1980 Progress Report . . .

Research in Beef Cattle Nutrition and Management

Eastern Oregon Agricultural Research Center

Special Report 574

March 1980

Agricultural Experiment Station • Oregon State University • Corvallis
in cooperation with Agricultural Research—SEA, USDA

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The Eastern Oregon Agricultural Research Center, which includes the Squaw Butte Station and the Union Station, is jointly operated and financed by Agricultural Research-SEA, United States Department of Agriculture and the Agricultural Experiment Station, Oregon State University, Corvallis, Oregon.

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Cover picture: Fall-calving cow and her calf on range, with Squaw Butte in the background.

ESTRUS SYNCHRONIZATION AND ARTIFICIAL INSEMINATION WITH PROSTAGLANDIN

H. A. Turner, Lloyd Swanson, and R. J. Raleigh

Despite the tremendous potential of artificial insemination (AI) to improve quality and efficiency of beef cattle production, only 2 to 3 percent of the beef cows are bred this way. Obviously there are some drawbacks or problems connected with AI.

There needs to be a certain amount of confidence that AI will work, as well as a desire to make it work, to have a successful AI program. It does require additional expertise or skill either by the producer or contracted help. The proper facilities and equipment are important and, in relation to natural breeding, takes extra labor and time. It certainly takes an intensification or change in management, including such things as individual identification of cows, record keeping, short breeding seasons, etc. In all cases these are not necessary but they all facilitate an AI program. Because of the extra effort involved, required changes in management, and, in some cases, the fear of lowered conception rates, most ranchers have chosen not to breed artificially.

The most difficult aspect of an AI program is heat detection which is probably the major reason cattlemen do not artificially inseminate. This requires the majority of the time and labor and also is the most difficult aspect of artificially inseminating. Heat detection requires visual observation, even when using aids such as vasectomized or altered bulls equipped with chin ball markers, mounting devices that change color under pressure, etc. The use of cows treated with hormones as teaser or marker animals has worked well as an aid in heat detection. These animals eliminate the chance of getting cows bred by the altered marker bulls and alleviate the problems connected with handling bulls and having extra animals around. They also save the expense of surgically preparing the bulls. The cows are injected with 200 milligrams of testosterone propionate every other day for 20 days prior to the breeding season and every 10 days during the breeding season. These cows have worked well in the Squaw Butte program. However, as with other aids, visual observation is required for maximum and accurate detection.

Whatever detection method is used the proper identification of cows in heat and timing so breeding is in the proper relationship to ovulation have to be done correctly to get animals bred. Short heats, silent heats, false heats, and missed detection all enter into making this a difficult job. Poor AI results are frequently the results of inadequate heat detection.

Prostaglandin ($PGF_{2\alpha}$), recently cleared for use as a heat synchronizer, may alleviate or possibly eliminate heat detection. Prostaglandin will be marketed under the trade name of Lutalyse and is available through veterinarians. Results of using prostaglandin for one breeding season in both the spring and fall-calving herds at Squaw Butte will be presented and discussed in this paper.

MODE OF ACTION

An understanding of the basic estrus (heat cycle) of the cow is essential to appreciate the mode of action of prostaglandin. During standing heat (day 0 of the estrus cycle) the estrogen level, which causes the behavior pattern of heat, is high and progestrone level is low. Luteinizing hormone and follicle-stimulating hormone prepare the ovary for ovulation. Ovulation occurs 12 to 14 hours after standing heat. By day 5, the corpus luteum which produces progesterone has been formed and persists to day 17. Progestrone levels, which block estrus and ovulation, are high during this time and estrogen levels low. An animal assumes it is pregnant to day 17. This is when the signal for corpus luteum maintenance or regression is received. During days 17 to 21, if conception has not occurred, the corpus luteum regresses, progesterone levels drop, estrogen increases, and the cycle repeats itself. If conception has occurred, the corpus luteum is maintained and continues to produce progesterone which blocks the repeating of the cycle.

Most previous synchronization products have been progesterone or progestins (progesteronelike substances). These products do not maintain the corpus luteum but substitutes the progesterone. These have been administered by feed or silastic implants, have been injected, sprayed on, used in vaginal sponges, etc. They block estrus and ovulation and are used until all animals are in the same stage of the cycle. The material is then removed and with progesterone no longer in circulation, estrogen levels increase and the cycle continues with all cows coming into heat about the same time.

In general, these products have provided excellent synchronization but erratic conception on first service. First service conception has run from 40 to 55 percent as opposed to the expected 70 percent. Conception ends up about the same as in control animals when breeding continues through the second and third cycles. So subsequent conception is not reduced. All the products are not this precise in synchronization and, at times, getting the proper dosage into the animal from day to day is a problem. So, in general, these materials have not been satisfactory and are not extensively used.

Prostaglandin, a naturally occurring hormone, causes rapid degeneration of the corpus luteum. This removes progesterone from circulation, permitting follicles to develop and secrete estrogen which then causes estrus and ovulation. There has to be a corpus luteum present to destroy for prostaglandin to work, so it is only effective on days 5 through 17 of the cycle. Those cows in day 0 to 5 and 17 to 21 of the cycle will not respond but many of those in the 17 to 21 day range will be coming into heat about the same time as those injected. So, about 65 to 70 percent will synchronize after one injection. However, almost all will synchronize if injected again after 11 days. This puts all cycling cows into the same stage of the cycle. Excellent experimental results have been obtained using prostaglandin in this country as well as in England, Canada, and Australia.

EXPERIMENTAL PROCEDURE

Spring-calving cows were divided into three treatment groups over three different times. Treatments consisted of a control group receiving no prostaglandin and two groups receiving injections 11 days apart. Cows were checked for estrus shortly after calving. Before cows were assigned to treatments, they had to be cycling and have had at least a 45-day interval from calving to going onto treatment. Treatment dates were June 1, June 8, and June 23. Cows that had not been detected in heat by June 23 were assigned to treatment anyway.

Cows were stratified by age and previous nutritional background and and randomly assigned to treatments. Control cows in each time period were bred as usual with cows inseminated approximately 12 hours after the onset of standing heat, beginning with the date of the first injection in the other 2 groups. Cows in the other 2 groups were injected intramuscularly 2 times with 25 milligrams of prostaglandin 11 days apart. One of the double injected groups was bred based on heat detection after the second injection and the other group was inseminated 72 to 74 hours after the second injection without regard to heat detection.

Epididymectomized bulls equipped with chin ball markers were utilized along with visual observations made at least 3 times daily for heat detection. Estrus was recorded for all cows even though none of them was bred after the first injection. The breeding season ran for 56 days, with cover bulls being used the last 17. Final conception results were tabulated using a combination of rectal palpation and recorded breeding and calving dates.

Fall-calving cows were divided into two treatment groups over two ifferent times. Different treatment times were used for the same reasons as the spring-calving study which was to get as many as possible bred early in the breeding season but allow enough time for uterine involution between calving and breeding. Treatment initiation dates were January 8 and 19. Allotment procedures and heat detection methods were the same as those previously described for the spring-calving herd.

