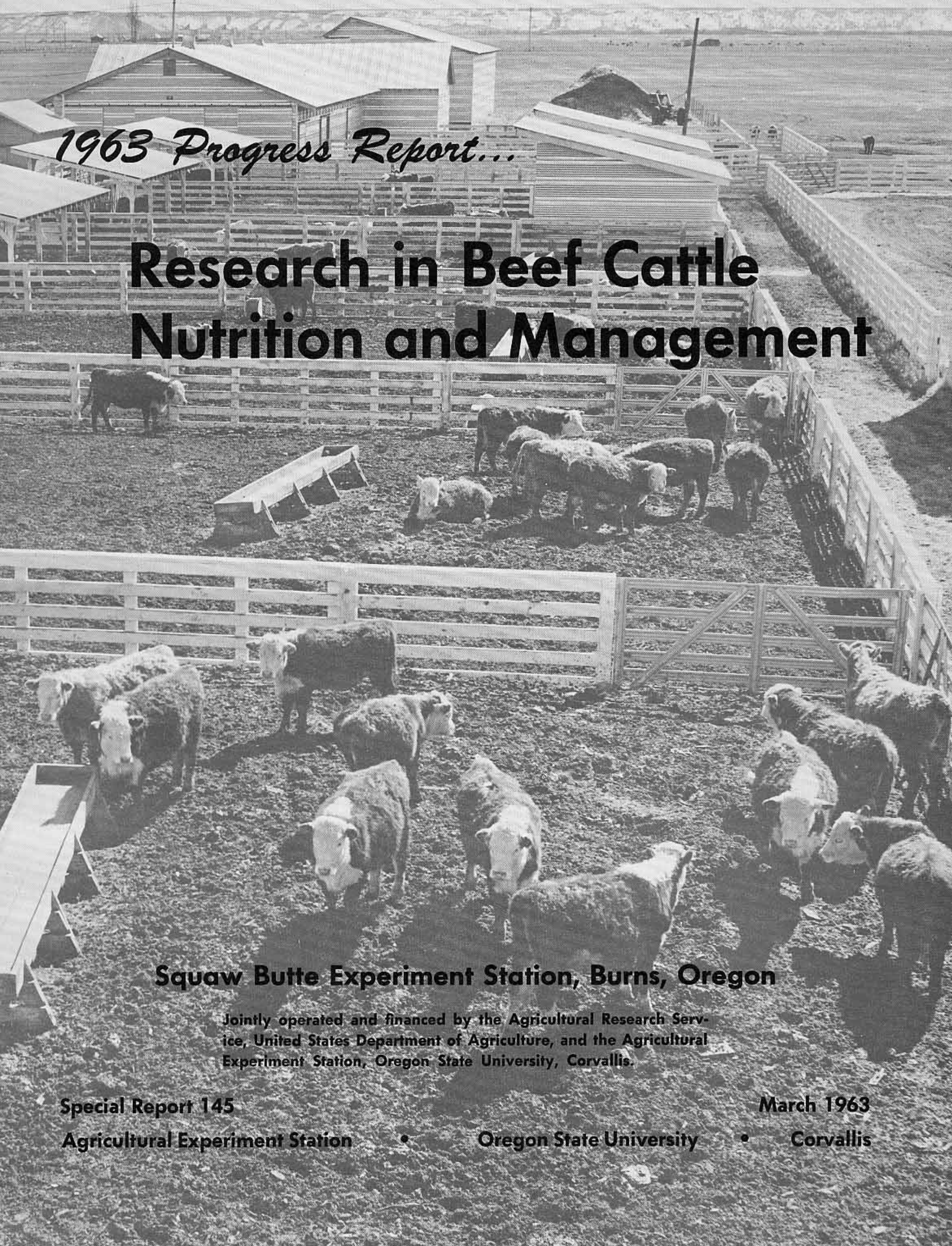

1963 Progress Report...

Research in Beef Cattle Nutrition and Management

Squaw Butte Experiment Station, Burns, Oregon

Jointly operated and financed by the Agricultural Research Service, United States Department of Agriculture, and the Agricultural Experiment Station, Oregon State University, Corvallis.

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- 1963 PROGRESS REPORT -

RESEARCH IN BEEF CATTLE NUTRITION AND MANAGEMENT

Robert J. Raleigh and Joe D. Wallace1/

Protein and Energy Supplements for Yearlings on Crested Wheatgrass Pasture

Some of the questions that arise when considering a supplementation program for yearlings on summer range concern when to start supplementing, what to supplement and how much to supplement. Probably one of the first steps toward answering these questions is to properly evaluate the range forage at various stages during the grazing period for nutrients available to the animal. Probably the nutrients we should be most concerned with in this area in regard to both deficiencies and economics are protein and energy. The supplementation of minerals and vitamins in a ration which is deficient in protein and/or energy will not substantially improve performance. In general, unless you are in a specific deficiency area, minor nutrients will be adequately supplied with the protein or energy supplement. Salt and a good phosphorus supplement should be available to animals at all times regardless of the management program.

