LEVEL OF WINTER FEEDING
OF RANGE BEEF COWS

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INTRODUCTION

The ecological members of Central Oklahoma grasslands are mainly tall summer grasses. These grasses offer range cattle excellent summer forage; however, due to lignification and leaf disintegration through weathering, they become poor sources of available nutrients after maturation and consequently offer relatively poor winter feed for cattle. Therefore, winter supplementation of the beef cow herd has profound economic importance because of the effect of additional nutrients on cow weights, calf weights, percent calf crop, average birth date of calves, and milk production of the dams.

One of the systems of winter management of cow herds in Oklahoma is to provide cottonseed meal alone or in a mixture with grain as a supplement to the dry range grass. Experiments reported in this thesis concern the effect of three levels of supplemental winter feed for range beef cows calving in the spring. Estimates of 24-hour milk production obtained at monthly intervals is one of the criteria used in evaluating the feeding regimes.

REVIEW OF LITERATURE

Winter Plane of Nutrition

Stanley (1938) reported the results of a five-year study of different levels of wintering Hereford cows in Arizona arid-grassland. The annual rainfall in the experimental area was about 14 inches with most of it falling during the late summer months. Winters were generally mild. He concluded that although winter supplementation of the cow herd with 1 to 1.5 lb. of cottonseed cake was reflected in the weaning weight of the calves and condition of the cows, winter feeding was generally uneconomical. Calf crop was 92.4 percent in the control group and 86.2 percent in the supplemented group.

Knox and Watkins (1958) studied range cow supplementation during the dormant period of the vegetation (February 10 to when green forage was available, in no case later than May 1). Supplements used were ground maize, cottonseed cake and cottonseed cake plus dehydrated alfalfa. The differences in results from the various supplements were small and of doubtful significance. However, all supplements slightly increased the average (8 years) number and weaning weight of calves in years with subnormal rainfall.

In New Mexico, where these experiments were conducted, the average annual rainfall is only 8.5 inches, with late summer as the season of heaviest rainfall. Supplementation, especially with protein-rich concentrates, helped young cows more than old ones. Five-year-old cows did not noticeably respond to supplementation.

In Montana, Black and associates (1938) studied the possible benefits derived from supplementing with cottonseed cake beef cows wintered on the range. Average annual precipitation was slightly less than that of Arizona but most of it fell in the spring giving rise to taller grasses. Experiments involving 542 Hereford cows were conducted during three winters in which all cows were kept on the range throughout the winter season. Approximately half of the cows received 1 lb. of cottonseed cake per cow daily during the winter. The other cows were not supplemented except where death loss was a menace. In general, the control lot of cows lost a few pounds during the winter while the supplemented group gained an average of 23 lb. Percent calf crop was essentially unaffected by treatments. However, there was a difference of nearly 2 lb. in birth weight and nearly 14 lb. in weaning weight of the calves in favor of the supplemented cows. Benefits from supplementation were not large enough to offset the cost of the extra feed.

Johnson (1952) studied the value of native hay, sorghum fodder, and cottonseed cake as supplements for cows grazing the range year-long. These studies extended for the period 1941-1949 and included trials on two locations in South Dakota. These locations differed slightly in rainfall but not enough to be different in range productivity. Temperatures throughout the winters in the two ranges were similar.

Results indicated that native hay, sorghum fodder and cottonseed cake were valuable for wintering cows in the order listed. The percent calf crop weaned and weight of calves at weaning were increased by supplementation. Winter feed also decreased weight loss of cows.

Calf production was found closely related to the weights of the dams at the end of the wintering season. The effects of poor winter rations were accumulative. In another experiment, early-cut windrowed hay was satisfactory as supplemental roughage but much greater amounts of it were needed per cow when compared to stacked hay.

Vinke and Dickson (1933) reported the results of a series of six Montana experiments comparing various forages for wintering beef cows. Oat hay was a considerably more desirable and economical forage than alfalfa, sweetclover, corn fodder, or bluejoint clover. Even the feeding of oat hay of poor quality resulted in fleshier cows in the spring than when other roughages were fed. The calf crop was apparently not affected by any of the treatments.

Wagnon and associates (1959) conducted wintering experiments (1937-48) with Hereford cows managed yearlong under range conditions on the San Joaquin Experimental Range in California. The herbaceous plant cover consisted mainly of annual plants whose success in establishing a new forage crop each year is dependent largely on whether or not there is adequate rainfall for plants to germinate.

The only feed available for the control herd was range vegetation. The supplemented herd was fed 1 lb. of cottonseed cake (43% protein) from August 1 to the beginning of calving in October and then increased to 2 lb. of cottonseed cake until the first rains in late fall, at which time 1 lb. of barley was added to the ration, bringing the total to 3 lb. of feed per cow daily for the period ending February 1 Both lots were treated equally during the rest of the year. The supplemented cows produced an average of 115 lb. more weaned calf than the unsupplemented cows because of improved conception rate, percent calf crop and weaning weights of the calves. In general, the heavier fed cows returned from $1.50 to $2.50 added income per dollar of supplemental feed expense than the control cows.

Patterson (1953) from a 6-year Mississippi study reported that during the winter the feeding of 30 lb. of sorghum silage, 5 lb. of hay and 1 lb. of cottonseed meal was a more productive and economical ration than pasture clippings either alone or plus 1 lb. of cottonseed meal, continuous oat or fescue grazing, or limited oat or rye grazing. All these rations, however, provided for maintenance. Pasture clippings plus 1 lb. of cottonseed meal was a satisfactory ration. In general, milder winters, which allowed some green forage to be available on the pastures, resulted in higher conception rate during the following breeding season. Some relationship appeared to exist between winter weight gain of the cows and weaning weight of the calves.

Langford and co-workers (1958), in North Dakota, limited winter feeding of beef cows to 75 percent of the NRC standards by feeding corn silage and grass hay. Six-year results indicate weight losses from 41 to 66 lb. of the cows' body weight. The recovery of these losses during the summer was evident. A mean difference of 4 and 33 lb. at birth and at weaning, respectively, was noted between the calves out of the cows fed normally (at 100 percent of the NRC standards) and those fed the limited ration. Percent calf crop was slightly in favor of the better fed cows. These advantages, however, were not enough to offset the saving in cost of winter cow feed.

Thomas et al. (1960) reported the results of a three-year winter feeding study conducted in Montana. Supplements containing 20, 30 and 40 percent protein and .75 or 1.5 percent phosphorus were compared. All rations were individually fed to grade Hereford cows at a level of 2 lb. per cow daily from December 15 to March 15. The weight loss of the cows during the winter tended to be less in the groups that were supplemented with the higher protein and higher phosphorus concentrates. Little difference was noted in weaning weight of the calves between protein treatments, but the high phosphorus level improved the weaning weights of the calves about 20 lb.

Foster et al. (1945) compared various amounts of protein supplements for wintering beef cows during three years in North Carolina forest range. The average loss of weight for nursing cows during winter was inversely proportional to the amount of protein fed. However, during the subsequent summer, the cows that lost more weight during the winter gained more rapidly than those that lost less weight during the winter as a result of higher levels of supplemental feed. Two pounds of either cottonseed or soybean meal per cow daily resulted in lower percent calf crop and lighter birth and weaning weights of the calves than feeding 4 and 6 lb. of the same supplements.