Treatments consisted of control animals artificially bred in the usual manner and the others on a single prostaglandin injection system. The prostaglandin group was inseminated as usual for four days. Mid-morning of the fifth day, all cows that were not in heat and had not been bred the preceding four days were injected with prostaglandin. Breeding was continued, based on heat detection, to the eighth day. On this day (80 hours after injection), all cattle which had not come in heat and had not been exposed yet were inseminated. Artificial insemination based on heat detection was then continued beyond this time. The 80-hour breeding may not be necessary but a few cows will be picked up that would otherwise be missed. A number of cows will show heat a few hours to a couple of days after the 80-hour breeding and should be rebred. They are cows on the end of their cycle (19 to 21 days) at the time of injection and not synchronized. The breeding season ran 63 days with cover bulls used the last 21. Results were a combination of rectal palpation, breeding dates, and calving dates.

RESULTS AND DISCUSSION

Table 1 shows the heat pattern of all the prostaglandin injected spring-calving cows. After the first injection, 69 percent were detected in heat within a 6-day period. Assuming all cows are cycling, this would be within the expected range. Cows in days 0-5 and some of those in days 17-21 of their estrus cycle will not respond to the first injection, so 30 to 35 percent will not be synchronized. If cows are being heat detected on a double injection program, these 65 to 70 percent synchronized after the first injection could and should be bred. Then the only ones requiring a second injection would be those not bred after the first injection. Because of the experimental design of this trial, all cows were bred after the second injection.

Table 1. Heat distribution following $PGF_{2\alpha}$ injections (spring-calving cows)

Day[1/]	Detected in heat: First injection	Detected in heat: Second injection
	%	%
1	3	4
2	14	34
3	33	33
4	11	10
5	5	4
6	3	4
7	0	0
8-13	0	5
19	-	3
Not detected	31	3
Total	100	100

1/ Days after $PGF_{2\alpha}$ injection, with the day of injection being 0.

After the second injection, 77 percent were detected in heat on days 2 through 4 and 89 percent in the first 6 days. An additional 3 percent were caught in heat and bred one heat cycle later on the heat detection treatment and 3 percent that were not detected in heat but conceived on the time breeding treatment were synchronized but missed on heat detection. So, a total of 95 percent apparently were synchronized into a 6-day period by the double injection of prostaglandin.

Table 2 shows the conception results on the spring-calving herd. First exposure conception rates were 79 percent on the controls over a 24-day period and 76 percent on the double-injected prostaglandin groups bred after detected in heat over a 3-day period. The double injected groups bred as a group 72 to 74 hours ater injection conceived at a 64 percent rate after the first exposure. Remember, this is just a one-day breeding plan.

Table 2. Conception results of the $PGF_{2\alpha}$ study in the spring-calving herd

Item	Treatment			Total
	Control	$PGF_{2\alpha}$-Estrus	$PGF_{2\alpha}$-Time	
Number of cows	29	37	36	102
Bred on first exposure, %	79	76[1/]	64	73
Bred on second exposure, %	7	11	19	13
Total AI, %	86	87	83	85
Bred by cover bull, %	7	5	11	8
Overall conception, %	93	92	94	93

1/ Excludes 5% that were bred on first service, but delayed one heat cycle. These were apparently synchronized but not detected in heat and show up in the table as bred on second exposure.

Even though the numbers of animals are small and care should be taken in drawing conclusions, the results of this were encouraging. The conception rate for first service was about the same for the controls and the prostaglandin with heat detection. But heat detection and breeding only covered 3 days with prostaglandin as opposed to 24 on the controls. Additional labor to inject these cows twice would be required, but this would be more than offset by the additional 21 days of heat detection for the controls.

Results also were encouraging for the double injection and time breeding which would eliminate heat detection allow cows to be bred in one day. First service conception was 64 percent for this group which is excellent, but 12 percent below those injected and bred as a result of heat detection. The majority of these cows were bred at 72 hours after injection and none of them after 73 1/2 hours, which may be crowding the lower limits for maximum conception. The literature shows little difference between 72 and 80 hours, but there does seem to be a small advantage for the center of the range. Outside of 72 to 80 hours, conception rates clearly drop. Most of the literature suggests a 5 to 10 percent reduction in first service conception when breeding at a given time as opposed to breeding after heat detection. The better the heat detection the wider this gap could be, because missed cows cannot be bred. They may be picked up on a time breeding program. If the heat detection program is weak, the time breeding may improve conception rates on first service.

Table 2 also shows that conception rates for the entire insemination period were not greatly different, being 86, 87, and 83 percent, respectively, for the controls, prostaglandin-estrus and prostaglandin-time breeding. Overall conception rates were almost identical between treatments, ranging from 92 to 94 percent. So, prostaglandin injections reduced the labor requirements of heat detection considerably without affecting overall conception rates and more cows were bred earlier in the breeding season.

Prostaglandin was studied in more than 900 cows in 20 herds around Oregon under basically the same protocol described. Overall heat detection rates were 66 percent over 24 days in the control cows and 51 percent over 6 days in prostaglandin treated cows. In the Squaw Butte herd, where the cattle were known to be cycling, the heat detection rate was 97 percent in the control animals and 89 percent in the others. Overall conception rates on first service were 58, 46, and 43 percent, respectively, for controls, prostaglandin with heat checks, and prostaglandin with time breeding. Note that the conception rate was considerably higher on the controls than the prostaglandin treatment and there was little difference (3 percent) between the prostaglandin groups. Remember, it was stated earlier that the less effective the heat detection, the less difference expected between the prostaglandin groups. Results were greatly different between herds, with some obtaining excellent performance and others very poor.

These results bring up some interesting points. First, prostaglandin never will cause an animal to cycle. If the cow has not had enough rest from calving, is not in the proper plane of nutrition, is having reproductive problems, has a disease problem, or for one reason or another is not cycling, prostaglandin will not force her to cycle. It only works in cycling cows. Prostaglandins are not a substitute for good management. The low percentage of detected heat activity and subsequent low conception rates are indicative of failure to observe cows that were in heat or the animals were not cycling. In some herds, AI was being incorporated for the first time and inexperience may have entered into the poor results. Make sure the use of prostaglandin fits your management system before expecting much from it.

Table 3 shows the heat pattern of all the prostaglandin treatment groups in the fall-calving cows. In the 5 days prior to injection, 29 percent came into heat. This was almost identical to the 28 percent of the control animals over the same 5 days. This indicates that nearly all animals were cycling and that the control and treatment groups were cycling at the same level.

This is an excellent tool to determine if your herd is cycling. If all cows are cycling, you would expect just under 5 percent per day to come into heat. In this study we actually heat detected the day preceding the 5 days so we could start breeding on the first day and detected on the morning of the injection day to avoid injecting those in heat that morning. So in essence we detected heat over a 6-day period and detected 28 1/2 percent in heat. If all cows were cycling, which seldom happens, we would have expected 29 percent. If animals are being detected, this is easy to calculate, but even if you are not set up for heat detection it is possible to get a good estimate of the readiness of a herd. Observing and counting those in heat for 5 days give an idea of how many are cycling. As discussed, if after 5 days you find around 25 percent, you know for practical purposes they are all cycling and should be ready for injection. If you find only 10 to 15 percent, you know half or less are cycling and it may not be advisable to inject, depending on what your goals are. Remember prostaglandin will not force them to cycle and breed, so the cost of injecting non-cycling cows is wasted.