Range grass is the major source of energy and it should be available in sufficient quantity so the animals can consume all they want if we expect to improve performance and profits through protein supplementation. If ample grass is available, it might be possible to increase gains profitably with supplementation of readily available energy as the plants become mature and digestible energy decreases.

Work conducted at this station over the past several years regarding the nutrient content of forage at various stages of growth as determined by clipped samples from animal trials and laboratory analysis has provided the data to calculate the protein and TDN content of crested wheatgrass at various times during the grazing season. This was used to calculate the pounds of crude protein and TDN that yearling cattle should take from a crested wheatgrass pasture during the grazing season, providing adequate grass was available. The work reported here is an attempt to determine the kind and amounts of supplementation required by yearling

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cattle on crested wheatgrass pasture to make a specified gain throughout the grazing season. These data should also be applicable to cattle grazing the native sagebrush-bunchgrass ranges of the area.

Experimental Procedure

Thirty uniform yearling heifers were randomly allotted to five treatments with six animals per treatment. Treatment 1 was a control group receiving only crested wheatgrass pasture. Treatment 2 received a low level of protein and a low level of energy supplementation. Treatment 3 received a low level of protein with a high level of energy supplementation. Treatment 4 was a high level of protein with a low level of energy supplementation. Treatment 5 received a high level of protein with a high level of energy supplementation.

The basis for selecting the levels of supplementation is shown in figures 1 and 2. This shows the calculated amount of protein and energy that yearling heifers will take from a crested wheatgrass pasture, during various intervals of the grazing season, when adequate forage dry matter is available. It further shows the amount of calculated protein and energy required to make a specified gain. The rations were adjusted during the grazing season so the decrease of nutrients in the forage were supplied by supplements. Table 1 shows the ingredients of the supplements.

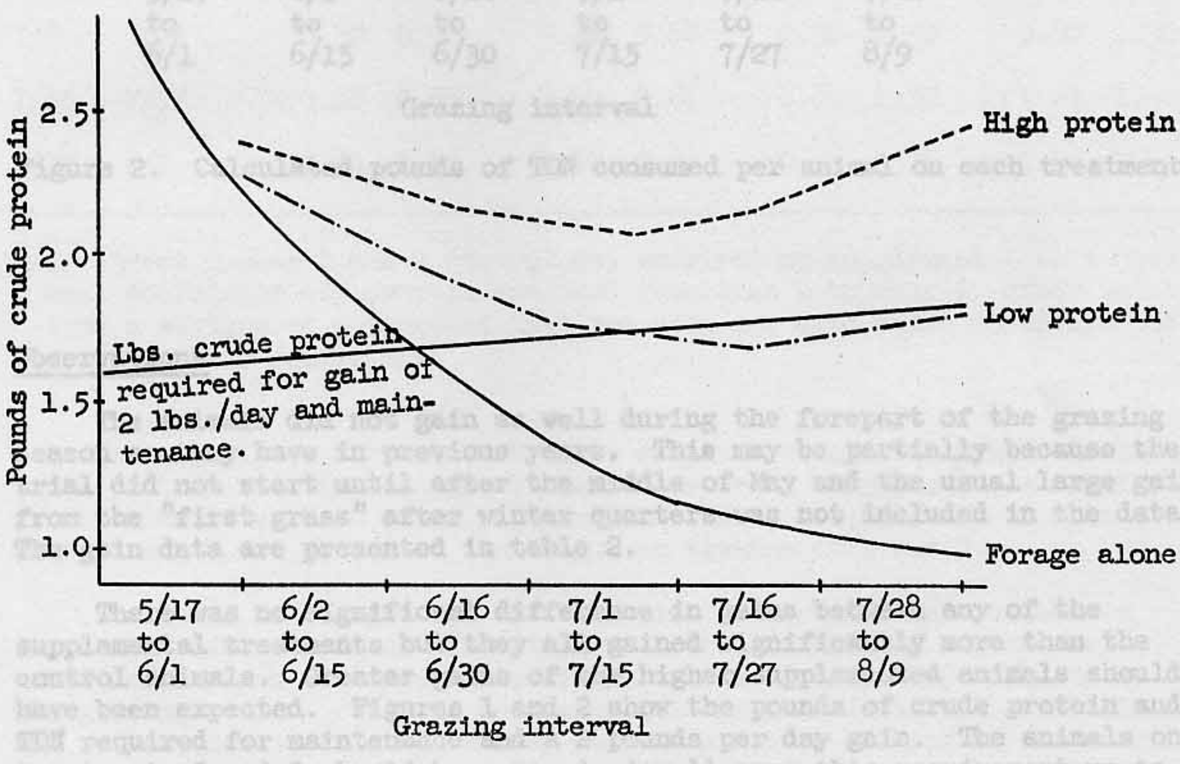

Figure 1. Calculated pounds of crude protein consumed per animal on each treatment.

