bc]
MS x A x H	18.7	15.0	10.9	14.9[c]
SE Mean = .62				
1/ Values With Unlike Superscripts Differ Significantly (P<.01).				

Table 8. Three Year Mean Cow and Calf Gains on Native Range. 1986-1988.

	Starting Weight	Final Weight	Gain 1/	ADG
COW:				
Hereford Control	1374	1431	57	.56
Angus x Hereford	1261	1302	41	.40
Simmental x Hereford	1335	1362	27	.26
MS x Angus x Hereford	1181	1213	32	.31
Hereford	1185	1214	56	.55
SE Mean = 16.83				
CALF:				
Hereford Control	260	504	245	2.40
Hereford	287	534	247	2.42
Angus x Hereford	300	565	265	2.60
Simmental x Hereford	308	583	275	2.70
MS x Angus x Hereford	315	593	278	2.73
SE Mean = 24.07				
1/ Gains for Cows and Calves do not Differ Significantly (P<.05)				

OVULATION INDUCTION-SYNCHRONIZATION METHODS COMPARED AMONG NON-CYCLING BEEF COWS

By
D. G. Landblom and J. L. Nelson

INTRODUCTION:

Normally, cows that calve during a sixty day calving period have little difficulty returning to estrus and rebreeding in order to maintain a 365 day calving interval. However, many cows calve late due to poor nutrition, disease, difficult delivery, a retained placenta or because they were mated to subfertile bulls. The use of ovulation induction techniques developed recently may allow cattlemen to shorten the time between calving and rebreeding and advance the calving date of late calving cows.

PREVIOUS WORK:

The chain of events that occur between calving and the start of the regular heat cycles is not completely understood. Short and co-workers (1972) found that cows having several cycles before breeding had higher conception rates than those bred at the first estrus following calving. Cows that cycle soon after calving have a chance for several cycles and higher fertility levels at the start of the breeding season. The effects of progesterone on estrus and ovulation have been investigated intensively since its discovery in 1935. When fed in the form of melengestrol acetate (MGA)[R] or implanted in the ear (Syncro-Mate B) [R] it causes a unique "priming" response in non-cycling cows which aids in the resumption of regular heat cycles. Smith et al. (1983) and Troxel et al. (1980) found that cows "primed" with Syncro-Mate B (SMB)[R] had an increased release of lutenizing hormone (LH) when a gonadotropin releasing hormone (GnRH) was given thirty hours after removal of the SMB implant. Troxel and Kessler (1983) and Smith et al. (1987) evaluated progesterone concentrations of cows given GnRH. They reported that progesterone priming produced normal corpus luteum life spans provided blood serum levels of progesterone were maintained between two and three nanagrams per milliliter of serum. Timing of GnRH administration is important if a sustainable LH release is to be obtained in the non-cycling cow. Troxel and co-workers (1980) found that interruption of nursing for a minimum of twenty-four hours was needed to obtain a satisfactory GnRH induced LH release. Smith et al. (1983) found that thirty-two hour calf removal (CR) increased pituitary responsiveness to injected GnRH provided calves were not allowed with their mothers for at least eight hours after the GnRH was given. Further review of the literature indicated that most emphasis has been placed on the use of GnRH as an ovulation induction compound when used with progesterone. Human chorionic gonadotropin (HCG), which was primarily LH activity, also produces a similar effect in the non-cycling cow. Pratt et al. (1982) evaluated GnRH and HCG in non-cycling cows and found both compounds increased the proportion of cows with palpable corpus luteums, but the luteal phases measured were abnormally short.

Considering the findings of these researchers, two breeding management experiments have been conducted in an effort to identify reliable methods for shortening the interval between calving and rebreeding.

The first trial was designed to evaluate the ovulation induction potential of progesterone priming when used with or without short-term calf removal and with either GnRH or HCG as precursor treatments to a delayed seven day single injection synchronized artificial breeding program using the prostaglandin product, Lutalyse. The objective was to determine ovulation induction techniques administered to cows approximately thirty-five days after calving would induce an additional heat cycle before the start of the regular breeding season that would result in a higher number of first service and twenty-five day pregnancies, when compared to untreated controls.

In trial two, two of the more economical and reproductively efficient progesterone priming treatments evaluated in trial one were compared to a third progesterone priming method that also utilized the prostaglandin Lutalyse as a final synchronizer in a natural breeding program in which the cows were exposed to fertile bulls on the induced heat.

PROCEDURE:

Trial I:

Ninety-four second calf and older Hereford and Angus x Hereford cows and their calves were subjected to the six ovulation induction-synchronization treatments shown in Table 1, but artificial breeding was delayed until the start of the second heat cycle.