Table 3. Heat distribution prior to and following $PGF_{2}\alpha$ injection (fall-calving cows)

Day	Detected in heat
	%
Prior to injection (5 days)	29
Following injection[1/]	
1	6
2	35
3	28
4	6
5	6
6	2
7	0
8-12	6
Not detected	11
Total of those injected	100

1/ Days after $PGF_{2}\alpha$ injection, with the day of injection being 0.

Table 3 shows 83 percent of the injected cows were detected in heat in a 6-day period. Eleven percent were not observed in heat. However, 6 percent of these conceived on the 80-hour breeding, so they were synchronized. Overall, 89 percent were synchronized by the injection. In the control group, 12 percent were not detected in a 24-day period. During the entire AI breeding, 93 percent were observed in heat.

Table 4 presents the conception data from the fall-calving herd. In both the control and prostaglandin treated groups, 76 percent were bred on first exposure. However, the control group was bred over a 24-day period as opposed to 8 days for the prostaglandin treatment. Total cows artificially bred were 84 and 89 percent for the controls and prostaglandin treated groups, respectively, with overall conception being 88 and 92 percent. Conception rate for the entire fall-calving herd was 91 percent.

Table 4. Conception results of the $PGF_{2}\alpha$ study in the fall-calving herd

Item	Treatment	
	Control	$PGF_{2}\alpha$
Number of cows	25	90
Bred on first exposure, %	76	76
Bred on second exposure, %	8	13
Total, AI, %	84	89
Bred by cover bull, %	4	3
Overall conception, %	88	92

As with the spring-herd, the results were encouraging for the use of prostaglandin, a way to shorten the breeding season and get more cows settled early. Number of days required to heat detect and breed was reduced by two-thirds by the use of prostaglandin with overall conception rates as good or better than the regular AI program. Unfortunately, this system does require heat detection. However, it may be possible to simply observe a herd for 5 days and not inject those seen in heat. They could be removed from the rest of the herd and injected 4 to 5 days later. Cows could be bred 72 to 80 hours after injection. This again would eliminate the need for heat detection other than the observation for pulling cows out in the 5-day period. This would not have to be a heat detection as refined as required when breeding based on heat detection.

In summary, there is a number of systems that could be devised for using prostaglandin. An individual needs to pick one that fits his herd, management, and capabilities. Whatever routine is used, it looks like prostaglandin will be an important tool in AI. It certainly does alleviate heat detection and with some regimes it is eliminated. It appears that first service conception will be reduced though by going without heat detection and breeding on a time basis. It may be that by selecting and culling animals over a period of years to fit the time breeding, a herd could be developed that would breed as efficiently as with heat detection. In other words, eliminate those animals that do not fit the system. More work is planned at Squaw Butte to address this point.

Prostaglandin has been cleared for use and can be obtained from veterinarians for about $4.50 per shot. Whether to use prostaglandin and if so, which system, will depend on economics. The double injection system requires 2 shots per cow; the single injection system described only requires two-thirds of a shot per cow. However, the cost of heat detection is eliminated with the double injection.

Prostaglandin has the potential to provide a considerable savings in time and labor required to breed cows artificially. It also may make it possible for some beef cattle operations to use AI that in the past have not found it feasible. If cows can be held in for a period of 8 to 14 days, depending on the prostaglandin system used, and they are cycling there is a chance to breed to 60 to 80 percent AI and then turn them out with a cover bull. The same results would take 24 days by conventional artificial breeding. If cows could be held for 30 to 35 days, the AI percentage could be increased to 80 to 90 percent as opposed to the same results over 40 to 45 days on a regular AI program.

Another important point to consider before using prostaglandin is the number of cows that can be handled and bred in one day. This will depend a great deal on the skill and amount of help available. Handling facilities, chute set up, temperament of the cows, location of the semen in relation to breeding facility, daylight hours, etc. will have an effect on how many can be bred in a day. In large herds, the injections may have to be staggered over a number of days.

Prostaglandin will work if used correctly and if cattle are cycling. It will not force cows to breed that would not breed without it.

MANAGEMENT ALTERNATIVES FOR FALL-BORN CALVES

D. A. Daugherty, H. A. Turner, and R. J. Raleigh

World wide energy consciousness has led to a reevaluation of our systems for producing slaughter beef. Competition from man for direct consumption and increasing world prices have limited the availability of grain supplies for finishing beef. These facts have created interest in maximizing the use of forage and minimizing the use of grain in production of slaughter beef.

The rangeland in southeastern Oregon and the majority of rangeland worldwide have no alternative use for producing of food other than through the grazing animal. The growing season in southeastern Oregon is from April through June and the available forage resources decline rapidly in nutritive quality with increasing maturity. A management plan to maximize the use of the forage resources should consider the seasonal quality of the forage and the class of livestock which can most efficiently utilize the forage.

Earlier research at Squaw shown shown that in some situations fall-calving is a feasible alternative for more efficient utilization of range forage. However, because of factors mentioned above, interest in maintaining ownership of calves past weaning has developed the need for research in postweaning management and marketing alternatives. The objectives of these studies were to examine the effects of several management alternatives on the weaning and postweaning performance of fall-born calves. Feedlot finishing or wintering and finishing on range with limited grain were compared for steer live animal performance and carcass quality.

EXPERIMENTAL PROCEDURE

Cow nutrition and creep feeding

Seventy-eight cow-calf pairs in 1976 and 91 cow-calf pairs in 1977 (Hereford and Hereford-Angus breeding) were assigned by cow age, cow weight, calf weight, and calf sex to a 2X2 factorial. The treatments consisted of two levels of supplemental energy for lactating cows and creeping or not creeping the calves.

During the 120-day winter study in 1976-77, the cows received either meadow hay alone as a low energy treatment or meadow hay plus 1.5 pounds barley daily as a high energy treatment. The daily barley supplement was increased to 1.5 pounds for the low energy and 3.9 pounds for the high energy treatments during the 126 day winter study period in 1977-78 because wheat hay was substituted for meadow hay. Meadow hay was in low supply because of 1977 drought conditions.

Half the calves from each cow treatment group had creep available during the winter period. The pelleted creep ration for both years consisted of 80 percent ground alfalfa, 13 percent rolled barley, 5 percent molasses, and 2 percent salt. Creep consumption was recorded to determine daily intake of calves and creep efficiency.

Early vs late weaning

Half the calves from each treatment group for both 1977 and 1978 were weaned on the April turnout date and moved to irrigated pasture. The other half remained with the cows on range and were weaned on August 2, 1977, and on July 31, 1978.