Nelson et al. (1954) reported the results of a four-year study in which they compared commercial beef cows under two management systems: (1) grazed on native grass pastures yearlong and fed 2.57 lb. per cow daily of cottonseed cake during the winter months and (2) grazed for seven months and fed native grass hay and cottonseed cake at the rates of 20.95 and 1.33 lb. per cow daily, respectively, during the winter months. Both systems proved satisfactory. Further, they studied the value of alfalfa hay as a protein supplement for replacing cottonseed cake. Yearlong grazing supplemented with approximately 8 lb. of alfalfa hay during the winter was more desirable in terms of economy of production than feeding about 4 lb. of alfalfa hay and prairie hay ad lib. in a trap during the winter. Approximately 8 lb. of alfalfa hay satisfactorily replaced 2.5 lb. of cottonseed cake as a winter feed for commercial cows grazing yearlong on the range.

Hubbert and associates (1951) reported studies on winter planes of nutrition of beef cows in the eastern part of Oregon. Meadow hay at the rate of 16.8 lb. per head daily resulted in heavier calves at weaning than approximately half that amount of hay. However, more calves and heavier weaning weights were obtained on 21 lb. of meadow hay, 0.9 lb. of barley and 1.2 lb. of cottonseed meal per cow daily. Apparently, winter nutrition of a range cow has an influence on her milk-producing ability the following summer.

Pinney et al. (1960), in Oklahoma, studied the accumulative effects of three levels of supplemental winter feeding of grade Hereford range cows grazed yearlong. Treatments per cow daily were: 1 lb. of pelleted cottonseed meal, 2.5 lb. of the same pellets, and 2.5 lb. of cottonseed pellets plus 3.0 lb. of oats for the low, medium and high wintering planes of nutrition, respectively. Winter feeding was started in late October or early November and was continued until early April when green grass was available. Results of the first 11 1/2 years of the study were as follows:

1. Longevity has been enhanced by the lower levels of wintering. Of the original 30 cows started at each wintering regime, 27,

19 and 16 were left on the low, medium, and high levels, respectively.

2. The summer weight recovery power of the lower level cows has been enough to offset the winter weight losses except in the case of those cows calving first as two-year-olds and maintained in the low level of wintering throughout their lives.
3. Cows calving first as two-year-olds have weaned an average of 1.19 more calves per cow than those calving first as three-year-olds.
4. The cows on the low level of wintering have calved an average of six to nine days later than those of the medium and high levels.
5. Production, in terms of percent calf crop and weaning weights corrected for age and sex, has been greatest on the low level cows.
6. Cow cost per cwt. calf weaned has been approximately $7.25, $10.50 and $14.00 for the low, medium and high levels of wintering, respectively.

Further work in Oklahoma on the problem of wintering fall-calving range beef cows has been reported by Furr et al. (1959). The supplemental winter feed was 1.5 lb. of pelleted cottonseed meal per cow daily for the low level and 2.5 lb. of cottonseed meal plus 3 lb. of grain per head daily for the high level. The high level of feeding decreased winter weight losses an average of 36 lb. and increased weaning weights of calves an average of 30 lb. The increase in value of the calves due to the high level of wintering cows was not equal to the increased cost of supplemental feed.

Miller *et al.* (1958), also in Oklahoma, have evaluated different protein supplements fed during four consecutive winters to beef females grazing native grass yearlong. The supplements were fed to the same cattle as calves, as yearlings, and when producing their first and second calves in the fall when they were 2 1/2 and 3 1/2 years old. Although the performances of all groups of cattle were relatively poor, during the third and fourth year, while suckling calves, cows fed 3 lb. per head daily of pelleted cottonseed meal lost less weight during the winter and produced heavier calves than cows fed 1.5 lb. of pelleted cottonseed meal, 3 lb. of 20 percent protein combination pellet or 3 lb. of 40 percent protein pellet containing urea. Feeding 1.5 lb. of pelleted cottonseed meal resulted in greatest winter weight losses of the cows and lightest weaning weights of calves.

Milk Production

The influence of winter feeding on milk production of beef cows was studied by Anthony and associates (1961) in Alabama. The winter rations fed to two groups of cows were (1) coastal Bermuda hay plus 2 lb. of cottonseed meal and (2) small grain-clover grazing plus hay and cottonseed meal as needed to supplement the grazing. Milk production differed little between treatments, although the average daily gain of the calves was quite different, 1.16 and 1.50 lb. for the two winter treatments, respectively. In another test, cows on treatments that permitted loss of weight during the winter did not produce as much milk as those that gained some weight during the same period. However, spring pasture had a greater stimulus on milk production of the cows permitted to lose weight during the winter.

Clanton and co-workers (1961), working with 32 bred yearling Hereford heifers at Nebraska, fed four different rations for 140 days during the winter. The rations were combinations of low or high protein and low or high energy supplementation. The low levels provided for maintenance. This was approximately 50 percent of the crude protein and digestible energy recommended by the National Research Council as minimums for optimum production. The high levels provided 1.5 times the amounts required for maintenance; approximately 75 percent of the levels recommended by the NRC.

The only lot of heifers that lost weight was that on the combination of low protein and low energy. The other groups gained from 20 to 116 lb. High-energy supplemented lots allowed more weight gain than high protein. As has been noted in many other investigations, the summer gain in weight of the heifers was inversely related to the winter gain.

The effect of growth as measured by height at withers was significantly different between energy levels but not between protein levels. Condition was also more closely associated with energy levels than with protein allowances.

Daily milk production was estimated monthly through calf weight differences before and after nursing. An average of 5 determinations was made in 18 weeks. Estimated total milk production figures by treatments were LP-LE, 1,208 lb.; LP-HE, 1,227 lb.; HP-LE, 1,249 lb.; and HP-HE, 1,346 lb. L indicates low, H high, P protein and E energy. Due to within-treatment variation, these differences were non-significant.

Low energy groups suffered rather severe retardation of post partum heat and there were indications that conception rate was also affected by the low energy rations. Apparently, lactation in cows constitutes a nutritional drain affecting the degree of negative balance or rate of recovery of condition and thus also affects recurrence of heat after parturition (Wagnon et al., 1959). On the other hand, Pinney et al. (1961) has found that a very high plane of nutrition allowing maximum body weight gain of heifers allocated to treatment at weaning is probably as detrimental to milk production as a low level of supplementation which allows no gain during the first winter and a loss of 20 percent of the body weight during subsequent winters. Similar results have been reported by Holland (1961) in studies with twin heifers. However, excessive fat was reported of less detrimental consequence in mature cows.

Howes et al. (1960) alloted 12 Hereford and 12 Brahman heifers at random to two planes of protein supplementation. One group was fed 100 percent and the other 50 percent of the National Research Council recommendations. The heifers were hand milked twice daily at calving and subsequent 28-day intervals throughout the 8-month lactation. Older cows were added to both groups the following year. In the heifer lactation the Brahmans significantly excelled the Herefords in milk yield and calf growth. The older Brahmans had less advantage over the Herefords, but the higher milking cows gave birth to heavier calves that grew faster. The 50 percent protein intake had more effect on the heifers than on the cows in decreasing milk yield, calf growth and dam's weight at weaning. Calf growth and milk yield were highly correlated only during the early part of the lactation.