Before the trial was started all cows were observed twice daily for standing heat to insure that none of the cows to be used had already resumed regular heat cyclicity. To further insure that the cows used had resumed cycling, each cow was bled for serum progesterone analysis. Any cows identified as having been in heat, based on progesterone analysis, were removed from the data. The postpartum interval of cows used averaged 35 days when Syncro-Mate B implants were installed.

Cows that received Syncro-Mate B (SMB) were implanted between 8 and 9 A.M. on day one, and were removed at approximately the same time 9 days later.

Treatments that included 48 hour calf removal, had their calves withheld from their mothers beginning when the SMB implants were removed, and were returned to their mothers 48 hours later. While separated from their mothers, they were housed in a sheltered feedlot pen with fresh water and first cutting alfalfa hay.

Those treatments assigned to receive either GnRH or HCG were injected intramuscularly thirty hours after SMB implant and calf removal. All cows assigned to receive HCG were injected with 2000 IU of HCG (2 ml), and those assigned to receive GnRH were injected with 100 micograms of GnRH (2ml).

After the induction techniques were completed, the cows were observed for standing heat with the aid of epididectomized marker bulls equipped with chin ball marking devices. Corpus luteum development and subsequent life span was monitored by measuring serum progesterone levels collected during the ovulation induction period and during the twenty day period following HCG and GnRH administration. Blood serum was harvested after clotting, frozen, and later analyzed by Mr. Jim Kirsh, under the direction of Dr. Dale Redmer, NDSU reproductive physiologist.

On May 28th of each year the treatments were combined and moved to a crested wheatgrass pasture where they were subjected to a seven day single injection synchronized breeding program using the prostaglandin product, Lutalyse. During the first six days of artificial breeding season, and with the aid of sterile epididectomized detector bulls, the cows were observed for standing heat and inseminated twelve to fourteen hours after detection with Charolais semen. On the morning of the seventh day all remaining cows that had not been detected in heat and inseminated were injected with 25 mg of Lutalyse (5 ml). After receiving Lutalyse the cows were detected and inseminated for an additional five days.

Trial II:

Trial II was partially developed from the preliminary results of trial I which show that using SMB-HCG-CR and SMB-HCG were the most economical and reproductively efficient, and the findings of Whittier et al. (1986) and Higgins et al (1986) who reported that when prostaglandins were administered during the later stages of the estrus cycle a more fertile estrus occurs. Theoretically, progesterone priming of non-cycling cows induced to ovulate with HCG should be pre-synchronized, and administration of a prostaglandin late in the estrus cycle should result in an estrus cycle characterized by a high degree of synchrony and fertility.

Based on this thinking, 56 non-cycling suckled beef cows were used to evaluate three ovulation induction-synchronization methods using natural breeding. SMB-HCG, SMB-HCG-CR, and SMB-HCG-CR-Lutalyse were compared to untreated control cows.

Syncro-Mate B, calf removal, and HCG were administered in the same manner as described in Trial I. In Trial I serum progesterone levels were found to be relatively high approximately sixteen days after the SMB implants were removed. Therefore, in the treatment assigned to receive the prostaglandin Lutalyse, all cows were injected intramuscularly with 25 mg (5 ml) on the morning of the sixteenth day after SMB implant removal.

Charolais bulls were placed with cows in the control, SMG-HCG and SMG-HCG-CR treated cows when the SMB implants were removed. Charolais bulls were not put with the SMB-HCG-CR-Lutalyse treated cows until immediately after the cows were injected with Lutalyse on day sixteen. After each of the synchronized breedings were completed, the treatment groups were combined for the remainder of the breeding season.

<u>RESULTS AND DISCUSSION</u>:

Corpus Luteum (CL) development and life span were monitored by tracking serum progesterone levels during the 20 day period following SMB implant removal. The percentage of cows that had normal CL life spans, short or altered life spans, and those that did not respond are shown in Table 2. Progesterone levels recorded for cows with normal length estrus cycles peaked on the 16th day after SMB implants were removed.

Pregnancy rates for each heat cycle during breeding, the 25 day pregnancy rates, the interval in days between calving and rebreeding, the estrus response before and after Lutalyse treatment, and the treatment costs for each method are summarized in Table 3. The 25 day pregnancy rate was 100% in the Control, SMB-HCG, and GnRH-CR treatments, respectively, but the control treatment cost/cow pregnant within 25 days was the lowest, costing $1.25/cow. When SMB was used, approximately 35% more cows developed corpus luteums with normal life spans. Progesterone priming obtained with SMB produce a pre-synchronizing effect that followed through into the second heat cycle, which resulted in 29% more cows being in heat and inseminated before Lutalyse was needed to complete the delayed synchronized breeding. The interval between calving and rebreeding did not appear to differ between treatments.