The early weaned calves were allotted by weight and previous treatment to either alfalfa-fescue or alfalfa-orchardgrass pasture treatments during both years. The calves remained on pasture 117 days in 1977 and 119 days in 1978 and were weighed off the study at approximately the time the calves on range were weaned. The effects of the early weaning pasture treatments, late weaning, and previous winter treatments on August calf weight and gains were compared.

Winter growth period

Eighteen steers in 1977 and 20 steers in 1978, representing all previous treatment groups, were placed on a postweaning growth ration starting in August of both years. The late weaned steers in 1976 were allotted to the early weaning alfalfa-fescue and alfalfa-orchardgrass treatments until October 4 when they were placed in drylot and worked up to a full feed of alfalfa hay. In 1977, the steers received meadow hay free choice plus 3 pounds barley per head daily.

After a 98- and 99-day postweaning period for 1977 and 1978, respectively, the steers were allotted by weight and weaning time to one of two levels of energy supplementation for the winter growth study. Both treatment groups received 5 pounds of bluegrass straw daily and alfalfa hay free choice. The high energy treatment received 3 pounds of rolled barley per day. Steers were weighed off the study in May and the effects of the treatments on hay intake and gain performance were determined.

Finishing on range

In May, the steers were allotted by weight and winter treatment to two levels of energy supplementation for finishing on range. Steers in 1977 were placed on native range and received either 2 or 5 pounds of barley daily. In 1978, the steers received the same levels of supplementation, however, they grazed crested wheatgrass range. The steers were weighed off study in mid-July and slaughtered at the Oregon State University Meat Science Laboratory. Live animal and carcass data were used to determine the effects of the wintering and finishing treatments.

Feedlot finishing

After the August weaning date, 20 steers in 1977 and 15 steers in 1978 were shipped to Corvallis for finishing in the Oregon State University feedlot. These steers were placed on good quality fescue hay for 25 days in 1977 and 68 days days in 1978. The steers were then weighed, implanted with 36 milligrams of Ralgro and allotted to feedlot finishing treatments. The steers were fed a starter ration until they reached a mean weight of approximately 800 pounds, then given a second Ralgro implant and continued on a finishing ration. The steers were weighed off study and slaughtered upon reaching a minimum of 0.3 inches backfat determined by measurement with an ultra-sonic sound device.

Four low quality roughages -- annual ryegrass straw, perennial ryegrass straw, wheat straw, and grass hay -- were compared in the feedlot treatments for 1977 and three roughages (perennial ryegrass straw omitted) for 1978. The 60 percent concentrate starter ration and the 80 percent concentrate finishing rations were formulated to 15 and 11 percent crude protein, respectively. Steam-rolled barley and wheat were the primary concentrate sources for both rations and tallow was added to the finishing ration to increase the energy density. Supplemental protein sources included cottonseed meal, feather meal, and urea. Molasses, calcium, and phosphorus supplements and vitamin A and rumensin premixes were added to complete the rations. Because of the limited number of animals involved in the feedlot studies (5 steers per treatment), the feedlot treatment groups were combined for comparison with the range finishing treatments.

RESULTS AND DISCUSSION

Cow nutrition and creep feeding

The effects of supplemental energy levels for the cows and creep feeding of the calves on calf weights and average daily gain (ADG) through spring turn out are shown in Table 1. The higher level of energy supplementation for the cows increased calf gains by 10.2 and 8.9 percent, resulting in 6.3 and 4.4 percent heavier turn out weights for 1977 and 1978, respectively. The difference in average calf gains between the two years is possibly explained by the difference in cow feed between the two years. The wheat hay fed in 1978 was of lower quality than the meadow hay fed in 1977. Lower quality results in lower digestibility, and, therefore, a slower passage rate and reduced intake. Apparently, the increased level of supplementation in 1978 was not sufficient to compensate for the decreased nutrient intake from the wheat hay and is reflected in lower calf gains. Calf gains were increased by the higher level of energy supplementation of the cows regardless of whether the calves received creep. However, in 1978, most of the difference in calf gains between cow treatments occurred with the creep fed calves. The non-creep fed calves had poor gains on both levels of cow supplementation and the higher level was apparently not sufficient to make much difference at these depressed gain rates.

Table 1. Effects of cow nutrition and creeping on calf performance

Cow treatment		Creep		No creep		Total	
		April wt.	ADG	April wt.	ADG	April wt.	ADG
		lb					
1977	Low	327	1.75	276	1.39	302	1.57
	High	340	1.88	301	1.57	321	1.73
	Total	334	1.82	289	1.48	312	1.65
1978	Low	300	1.48	244	1.01	272	1.24
	High	324	1.67	247	1.06	284	1.35
	Total	312	1.58	246	1.03	278	1.30

Creep feeding, ignoring cow treatments, increased calf gains by 23.0 and 53.4 percent, resulting in 15.6 and 26.8 percent heavier calves by spring turn out for 1977 and 1978, respectively. Previous research at Squaw Butte showed similar gain advantages to creep feeding during the wintering period.

Daily creep consumption was similar both years and averaged 2.9 pounds per head. In 1977, 8.6 pounds of creep were required to produce a pound of gain and this was reduced to 5.2 pounds in 1978. The improved creep efficiency in 1978 probably was from lower milk production by cows on wheat hay. Although the increased gains obtained in these studies would be profitable for the wintering period at current feed cost and market values, economic conditions can change drastically. Also, gain advantages from creeping in the winter often are partially lost in the subsequent summer period.

Early vs late weaning

The effects of weaning time and early weaning treatment on August calf weights and gains from April turn out are shown in Table 2. The calf gains were decreased 20 and 77.5 percent by the early weaning treatment which resulted in 63 and 119 pound lighter calves by August for 1977 and 1978, respectively. The winter calf gains in 1978 were poor and after turn out the calves remaining on the cows experienced compensatory gains. This was not observed for the early weaned calves.

The early weaned calves on the alfalfa-orchardgrass pasture had higher gains than the alfalfa-fescue pastured calves for both years, but to a lesser degree in 1978. Other research with yearlings on fescue suggests a reduced intake, possibly from an inhibitor.

Table 2. Early vs late weaning (April to August)

	Early wean						Late wean	
	Fescue		Orchardgrass		Total			
	Aug. wt.	ADG	Aug. wt.	ADG	Aug. wt.	ADG	Aug. wt.	ADG
	lb							
1977	459	1.41	527	1.87	494	1.65	556	1.98
1978	441	1.30	460	1.46	451	1.38	570	2.45
Average	450	1.35	494	1.67	473	1.51	563	2.22

No major interactions between creep and cow treatments were found for the early weaned calves on the irrigated pasture treatments. The calves from the low energy cow treatments gained at a faster rate regardless of pasture treatment for both years. The effects of these compensatory gains resulted in August calf weights equal to those of the calves from the high energy cow treatment. Previous creep feeding had little or no effect on pasture gains. However, creeping resulted in heavier calves in August for both years.