A study of the factors influencing rate of gain of beef calves during the suckling period was reported by Knapp and Black (1941). Partial correlation indicated that milk consumption had the greatest influence on rate of gain followed by the amount of hay and grain being consumed by the calves. The combined influence of these three variables accounted for 41 percent of the variation in rate of gain during the suckling period. Average daily gain before weaning and estimates of daily milk production were significantly correlated (r = 0.517**). It was also noticed that when selection of breeding animals was made during the suckling period the calves selected were those that made the greatest gain and they were from cows that gave the most milk but scored the poorest beef characteristics.

Cole and Johansson (1933) reported that in Aberdeen Angus cattle the best milk producer was a long-bodied and upstanding cow while the poorest milk producer had the best beef characteristics. They mention, however, that their second best producer was what is commonly called a typy cow. Thus, no conclusions concerning the correlation between beef conformation and the milk production of the beef cows were drawn from this study.

Neville et al. (1960) reported results of 3 years of work on the influence of sire, dam's milk production, 3 levels of nutrition, and other factors on 120- and 240-day weight of Hereford calves. Data were obtained from 135 calves by 5 sires.

Cows were on different planes of nutrition from December until the calves were 4 months old; subsequently, the nutrition levels were similar. Winter rations were as follows: low plane, silage plus 1 lb.

cottonseed meal; medium plane, corn silage plus 1 lb. cottonseed meal; and high plane, same as medium plane plus limited winter pasture.

Daily milk production was estimated by using the difference between weights of calves before and after nursing. Data were obtained every 2 months and twice during the 24-hour period.

Average daily milk production of cows up to 8 months and 8-months calf weights corrected for sire and sex effects were, respectively: low plane, 8.1 and 400 lb.; medium plane, 9.6 and 448 lb.; and high plane, 10.5 and 461 lb. Regression of 8-month calf weight on dam's milk production in 100 lb. units was 8.65, 8.12, and 5.20 for the low, medium and high plane calves corrected for year, sire and sex effects. All three "b" values were significantly different. Regression of daily calf gain on daily milk production and their corresponding correlations for the 4 consecutive periods within year, nutritional level, sex and sire were: 0.064, .70; .055, .61; .044, .63 and .048, .64, respectively. The overall correlation of total milk production with 8-month calf weight within year, nutrition, sex and sire value was 0.798.

Gifford (1953) sampled milk production of 28 Hereford, 7 Aberdeen Angus, and 5 Shorthorn cows. Milk and butterfat production were estimated during a two-day period each month by obtaining the milk produced by one half of the udder one day and the other half the following day. The combined production constituted a 24-hour sample and was used to estimate monthly production. Cows and calves were kept on pasture 9 to 10 months. During the remainder of the year they received silage, prairie hay and 1.5 lb. of cottonseed meal daily. Two to four lb. of grain were fed per cow when lactation occurred during the winter. Creep feeding was practiced during winter months and calves were weaned at eight months.

Results indicate that the quantity of milk produced had a tendency to increase up to about six years or to the fourth lactation period.

The lactation curve did not follow the norm reported for dairy cows but declined at an ever decreasing rate beginning with the first month. Also, there were indications that at an early age the calf limits the cow to her level of milk production.

Correlation coefficients between average daily gain of the calves and estimated daily milk production of the dam for the first, second, third and fourth month of lactation were: .60, .71, .52, and .35, respectively. Average daily gain was correlated to daily butterfat production but not as highly as to the estimates of daily milk production.

Correlation coefficients between gross weight of the calves at various ages and accumulated milk production to the corresponding time ranged from 0.52 to 0.67 for each month during the suckling period.

Repeatability of cows milk production was calculated as 0.47. This figure agrees very closely with Koch (1951) who concluded that differences between Hereford cows accounted for 52 percent of the variance in the calves' corrected weaning weight.

Cows that produced less than 6.5 lb. of milk daily during maximum production weaned calves that averaged 354 lb. Those cows that yielded between 6.5 and 12.9 lb. of daily milk weaned 405 lb. calves. In order to wean a 475 lb. calf, the cow had to average higher than 13 lb. of milk at the peak of her production.

Rather high correlations were encountered between post weaning growth of heifers up to 36 months of age and the average daily milk production of their dams.

Dawson *et al.* (1960) obtained an overall average of 4,400 lb. of milk with 3.98 percent butterfat from 30 beef Shorthorn cows during a lactation period of 252 days. For Aberdeen-Angus cows, Cole and Johansson (1933) reported 3,100 lb. of milk with an average of 4.1 percent butterfat for a 180-day lactation period. Extrapolating for a 252-day lactation, the Angus cows yielded only about 170 lb. less pounds of milk than the Shorthorns. In contrast to Gifford (1953), Dawson observed that a cow's peak production was at the end of the second month.

Milk production of beef cows observed both at Beltsville, Maryland, and at Manhattan, Kansas, agree in that production was affected by year and age of the cow. Data indicated that heaviest milk production is attained at six years of age. Similar results have been reported by Koch and Clark (1955), Gifford (1949) and Knapp *et al.* (1942).

Drewry and associates (1959) studied relationships among several factors associated with mothering ability of beef cattle. They estimated that the milk requirement to make a pound of gain by the calf is 12.5, 10.8 and 6.3 in the first, third and sixth month of lactation, respectively. They noted that older cows had a tendency to yield more milk and also to produce heavier calves at birth, although the calves were usually born later in the season.

The correlations between calf gain from birth and estimated milk production of the dam were -.15, 0.35, and 0.48 for the first, third and sixth month of lactation, respectively. These figures suggest that these relationships are perhaps influenced by age of calf.

The correlation between pound of milk per pound of gain and pre-weaning growth suggests that calves suckling heavier-producing dams made the least gain from a pound of milk. This could be partially due to the larger maintenance requirements of heavier calves.

Multiple correlation and standard partial regression coefficients indicated that factors other than milk production may contribute to mothering ability as measured by total gain of the calf. Lactation number, mothering score, average daily milk production of the dam, birth weight, age, and suckling time of the calf accounted for 75, 77 and 60 percent of the variability associated with total gain of the calf up to 1, 3, and 6 months of age, respectively. Thus, the relationship between mothering ability changes as the calf grows older.

Gregory _et al_. (1950) noted that the weight of the dam had a significant effect on the birth weight of her offspring. Also, the cows making the smallest gains during the nursing period tended to produce calves making the largest gains from birth to weaning. This was probably the result of increased milk flow. Knapp _et al_. (1942) also reported that weaning weights were more closely correlated to the weight of the dam at weaning time than her past fall or spring weight.

TRIAL I

Materials and methods

On November 11, 1958, 68 grade Hereford bred cows from 5 to 10 years of age were alloted to three different levels of winter feeding on the basis of age, weight, and previous record of performance. Nearly half of the cows were 5-year-old cows from the Ft. Reno Beef Cattle Experiment Station where they had been used in a level of wintering study. The cows were all allowed to graze in the native grass pastures year-round. The number of cows per treatment and the supplemental winter feed per cow daily was as follows:

Lot	Number of Cows	Winter Ration
1	22	Range plus no winter supplement
2	25	Range plus 2.0 lb. cottonseed meal pellets
3	22	Range plus 2.4 lb. cottonseed meal and 3.5 lb. of milo

Stocking rate was approximately 8 acres per cow. The pastures had ample grass dominated mainly by little bluestem with considerable amounts of Indian and switch grass and some winter annuals that generally furnished green forage as early as the middle of March. First calves were dropped in early February. Each lot of cows was managed on different pastures of approximately equal size and forage productivity.