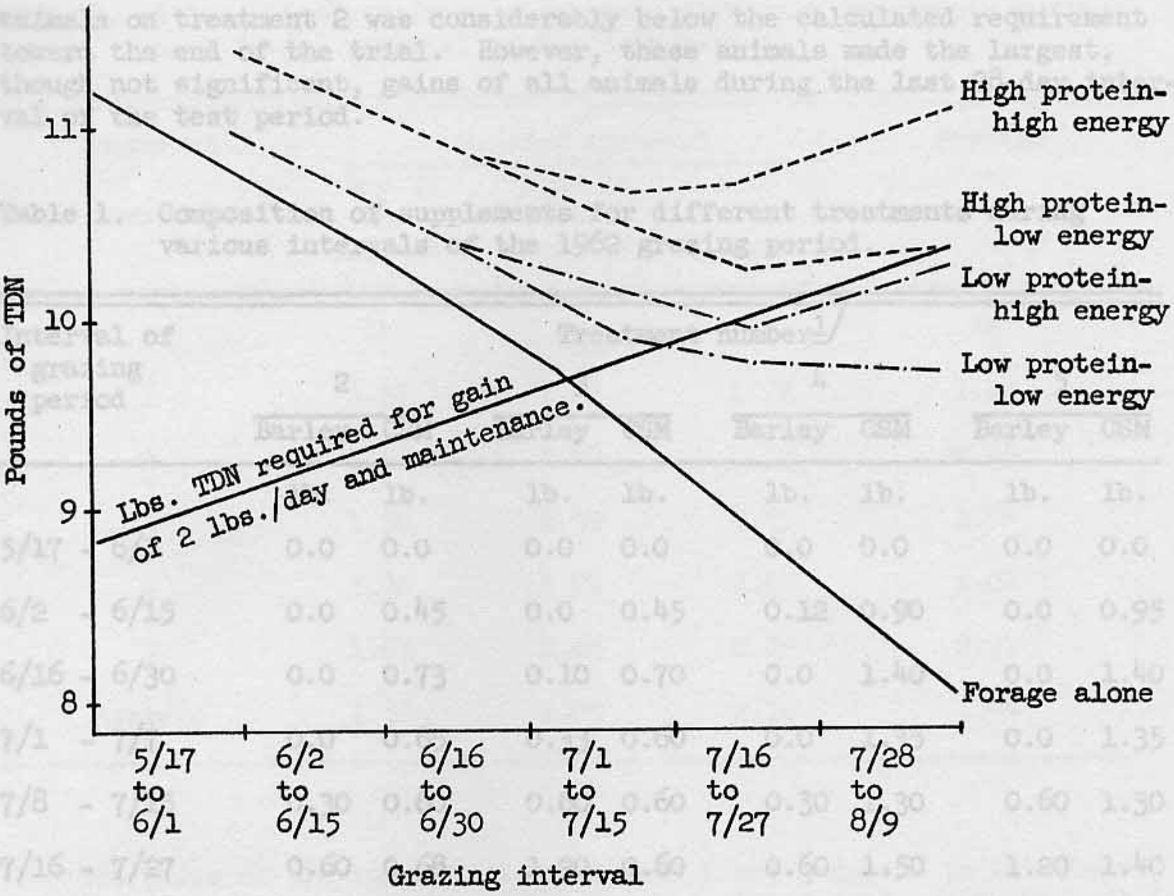

Figure 2. Calculated pounds of TDN consumed per animal on each treatment.

Observations

The animals did not gain as well during the forepart of the grazing season as they have in previous years. This may be partially because the trial did not start until after the middle of May and the usual large gain from the "first grass" after winter quarters was not included in the data. The gain data are presented in table 2.

There was no significant difference in gains between any of the supplemental treatments but they all gained significantly more than the control animals. Greater gains of the higher supplemented animals should have been expected. Figures 1 and 2 show the pounds of crude protein and TDN required for maintenance and a 2 pounds per day gain. The animals on treatments 2 and 3 should have received well over this requirement up to about the 10th of July and after this time only slightly below this for protein in both treatments and for TDN in treatment 3. The total TDN for animals on treatment 2 was considerably below the calculated requirement toward the end of the trial. However, these animals made the largest, though not significant, gains of all animals during the last 28-day interval of the test period.

Table 1. Composition of supplements for different treatments during various intervals of the 1962 grazing period.