The effects of supplemental energy levels for the cows and creep feeding of the calves on calf gains from birth to August and on August calf weights are shown in Table 3. The gain advantage for the calves on high energy supplemented cows that existed at spring turn out disappeared by August. The same results were found for the two cow energy levels across the creep feeding treatments.

Table 3. The effects of cow nutrition and creeping on calf performance (birth to August)

Cow treatment		Creep		No creep		Total	
		Aug. wt.	ADG	Aug. wt.	ADG	Aug. wt.	ADG
		lb					
1977	Low	548	1.82	498	1.63	523	1.72
	High	538	1.79	512	1.69	524	1.73
	Total	543	1.80	505	1.66	524	1.73
1978	Low	552	1.77	465	1.42	508	1.59
	High	559	1.81	469	1.44	514	1.63
	Total	555	1.79	467	1.43	511	1.61

Creep fed calves maintained a gain advantage in August for both years and the gains were similar regardless of cow treatment. The 38 and 88-pound gain advantage for creep fed calves would appear to be profitable. Previous research at Squaw Butte showed that gain advantages from winter creeping generally decrease below an economical level through the summer. In addition to the favorable relationship between feed cost and market value of the calves during these studies, the calves are now Hereford-Angus crossbreds as opposed to straight Herefords in earlier studies and they possess a greater growth potential.

The data through August indicate that increases in weight of fall calves can best be accomplished by weaning in late summer. Also, supplying additional nutrients directly to the calf in the winter is more beneficial for increasing weaning weights than supplementing the cow to increase milk production.

Winter growth period

The ADG for the postweaning period and the results of the winter growth study are shown in Table 4. The differences in the postweaning period between the two years greatly affected the results of the winter growth study. The meadow hay plus 3 pounds barley (1978-79) more than doubled the steer gains over irrigated pasture (1977-78). The late weaned steers gained very little on the irrigated pastures during the first 30 days because of weaning stress. They then gained 1.7 and 1.8 pounds per day for the remainder of the pasture study on alfalfa-fescue and alfalfa-orchardgrass treatments, respectively. The early weaned steers maintained gains of 1.3 and 1.9 pounds throughout the pasture study for the alfalfa-fescue and alfalfa-orchardgras treatments, respectively. The move to drylot and alfalfa hay set all steers back temporarily, but the late weaned steers then compensated on the high quality alfalfa hay resulting in equal gains for all treatments from August to December.

Table 4. Winter study results

Winter treatment		Postweaning period ADG	Initial weight	May wt.	Winter ADG	Intake per head Barley	Hay
		lb					
1977	Low	.98	643	77	.84	0	21.8
	High		637	833	1.22	483	21.0
1978	Low	2.15	720	967	1.49	297	27.0
	High		736	988	1.52	795	25.8

The increased gains in 1978-79 resulted in the steers entering the winter growth study approximately 90 pounds heavier. This increased weight had a carry over effect on the winter growth study. The high energy winter treatment resulted in a 45 percent increase in steer gains for 1977-78. However, the gains were higher for both treatments in 1978-79 and feeding 3 pounds of barley per head daily had no value. The difference in gain and treatment effects can be partly explained by the difference in hay consumption between the two years. In 1978, steers consumed approximately 5 pounds more hay per head daily. The winter of 1978-79 was colder and the steers were heavier which would account for some of the increased hay intake. However, another possibility is that in 1977-78 the steers may not have been allowed sufficient weighback to maintain maximal intake. If the hay intake was not sufficient, as indicated by the lower gains in 1977-78, then the 3 pounds of barley daily would have a more beneficial effect.

Winter gains are important to subsequent summer gains especially for heavy fall steers entering a short finishing period on range. It is generally accepted that winter gains have a negative relationship with subsequent summer gains. Previous research at Squaw Butte with spring-born weaner calves concluded that when feed cost to market value relationships are favorable, the most economical gains through summer would be obtained by feeding for winter gains of 1.6 to 1.8 pounds per day. With less favorable cost to value relationships, winter gains should be reduced to 1.2 to 1.4 pounds per day.

A similar relationship between winter gains and summer gains exists for fall-born yearlings. This relationship is largely dependent on the weight the yearlings enter the winter period and subsequent management plans. Higher rates of gain (1.6 to 1.8 pounds per day) through the winter period are generally the most economical for fall yearlings they enter the finishing phase at heavier weights and require less time to reach slaughter weight.

Finishing on range

The effects of the two levels of energy supplementation and the previous winter treatments on finishing performance are shown in Table 5. The gains were similar for the two years with 12.6 and 20 percent greater gains for the high energy level of range supplementation. However, the effects of the previous winter treatment varied between the two years. In 1978, the winter treatments had no effect on steer gains which was expected because there were no differences during the winter study. In 1977-78, differences in winter gains resulted in compensatory gains for the low group during the finishing phase.

More importantly the effects of winter gains in 1977-78 affected the finishing weight. The steers in 1977-78 were slaughtered at 160 and 186 pounds lighter than the steers in 1978-79 for the low and high energy levels, respectively. The heavier weights in 1978-79 required an increased barley consumption of 297 pounds per head during the postweaning period.

Quality grades were similar for both years and all treatment groups. Within treatment variations were large and quality grades differed between treatments by only a third of a grade.

Table 5. Range finishing and the effects of previous winter treatments

		Finishing treatment								
		Low			High			Total		
Winter treatment		Final wt.	ADG	Barley intake per head	Final wt.	ADG	Barley intake per head	Final wt.	ADG	Barley intake per head
		lb								
1977	Low	909	1.97	124	905	2.25	310	907	2.09	207
	High	913	1.11	607	913	1.43	793	913	1.29	710
	Total	911	1.59	339	909	1.79	578	910	1.69	459
1978	Low	1057	1.55	421	1087	1.83	607	1072	1.69	514
	High	1085	1.52	919	1103	1.89	1105	1094	1.71	1012
	Total	1071	1.54	670	1095	1.86	856	1083	1.70	763

Feedlot finishing

The results of the feedlot studies and a comparison to range finishing are shown in Table 6. The feedlot steers maintained a 3 plus pound ADG and were slaughtered 5 to 6 months younger than the range finished steers. This required 2.5 to 6.4 times the grain consumption as that of the range finished steers.

Table 6. Feedlot vs range finishing

Treatment	Slaughter age	Days on feed	Initial wt.	Final wt.	Finishing ADG	Postweaning ADG	Barley intake
	mo		lb				
1977							
Feedlot	15	140	564	996	3.09	2.87	2158
Range							
Low	21	62	812	911	1.59	1.19	339
High	21	62	798	909	1.79	1.19	578
1978							
Feedlot	16	120	625	990	3.04	2.69	2062
Range							
Low	21	62	976	1071	1.54	1.66	670
High	21	62	980	1095	1.86	1.76	856

The quality grades were increased approximately one-third of a grade in the feedlot. The quality grades for the feedlot finished steers were lower than for a typical feedlot situation. The feedlot trials also were comparing the effects of low quality roughages on feedlot performance and this may have reduced quality grades.