The supplemental feed was fed every other day, twice the daily allowance at each feeding. A mixture of two parts salt and one part steamed bone meal was available at all times. The winter feeding period lasted from November 11, 1958, to April 23, 1959. All cows and calves in the experiment were weighed at approximately monthly intervals.

The calves were weighed and ear-tagged shortly after birth. They were dehorned and the bull calves were castrated when they were between one and two months old.

All calves were creep-fed from April 23 until weaning on October 10. One-third of each lot was creep-fed a basal mixture, one-third was creep-fed the basal mixture plus stilbestrol (5 mg. per head daily), and one-third was fed the basal plus stilbestrol and erythromycin (45 mg. per head daily).

The breeding season lasted from May 1 to July 30, 1959. A registered Hereford bull was placed in each pasture and these were rotated among the three pastures every two weeks in order to equalize the genetic effects due to sire.

Results and discussion

A summary of the results of Trial I is given in Table I. Wintering cows with no supplemental feed resulted in 7.6 percent loss (-85 lb.) in body weight to calving. Corresponding figures for the medium and high levels of wintering were 5.4 (-61 lb.) and 1.7 (-20 lb.) percent, respectively. Accumulative weight losses from fall to spring, when the supplemental feeding was discontinued, were 34, 22 and 21 percent for Lots 1, 2 and 3, respectively. Apparently, the medium level cows consumed enough additional grass from January 30 to April 23 to almost completely offset the differences in weight loss between them and the high level group. Forage intake was not determined. Summer weight gains were inversely related to average winter weight loss. Thus,

TABLE I

THE EFFECT OF LEVEL OF WINTER FEEDING UPON THE PERFORMANCE OF SPRING-CALVING BEEF COWS AT LAKE BLACKWELL (1958-1959)

Lot Number Level of Winter Feeding	1 Low[1]	2 Medium[2]	3 High[3]
Number of cows			
Total	22	25	22
Failed to calve	2	1	0
Lost calf before weaning	0	1	2
Raised calf to weaning	20	23	20
Average weight per cow (lb.)[4]			
Fall (11-11-58)	1120	1124	1172
Before calving (1-30-59)	1035	1063	1152
Spring (4-23-59)	735	877	927
Fall (10-10-59)	1086	1082	1119
Gain to calving (80 days)	-85	-61	-20
Winter gain (163 days)	-385	-247	-245
Summer gain (170 days)	351	205	192
"Yearly" gain (333 days)	-34	-42	-53
Average calving date	March 1	March 3	Feb. 24
Number of calves			
Steers	8	11	10
Heifers	12	12	10
Average weight per calf (lb.)			
Birth	68	78	78
Spring (4-23-59)	107	139	167
Weaning (10-10-59)	423	480	527
Supplemental winter feed			
Pounds per cow (lb.)			
Cottonseed meal	0	326	391
Milo	0	0	570
Cost per cow ($)	-	10.43	24.48
Total pasture and feed cost per year per cow ($)	25.00	35.43	49.48
Creep-feed cost per calf (426 lb./calf) ($)	11.42	11.42	11.42
Return per cow over feed cost[5] ($)	78.38	83.91	83.02
Number of cows open 10-10-59	1	2	0

TABLE I FOOTNOTES

[1]No supplemental protein.

[2]Two lb. pelleted cottonseed meal per head daily.

[3]2.4 lb. cottonseed meal and 3.5 lb. ground milo per head daily fed as pellets.

[4]Includes only those cows which weaned calves.

[5]Includes feed cost for only those cows raising calves. Calf value ($28 per cwt.) minus pasture and feed cost of cow and calf.

the yearly weight changes of the cows were of the same order for all treatments.

The percent of cows that calved was 91, 96 and 100 in the low, medium and high levels of wintering, respectively, although the percentage calf crop at weaning was nearly equal. Average calving date was approximately seven days earlier for the high level cows as compared to those in the other two lots.

All calf weights were corrected to a steer equivalent by the addition of 4 lb. to the birth weight and 25 lb. to the weaning weight of the heifers (Botkin and Whatley, 1953). Birth weight of calves did not differ between the medium and high level of wintering. However, the calves in the low level group were an average of 10 lb. lighter at birth. In mid-April, calf weight differences between treatment groups were marked and related to level of wintering. Weaning weights of calves were also affected by level of wintering of the dams. These weights were 423, 480, and 527 lb. for the low, medium and high levels of wintering, respectively.

When prevailing pasture and other feed cost and selling values of calves were considered, it was more profitable to furnish supplemental feed during the winter months than not to furnish any additional feed as was the case in Lot 1.

TRIAL II

Materials and methods

Many of the older cows used in Trial I were sold at weaning on October 10, 1959. Of the five-year-old cows, two out of Lot 2 were removed from the experiment because examination revealed that they were not pregnant and one cow from Lot 3 was sold because of an abnormal reproductive tract. The remainder of the cows continued on their respective levels of wintering. In addition, 32 four-year-old Hereford cows that had previously been under similar levels of winter feeding at Ft. Reno were added to the experiment. This made a total of 20, 22 and 22 cows per treatment for Lots 1, 2, and 3, respectively, for the winter period 1959-1960.

The management of the cows was essentially as described for Trial I except that the Lot 1 cows were not supplemented from November 5 until the beginning of the calving season (January 29). At this time, they were fed pelleted cottonseed meal at a rate of 1 lb. per head daily until the end of the winter, April 14, 1960. Winter feeding for the Lot 2 cows was not changed. The Lot 3 cows were supplemented with 6 lb. per head daily of a pellet containing 40 percent cottonseed meal and 60 percent ground milo. None of the calves were creep fed.

All the cattle were weighed at about monthly intervals. Estimates of 24-hour milk production were also obtained on the same dates from March 18 until weaning on October 12 for the cows in Lots 1 and 3 (low and high levels) using the method of weighing the calves before and after nursing. In this procedure, the cows were kept separated from their calves from noon to approximately 5 p.m. of the day preceding data collection. At about 5 p.m., the calves of each lot were allowed to suckle their dams. Eight or twelve hours later, according to the average age of the calves, milk production for that interval was estimated by weighing the calves in each lot before and after suckling their dams. Care was taken to insure defecation and urination of the calves before they were weighed for the first time. If the 24-hour estimate was made at 8-hour intervals, the same procedure was repeated two more times during that day. If, however, the age of the calves permitted milk production to be estimated at 12-hour intervals, the calves nursed only once more at the same time they had suckled their dams for the first time the day before. Usually, daily milk production was estimated through three suckling periods for the first three months. In later months, two nursing periods were thought to be sufficient. Milk production estimates were not corrected for fat content since samples were not obtained.

