breeds. The longheaded dwarf gene is a different gene from the snorter dwarf gene. Bulls may be progeny tested for snorter dwarfism on snorter carrier cows of either the Hereford or Angus breeds. However, bulls may be tested for snorter dwarfism only on snorter carrier cows, and for longheaded dwarfism only on longheaded carrier cows. Longheaded dwarf calves may be identified at birth on the basis of characteristic abnormalities of the lumbar vertebrae. Since these abnormalities are similar to those that have been observed in snorter dwarfs, and have never been seen in non-dwarfs, they offer an accurate method for identifying dwarf calves of either type.

Lifetime Performance of Beef Cows Wintered Each Year on Three Different Levels

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Few studies with beef cows have been continued over an interval of time necessary to show the accumulative effects of different feed levels on lifetime production. This is an important issue since (1) most producers have a tendency to be either "good" or "poor" feeders, i.e., following high or low feeding regimes year after year; (2) beef cattle have remarkable ability to recover from one or, perhaps, several years of poor winter feeding by compensatory gains on lush summer grass; and (3) some of the effects of good or bad feeding practices may be accumulative, affecting the life span and productivity of the beef cow, which one year's data may not reveal.

Surprisingly, our knowledge of the exact requirements of the beef cow is still fragmentary. It is important to the Oklahoma cattle industry, however, as nearly 60 percent of our total beef cattle population is classified as breeding females over two years of age. To study the effects of continuous low, medium, or high levels of supplemental feed on the performance of the range beef cow during her life span in the herd, a project was initiated in the fall of 1948 with a group of weaner, heifer calves. The results of individual years have been reported in this series of publications.[1] This report summarizes the results from this experiment to the fall of 1961, at which time most of the cows have passed out of production and only a remnant of the original herd remain on test.

As background for this study, let us first consider the yearly picture for native range grass since this is the basic foundation for a profitable herd and for our methods of feeding beef cows in the Southwest. Results

[1]See Okla. Agr. Expt. Sta. MP-22,27,31,34,43,45,48,51,55 and 57.

of numerous chemical analyses of samples of native grass (bluestems and associated "tall" grasses) consistently show that much of the forage produced on our 21 million acres of native range is deficient at least six months out of the year in several nutrients needed by beef cattle. A sharp drop in digestible protein and phosphorus, two of the most critical items needed by beef cows, occurs from the time the grass matures in July to mid-winter. By December, most of native tall grasses have lost 80 percent or more of the protein and phosphorus they contained during early growth. Hence, the need to supplement this dry, weathered range forage has long been recognized by successful stockmen, but the question remains: How much should I feed?

Feeding less supplement than a beef cow needs to prevent excessive weight loss, resulting in thin, weak females at the end of the winter, delayed calf crops, poor milk production, and unprofitable weaning weights is "pennywise and pound foolish." On the other hand, to feed more than a beef cow requires to come through the winter in strong, thrifty shape may seriously reduce the net returns with surprisingly little increase in production.

Plan of Experiment

In the fall of 1948, 120 weaner, Hereford, heifer calves were selected from a large commercial herd in the Hereford Heaven area and the Lake Blackwell experimental herd. They were started on test in late October. Three rates of supplemental winter feed were offered on native grass. One-half of the heifers in each winter treatment were bred to calve first as two-year-olds, while the remainder calved first as three's. Calving for all heifers was in late February or March. Each winter, after grazing together during the summer, the females were returned to their respective winter feed levels. This practice has been continued throughout their productive lives in the herd (i.e. 14 years of age). Cows that failed to calve by three years of age or which failed to calve and raise a calf for two successive years were removed from the test, together with animals removed for death loss, disease, or unsoundness rendering them unfit for future production.

The three feeding regimes imposed on native grass pastures (principally bluestems) from early November to mid-April each year were:

Low level (Lots 1 and 2)—1 lb. cottonseed meal pellets per head daily.

Medium level (Lots 3 and 4)—2.5 lbs. cottonseed meal per head daily.

High level (Lots 5 and 6)—2.5 lbs. cottonseed meal and 3 lbs. oats per head daily.