Carcass data and taste panel evaluations are being conducted in cooperation with the Oregon State University Meat Science Laboratory and the Food Science and Technology Department. Economic comparisons between range and feedlot finishing also will be conducted by the Agriculture Resource and Economics Department. The results will be presented later future date and should help to further evaluate the range finishing treatments and the acceptability of this beef to the consumer.

IRRIGATED PASTURES AS A COMPLEMENT TO RANGE

R. J. Raleigh and H. A. Turner

In the western states, rangeland traditionally provides most of the summer feed for the brood cow herd and for calves that are held and sold as long yearlings. Improved pasture, when used to advantage, contributes flexibility in the livestock operation.

In dry years, and particularly in a series of dry years, the rancher may be forced to remove the herd from the range early. The rancher also may be be forced to heavy culling and premature selling. If sufficient irrigated pasture or supplementary hay is available during these short-feed or dry periods of short range, he might survive and maintain his herd at normal numbers.

Fall calving has been proposed as an alternative management practice to increase calving and weaning percentages, and increase weaning weights. Fall-born calves can be weaned early and put on range or improved pasture when they are old enough to use forage efficiently.

Irrigated pasture is an excellent "buffer" in dry years when range forage is limited. Yearlings make good gains on irrigated pasture. Cows and spring-born calves can be held on pasture later than usual to allow the range plants to produce to their maximum; or animals may be brought from the range when that source of forage is exhausted. In years when moisture is adequate and irrigated pasture is not needed for grazing, it can be cut and stored as hay.

Early weaning offers additional advantages to fall-calving herds. Weaned in April, fall-born calves can take advantage of high quality summer pasture and dry cows can go onto range without the demand of the calf for milk. Spring-born calves also can be weaned in mid-summer and put on pasture, allowing cows on range to go into the winter in good condition, reducing winter feed requirements. Cows without calves are better distributed over the range and utilize less forage than cows with calves.

The primary objective of irrigated pasture research at Squaw Butte is to investigate alternative uses of improved pastures and how they affect management and income. Contrary to pasture research and management in the Midwest, where pastures generally are independently managed units, the irrigated pastures on the station are part of a forage complex which includes native and improved rangelands and meadowland areas, as well as the more intensively managed irrigated pastures. Around this total forage complex a beef cattle management system is manipulated and managed to get optimum production. The irrigated pasture, in some cases, may be used for income or "sale" animals to give the greatest return per acre, or it may be used as an alternative forage for the breeding herd in drought years, or at times when rangelands are being "rested" or taken out of grazing for a range improvement program.

The station pastures are mixtures of alfalfa and tall fescue. Grazing generally begins about May 1 and continues through August. Depending on the year, grazing may continue for about 30 days after the first killing frost. It should be recognized that this is a relatively short productive season and the economics basically dictate the type of animals used. Generally, the benefits may be measured in other than gain per acre, such as the range improvements made possible by the flexibility provided by the irrigated pasture.

The carrying capacity per acre of pasture for the season has been 3 to 3.5 yearlings, 1.5 to 2 mature cows with their spring-born calves, or 6 to 8 early-weaned fall-born calves. This stocking rate is equivalent to 10 or more animal unit months (AUM's) per acre when forage quality is excellent. The amount of beef produced depends on the class of animal and the grazing management imposed. Yearling heifers weighing 450 pounds in May have gained up to 2.0 pounds/day over a 112-day test period. In addition to the average 700 pounds/acre gained, the pastures provided an additional 2 AUM's/acre of late fall grazing during which animals gained 1.1 pounds/day for 45 days.

During the same 112-day test period, early-weaned calves born the previous fall (October and November), gained 1.6 pounds/day on pasture forage alone. Calves supplemented with 3/4 and 1 1/2 pounds of barley per day gained 1.7 and 1.8 pounds/day, respectively. Without supplement, calves produced 1,075 pounds/acre; with supplement over 1,200 pounds/acre.

Mature cows with spring-born calves gained 1.9 pounds/day while calves gained 1.8 pounds, gains equal to 426 pounds/acre for cows and 404 for calves or a total gain of 830 pounds/acre. It should be noted that the gain on the brood cow is not saleable, except for cull cows sold at this time, thereby limiting the cash return per acre to the 404 pounds of calf produced.

Yearling steers grazing alfalfa-tall fescue pasture gained 1.7 pounds/day while those receivng 3 pounds of barley gained 2.0 pounds/day. When liquid supplements were fed free choice on pasture, steers gained 1.8 pounds and 2.2 pounds/day, respectively, consuming 2.5 pounds of molasses fortified with vegetable oil and 4.9 pounds of molasses fortified with propylene glycol.

Management of animals and pastures significantly affected gains and total beef production. Heifers gained only slightly more per day on fertilized pasture than on unfertilized but produced 150 pounds/acre more beef because of the higher carrying capacity of the fertilized pastures. Fertilization with nitrogen is essential for maximum production of grass. Fertilization was applied at 120 pounds/acre of nitrogen as urea, ammonium-sulfate, or ammoniun-nitrate with urea the most economical on a nitrogen basis. Split applications, 60 pounds/acre June 1 and 60 pounds/acre July 15, probably give most efficient use of the fertilizer. A single application of 120 pounds/acre of N caused rank growth of fescue that reduced daily gain. Pastures should be irrigated immediately after fertilization to get the nitrogen into the soil and reduce gaseous loss of ammonia.

Grazing systems significantly affected gains and production. When grazing 14 days in a 28-day two-pasture rotational grazing system, yearling heifers gained up to 0.4 pounds/day more than they did when grazing 7 days in a 28-day four-pasture system. Tall fescue, when allowed to regrow for 21 days before being grazed again, became coarse and more mature, which probably reduced forage quality and intake.

Because of the chemical nature of the soil, an ancient lake bottom, the resulting forage is borderline decifient in copper and borderline excessive in molybdeum. Consequently, animals grazing these pastures may become syptomatically copper deficient. The addition of 0.5 pounds of finely ground copper sulfate to 100 pounds of salt increased gains of yearling heifers up to 0.4 pounds/day above those receiving no copper. When yearling heifers were pastured under a combination of the productive treatments, i.e., alfalfa-grass, 14 days grazing in 28 days and copper supplement only, they gained 2.4 pounds/day.

Pastures that were cut for hay yielded 4 to 6 tons/acre of high quality alfalfa-grass hay. This compares to average yields of 3/4 to 1 1/2 tons/acre from adjoining native meadows.

The seasonal rate of gain for various classes of animals is shown in Table 1. These gains are somewhat lighter than we would expect from these same classes of animals grazing on improved native ranges during May and June, about equal during July, and considerably heavier during August. A typical gain for a yearling steer on range forage is about 2.0, 2.0, 1.5, and 0.8 pounds, for May through August, respectively. Other classes of animals follow this same trend.