Water was made available for both cows and calves during the intervals between nursing periods. Cows were kept in native grass pastures except when they were being nursed, thus forage was available. As the calves grew older, alfalfa hay was made available to them between milkings. The 24-hour milk production estimates were the sum of the weight differences of the calves before and after suckling their dams.

All cows and the Lot 2 calves were weighed in the morning of the data collection day.

Results and discussion

Table II is a summary of the data collected during the 1959-1960 winter and the subsequent summer season. Body weight losses of cows from the beginning of the winter season until the start of calving were greater than those recorded during the preceding winter, probably the result of a "harder" winter season. The average weight loss for the low level cows was 12 percent (-143 lb.). The losses for the medium and high level cows were 10 and 8 percent, respectively. Winter weight loss from November to the end of the supplementation period in mid-April were 26 percent for the low level cows and approximately 18 percent for the other two lots of cows. As was true in 1958-1959 (Trial I), there was essentially no difference in winter weight losses between cows fed on the medium and high levels of supplemental feed. It is assumed, therefore, that the cows on the medium level consumed more forage, although no measures of forage intake were made.

There were only small differences in calving failures between treatments, although the trend was the same as that recorded in 1958-1959. Average birth dates were earliest for calves in the high level lot. The average calving date for the low level cows was six days later than for the high level cows. The calving dates for the medium level cows was intermediate. Differences in calf crop weaned were small.

Average birth weights of calves differed little between treatment groups. Less difference was noted in 1960 between the calves in the low level lot and those in the other two lots than in 1959. Although April calf weights were heaviest in the high level lot, weaning weights were nearly equal in the medium and high level lots. Cows fed on the

TABLE II

THE EFFECT OF LEVEL OF WINTER FEEDING UPON THE PERFORMANCE OF SPRING-CALVING BEEF COWS AT LAKE BLACKWELL (1959-1960)

Lot Number Level of Winter Feeding	1 Low[1]	2 Medium[2]	3 High[3]
Number of cows			
Total	20	22	22
Died or sold[4]	2	1	2
Failed to calve	3	3	1
Lost calf before weaning	0	1	3
Raising calves to weaning	15	17	16
Average weight per cow (lb.)[5]			
Fall (11-5-59)	1108	1089	1120
Before calving (1-29-60)	965	1003	1006
Spring (4-14-60)	812	882	925
Fall (10-12-60)	1067	1099	1113
Gain to calving (85 days)	-143	-86	-114
Winter gain (161 days)	-296	-207	-195
Summer gain (181 days)	255	217	188
"Yearly" gain (342 days)	-41	10	-7
Number of calves			
Steers	9	10	9
Heifers	6	7	7
Average calving date, March	7	4	1
Average weight per calf (lb.)[6]			
Birth	73	75	76
Spring (4-14-60)	91	113	131
Weaning (10-12-60)	377	436	433
Supplemental feed (lb.)			
Cottonseed meal	76	322	386
Milo	-	-	580
Total pasture and feed cost per year per cow ($)	27.47	35.46	47.69
Return per cow over feed cost ($)[7]	67.17	74.52	61.51
Number of open cows (10-12-61)	0	1	2

TABLE II FOOTNOTES

[1]1.0 lb. of pelleted cottonseed meal per head daily from January 29 until April 14.

[2]2.0 lb. of pelleted cottonseed meal per head daily from November 5 until April 14.

[3]2.4 lb. of cottonseed meal and 3.6 lb. of ground milo per head daily, fed as pellets, from November 5 until April 14.

[4]In Lot 1, one cow died and one was sold because of cancer eye. One cow died in Lot 2 and two cows died in Lot 3.

[5]Includes only those cows which weaned calves.

[6]Weights of calves were not corrected for age. Sex corrections to steer equivalent were made by adding 4 lb. to the birth weight of heifers and 25 lb. to their weaning weight. Sex corrections for spring weights have not been determined.

[7]Calf value ($26/cwt.) minus pasture and feed cost of cow and calf. Does not include feed cost of cows not raising calves.

low level of supplement weaned significantly lighter calves. The reason why the high level cows did not wean heavier calves in spite of the advantage in weight of their calves in the spring is not apparent. However, the stress resulting from calf separation from their dams during the days of collecting milk production data may be partly responsible. This stress was never imposed upon the medium level lot.

When prevailing prices were used as an aid in studying practical application of the data, the high level of winter feeding decreased returns over feed cost, but feeding on the medium level was more profitable than on the low level.

Monthly estimates of 24-hour milk production for the cows in Lots 1 and 3 are given in Table III. These values are presented graphically in the lactation curves shown in Figure 1. The first estimates were obtained on March 18, which is about two weeks later than the average calving date, although many calves were more than one month old on the date of this first estimate. The results indicate that mature Hereford cows calving in February and March experience an increase in milk production to reach maximum flow in May when green grass is available. Dawson (1960) reported a peak in milk production during the latter part of the second month of lactation of Hereford cows. Decrease in milk flow was noted from the time maximum production was reached until weaning, at which time the average milk production of both lots of cows was less than half the yield at the start of the lactation period. The decrease was from 5.80 ± .42 to 1.64 ± .33 lb. of milk for 24 hours in Lot 1 and from 8.61 ± .74 to 3.06 ± .57 lb. in Lot 3. The general pattern of the curve is somewhat similar to dairy cow lactation curves, although dairy cows apparently reach maximum milk production about a month earlier (Smith, 1952)

TABLE III

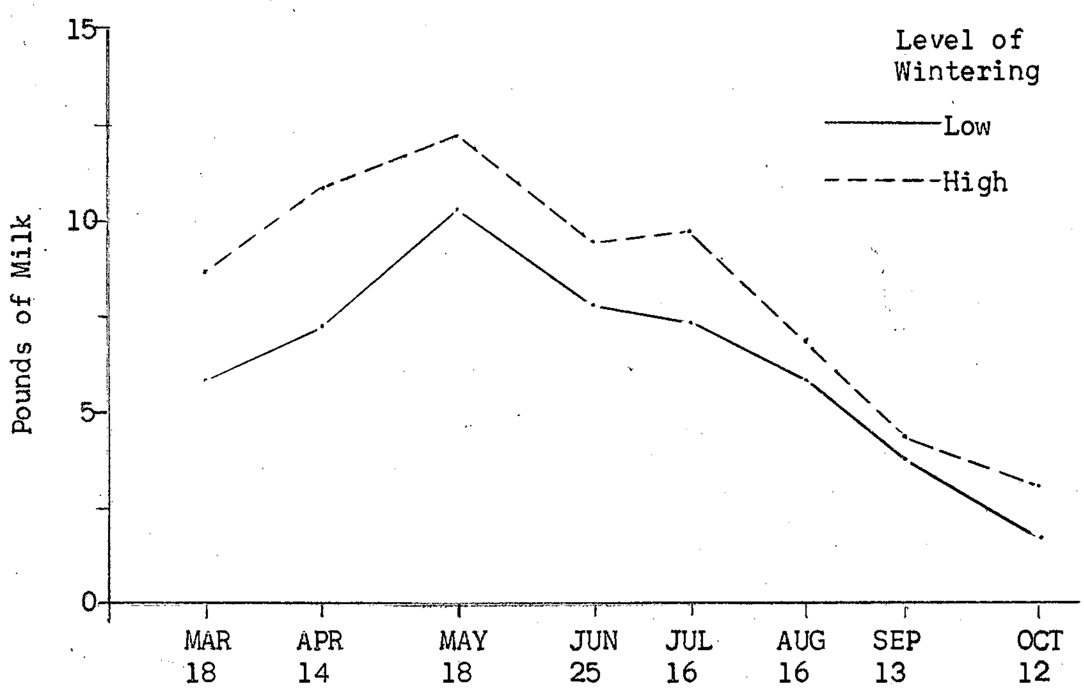
MONTHLY ESTIMATES OF 24-HOUR MILK PRODUCTION OF MATURE RANGE BEEF COWS (1960)