Interval of grazing period	Treatment number 1/							
	2		3		4		5	
	Barley	CSM	Barley	CSM	Barley	CSM	Barley	CSM
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
5/17 - 6/1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6/2 - 6/15	0.0	0.45	0.0	0.45	0.12	0.90	0.0	0.95
6/16 - 6/30	0.0	0.73	0.10	0.70	0.0	1.40	0.0	1.40
7/1 - 7/7	0.0	0.65	0.33	0.60	0.0	1.35	0.0	1.35
7/8 - 7/15	0.30	0.60	0.60	0.60	0.30	1.30	0.60	1.30
7/16 - 7/27	0.60	0.68	1.20	0.60	0.60	1.50	1.20	1.40
7/28 - 8/9	0.96	0.96	1.80	0.80	0.96	1.96	1.80	1.80

1/Treatment number 1 was a control and received no supplement. Cottonseed meal containing 41% protein was used from June 2 to July 1, after which time a mixture of cottonseed meal and urea was used which contained 58% crude protein equivalent.

The animals on treatments 4 and 5 received considerably more of both crude protein and TDN throughout the entire trial than should be required for them to make the 2 pound per day gain. Yet these animals on treatments 4 and 5 did no better than those on treatments 2 and 3.

It should be brought out that the line represented as treatment 1 for both crude protein and TDN (figures 1 and 2) is based on the estimated consumption of measured nutrients in the forage at specific times of the grazing season. This is assuming that adequate forage is available and consumption is related to body weights and rate of gain of the animals. The control animals (treatment 1) seemed to fit this situation as their gains are quite well related to their intake of crude protein and TDN.

Table 2. Average daily gain of animals on different treatments during each 28-day interval of the test period.

Treatment number	Grazing interval May 17 to June 14	June 14 to July 12	July 12 to August 9	Average
	lb.	lb.	lb.	lb.
1	1.37	1.82	1.72	1.64
2	1.55	2.26	2.35	2.05
3	1.50	2.02	2.29	1.94
4	1.82	2.08	2.14	2.01
5	1.67	2.26	2.29	2.07
Average	1.58	2.09	2.16	1.94

The gains of the animals on treatments 2 and 3 appear to fit their calculated intake curve quite well. However, the animals on treatments 4 and 5 should have gained considerably more if they actually consumed the amount of their calculated intake (forage and supplement). Apparently these animals did not consume this amount or they would have done better. The supplement was individually fed which insured each animal of receiving an equal intake. Therefore, the assumption that forage consumption was reduced in the high supplemented groups (treatments 4 and 5) would seem logical.

After about the middle of July range forage is generally quite dry and "unpalatable" as compared to earlier in the season. Rather than having their appetites stimulated by the larger amount of supplement, it must have had an adverse effect and actually inhibited their desire for forage. The animals on the lower levels of supplements may have been stimulated to eat more. The data indicates that they made better use of their total feed.

Similar results have been observed in previous studies where the spread in gain during late season has not been as great as the spread in supplements fed, suggesting that there is a maximum level of supplementation that will bring the greatest return from yearlings on range pasture. It further suggests that there is a point beyond which we can not afford to supplement stocker cattle on range forage or even keep this type of cattle on range feed.

Energy, Protein and Urea Supplements with a Meadow Hay Roughage for Weaner Calf Rations

Beef cattle in eastern Oregon and many parts of the west are wintered on a low quality native meadow hay. Factors contributing to the quality are low levels of crude protein, low digestibility and bulk. Weaner calves receiving this hay alone generally will do little more than maintain themselves. Gains up to about 1.5 pounds per day are desirable.

Previous work at this station showed that increasing the protein level resulted in increased calf gains. Also an increase in energy, by supplementation, when accompanied by the increased protein resulted in a beneficial animal response. Urea as a partial replacement for cottonseed meal was satisfactory but was totally unsatisfactory as the sole crude protein supplement. There was also some indication that energy was limiting in the diets containing urea. The supplements in the work referred to above were all fed in a single feeding once a day. Other workers have shown that ruminants make better use of urea when self-fed than when hand-fed. This is especially true when energy is limited.

The purpose of this work was to determine the combination of protein and energy which will give maximum performance and to determine if urea utilization will be increased by feeding the urea-containing supplement several times a day rather than once a day.

Experimental Procedure

Thirty-two heifer calves were stratified by weight into four replications of eight each. These eight calves in each group were then randomly allotted to treatments shown in table 3. The diets were composed of meadow hay fed free choice and a supplement balanced to supply the protein and energy as prescribed for the respective treatments. The supplements were pelleted and the hay was coarse chopped. The supplements were calculated so that one-half of the crude protein of each supplement was from urea. Energy was adjusted to the desired levels with barley. Small amounts of potato starch and wheat gluten were used, when necessary, to meet the exact amounts of energy and protein specifications, respectively.