Table 1. Average daily gain of various classes of growing cattle on alfalfa-fescue pastures on a 14-day grazing schedule

Class of animal	Month: May	June	July	August	Average
			lb		
Yearling steers	1.8	1.9	1.8	1.5	1.75
Yearling heifers	1.6	1.8	1.7	1.4	1.62
Early wean fall calves	1.4	1.7	1.6	1.3	1.50
Spring-born suckling calves	1.6	1.7	1.5	1.3	1.52

Yearling steers were run on range and on irirrigated pastures in a study to determine if an acceptable slaughter grade beef could be attained with modest supplementation. These steers were on either range or irrigated pastures from May to November when they were slaughtered. They were given a moderate level of supplement for the first three months and were increased to a free choice level during the last three months. Range forage was the only roughage received by the steers on range while those on pasture received meadow hay for the last five weeks of the study to make sure adequate roughage was available. These data are presented in Table 2.

Table 2. Gain, supplement and carcass data

Item	Type of Forage: Range	Irrigated Pasture
Production data		
Initial wt., lb	429	430
Slaughter wt., lb	970	953
ADG, lb	2.9	2.8
Grain consumption/hd, lb	1348.0	1439.0
Average daily gain/hd, lb	7.2	7.7
Hay consumption/hd, lb	0.0	152.0
Carcass data		
Weight, lb	557	521
Dressing percent, %	57.5	55.4
Grade		
good	21	11
standard	9	19

The average daily gains on both groups of steers were satisfactory, but perhaps a heavier animal would be more desirable. The size of these calves when starting a program of this type is important and depends winter management. The calves on this study only gained 0.26 to 0.9 pounds per day through the winter. For the most economical level of production, and high quality carcass grades, previous work done on this station indicated that steers should gain from 1.0 to 1.75 pounds over the winter depending on relative price of cattle and feed for this type of summer management program.

SUMMARY

Results of these studies indicate that the rancher can use irrigated pasture to improve the management of a range livestock operation. Because of the nature of the land to which irrigation can be applied, the value returned must be equal to or greater than that which could be obtained from other land uses or crops. When climate dictates that only hardy forage crops can be grown, the decision is not difficult. The rancher, however, must decide the class of animal to use, what species to plant, and how the pasture will best meet needs.

Tall fescue was the only grass used in our studies. Since fescues may be high in alkaloids, which have been implicated in reducing gains, other grasses might improve production especially of younger animals.

When range forage is less expensive in relation to the economic worth of irrigated land, the rancher probably cannot afford to use irrigated pasture exclusively for a cow-calf operation. The value of the for e is through the sale of beef. Therefore, the most productive gains fr an acre of pasture will be from young, fast-growing animals. The early-weaned, fall-born calf probably will give the best return. Growing yearlings to feedlot size also yields good returns and competes fairly well with other crops in an overall economic analysis.

The gain in body weight made by a brood cow on pasture is of questionable importance. Her increased weight cannot be marketed, but has value in maintaining good animal health and may determine how well she breeds, winters, and calves again. Although calves with their mothers on pasture out-gain weaned calves, they are physically capable of growing fast enough to compensate for the additional forage taken by the cow and her unsaleable weight gains.

For a given set of economic conditions, a rancher might use irrigated pastures profitably for any class of animal. The level of profit would depend on the nature of the "environmental" pressures brought against the business. The rancher's foresight in having pasture available when needed and the judgment of how to use it best should increase the flexibility of the operation. That flexibility might determine whether the rancher stays in business or is squeezed out.

THE EFECTS OF METHIONINE HYDROXY ANALOG AND COW NUTRITION ON MILK AND CALF PRODUCTION OF THE BEEF COW

D. A. Daugherty and H. A. Turner

Estimates of 6 to 8 pounds average daily milk production for the British beef breeds and the fact that growth potential of calves has increased through selection and crossbreeding suggest that a need for increased milk production exists in many herds. Individually, a decision to increase milk production must consider the growth potential of the calves in relation to available milk. It would be undesirable to increase milk production beyond that required for maximum growth potential of the calf. This would result in fat deposition by the calf, increased scours problems, and discounted market value since postweaning gain efficiency would be reduced.

Once the growth potential is established, increased milk production may be increased either genetically, through crossbreeding, or possibly introduction of dairy breeding, or nutritionally. Limited information is available on the effects of increasing milk production of the beef cow through supplementation. Recently, interests in the effect of an amino acid supplement (Hydan) on milk production in dairy cattle have stimulated research on the supplemental effects of this product in beef cattle. Methionine Hydroxy Analog (MHA) is a synthetic form of the essential amino acid methionine. Although amino acids and protein quality generally are not of concern in ruminants because of the degradation of dietary proteins and synthesis of high quality microbial protein in the rumen, research has shown that microbial protein is limiting in methionine for maximal milk production. Methionine hydroxy analog is believed to by-pass the rumen to a large degree and is then available postruminally for synthesis of tissue or milk protein and as an important part of nutrient transport compounds in the blood.

MHA research has resulted in varying effects on beef cow milk production and calf gains. Increased weaning weights of up to 90 pounds have been reported from supplemental MHA. Milk production and milk fat were significantly increased. However, other research has failed to show any beneficial effects from MHA

The objectives of these studies were to further investigate the effects of MHA on beef cow milk production and calf gains. The effects of two levels of energy and protein supplementation also were evaluated to determine dietary interactions on the effects of MHA supplementation.

EXPERIMENTAL PROCEDURE

The effects of MHA and four levels of cow nutrition on the fall-calving cow's milk production and calf gains were evaluated over a two-year period. Seventy-eight Hereford and Hereford-Angus cows were allotted to a 2X2X3 factorial of treatments for year 1 (1978-79) by production index, age, metabolic weight, and expected calving date. The treatments consisted of two levels of supplemental energy (one or three pounds barley per head daily) and two levels of supplemenal protein (zero or one pound of cottonseed meal (CSM) substituted for one pound of barley). The nutritional treatments were replicated three times to include a control replicate, supplemental MHA for 60 days postcalving, and supplemental MHA for 120 days postcalving. The MHA was premixed with the grain portion of the supplement to supply 10 grams active ingredient per head daily as recommended by E. I. DuPont Nemours and Co.

Sixty-eight cows were allotted to a 2X2X2 factorial of treatments in year 2 (1979-80) with 56 cows from the previous year in the second trial. A switch-back design was used so cows from year 1 were placed on treatments of opposite energy, protein, and MHA during year 2. In addition to the previous allotment criterion, 4 percent fat-corrected milk production (4% FCM) from year 1 was used. The treatments were identical for year 2 with the exception of the removal of the 120-day MHA replicate.

The cows were started on treatment 30 ± 5 days before their expected calving date and removed from treatments 120 days postcalving for year 1 and 60 days postcalving for year 2. All cows for both years received meadow hay free choice and had access to salt and bonemeal. After the treatment periods, all cows received one pound barley per head daily until spring turnout.

Cow weights were taken at trial initiation, 30, and 60 days postcalving, and spring turnout for both years. Calf weights were taken at birth, 60 days postcalving and spring turnout in year 1, with an additional weight taken at 30 days postcalving in year 2. The cows were from their calves for 6 hours and individually milked at 30 and 60 days postcalving following an intravenous injection of 1cc oxytocin. The milk was then analyzed for percent milk fat, solids-not-fat (SNF) and milk protein.

