114

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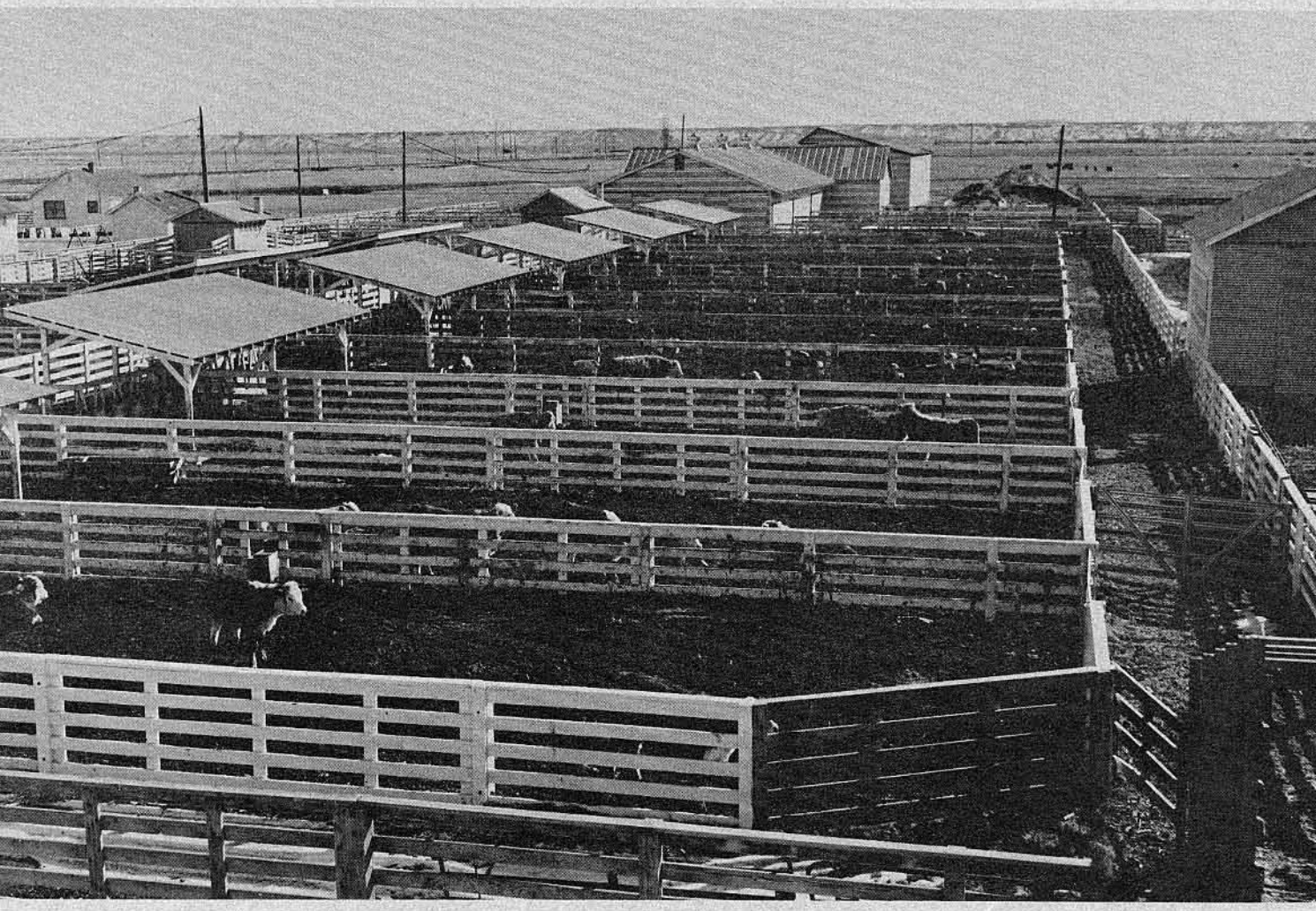
Research in Beef Cattle Nutrition and Management



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1967 PROGRESS REPORT

RESEARCH IN BEEF CATTLE NUTRITION AND MANAGEMENT

Robert J. Raleigh and Harley A. Turner

UREA IN A GROWING RATION FOR BEEF CATTLE

Urea has been used as a substitute for protein in the diet of ruminants for 50 years or more. The use of urea in ruminant feeds has increased nearly 3 times in the last 10 years. This is primarily due to the higher demand on vegetable proteins for human consumption and non-ruminant feed use and the resultant high cost. Also, as a result of research we are learning more about feeding non-protein nitrogen substances.