All cows have had access to a mineral mix of two parts salt and one part steamed bone meal, year-long. The above supplements were fed every

other day, twice the daily allowance. The pasture allowance has been about six to eight acres per head, year-long. During the breeding season, all females were exposed to bulls under pasture conditions from May 1 to August 15 each year. Two additional lots were wintered at a Medium level and used in a summer feeding study during the first five years; whereupon they were continued on test with the Medium level group with no summer feeding. These females have been used only in comparing two- vs. three-year-old calving.

Detailed records on weight changes of the cows, calf production, and reasons for removal from test have been maintained. At present, the cows are 14 years of age (March 1, 1962) and have weaned 12 or 11 calf crops, for those that calved first as two's or three's, respectively.

Results

Survival and Weight Changes of Beef Cows

The effects of continous winter feed levels on the survival of range beef cows and their productivity to 14 years of age are shown in Table 1. In these data, results from two- and three-year-old calving groups within each treatment have been pooled. Some startling differences are apparent from the results. Of 30 females that started on test in the fall of 1948 on the three different feed levels, 16, 11, and 5 remain in the herd for the Low, Medium, and High levels, respectively. Reasons for removal of the cows from test indicate that 50 percent more females have been removed from the High vs. the Low level for failure to calve, and that the disease loss was nearly twice as great for High level. Note also the increase in cancer eye incidence. The greater survival of females wintered consecutively on Low as compared to High feed levels appears to be due to greater fertility and lower disease loss—corresponding to results from more basic studies with identical twin cattle in Scandanavia and with laboratory animals. Medium level females were intermediate in these respects.

Starting with an average weight of 475 lbs. as weaner heifers, Low level females have gained less, or lost more, during each winter than the other groups, with the exception that at maturity there was little difference between Low and Medium treatments for several years. Weight losses among the Lows were most severe the first three winters as young heifers, or as older cows (1960-61), which is to be expected. Low level females were observed to be better rustlers and more active in grazing habits—hence, they may have overcome some of the disadvantage of lower levels of supplement.

Using fall weights in 1956 as a mature weight, at which time the cows were 8.5 years of age and most cows had raised a calf, the accumulative differences due to winter feed level were small (only 52 lbs. difference between Low vs. High level treatments). If the data is broken down into two- vs. three-year-old calving groups within each feed level,

it is apparent that the Lows calving at two's were lighter and High's calving as three's heavier than the other lots. Other groups tended to weigh about the same. Hence, little difference was apparent between levels of winter feed in terms of body weight at maturity, as was also indicated by various measurements of skeletal size.

Low level cows have calved somewhat later on the average than the Medium or High groups. This was most pronounced during the early crops and not during mature production. The percent calf crop weaned has been approximately 6.5 percent greater for the Lows, based on 11 or 12 opportunities to calve within each group. Surprisingly,

Table 1.—Long-Term Effects of Three Winter Feeding Regimes on the Performance of Range Beef Cows.

Winter Feed Level	Low 1 lb. CSM	Medium 2.5 lbs. CSM	High 2.5 lbs. CSM 3.0 lbs. oats
Number females started on test (Fall, 1948)	30	30	30
Number remaining, March, 1962	16	11	5
Reasons for removal from test:			
Open or failing to calve in two successive years	6	9	9
Cancer eye	1	4	5
Spoiled udder	2	1	4
Crippled	1	2	1
Disease	0	1	2
Hardware disease	1	0	2
Accidental	1	0	0
Unknown	2	2	1
Avg. weight change, lbs.			
Initial wt., Fall, 1948	476	476	476
First winter gain	22	58	88
Avg. 4-9th winter, mature cows	—104	—128	— 79
Winter loss, 1960-61	—235	—166	—128
Mature weight, Fall, 1956	1142	1147	1194
Reproductive performance:			
Avg. calving date	3/15	3/10	3/9
% calf crop weaned[1]	90.3	83.9	83.8
%calf crop born	94.7	90.8	92.1
%calves lost—birth to weaning	3.9	7.2	8.6
Avg. birth weight, lbs.[2]	77.6	77.6	78.8
Avg. weaning weight, lbs.			
1961 calf crop[2]	451	478	471
All calves[2]	479	482	483