Ovulation was induced with either HCG or GnRH. There was no difference in first service or 25 day pregnancy with either compound, however, HCG was much cheaper to use. Using HCG or GnRH an average 45 days after calving, with 48 hour calf removal, was associated with the highest service pregnancy rate of approximately 85%, which was 14% higher than the control cows.

A positive effect from calf removal was dependent upon whether breeding occurred on the induced heat cycle or was delayed until the second heat cycle. When breeding was delayed in Trial I, calf removal used with SMB was associated with a 16% lower first service pregnancy rate. In Trial II, when breeding was done on the induced heat cycle, using SMB-HCG, with CR resulted in pregnancy rates of only 27.3%. However, when calf removal was included first service pregnancy rates increased 26.5% to 58.3%.

In conclusion, delaying breeding 16 days and then administering Lutalyse, as was done in the SMB-HCG-CR-Lutalyse treatment of Trial II, was the most reproductively efficient method test, settling 91.5% of the cows within 25 days at a cost/cow settled of $14.29. While this treatment was very reproductively efficient, the logistics necessary to complete the induction-synchronization were both costly and too labor intensive for widespread commercial acceptance.

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Table 1. Schematic of ovulation induction treatments compared in trials I and II.

TRIAL I [1/]

Steroid Treatment	48 Hour Calf Removal	Gonadotropin: Given 30 Hrs. After Implant Removal	Releasing Horm.: Given 30 Hrs. After Implant Removal
1. Syncro-Mate-B	Removed	-	GnRH
2. Syncro-Mate-B	Removed	HCG	-
3. Syncro-Mate-B	Not Removed	-	GnRH
4. Syncro-Mate-B	Not Removed	HCG	-
5. --	Removed	-	GnRH
6. --	Removed	HCG	-
7. Control	Not Removed	-	-

TRIAL II [2/]

Steroid Treatment	Calf Removal	Gonadotropin: Given 30 Hrs. After Implant Removal	Releasing Horm.: Given 16 Days After Implant Removal
1. Control	-	-	-
2. Syncro-Mate-B	Not Removed	HCG	-
3. Syncro-Mate-B	Removed	HCG	-
4. Syncro-Mate-B	Removed	HCG	Lutalyse

1/ Trial I cows were bred artificially on the second heat cycle after ovulation induction treatments were Performed.

2/ Trial II cows were bred naturally on the induced heat cycle.

Table 2. **Summary of corpus luteum span based on serum progesterone analysis.**

Treatment	Ovulations with Normal CL Life Span	Ovulations with Short or Altered CL Life Span	No Response
SMB-GnRH-CR	71.4	21.4	7.2
SMG-HCG-CR	71.4	14.3	14.3
SMB-GnRH	50.0	35.7	14.3
SMB-HCG	78.6	21.4	-
GnRH-CR	21.4	35.7	42.9
HCG-CR	42.9	35.7	21.4
Control	35.7	21.4	42.9

Table 3. **Summary of ovulation induction-synchronization treatments in trials I and II.**

Treatment	Pregnancy Rate, % 1st Cycle	2nd Cycle	3rd Cycle	4th Cycle	Open	25 Day Preg. Rate, %	Calving to Preg. Inter-val, Days	Lutalyse Response, % Before Treatment	After Treatment	Treatment Cost, $
Trial I										
Control	71.4	28.6	-	-	-	100.00	75.7	64.3	35.7	$ 1.25
SMB-GnRH-CR	69.2	7.7	15.4	-	7.7	76.9	78.5	76.9	23.1	18.34
SMB-HCG-CR	69.2	15.4	7.7	-	7.7	84.6	74.9	61.5	38.5	12.94
SMB-GnRH	61.5	15.4	23.1	-	-	76.9	90.3	69.2	30.8	18.69
SMB-HCG	78.6	21.4	-	-	-	100.00	73.6	71.4	28.6	10.60
GnRH-CR	84.6	15.4	-	-	-	100.00	73.3	30.8	69.2	9.72
HCG-CR	85.8	7.1	-	-	7.1	92.9	77.4	28.6	71.4	6.57
Trial II										
Control	40.0	30.0	-	-	30.0	70.0	58.4	-	-	-
SMB-HCG	27.3	18.2	27.3	9.1	18.2	-	72.6	-	-	21.12
SMB-HCG-CR	58.3	23.1	15.4	-	7.7	76.9	50.1	-	-	12.48
SMB-HCG-CR PGF2alpha	75.0	16.7	8.3	-	-	91.7	71.2	-	-	14.29