The majority of the research with urea feeding, until recent years, has been with fattening rations. The rate of urea hydrolysis and rate of microbial protein synthesis in the rumen are the controlling factors for optimal utilization of urea. Therefore, in order to get the most out of urea it is necessary to provide a media in the rumen as near ideal as possible for the microorganisms. Readily available energy, a balance of mineral elements, certain vitamins and amino acids, and other unidentified growth factors seem to stimulate the bacteria into making better use of urea. Much research has shown that alfalfa, and particularly dehydrated alfalfa, contains some of these unidentified growth factors.

High urea supplements have not been as satisfactory in growing rations as in fattening rations. It is thought that this is because of the lower levels of energy and the predominance of roughage. Work at the Squaw Butte Station has shown that urea can play an important role in the growing cattle ration. The work reported here is a continuation of these studies to determine factors that will provide for optimum urea utilization.

Experimental Procedures

Two levels of urea in combinations with alfalfa and trace minerals were used in a growing ration for replacement heifer calves to compare feed intake and efficiency, animal performance, and economy of performance. Forty animals were used in the trial and were allotted to treatments as shown in Table 1.

The calves were individually fed their entire ration. Chopped meadow hay was weighed in daily with hay refusals weighed out each week. The alfalfa was fed pelleted. The daily grain supplement and alfalfa pellets, where applicable, were equally divided and fed twice daily, at 7:30 a.m. and 12:00 noon. The calves were weighed every 4 weeks after an overnight restriction from feed and water. Water, salt, and a salt-bonemeal mixture were available to the animals at all times other than the 12 hours prior to each weighing. The trial ran for 112 days.

Table 1. Experimental design

Protein source	Urea levels	Trace mineral (% of ration)	
		0	1
	(lbs/day)		
Cottonseed meal	0.11	5 [1/] (1)	5 (2)
	0.16	5 (3)	5 (4)
Alfalfa	0.11	5 (5)	5 (6)
	0.16	5 (7)	5 (8)

1/ There were 5 replications; numbers in parentheses are treatment numbers as shown in Table 2.

The diets are shown in Table 2. Half of the barley of the supplement was finely ground and premixed with the urea portion of each diet, and then mixed with the rest of the supplemental ration.

Table 2. Composition of the daily diet 1/

Treatment number	Meadow hay	Ingredients of supplement				
		Alfalfa	Barley	Cottonseed meal	Urea	Trace minerals
	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)	(lb.)
1	9.5	----	2.5	0.25	0.11	----
2	9.1	----	2.5	0.25	0.11	0.1
3	9.7	----	2.5	0.25	0.16	----
4	9.1	----	2.5	0.25	0.16	0.1
5	8.6	1.0	2.5	----	0.11	----
6	9.0	1.0	2.5	----	0.11	0.1
7	8.9	1.0	2.5	----	0.16	----
8	9.1	1.0	2.5	----	0.16	0.1

1/ Amount of each ingredient actually consumed per head daily during the trial.

Observations

The animal production data are presented in Table 3. In general, gains were somewhat lower than those in a previous study on similar rations. This is probably the difference in barn-fed and lot-fed animals; as animals group-fed will generally gain better than those individually fed.

Table 3. Average daily gain, feed efficiency, and cost per pound of gain for each treatment

Treatment number	Daily gain	Feed/lb gain	Cost/lb gain 1/
	(lb.)	(lb.)	($)
1 (CSM, low urea)	1.19	10.5	14.4
2 (CSM, low urea, trace minerals)	1.16	10.4	14.3
3 (CSM, high urea)	1.13	11.3	15.7
4 (CSM, high urea, trace minerals)	1.18	10.3	14.5
5 (Alfalfa, low urea)	1.06	11.9	16.5
6 (Alfalfa, low urea, trace minerals)	1.06	12.0	16.4
7 (Alfalfa, high urea)	1.12	11.3	15.8
8 (Alfalfa, high urea, trace minerals)	1.09	11.7	16.2

1/ Native hay was priced @ $20, alfalfa pellets @ $40, cottonseed meal @ $90, barley @ $50, and urea @ $120, and trace mineral salt @ $56 per ton. No labor or yardage costs were charged.