[1] Based on number females exposed and calves weaned the following year.
[2] Corrected for sex by adding 5 lbs. to birth weight and 24 lbs. to weaning weight.

this advantage has been largely due to more calves saved from birth to weaning, rather than a greater percent calf crop born. As shown in Table I, Low level cows lost only 3.9 percent of their calves from birth to weaning, whereas the Highs lost 8.6 percent. This may be a reflection of a more vigorous and active female due to the lighter body weights and better rustling tendencies.

Calf Production Data—Financial Results

The planes of nutrition imposed by the three different feed levels were not severe enough to significantly affect birth weights. During most years, weaning weights differed only slightly. Note, however, that as the cows advanced in age the Low level group appeared to wean lighter calves, as indicated by the results of their most recent (1961) calf crop.

In Table 2, the results in terms of lifetime performance are summarized. A marked difference exists in total "cow years" accumulated for each treatment. The increase in favor of Low level cows was nearly 21 percent over the Highs with the Moderate intermediate. Hence, the calving opportunities were greater for the Low cows and this, together

Table 2.—Summary of Total Production of Beef Cows Wintered at Three Different Levels.

Winter Feed Level	Low 1 lb. CSM	Medium 2.5 lbs. CSM	High 2.5 lbs. CSM 3.0 lbs. oats
Number females started on test (Fall, 1948)	30	30	30
Number cows years/lot to 1962	364	331	306
Total number calves weaned	290	245	223
Total lbs. calves weaned/lot	138,186	117,237	107,296
as % of Low lot	--	84.8	77.6
Financial results, ($)			
Value cows salvaged and those remaining[1]	4,644	4,574	4,702
Value calves weaned[2]	35,543	29,531	27,064
Total supplemental feed, pasture, and mineral cost/cow[3]	374.48	486.01	646.24
Total net returns (value cows & calves minus feed costs)	29,585	21,623	16,450
Net return/cow year[4]	81.25	65.41	53.83
Cow cost/cwt. calf weaned	7.62	10.89	14.39

[1] Based on average value of 14/cwt. for cows sold and those remaining on test.
[2] Based on yearly Kansas City prices for Choice feeder steer calves.
[3] Based on current yearly prices of feed, pasture, and mineral.
[4] Net return divided by total number of years spent by all cows in each treatment group.

with a larger percentage calf crop and better survival of calves to weaning, resulted in nearly two extra calves per female starting on test for the Low as compared to the High level. Again, as in nearly all measures of performance, the Moderates were intermediate. It is also striking that the total pounds of calf produced per lot throughout the entire trial has been only 84.8 and 77.6 percent as great for Moderates and Highs, respectively, as for the Lows.

Complete records have been maintained on the costs of maintaining the cows and of producing a calf under each system of management. The average value of the calves at current yearly prices, together with the value of cows salvaged and those remaining, have been summarized in Table 2. Note that the total cost of feed, pasture, and mineral for the Low level treatment was only 77 percent as much as for the Mediums and only 58 percent as much as for the Highs.

When the entire financial results of each lot in this experiment are summarized, Low level cows returned $7,962 more than the Mediums and $13,135 more than the Highs. Expressed as "net returns per cow per year—over all feed, pasture, and mineral costs," this amounts to 24 percent more return for the Low vs. the Mediums, and 43 percent for the Lows over the Highs. This is further illustrated by the "cow cost per cwt. calf weaned" which was $7.62, $10.89, and $14.39 for the Lows, Medium, and High levels, respectively.

It must be borne in mind that the females in this experiment represent only one sample or test group. Due to the possibility of unkown bias in selection of the females, there is necessity of repeating the test. Also, native range pastures have always been adequate even during the exceptionally dry years of 1954 and 1956. The cows have never suffered for lack of grass in either the summer or winter, a factor which is highly important and may cause results to differ in areas where sparse range and overgrazed pastures are common. There is no question that too low feed levels can adversely affect the performance of a beef female to the point where such a practice is both unwise and unprofitable. Moreover, the "Low level" as practiced in this experiment actually proved too "moderate" or satisfactory in terms of cow performance. This factor has been considered in later studies and has resulted in a more severe feeding regime at the low level.