The calves were individually fed from October 16 to January 22 for a total of 14 weeks. They were tied to their feed bunks from 7:00 a.m. until 3:00 p.m. each day and ranged in a common lot the rest of the time. Half of the calves received all their supplement at 7:00 a.m. each day and the other half received one-third of their total daily supplement at 7:00 a.m., 10:00 a.m. and 1:00 p.m. each day. Water was available at their feed bunks and in the lots. Salt and bonemeal were available in the lots. The calves were weighed initially and at two week intervals during the trial. All weights were made after an overnight restriction from feed and water.

Table 3. Experimental design with average daily gain of the four animals on each treatment.

Protein level	Energy level[1] TDN	D.E.	Times fed/day 1	3	Average
%	%	Therms/lb.	lb.	lb.	lb.
11	54	1.02	0.84	0.82	0.83
	61	1.20	0.94	0.97	0.96
14	54	1.02	0.53	0.97	0.74
	61	1.20	1.01	1.04	1.03
Average			0.83	0.96	0.90

1/The energy levels used are presented in terms of percent total digestible nutrients (TDN) and therms of digestible energy (D.E.) per pound of feed. Traditionally the term TDN has been used and is probably the most common term to the stockman. However, with modern feed formulations, more refinement of measurement is required. The calculation of energy of feeds as digestible energy is a trend in that direction. Their dual presentation here is made to provide the reader with a comparison.

Observations

The calves were slow to start on their feed, resulting in small gains during the first four weeks of the trial. They did fairly well after this but overall gains were somewhat lower than expected due to this slow start. Average daily gains for calves on each treatment are presented in table 3.

The average daily gain of all the calves was 0.90 pounds. The poorest doing calves were on the treatment receiving the higher level of protein and low level of energy in one daily feeding. These calves gained 0.53 pounds per day. This would indicate that there wasn't sufficient energy in the ration for the animals to properly utilize the urea. However, calves on this same ration gained 0.97 pounds per day when the supplement was divided and fed at three different times each day, suggesting that the urea was better utilized when fed over a prolonged period. The number of times fed did not affect performance when the high level of energy was fed with the 14 percent protein ration. Apparently there was adequate energy in this ration for the animals to fully utilize the urea.

The number of times fed had no effect on gains at the 11 percent protein level of feeding with either level of energy. The amount of urea in the rations was apparently low enough that adequate energy was available for utilization, or differences at this low level of protein were not expressed in the gain. There was a significant increase in gains in calves receiving the high level over those on the low level of energy in both protein groups. The level of protein had no significant effect on gains of the calves. The average gain of the calves on the 11% protein ration was equal to that of those on the 14% protein ration. This indicates that the calves on the 14% protein ration probably needed a higher level of energy to make maximum utilization of the total protein.

Feed efficiency, or feed required per pound of gain and maintenance, and cost per pound of gain are presented in tables 4 and 5. The poor performance of these calves during the first four weeks of the trial added to the increased costs per pound of gain and the poor feed efficiency. Since maintenance requirements hold relatively constant, regardless of gain, anytime we get low gains we get increased costs per pound of gain. The least feed required per pound of gain was with the high protein-high energy ration. However, the lowest cost gain was obtained from the calves on the low protein-low energy ration.

Table 4. Average feed required per pound of gain on each treatment.

Protein level	Energy level TDN	Energy level D.E.	Times fed/day 1	Times fed/day 3	Average
%	%	Therms/lb.	lb.	lb.	lb.
11	54	1.02	10.63	10.43	10.53
	61	1.20	10.15	10.00	10.08
14	54	1.02	18.75	10.19	14.47
	61	1.20	8.59	8.97	8.78
Average			12.03	9.90	10.96

Table 5. Average cost per pound of gain for calves on each treatment.1/

Protein level	Energy level TDN	D.E.	Times fed/day 1	3	Average
%	%	Therms/lb.			
11	54	1.02	$0.117	$0.114	$0.115
	61	1.20	0.142	0.140	0.141
14	54	1.02	0.218	0.118	0.168
	61	1.20	0.124	0.129	0.127
Average			0.150	0.125	0.138

1/Native hay was priced at $20.00, cottonseed meal at $70.00, urea at $120.00 and barley at $50.00 per ton in arriving at cost figures. No cost was figured for the small amounts of starch and wheat gluten since they are not practical for other than research use.

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Digestibility Measurements on Native Meadow Hay and Their Effect on Animal Performance

Livestock production in eastern Oregon is largely dependent on hay production on the native flood meadows. Any factors which will increase production or the quality of this hay are of benefit to the livestock producer. Harvesting of this hay generally begins in early July and often continues into late August or September.

Chemical analysis of the important livestock nutrients in this hay shows that crude protein decreases rapidly, gross energy changes slightly and most of our more important minerals and vitamins decrease with stage of growth. Nitrogen fertilization generally results in increased yields with little if any increase in nutrient quality.