There were no significant differences in rates of gain between any of the treatments. However, in all cases the animals receiving equal amounts of natural protein from cottonseed meal gained more with less feed and less cost than those receiving alfalfa pellets. There may be a small advantage in feed efficiency and cost of gain from the addition of trace minerals if alfalfa is not included in the ration. When alfalfa was included in the ration, there was no advantage from trace minerals.

Results of this trial, and other trials at the Station, indicate that urea can be used successfully as a protein substitute in the growing ration for beef calves. In a properly balanced and well-mixed ration, urea can increase efficiency and lower cost of production. Thorough mixing of the urea and uniform feeding practices are essential for good results.

DIGESTIBILITY OF RYE HAY

Several range operators in eastern Oregon depend on dryland rye hay as the major roughage for wintering beef cattle. Rye hay is a variable product with regard to both quality and quantity and at best rye hay can not replace native flood meadow hay as a roughage for livestock production.

Previous work at this Station indicates that crude protein content of rye hay is higher at the flower stage and decreases quite rapidly as the plant matures. Near maximum yields were also obtained by flowering, which is similar to results found in studies on flood meadow hay.

A measure of quality that can be used to estimate livestock production is the digestibility of nutrients in the forage, or the amount of forage nutrients used by the animal. Digestibility trials were conducted, using sheep, on rye hay harvested at different stages of growth.

Experimental Procedure

Columbia wether sheep were used in digestibility trials to determine the value of rye hay harvested at the flowering, dough, and seed stages of growth during the summers of 1963, 1964, and 1965. The rye hay was coarsely chopped and fed to the sheep in digestion cages which are equipped to collect and separate total fecal and urine excretion. Four sheep were used in a randomized block design over 3 digestion periods so each cutting of rye hay was fed to each of the 4 sheep. The digestion trials were conducted in the winter following each summer harvest.

The daily hay ration for each animal was weighed and divided into morning, noon, and evening feedings. Samples were taken daily of each animal's ration for chemical analysis. Feces and urine were collected over the entire collection period and then sampled for chemical analyses. The animals were on their respective diets for a 5-day preliminary digestion period and a 5-day collection period.

Observations

The crude protein values of the rye hay during each stage and year of harvest are presented in Table 4. Crude protein content decreased with each later date of harvest during 1963 and 1964 but increased at the dough stage in 1965. The variation in quality between years was as great as that between harvest dates in any one year. This follows the observed performance of cattle on rye hay. Some years cattle appear to do quite well on rye hay, while other years they nearly starve on seemingly comparable hay. Apparently, fertility of the soil and amount of moisture, which influences yield, affect the quality of the forage.

Table 4. Crude protein content of rye hay for each stage and year of harvest

Year of harvest	Stage of growth		
	Flower	Dough	Seed
	(%)	(%)	(%)
1963	4.6	3.6	2.5
1964	9.3	5.7	3.9
1965	4.4	5.8	4.3

Table 5 gives the digestibility values for the various nutrients at each stage of growth and year of harvest. Dry matter digestibility values were comparable for hay cut in the flower and dough stages and both were higher than hay harvested at the seed stage. Crude protein digestibility followed the same trend as crude protein content, with higher values for flower stage hay in 1963 and 1964, while the dough stage hay had the highest digestibility value in 1965. However, in all cases protein digestibility was significantly lower in the hay cut at seed stage than that cut at either of the other stages of harvest. Gross energy and cellulose digestion generally decreased with each later date of harvest but the decrease was not as large as that of protein.

Table 5. Apparent digestion coefficients for dry matter, crude protein, gross energy, cellulose, and ash

Nutrient	Year of harvest	Stage of growth		
		Flower	Dough	Seed
		(%)	(%)	(%)
Dry matter	1963	55.0	56.4	52.7
	1964	60.6	57.4	57.8
	1965	62.6	62.4	60.7
Crude protein	1963	46.3	31.8	5.5
	1964	53.7	50.7	44.8
	1965	52.5	60.7	46.9
Gross energy	1963	55.5	56.8	51.9
	1964 1/	----	----	----
	1965	62.6	61.4	60.2
Cellulose	1963	61.9	55.2	55.0
	1964	68.8	61.6	58.0
	1965	65.7	63.6	60.1
Ash	1963	20.9	19.5	22.2
	1964	22.1	25.2	30.3
	1965	21.2	28.5	16.7

1/ Energy digestibility not determined in 1964.