Nevertheless, the results clearly indicate that once a beef cow meets her nutritional needs, higher feed levels are both unprofitable and may actually prove detrimental in terms of life span and percent calf crop weaned. In well-managed, commercial herds where feed is abundant, or in purebred herds where beef females are maintained in 'show conditions" as an advertisement, producers should carefully guard against the adverse effects of too high planes of nutrition.

Two- vs. Three-year-old calving on lifetime performance.

This project has permitted the best estimate thus far of the effects of early calving on lifetime usefulness of the beef female. Average results to 14 years of age are shown in Table 3. The survival of beef cows has not been adversely affected by early calving as a two-year-old. Little difference between two- and three-year-old calves is apparent in reasons for removal of females from the test including those removed as open cows, or for failing to calve two successive years, disease, or unsoundness. Therefore, if the beef heifer is sufficiently well-developed to calve first as a two-year-old, subsequent reproductive processes and her life span in the herd are not adversely affected.

Note that nearly 50 percent of the two-year-old heifers had to be assisted at first calving, whereas only one heifer required help in the three-year-old group. The slight effect on average body weight at maturity is due chiefly to Lows that calved first as two-year-olds being slightly lighter, and the three-year-olds that were wintered at the High level slightly heavier, than the average of the other groups.

Table 3.—Two- vs. Three-Year-Old Calving and Lifetime Performance.

Age at first calving	Two-Year-Old	Three-Year-Old
Number females started on test, Fall, 1948	60	60
Number remaining, March, 1962	23	22
Reasons for removal from test		
Open or failing to calve in two successive years.	16	16
Cancer eye	9	6
Spoiled udder	4	5
Crippled	2	2
Disease	1	2
Hardware disease	2	1
Accidental	0	2
Unknown	2	3
Heifers assisted at first calving	28	1
Avg. mature body wt., Fall, 1956 (lbs.)	1148	1178
Total number calves weaned	533	482
Number calves weaned per cow year	.80	.71
Total percent calf crop weaned	86.7	85.2
Average weaning wt., all calves (lbs.)[1]	476	485
Average weaning wt., minus two-yr.-old calf	482	485
Cow cost per cwt. calf weaned, $	10.33	11.34

[1] Sex corrected (See footnote table 1).

An extra 51 calves have been obtained from the two-year-old calving program. This is about .85 more calve per female started on test than the three-year-old-group. This has amounted to nearly .1 more calf per cow year in the herd, or an advantage of nearly 330 lbs. calf for the two-year-old group.

Weaning weights between the two groups have differed only slightly, and the small difference seen is almost entirely due to the lighter weights of the first calves from two-year-old heifers (nearly 68 lbs. lighter than the average of their mature production). Cow cost per cwt. calf weaned, therefore, has been reduced by $1.01 for the two-year-old calving regime.

Summary

Lifetime studies with beef cows, subjected each year to Low, Medium, or High feeding regimes on native bluestem pastures, show that females receiving 1 lb. of cottonseed meal pellets per head daily survived longer in the herd, produced a 6.5 percent greater calf crop, and returned 43 percent more net return than those fed 2.5 lbs. cottonseed meal plus 3 lbs. oats per head daily. Cows carried at the Medium levels (2.5 lbs. cottonseed meal) were intermediate in performance. Cows on the Low level appeared to be more active grazers and saved more of their calves from birth to weaning.

The results show that there is no necessity to feed the spring-calving beef cow more than needed to maintain her in a thin, but strong, thrifty condition. In fact, more liberal feed levels may actually prove detrimental.

Beef females which calved first as two-year-olds produced nearly .8 more calf per cow over their entire productive life at 10 percent less cost than those calving first as three-year-olds. The results show little or no affect on mature size or longevity. Thus, where practical, early calving appears desirable.