Data collected at this station shows that maximum hay yields occur about July 12 and maximum crude protein yields about July 5. The work reported here was designed to determine what stage of growth provides the maximum production in terms of animal utilization.

Experimental Procedure

Four Columbia wether lambs were used in a trial designed to compare the digestibility of meadow hay harvested at four dates. The design was a latin square which made it possible to compare hay from each harvest date with each sheep and thereby account for errors or variation between sheep. These lambs were kept in digestion stalls where total intake and excretion products could be measured. The four harvest dates were June 9, June 28, July 17 and August 4. Digestibility values for nitrogen (crude protein), dry matter, organic matter, cellulose and ash were obtained.

Observations

Apparent digestibility values appear in table 6. There was a general decline in all digestibility values with each harvest date. Crude protein digestibility declined more rapidly, with each date of harvest, than dry matter, cellulose or organic matter. These data indicate that hay harvested in this area during the last week of June and first week or two of July should give maximum animal production. These dates also agree with the above mentioned dates of July 5 and 12 when maximum protein and dry matter production of the hay is reached. The June 9 harvest date, even though digestibility was highest at this date, can be ruled out from a yield standpoint as well as being physically impractical due to flood water.

Table 6. Apparent digestibility of dry matter, protein, cellulose, ash and organic matter of meadow hay harvested at four dates.

Harvest date	Dry matter	Protein	Cellulose	Ash	Organic matter
	%	%	%	%	%
June 9	61.76	63.02	67.97	41.34	63.28
June 28	56.60	60.24	59.81	38.42	58.16
July 17	51.73	48.37	55.14	30.69	53.48
August 4	49.16	35.20	53.98	25.93	51.12

The decrease in crude protein content and digestibility with stage of growth is probably the most critical single factor from the standpoint of animal production. TDN or energy probably is not as critical since the decrease in digestibility is not as great with advancing maturity as it is for protein. Table 7 was prepared to show the effect of date of hay harvest toward meeting the requirement of certain classes of cattle with regard to digestible protein needs. According to the National Research Council Bulletin on nutrient requirements of beef cattle, weaner calves require feed containing 6.2 percent digestible protein in order to gain one pound per day; yearling cattle require feed containing 4.5 to 5.0 percent digestible protein in order to gain from 0.5 to 1.0 pounds per day; and, pregnant cows require feed containing 4.5 percent digestible protein in order to take care of body maintenance and fetal development.

Table 7. Crude protein and digestible protein content of meadow hay harvested at four dates and the extent to which it meets the digestible protein requirements of different classes of cattle.1/

Date harvested	Crude protein	Digestible protein 2/	Classes of cattle		
			Weaner calves	Yearlings	Pregnant cows
	%	%	%	%	%
June 9	10.1	6.36	+0.16	+1.61	+1.86
June 28	8.2	4.94	-1.26	+0.19	+0.44
July 17	5.8	2.80	-3.40	-1.95	-1.70
August 4	4.7	1.65	-4.55	-3.10	-2.85

1/The requirements were calculated for weaner calves to gain one pound per day, yearlings to gain from 0.75 to 1.0 pound per day and for pregnant cows to take care of maintenance and fetal development. The amounts listed are the percent of digestible protein that the animals will receive either above, or below, that required for each class.

2/Digestible protein was calculated by multiplying the percent crude protein by the percent of digestible protein at each date as shown in table 6.

The data presented in table 7 shows that hay harvested at the June 9 date only would furnish adequate digestible protein for weaner calves. By June 28 the digestible protein of the ration would have to be increased by about one-fourth and calves fed hay harvested in mid-July, or later, would have to receive more than half of their digestible protein from supplements in order to gain up to one pound per day. Yearlings and pregnant cows fare considerably better and should receive adequate protein from hay harvested in late June or early July. Actually the capacity of the mature animal is large enough that rarely would one encounter a severe protein deficiency on hay harvested at any of the above dates. Providing that hay is plentiful a mature cow will generally put enough of it through her to meet her needs.

However, this is not possible with a yearling or weaner calf as this hay is bulky and quite often animals of these sizes cannot, or will not, consume sufficient quantities to do well without a supplement. Other work at this station has shown that weaner calves wintered on meadow hay alone will do little more than maintain themselves. In order to get gains in the desired range of 1.0 to 1.5 pounds per day it has been necessary to provide both a protein and an energy supplement. However, when this hay was pelleted they were able to eat more and made reasonable gains without additional supplements.

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Wintering Mature Cows on Limited Rations

Winter hay supplies have become quite critical on many ranches in southeastern Oregon due to limited production on native meadows in recent years. Some ranchers have reduced their herd size to cope with this problem. Such management practices as fall pregnancy testing to avoid wintering open cows and placing greater emphasis on production in fall culling programs have proven helpful in these situations.