The effect of this change in nutrient composition on livestock production is shown in Table 6. Protein would be the first limiting factor in terms of livestock production. Energy would also be short in most years, primarily due to low feed intake as a result of the bulkiness of the hay and the low protein value. Digestible protein was not adequate to supply the protein needs of growing weaner calves at any stage of harvest in the year studied. The flower-stage hay in 1964 was the only hay that met the requirement for yearlings or pregnant cows. This means that rye hay usually, regardless of stage of cutting, cannot be depended on to meet the total nutrient requirement for wintering beef cattle, and supplemental protein needs to be provided for

all classes of cattle. Supplemental energy would also be required for calves and yearlings. Rye hay, at best, cannot be considered a good forage, however, the flower stage appears to be the optimum time for harvest.

Table 6. Crude protein and digestible protein content of rye hay harvested at 3 stages of growth and the extent to which it meets the requirement of various classes of cattle 1/

Stage & year of growth		Crude protein	Digestible protein 2/	Classes of cattle		
				Weaner calves	Yearlings	Pregnant cows
		(%)	(%)	(%)	(%)	(%)
1963	Flower	4.6	2.1	-4.1	-2.9	-2.4
	Dough	3.6	1.1	-5.1	-3.9	-3.4
	Seed	2.5	0.2	-6.0	-4.8	-4.3
1964	Flower	9.3	5.0	-1.2	0.0	+0.5
	Dough	5.7	2.9	-3.3	-2.1	-1.6
	Seed	3.9	1.7	-4.5	-3.3	-2.8
1965	Flower	4.4	2.3	-3.9	-2.7	-2.2
	Dough	5.8	3.5	-2.7	-1.5	-1.0
	Seed	4.3	2.0	-4.2	-3.0	-2.5

1/ The requirements were calculated for weaner calves to gain 1.0 pound per day, yearlings to gain 0.75 to 1.0 pound per day, and for pregnant cows to take care of body weight maintenance and fetal development.

2/ Digestible protein is determined by multiplying the percent crude protein by the digestion coefficients in Table 5.

PRODUCTION OF FALL CALVES

Range livestock operators in eastern Oregon and much of the western range states can be divided into 2 groups: those classified as cow-calf operators who sell their calves as weaners and those classified as cow-calf-yearling operators who hold their calves over the winter to sell them as long yearlings off range the following year. Probably the major reason for each type of operation should be the size of calf at weaning.

Calf weaning weights and percent calves weaned can be increased by good management, nutrition, selection, and breeding practices. Declining forage quality as the season advances reduces the rate of gain on range calves to one pound, or less, per day after the first of August.

Fall calving, while increasing the cost of wintering the lactating cow over a dry cow, should provide a bigger calf to go on range in spring and make better use of the high-quality range feed through May, June, and July. This should permit weaning an 8-9 month old calf weighing in excess of 500 pounds.

Experimental Procedures

The Station initiated a program 3 years ago to study the advantages and disadvantages of fall calving and the nutritional requirements and management problems associated with fall calving. At this date about half of the Station herd has been converted to fall calving. A fall and spring calving herd will be maintained for comparative studies.

The first crop of calves (61 head) from the fall group were weaned in July 1966. These calves were born in October and November of 1965. During the winter of 1965-66, the cows were fed native meadow hay free choice. From January 1 to April 18, they received supplemental protein and energy consisting of 1 pound of cottonseed meal and 1.5 pounds of barley per head daily. The cows were bred back during January and February of 1966 and the second crop of calves was dropped in October and November.

The first crop of calves was creep-fed starting in January, when the calves averaged 65 days of age. They were fed until they went on range April 18. The second calf crop is being managed in the same manner. The creep ration consisted of barley, alfalfa pellets, cottonseed meal, vitamin A, and terramycin, Table 7. The calves were weighed and ear tagged at birth, and weighed periodically up to weaning time.