RESULTS AND DISCUSSION

The effect of MHA supplementation on 4% FCM production and calf gains is shown in Table 1. The 60- and 120-day MHA replicates were combined for year 1 because no differences were found betwen them. The 4% FCM production was lower both years for MHA-supplemented cows at 30 days post-calving. However, milk production had increased by 60 days postcalving for MHA supplement cows which resulted in production higher than the controls for year 1 and equal to controls in year 2. The cows in year 2 produced an average of 2.6 pounds less 4 percent FCM per head in the 6-hour period than during year 1. The lower production possibly is because the cows started the study at an average of 85 pounds lighter during year 2 and hay was fed more conservatively than in year 1 to reduce wastage. Quality of hay and weather also could have had an effect. The heavier cow weights during year 1 may have resulted in more body energy reseves to be drawn on for the demands of lactation.

Regardless of the differences in 4% FCM production between treatments, no differences were found for calf gains. Research has shown that increases in milk production had their greatest effect on calf gains during the first 90 days of life. After this time, the calf is less dependent on milk and can utilize more forage. A weight advantage in the first 60 to 90 days usually will be carried beyond weaning provided the calf remains on a high level of gain. Differences in weight occurring after 90 days and up to weaning are often partially compensated for after weaning, depending on plane of nutrition. As no gain advantage was present from MHA supplementation, by 60 days, any benefits past this date probably could be more economically obtained through direct supplementation of the calf.

Table 1. The effects of MHA supplementation on 4% FCM production and calf gains

Treatment	4% FCM, lb/6 hr 1/		Calf ADG, lb 2/		
	30	60	30	60	152
1978-79					
Controls	9.49	7.80	-	1.51	1.52
MHA	8.13	8.35	-	1.48	1.51
1979-80					
Controls	6.29	6.51	1.43	1.35	N.A.
MHA	5.56	6.54	1.41	1.34	N.A.

1/ Milk production after calf was held from cow for 6 hours, production was adjusted to a 4%-milk-fat basis.

2/ Average daily gains adjusted for sex at 30 and 60 days and for sex, age of dam, breed, and days of age for 152-day spring turnout.

3/ Not available at this time.

No major differences in cow weight losses or calving interval were found from MHA supplementation (Table 2). Normally, cows with higher milk production lose more weight through lactation and have a longer calving interval. A product such as MHA, which supposedly improves the efficiency of milk production, would be expected to increase the cow weight losses through lactation. However, since no increase in milk production was observed in these trials, no increase in cow weight losses was expected.

MHA supplementation has been reported to increase the fat content of milk but this was not observed in these trials (Table 3). Similarly, no difference in SNF or milk protein was observed from MHA supplementation.

Although these trials failed to show any benefit from MHA supplementation, the increased levels of protein and energy supplementation had a positive effect on milk production and calf gains. The effects on 4% FCM production and calf gains of energy and protein supplementation are shown in Tables 4 and 5, respectively.

The high energy level resulted in in 1.6 and .9 pounds increased FCM production in the 6-hour production period for year 1 and 2, respectively. This resulted in increased calf ADG of .09 pounds through 60 days postcalving. However, by spring turnout in year 1, the gain advantage of 7.6 pounds was costly, considering in increased barley consumption by the high energy cows of 180 pounds.

Table 2. The effects of MHA supplementation on cow weight losses and calving interval

Treatment	Cow weight losses 1/ Initial-30	30-60	Total	Calving interval, days 2/
	lb			
1978-79				
Controls	88.1	24.4	132.3	360.6
MHA	81.6	36.0	143.9	363.7
1979-80				
Controls	80.6	32.1	N.A.	N.A.
MHA	88.7	22.2	N.A.	N.A.

1/ Cow weight losses from start of study period to 30 days postpartum, 30 to 60 days postpartum, and total losses to spring turnout.

2/ Based on actual calving records.

3/ Not available at this time.

Table 3. The effects of MHA supplementation on milk composition at 30 and 60 days postcalving

	Milk fat 30	60	Solids-not-fat 30	60	Milk protein 30	60
	%					
1978-79						
Control	4.9	5.3	9.1	9.2	3.05	3.07
MHA	4.9	5.4	9.2	9.1	3.06	3.15
1979-80						
Control	4.5	4.9	8.9	8.8	3.02	2.95
MHA	4.6	5.0	9.0	8.8	3.07	2.93

Table 4. The effects of energy supplementation on 4% FCM and calf gains

Energy	4% FCM 30	4% FCM 60	Calf ADG 30	Calf ADG 60	Calf ADG 152
	%				
1978-79					
Low	8.43	7.37	-	1.45	1.49
High	8.74	8.96	-	1.54	1.54
1979-80					
Low	5.05	6.07	1.36	1.30	N.A. 1/
High	6.68	6.93	1.44	1.39	N.A.

1/ Not available at this time.

Table 5. The effects of protein supplementation on 4% FCM and calf gains

	4% FCM 30	4% FCM 60	Calf ADG 30	Calf ADG 60	Calf ADG 152
	lb				
1978-79					
Low	8.71	7.35	-	1.52	1.52
High	8.46	8.98	-	1.46	1.51
1979-80					
Low	5.35	6.11	1.37	1.30	N.A. 1/
High	6.44	6.75	1.47	1.39	N.A.

1/ Not available at this time.

The high level of protein supplementation resulted in nearly identical results for FCM production and calf gains as the high energy level through 60 days. However, no benefit was observed at the 152 day spring turnout date.

No differences in calving interval were found during year 1 for the two levels of energy or protein supplementation. Cow weight losses through turnout were similar during year 1 for the two energy levels. However, cows on the low protein level lost 26 more pounds than on the high protein level. Most of this loss occurred during the first 30 days post-calving with losses similar for both protein levels after 30 days.

Both high energy and high protein resulted in increased milk fat levels (Table 6). The effects of energy on milk fat were variable with a 10 percent increase in year 1 at 60 days postcalving and no increase in year 2. Although the increases in milk fat from the high protein level were small, they were consistant. These increases in milk fat probably are responsible for the increased calf gains.

Table 6. The effects of protein and energy levels on milk fat percent

	Protein		Energy	
Milk fat	Low	High	Low	High
1978-79				
30 days	4.8	5.0	4.8	5.0
60 days	5.2	5.5	5.1	5.6
1979-80				
30 days	4.5	4.6	4.3	4.8
60 days	4.8	5.1	5.0	5.0

Although MHA failed to show any benefits in these trials, more reseach needs to be conducted. The variable results between research trials indicate a dietary interaction that is affecting the outcome. In dairy trials, MHA has consistently increased milk fat production when the cows are on a 50 percent plus concentrate ration. Low protein diets also benefit from MHA supplementation with increases in total milk production and milk fat. However, beef cows are seldom, if ever, fed high concentrate diets and the mode of action of MHA in beef cows is as yet undetermined. Further analysis of the data from these trials is planned to examine dietary interactions and the results will be made available.