Date 1960	Level of Wintering Low	High
	Lb.	Lb.
March 18	5.80 ± .42[1]	8.61 ± .74[1]
April 14	7.36 ± .47	10.84 ± .60
May 18	10.49 ± .79	11.20 ± .89
June 25	7.69 ± .64	9.42 ± .92
July 16	7.46 ± .55	9.59 ± .79
August 16	5.76 ± .45	6.81 ± .55
September 13	3.75 ± .56	4.44 ± .42
October 15	1.64 ± .33	3.06 ± .57
Birth to weaning	6.25 ± .39	8.12 ± .50

[1]Standard error of mean.

FIGURE 1

LACTATION CURVES OF MATURE RANGE HEREFORD COWS BASED ON MONTHLY 24-HOUR MILK PRODUCTION ESTIMATES (1960)



than the beef cows used in these trials. Contrary to the pattern of these lactation curves, Gifford (1953) observed that milk production of beef cows declined at an ever decreasing rate beginning with the first month in lactation.

The average of the monthly estimates of 24-hour milk production was 6.25 ± .39 lb. for the cows in Lot 1 and 8.12 ± .50 lb. for those in Lot 3. Using these values, total milk production might be estimated to be 1,312 and 1,705 lb. in 210-day lactations for the low and high level cows, respectively. Gifford (1953) noted that Hereford cows of comparable ages had an average milk yield of 1,575 lb.

Average daily gain of calves, average milk production of their dams and simple correlation coefficients between these two measurements by periods are summarized in Table IV. Average milk production for each month is the mean of two consecutive observations, for instance if a cow yields 7.0 lb. on April 14 and 9.0 lb. on May 18, her average milk production for the period between those two dates would be considered 8.0 lb. Standard errors accompany each mean.

Higher average daily milk yields by month were observed in the high level group during all periods. Average daily gain of calves per month was also in favor of the calves in the high level group. The gains of the two groups of calves were nearly equal during the month prior to weaning; possibly because all calves were making most of their growth as a result of consuming pasture forage, with milk meeting only a small portion of the nutritive requirements. The difference of 2 lb. in the overall average 24-hour milk production estimates, when the yield was from 6 to 8 lb. of milk per day and the calves had plenty of grass available, resulted in weaning weights of calves that differed an average of 56 lb.

TABLE IV

MONTHLY ESTIMATES OF AVERAGE 24-HOUR MILK PRODUCTION OF COWS, AVERAGE DAILY GAIN OF CALVES AND CORRELATION BETWEEN THE TWO MEASUREMENTS (1960)

	Level of Wintering											
	Low						High					
Period	n[1]	ADG[2]	$S\bar{x}$[3]	Milk[4]	$S\bar{x}$[5]	r[6]	n[1]	ADG[2]	$S\bar{x}$[3]	Milk[4]	$S\bar{x}$[5]	r[6]
March 18-April 14	11	0.88	± .05	6.38	± .46	.96**	14	1.24	± .06	9.40	± .55	.70**
April 14-May 18	15	1.63	± .08	8.92	± .58	.68**	17	1.81	± .06	10.85	± .68	.45*
May 18-June 17	15	1.57	± .07	9.11	± .64	.57**	16	1.68	± .04	10.21	± .83	.04
June 17-July 16	15	1.46	± .09	7.58	± .55	.19	16	1.68	± .06	9.48	± .73	-.29
July 16-August 16	15	1.46	± .01	6.48	± .46	-.02	16	1.63	± .10	8.20	± .57	.34
August 16-September 13	15	1.25	± .08	4.67	± .41	.14	16	1.10	± .14	5.48	± .45	.30
September 13-October 15	15	1.82	± .13	2.70	± .39	.77**	13	1.84	± .13	3.98	± .44	-.37
Birth-May 18	15	1.09	± .28	8.17	± .53	.90**	15	1.44	± .08	10.08	± .71	.66*
May 18-Weaning	15	1.51	± .05	5.22	± .41	.46	16	1.61	± .04	6.77	± .44	.17
Birth to Weaning	15	1.37	± .05	6.25	± .39	.76**	16	1.56	± .05	8.12	± .50	.55*

TABLE IV FOOTNOTES

[1]Number of observations.

[2]Average daily gain of calves.

[3]Standard error of mean for average daily gain.

[4]Average of milk production estimates obtained at beginning and end of period.

[5]Standard error of mean for milk production.

[6]Correlation coefficient between average daily gain and milk production.

**P < .01

*P < .05

Correlation coefficients between average daily gain of calves and estimated monthly milk production of their dams were highest (.96) for the low level group for the period from March 18 to April 14, 1960. During this interval, milk production of the dams accounted for 92 percent of the variation in average daily gain of the calves. In this period, calf gains may have been severely restricted by their dams' milk yield because the cows lost an average of 34 percent of their body weight from November 5 to March 18. The correlation coefficient was .70 for the high level of feeding during the same period. Both of these correlations were significant at $P < .01$ when "t" tests were conducted according to Snedecor (1956) methods. In general, calf gains were highly correlated with milk production of their dams during the first 3 to 4 months of life, although a correlation coefficient of .04 was calculated for the period ending June 17 for those on the high level. Gifford (1953) also noted highly significant correlations between daily gains of calves and milk production of their dams during the first 3 to 4 months of life of the calves. The correlations for the period from birth to May 18 were .90 and .66 for the low and high levels, respectively. These values were highly significant ($P < .01$). It appears that after 3 to 4 months of age calves made most of their gains from grass.

Considering the period from mid-May to weaning, correlation coefficient values were relatively small, .46 and .17 for the low and high levels, respectively. The correlation between average daily gain of calves and average estimate of daily milk yield for the entire period from birth to weaning was .76 for the low level and .55 for the high level. Neville *et al.* (1960), working with comparable material, reported correlation of total milk production and 8-month calf weights of .798. Knapp and Black (1941) reported a correlation coefficient of .51. It is peculiar that calf gains in the low level group are highly correlated (r = .77) to the milk they were obtaining from their dams during the last month prior to weaning. Gifford (1953) also recorded significant correlation during the last period before weaning. The correlation value in the high level group during the last month of lactation was -.37. During this month both groups of calves gained at nearly the same rate; however, milk production estimates were not nearly as high for those on the low level as those on the high level.

TRIAL III

Materials and methods

At weaning in 1960 (Trial II) the six-year-old cows were removed from the test. The five-year-old cows remained in the experiment during 1960-1961. Also, 38 4-year-old Hereford cows from Ft. Reno were added to the study. Up to this time, these latter cows had been wintered on three similar planes of nutrition at the Ft. Reno station.