Table 7. Daily intake per head of creep ration ingredients

Feeding period	Ingredients					
	Alfalfa	Barley	Cottonseed meal	Vitamin A	Terra-mycin	Total
	(lb.)	(lb.)	(lb.)	(IU)	(mg)	(lb.)
1/1-1/12	0.16	0.16	0.10	20,000	75	0.36
1/13-1/17	0.16	0.25	0.10	20,000	75	0.51
1/18-2/1	0.22	0.32	0.12	20,000	75	0.66
2/2-2/9	0.32	0.32	0.16	20,000	75	0.80
2/10-2/23	0.42	0.42	0.16	20,000	--	1.00
2/24-3/17	0.50	0.50	0.16	20,000	--	1.16
3/18-4/1	0.60	0.58	0.25	20,000	--	1.43
4/2-4/18	0.75	0.32	0.25	20,000	--	1.32

Observations

Only minor problems were encountered with the calves. A few required treatment for scours, pneumonia, and other calfhood diseases. The calves went on the creep feed readily and by the fourth day of feeding 90% or more were using the creeps. The calves remained on the cows after they went on range and at the time of weaning only one calf appeared to have weaned itself.

The weaning weights of steer and heifer calves from first-calf heifers and mature cows are shown in Table 8. Of particular interest is the spread (58 pounds) in weaning weights of steer and heifer calves from the mature cows compared to only 2 pounds difference in those from the first-calf heifers. Steers have a genetic potential for faster growth than heifers. However, if feed is limited, the steers are limited more than heifers because they are unable to respond to their genetic capacity. In this case the first-calf heifers probably limited their calves more on milk than did the mature cows, causing the steers to perform about the same as the heifers. First-calf heifers do not give as much milk as mature cows and do not milk as long.

Table 8. Weaning weight

Sex	Class of cow: First-calf heifer	Class of cow: Mature cows	Weighted average
	(lb.)	(lb.)	(lb.)
Steers	471 (11) 1/	546 (26)	524
Heifers	469 (10)	488 (14)	480
Average	470 (21)	526 (40)	507

1/ Numbers in parentheses are the numbers of calves in that classification.

Table 9 shows birth date, birth weight, weight on range, weaning weight, and weaning age of the calves. The average weaning weight of all the calves was 507 pounds. The cost of the creep ration was $2.48 per head for the entire season. The Station cows that calve in the spring are fed meadow hay free choice during the winter and a pound of cottonseed meal per head per day from January first until they go on range. This means that the only additional feed going into the fall-calving animals was the 1.5 pounds of barley from January first until they went on range. This amounts to 160 pounds of barley at a cost of about $4.00, making a total extra feed cost of $6.48 for the creep feed and extra supplement for the fall-calving cow.

There are many other items to consider, and data will be kept over several years before an adequate evaluation of fall and spring calving can be made. It should be pointed out that these cattle were bred back in January and February and at this point in our studies conception rates have been as good or better in this group of cattle as they have been with the spring-calving group bred in June and July on good-quality range.

Table 9. Average birth date, birth weight, weight on range, weaning weights, and weaning age of calves from first-calf heifers and mature cows

Measure of performance	Class of cow	
	First calf heifer	Mature cow
Birth date	10/27/65	10/28/65
Birth weight, lbs.	67.5	77.9
Weight on range (4/19/66), lbs.	291.0	334.0
Weaning weight (7/29/66), lbs.	470.0	526.0
Weaning age, days	275	274
Daily gain (birth to weaning), lbs.	1.46	1.63

FINISHING STEERS ON RANGE FEED

Yearling cattle on range can be supplemented at a low level to maintain daily gains of about 2.5 pounds from May to mid-August. After August, forage quality has dropped to the point that high levels of supplementation are needed to maintain this type of gain. Also, having received supplemental feed for 3.5 months, these cattle have some condition on them. It was postulated that another 90 days of supplementation might bring them to a suitable slaughter grade. This would essentially consist of using the range as a source of roughage and a feed ground, with the bulk of the feed coming from supplements. These animals should reach a body weight of about 1000 pounds at an age young enough that they should reach a slaughter grade without excess body fat.

This is the second year of this study. Results of the first year's trial were reported last year. The data collected the first year indicated that with proper supplementation yearling cattle could be finished to a reasonable slaughter grade on the range. The trial this year was designed to further study the possibility of finishing cattle on range and also to compare these with similar cattle finished under commercial feedlot conditions. The data from the cattle finished under feedlot conditions are not available at this time so only the data on the range-finished cattle will be reported here.

Experimental Procedures

Fifty yearling steers with an average weight of 540 pounds were grazed together on crested wheatgrass at the Squaw Butte Range from May 10 to July 28. During this time they received a supplement designed to maintain gains at about 2.5 pounds per day. The supplementation schedule for this period is given in Table 10.