Surplus grain programs have in some instances helped to alleviate hay shortages. In the local area milo has been used more extensively than other grains for this purpose. From a nutritive value standpoint, 5 lb. of milo is equivalent to 8 lb. of meadow hay in digestible energy and about 13 lb. of meadow hay in digestible protein. Barley and corn have approximately the same hay replacement values as milo. Cottonseed meal (or cubes) and alfalfa have also been used to stretch hay supplies. Forty-one percent cottonseed meal contains 1-1/2 times more digestible energy and about 11 times more digestible protein than meadow hay. Alfalfa hay and meadow hay are about equal in digestible energy content but alfalfa contains almost 3-1/2 times more digestible protein.

Meadow hay is utilized by the animal to a greater extent when fed with a concentrate supplement than when fed alone; therefore, the replacement values mentioned above are probably conservative when considering a ration composed of both meadow hay and a concentrate supplement.

Limited feeding of mature cows during pregnancy is generally considered to have little effect on production. If, however, cows are underfed during lactation, they usually fail to come in heat properly, have low conception rates and provide a limited milk supply which in turn results in reduced weaning weights. When a rancher is forced to underfeed his herd the practice should be confined to mature cows during pregnancy. Weaner calves and replacement stock should receive adequate feed for normal growth.

At the Squaw Butte Station, some research has been completed and more is in progress related to studying the effects of limiting winter rations for mature pregnant cows.

Experimental Procedure

In December, 1961, an experiment was initiated to compare the performance of mature pregnant cows wintered on different levels of meadow hay with and without a protein supplement. Forty-eight uniform cows from the station herd were randomly allotted to 3 groups of 16 animals each. Each group was placed in a separate field for the wintering period. One-half the animals in each group were fed a supplement of 1 lb. of cottonseed meal per head daily while the other half received only hay. Hay was fed to the 3 groups at the following rates: (1) All the hay they would clean up in a 24-hour period; (2) 75% of this amount, and (3) 50% of this amount. As the animals calved they were taken out of the experimental groups and placed with the main breeding herd where adequate feed was provided for all animals.

Observations

The average weight gains for cows on each experimental treatment are presented in table 8. Weight gains decreased with each reduction in hay intake and were also lower on animals receiving no supplement as opposed to supplemented groups. Average daily hay consumption was 27.7, 20.8 and 13.8 lb. for the 100, 75 and 50% hay groups, respectively.

Table 8. Average total gain made by cows on each treatment.

	Hay intake[1]			
Supplement	50%	75%	100%	Average
	lb.	lb.	lb.	lb.
1 lb. CSM	88	132	170	130
No suppl.	84	96	140	107
Average	86	114	155	118

1/100% group received a full feed of meadow hay and other groups were fed 50% and 75% of this amount.

Body weight changes or winter hay consumption, brought about by winter treatment, did not significantly affect the productive performance of the cows. The average birthweight and weaning weight of calves from cows wintered on each experimental treatment are shown in table 9. Birthweights and weaning weights were essentially the same regardless of level of hay or supplement fed to cows during the winter pregnancy period. It should be pointed out that these cows were summered on range where forage was adequate and had they been on poor range, the results may have been different. Conception rates for all cows involved in this study will be determined during the current spring calving season.

With the results of this study in mind another experiment was started this past fall in which cows are being individually fed allowing greater refinement in technique and procedure.

Table 9. Average birth and weaning weight of calves from cows on each treatment.

Cottonseed meal	Hay intake1/			Average
	50%	75%	100%	
lb.	lb.	lb.	lb.	lb.
Birth weights				
0	84.4	75.8	84.4	81.5
1	81.8	81.9	79.5	81.1
Average	83.1	78.8	82.0	81.3
Weaning weights2/				
0	476.2	458.2	476.5	470.3
1	452.8	473.5	470.8	465.7
Average	464.5	465.9	473.6	468.0

1/100% group received a full feed of meadow hay and other groups were fed 50% and 75% of this amount.

2/Weaning weights were adjusted for age and corrected for sex of calf and age of dam.

Performance Traits in Weaner Calves as Indicators of Future Performance and as Related to Weight of Their Dams

Performance traits in young cattle, their relationship during different periods of growth, how they may be affected by nutritional level, and their relationship to weight or size of their dams are interesting and sometimes controversial subjects among stockmen. In recent years production testing has stimulated a keener interest and the desire for a more thorough understanding of factors related to rate and efficiency of gain in beef cattle. During the past 10 years this station has accumulated considerable information regarding these factors. This work involved individual feeding tests with 254 weaner calves and 53 long yearling heifers.

Some of the objectives of this work were:

1. To study the relationship between weaner performance under high and low levels of feeding, yearling performance on summer range and long yearling performance under a high level of feeding.