The cows which had previously been fed the low level of supplemental feed were switched to the high level of feeding. These cows had been fed on a low level for five or six consecutive years, depending upon the age of the cow. This change was made to allow a study of whether or not cows fed on a low level for several years would increase production when changed to a higher level of supplemental feed. The cows on the high level in previous years were changed to the low level. The Lot 2 cattle were continued on the medium level. Cow numbers per treatment were 22, 23, and 21 for Lots 1, 2, and 3, respectively, or low, medium, and high level of feeding.

Supplemental winter feeding to these cows was started on November 12, 1960. The Lot 1 cows were fed 1.1 lb. of cottonseed meal pellets per head daily for the winter season which ended April 21, 1961. The Lot 2 cows were fed cottonseed meal pellets at the rate of 2.6 lb. per cow daily, and the Lot 3 cows were self-fed a mixture of milo, salt and cottonseed meal which allowed them to consume an average of 4.3, 1.6 and 1.5 lb. per cow daily, respectively. This mixture contained either 65, 15, and 20 percent or 55, 25, and 20 percent of milo, salt and cottonseed meal, respectively. The mixture was changed in an attempt to obtain a relatively constant rate of intake.

Twenty-four-hour milk production estimates were obtained at about monthly intervals using the procedure described for Trial II. All other management practices remained the same as in the earlier studies. However, only data collected through July 29, 1961, are reported. Data on calf weaning weights, cow weights at weaning, percent calf crop raised, and milk production estimates for August, September, and October will not be available until weaning in October.

Results and discussion

Results of Trial III have been summarized in Table V.

Average cow weight losses from fall to calving were 5.4, 3.0 and 1.3 percent of their body weight for the low, medium, and high level groups, respectively. Corresponding weight losses of these cows from fall to spring (April 14) were 20.5, 16 and 16 percent. This represents losses of 228, 180, and 170 lb., respectively. The winter weight losses of cows has been greater for the low level group in all three trials. Also, the difference in losses between the medium and high groups has been small. Apparently, 2.5 lb. of cottonseed meal pellets (41 percent protein) meets the protein requirement of these cows.

In Trials I and II, summer weight gains of the cows were inversely related to their winter weight losses. This has been noted in many other experiments concerned with nutritional levels of wintering range brood cows. In 1960-1961, however, cows that lost the most weight during the winter, Lot 1, did not gain the most during the subsequent summer, while

TABLE V

THE EFFECT OF LEVEL OF WINTER FEEDING UPON THE PERFORMANCE OF SPRING-CALVING BEEF COWS AT LAKE BLACKWELL (1960-61)

Lot number Level of winter feeding	1 Low[1]	2 Medium[2]	3 High[3]
Number of cows			
Total	22	23	21
Failed to calve	1	0	2
Lost calf before weaning	0	2	1
Raising calves to (July 29, 1961)	21	21	18
Average weight per cow (lbs.)[4]			
Fall (11-12-60)	1108	1103	1069
Before calving (1-24-61)	1048	1070	1055
Spring (4-21-61)	880	923	899
Summer (7-29-61)	1072	1154	1104
Gain to calving (73 days)	-60	-33	-14
Winter gain (160 days)	-228	-180	-170
Summer gain (99 days)	192	231	205
Total gain	-36	51	35
Average calving date, March	15	10	15
Number of calves			
Steers	9	11	5
Heifers	12	10	13
Average weight per calf			
Birth[5]	78	75	74
Spring (4-22-61)	118	149	125
Summer (7-29-61)[6]	293	360	287
Supplemental winter feed (lb./cow)			
Cottonseed pellets	184	422	241
Milo	0	0	696
Total pasture and feed cost per cow[7]($)	31.26	39.35	44.33

[1]1.1 lb. cottonseed meal pellets per head daily from November 12, 1960, until April 21, 1961.

[2]2.6 lb. cottonseed meal pellets per head daily from November 12, 1960, until April 21, 1961.

[3]1.5 lb. cottonseed meal and 4.3 lb. of ground milo per head daily self-fed as a mixture of cottonseed meal, ground milo, and salt, from November 12, 1960, until April 21, 1961.

[4]Includes only those cows which were raising a calf on July 29.

TABLE V FOOTNOTES (Continued)

[5]Corrected for sex by the addition of 4 lb. to the birth weight of each heifer.

[6]Corrected for sex by the addition of 25 lb. to the weaning weight of each heifer.

[7]Using prevailing prices.

both the medium and the high level cows surpassed their previous fall weight by mid-summer. Whether or not the poor summer gains of the cows on the low level is due to carry-over effects from the high level of feeding in previous winters is not easily discernible.

Average calving dates in 1961 differed only slightly with the medium level cows calving an average of five days earlier than the other two groups of cows. Average calf birth weights were slightly in favor of the low level cows, although differences between treatments were not statistically significant. Spring and summer weights of calves were considerably heavier in the medium level lot than in the other lots. The reason for these relatively great weight differences is not apparent. The weights of the calves in Lots 1 and 3 were nearly equal in the spring and again in mid-summer. The results obtained to date suggest that cows fed on a low level of winter feeding for several successive years may not respond to a higher level of winter feeding when the response is measured by weights of the calves.

The calf crop percentages as of July 29 were 95, 91, and 86 for the low, medium, and high levels, respectively.

Average milk production estimates for the cows on the low and high level of winter feeding are given in Table VI. As was true in 1960, the cows on the high level produced more milk in each of the 24-hour periods in which estimates were obtained. Cows on the low level produced 8.86 ± .85 lb. of milk on March 24. Production increased to a peak of 11.15 ± .86 lb. on May 26 and declined to 8.95 ± .75 by July 29. These changes can be noted in the lactation curve presented in Figure 2. The curves of the two groups of cows are very similar.

TABLE VI

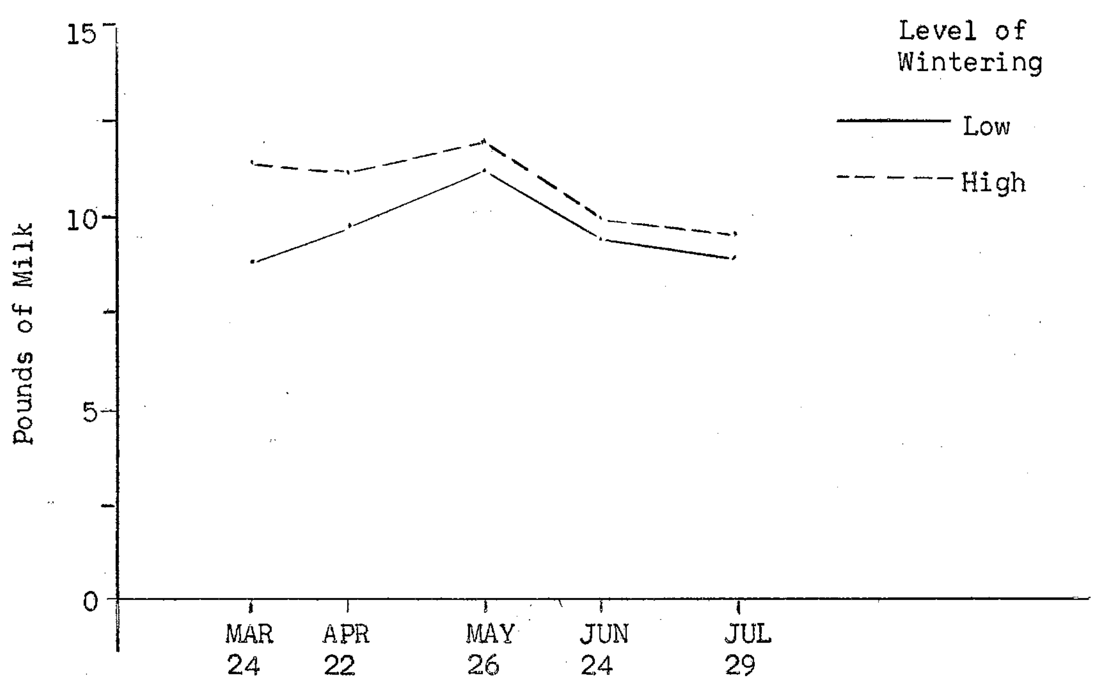
MONTHLY ESTIMATES OF 24-HOUR MILK PRODUCTION
OF MATURE RANGE BEEF COWS (1961)