Table 10. Supplementation schedule from May 10 to July 28

Feed period	Ingredients per head per day	
	Barley	Cottonseed meal
	(lb.)	(lb.)
5/10-6/24	1.0	----
6/25-6/30	1.2	0.25
7/1-7/7	1.2	0.50
7/8-7/14	1.2	0.75
7/15-7/21	1.4	0.85
7/22-7/28	1.6	1.00

The steers were weighed on July 28 and allotted to 5 groups of 10 each and each group allotted to one of the following treatments:

Group 1. Malheur Experiment Station feedlot from July 28 to November 8 at which time they were slaughtered.

Group 2. Malheur Experiment Station irrigated pasture from July 28 to September 15 and then the feedlot till January 16 at which time they were slaughtered.

Group 3. Malheur Experiment Station feedlot from July 28 to January 16 at which time they were slaughtered.

Group 4. Squaw Butte Range with supplements from July 28 to November 8 at which time they were slaughtered.

Group 5. Squaw Butte Range with supplements from July 28 to November 8 and Malheur feedlot from November 8 to January 16 at which time they were slaughtered.

The supplements fed to groups 4 and 5 at Squaw Butte from July 28 to November 8 are shown in Table 11. Due to the drought year, range feed was shorter than expected and the steers were moved to several pastures and finally on October 10 the decision was made to feed meadow hay to take the place of range forage.

Groups 1 and 4 were slaughtered November 9 and the other groups were slaughtered January 17. Performance data on all animals up to July 28 and on groups 4 and 5 up to November 8 and carcass data on groups 1 and 4, that were slaughtered on November 9, are included in this report. Carcass data on all the animals and feedlot data will be presented in a later report.

Table 11. Feed intake of groups 4 and 5 from July 28 to November 8

Feed period	Ingredients fed per head daily		
	Barley	Cottonseed meal	Meadow hay 1/
	(lb.)	(lb.)	(lb.)
7/29-8/11	2.0	1.2	---
8/12-8/25	4.7	1.4	---
8/26-9/14	8.0	1.4	---
9/15-9/22	10.1	1.4	---
9/23-10/6	13.4	1.4	3.5
10/7-10/20	15.9	1.4	7.0
10/21-11/3	16.6	1.4	7.0
11/4-11/8	17.0	1.4	7.0

1/ Range feed was short and from September 23 to November 8 the steers were fed meadow hay.

Observations

The average daily gain of all steers from May 10 to July 28 was 2.73 pounds per day and a total gain of 216 pounds per steer for the 79-day period (Table 12). The average daily cost was 5 cents per head during this period.

Table 12. Summary of gain, feed consumption, and gain costs

Item	Period 1/		Total
	5/10-7/28	7/29-11/8	5/10-11/8
Avg. da. gain, lb.	2.73	2.11	2.38
Avg. da. barley cons., lb.	1.14	10.37	6.34
Avg. da. CSM cons., lb.	0.30	1.37	0.90
Avg. da. hay cons., lb.	----	2.20	1.24
Avg. da. feed cost, $ 2/	.050	0.29	.171
Cost per lb. gain, $	.018	0.137	.085

1/ The period from 5/10-7/28 includes all 5 groups of steers while the period from 7/29-11/8 and the total period from 5/10-11/8 includes only groups 4 and 5.

2/ Cost includes range feed @ $.30 per A.U.M., barley @ $50 per ton, cottonseed meal @ $90 per ton, and hay @ $20 per ton.

This made a cost per pound of gain of 1.8 cents including the supplement and range charge. The average daily gain of the steers in groups 4 and 5 for the period from July 29 to November 8 was 2.11 pounds per steer. This was about a quarter pound less daily gain than last year and probably due to the excess shifting of pastures to keep them on range feed. The cost per pound gain during this period was 13.7 cents. The average daily gain for the entire summer period was 2.38 pounds per steer at an average cost of 8.5 cents per pound including the cost of supplemental feed and range.

The steers in groups 1 and 4 were slaughtered November 9. Three of the steers in group 1 (the group on range to July 28 and then in the feedlot to time of slaughter) graded choice and six graded good with one steer dying in the feedlot. All the steers in group 4 (those slaughtered directly off range) graded good and sold for 1 cent a pound of carcass weight less than those grading choice. The grades were not as high for range-finished steers as in the previous year, and this was probably due to the drought range condition.