2. To study the relationship between calf performance traits and weight of its dam at 18 months and 5-1/2 years of age.

Experimental Procedure

Approximately 28 weaner heifers were individually fed each winter during the years 1951 through 1958. Feeding periods averaged about 120 days during the 7 years. During each feeding period one-half the animals received a ration composed chiefly of native meadow hay while the other half received a more liberal growing ration. Individual records of weight gains, feed consumption and feed efficiency were maintained for all animals during each test period. Following the feed test each year all animals grazed in common on sagebrush-bunchgrass range. This procedure made it possible to study the association between winter and summer performance.

From 1959 through 1961 offspring of dams previously tested as weaner calves (1956-1958) were individually gain-tested. These animals were all fed a common ration. Data from this phase of the study was used along with the earlier work to study the relationship of performance traits during different periods of growth and will also provide information for estimating heritability of performance traits. At this time heritability studies are not complete.

During 1955 and 1956 long yearling heifers, previously tested as weaner calves, were individually fed through the winter period. The long yearling animals received a common ration (50% roughage and 50% concentrate).

Weights of the dam of each animal feed-tested were recorded at 18 months and 5-1/2 years of age. These data were used to study the relationship of calf performance traits with weight of its dam.

Observations

Upon completion of all feeding work the resulting information was coded on IBM cards and analyzed in the U.S. Beef Cattle Breeding Research Unit at Denver, Colorado.

Correlation coefficients by level of feeding for several test traits and one pre-test trait (suckling gain) are shown in table 10. The correlations expressed in this table are an index to the degree of relationship between any two traits. Correlation coefficients are abstract numbers which vary from +1 to 0 to -1 with plus numbers indicating a positive association (as 1 trait increases, the other trait also increases), 0 indicating no association, and minus numbers indicating a negative association (as 1 trait increases, the other trait decreases). Larger numbers are indicative of a closer relationship between two traits. In cases where feed efficiency is involved, a negative correlation denotes a more efficient animal.

Observations from the data shown in table 10 are as follows:

1. The relationship between suckling gain and performance on feed tests or on summer range was low and in most cases quite meaningless. Suckling gain was, however, strongly correlated with final weight (weight at approximately 2 years of age).

2. The relationship between gain on test as a weaner calf and yearling gain on range was quite low. This would tend to substantiate past work from this station which has pointed out that feeding for adequate growth during the winter does not adversely affect summer gain.

3. The association between performance traits as weaner calves and the same data as long yearlings were quite meaningful when weaners were tested under the higher level of feed; however, this did not hold true when weaners received the lower level of feed. This probably indicates that animals were not able to express their inherent growth potential under the low level of feeding. These data would also suggest that in order to use performance during an earlier period of growth to predict feedlot performance a higher level of feeding should be used.

4. In relating performance during earlier periods of growth to weight at 2 years of age (final weight) these data show that daily gain on test as a weaner calf was more closely associated to final weight than were suckling gains when the higher level of feeding was used; however, when the low level of feeding was used suckling gain was more strongly related to final weight than gain on test.

Correlations among calf traits and weights of dam at 18 months and 5-1/2 years of age are shown in table 11. The results show that the dam's 5-1/2 year weight was more closely associated to performance traits of her offspring than was her 18-month weight. The correlations of cow weight

Table 10. Correlations among performance traits under two levels of feeding.

	Traits											
	Gain on test1/		Feed efficiency1/		Gain on range		Gain on test2/		Feed efficiency2/		Final weight3/	
	(Low)	(High)	(Low)	(High)	(Low)	(High)	(Low)	(High)	(Low)	(High)	(Low)	(High)
Suckling gain	.12	.01	.20	.09	.08	-.23	.27	.22	-.17	-.13	.67	.44
Gain on test1/			-.71	-.67	.27	.08	.21	.44	-.30	-.14	.39	.72
Feed efficiency1/					-.14	-.17	-.13	-.58	.24	.38	.09	-.35
Gain on range							.36	-.20	-.49	.07	.59	.02
Gain on test2/									-.89	-.90	.69	.47
Feed efficiency2/											-.60	.16

1/Performance as weaner calf.

2/Performance as long yearling.

3/Weight at approximately 2 years of age.

with rate and efficiency of gain of her offspring indicate that heavier cows tended to produce calves which were faster, more efficient gainers. There was, however, practically no relationship between weight of cow and gain of her offspring on summer range as a yearling. A similar study from the Miles City Station indicated that increases in cow weight over the winter were positively associated with heavier, faster-gaining calves, whereas increases in cow weight during the suckling period were negatively correlated with calves' weights and gains.

Table 11. Correlations among calf traits and weights of dam.

Calf trait	Weights of dam	
	18 mo. wt.	5-1/2 yr. wt.
Birth weight	.32	.44
Suckling gain	.20	.26
Gain on test	.19	.21
Feed efficiency	-.10	-.21
Gain on range	.02	.07