Date	Level of Wintering	
	Low	High
	Lb.	Lb.
March 24	8.86 ± .85[1]	11.40 ± .40[1]
April 22	9.70 ± .81	11.07 ± .48
May 26	11.15 ± .86	11.96 ± .53
June 24	9.30 ± .72	9.96 ± .62
July 29	8.95 ± .75	9.50 ± .98
Birth to Weaning	9.20 ±1.38	10.32 ± .86

[1]Standard error of the mean.

Figure 2

LACTATION CURVES OF MATURE RANGE HEREFORD COWS BASED ON MONTHLY
24-HOUR MILK PRODUCTION ESTIMATES (1961)



The average milk production was 9.20 ± 1.38 lb. for the low level and 10.32 ± .86 lb. for the high level. In the first 145 days of lactation the calculated milk production was 1,392 and 1,495 lb., respectively. In 1960, the average production from calving to mid-July (145 days) was 778 and 1,437 lb. of milk for the low and the high level groups, respectively. Differences between years in the high level groups were small, but in the low level groups milk production was higher in 1961. It should be noted that in 1960 the low level cows were fed 1 lb. of cottonseed meal pellets only after the beginning of the calving period, starting in late January, while in 1961 the protein supplement was fed throughout the winter season. Another consideration is that the cows on the low level in 1961 were on the high level in previous winters. Average calf weights in July were 234 and 278 lb. for those on the low level in 1960 and 1961, respectively. Corresponding values for the calves on the high level were 285 and 287 lb.

Correlation coefficients between average daily gain of calves and estimated milk production of their dams is given in Table VII. There was considerable variation in correlation values between periods and level of winter feeding. During the month starting March 23, the correlations were .70 and .64 for the low and high levels, respectively, but in the following month the correlations were .44 and .73 with the higher value being for the high level of wintering. For the period from birth to July 27, the correlation of .71 for those on the low level was highly significant ($P < .01$). The low correlation of -.26 for the period beginning on June 24 for those on the low level is largely responsible for the overall correlation of -.01 for the complete period from birth to July 27. The calves on the high level consumed more milk but gained at a slower rate than those on the low level.

TABLE VII

MONTHLY ESTIMATES OF AVERAGE 24-HOUR MILK PRODUCTION OF COWS, AVERAGE DAILY GAIN OF CALVES AND CORRELATION BETWEEN THE TWO MEASUREMENTS (1961)

	Level of Wintering							
	Low				High			
Period	n[1]	ADG[2] ± $S_{\bar{x}}$[3]	Milk[4] ± $S_{\bar{x}}$[5]	r[6]	n[1]	ADG[2] ± $S_{\bar{x}}$[3]	Milk[4] ± $S_{\bar{x}}$[5]	r[6]
March 24-April 22	13	1.12 ± .08	9.47 ± .86	.70**	12	1.24 ± .06	11.03 ± .42	.64**
April 22-May 26	19	1.51 ± .07	10.71 ± .75	.44	17	1.49 ± .07	11.40 ± .38	.73**
May 26-June 24	20	1.90 ± .08	10.23 ± .70	.52**	17	1.54 ± .10	10.03 ± .78	.78**
June 24-July 29	21	2.00 ± .07	9.12 ± .67	.53**	16	1.87 ± .07	9.20 ± .72	-.26
Birth-May 26	13	1.26 ± .10	9.83 ± .81	.73**	13	1.36 ± .06	11.30 ± .39	.72**
Birth-July 29	13	1.58 ± .03	9.60 ± .83	.71**	13	1.48 ± .05	10.31 ± .50	-.01

[1]Number of observations.

[2]Average daily gain of calves.

[3]Standard error of mean for average daily gain.

[4]Average of milk production estimates obtained at beginning and end of period.

[5]Standard error of mean for milk production.

[6]Correlation coefficient between average daily gain and milk production.

**$p < .01$

SUMMARY

The feeding of three levels of supplemental winter feed to mature, spring-calving Hereford cows, 20 to 25 per lot, was studied in 3 trials at the Lake Carl Blackwell experimental range area in North-Central Oklahoma. The cattle were kept in the native grass pastures yearlong and the supplements were fed from November to mid-April. At the end of each year, about one-half of the cows were removed from the study and replaced with cows from similar level of wintering studies at the Ft. Reno experiment station. In Trial III, cows which had been on the low level of feeding during the previous winters were changed to the high level and vice versa.

Estimates of 24-hour milk production of cows on the low and the high levels of winter feeding were obtained at approximately monthly intervals in 1960 and during the first five months of the 1961 lactation period. These estimates were the differences in weight of the calves before and after nursing.

During the winter period the cows on the low level lost considerably more weight than those on the other levels. There was little difference in weight losses of the cows on the medium and high levels. Summer gains of cows were inversely proportional to winter weight losses in Trials I and II but not in Trial III in which the low level cows had previously been on the high level.

Differences in average birth weights and average calving date were small. Weaning weights of calves on the low level were lower than those

in the other lots. In Trial I, the calves on the high level were the heaviest, but in Trial II the weights of those on the medium and high levels were nearly equal. In July, 1961, (Trial III) the calf weights were 293, 360 and 287 lb.

The average 24-hour estimates of milk production were 6.25 ± .39 and 8.12 ± .50 lb. for the complete lactation period for the low and high level lots in 1960. This nearly 2 lb. difference in milk production resulted in an average difference of 56 lb. in weaning weight of calves. The milk production values for the first 145 days in 1961 were 9.20 ± 1.38 and 10.32 ± .86 lb. Correlation coefficients between average daily gain of the calves and milk production estimates of their dams in 1960 were .76** and .55* for the low and the high levels of feeding, respectively. In 1961, the correlation values were .71** and -.01. Milk production increased for the first two months and then slowly decreased. Correlation between average daily gain and milk production were nearly always highly significant ($P < .01$) during the first three to four months of lactation with lower correlations in later months.

Performance of the cows indicated that 2.5 lb. of cottonseed meal pellets provided adequate supplemental winter feed.

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