25% for grade limited the selection for yearling weight in this instance. The yearling weight of calf 332 was 975 pounds being 81 pounds above the average weight of his contemporaries. If heritability of yearling weight is 60% his progeny should average 24 pounds above herd average. (½•81•.60 = 24)

MEASURES OF GENETIC CHANGE

Genetic progress is measured by using each selected sire two years. Each year two sires are mated to a comparable half of the females in each line. The difference between the average performance of progeny by the new sire when compared with the progeny average of the repeat sire constitutes the measure of genetic gain from selection. The comparison of the progeny averages of a sire from the first year to the second year gives the environmental change from one year to the next. Also semen is being frozen from foundation sires used over all lines. This semen will be stored for five years and used in comparison with the sires currently in use for another measurement of genetic change.

SUMMARY

This selection study involving beef cattle is designed to measure the genetic change resulting from selection for increased weaning weight and grade or yearling weight and grade. The experimental procedure is briefly outlined. The method of selection is illustrated using data from the 1963 season.

Effect of High or Low Winter Feed Levels in Alternate Years on Growth and Development of Beef Heifers

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Due to the significance of the cow-calf operation to the agricultural economy of Oklahoma, we must be intensely concerned with proper feeding and management to bring out the inherent producing ability in the beef female. Extensive studies at the Ft. Reno station since 1949 have explored different winter feed levels and systems of feeding to get maximum production, yet reduce supplemental feed costs as much as possible.

From this research a system of "weight control" has been developed which sets a pattern of maximum weight gain or loss the female should sustain during the winter and yet calve successfully in February-March and wean calves of satisfactory weights in October.

Several questions have evolved from these studies. What is the optimum level of winter feeding for replacement heifers until two years of age if they are to be well fed thereafter? Which is most damaging to subsequent performance, a low winter feed level during the first winter as a weaner calf or during the second winter as a bred yearling? Can feed levels be reduced sufficiently during the first and/or second winter, to effect important savings in terms of feed cost.

The results of two trials are now available. The results of the first trial were reported in detail last year.[1] This report covers the results of the second trial and the average effects for both trials on weight changes and reproductive performance of beef females. Obviously, the effects of extremely low levels of winter feed during one or two winters prior to the first calving may show up later in terms of a delayed conception and in lack of uniformity in the calf crop or in poor growth and lactation performance. Little is known about carryover effects resulting from restricted energy intake during the early developmental period of the beef female.

PROCEDURE

In each trial, 75 weaner Hereford heifer calves were selected from the Experiment Station herd and allotted to 5 groups on the basis of age, sire, body weight and productivity of dam. They were placed on three levels of winter feed the first winter as designated in Table 1. This table also gives the number of heifers completing each winter treatment. Unfortunately, due to failure to vaccinate the young heifers in trial 1 for Leptospirosis, a large number of abortions in November resulted in heavy losses of calves from heifers on all treatments. The heifers which had aborted were dropped from the test. This, together with above-normal difficulty at calving, reduced the numbers completing each treatment at 2.5 or 3.5 years of age. Only the heifers in trial 2 were continued into the second breeding season to study carryover effects.

The prescribed levels of winter gain or loss within each treatment were accomplished by varying the amounts of cottonseed meal and ground milo at approximately 2-week intervals during the winter, according to the weight gain or loss of the females. Weaner heifer calves on the Low level (lot 1) were to make no gain from November 1 to mid-April and following summer recovery on good native grass, they were to lose 50-75 lb. during the second winter up to calving, with a further loss of 100 lb. (including loss at calving time) until spring grass was ample.

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[1] Oklahoma Mis. Pub. MP-70, P. 42.

Table 1. Design of Experiment and Number of Heifers Completing Test

Lot No.	1st Winter as calves		2nd Winter as bred yearlings*		3rd Winter as 2 year-olds**
1	Low	—30	Low	—18	Moderate — 12
2	Low	—30	High	—20	Moderate — 13
3	Moderate	—30	Moderate	—21	Moderate — 13
4	High	—30	High	—22	Moderate — 12
5	High	—30	Low	—20	Moderate — 14

* The lower number is due to removal of heifers with Leptospirosis.
** Heifers remaining on test from Trial 2.

Heifers on the Moderate regime (lot 3) were to gain approximately 100 lb. during the first winter as calves, and to maintain weight during the second winter as bred yearlings up to calving, with a loss of less than 50 lb. until spring grass was ample. The high level heifers (lot 4) were to gain one pound per day the first winter and sustain no loss during the entire second winter until spring grass was ample. Except for lot 1 during the early winter dry lot period all heifers were maintained on native grass pastures year-long with supplemental feed as necessary from November to mid-April, and a mineral mix of 2 parts salt and 1 part steamed bone meal, free choice, at all times. To initiate the early weight loss, heifers on the Low level were confined to drylot with wheat straw and no supplement for 4-6 weks each year. This treatment is considered to be similar to poor pasture conditions which may exist during drought conditions or low level feeding that might result from the scarcity of harvested roughage.

The experiment was designed so that some heifers on the Low and High levels as calves could be reversed to the opposite regime the second winter as bred yearlings (lot 2 and 5). Following the first two winters all heifers were maintained on the moderate level. The results obtained in terms of average winter weight loss, summer weight recovery, final body weights, reproductive data and calf birth and weaning weights are shown in tables 2 and 3. The birth and weaning weights of all calves were corrected for sex, but not for age, since an earlier calf was considered advantageous for Moderate or High winter feed levels.

RESULTS

The period between 8 and 13 months of age is critical to the growing and developing beef heifer. Not only must nutritive demands for growth be met but the heifer must reach puberty and start cycling regularly before the start of the breeding season, if she is to calve as a two-year old. As shown in table 2, heifers on the Low level (lots 1 and 2) actually lost 26 to 28 lbs. during the first winter on the average, while those on the

Table 2. Effect of Winter Feed Level for Beef Females on Weight Change and Feed Cost.

Lot No. and Winter Feed Level 1st Winter 2nd Winter	1 Low Low	2 Low High	3 Moderate Moderate	4 High High	5 High Low
Average wt. change, lbs.					
Initial weight	438	436	438	438	438
8 to 18 months of age					
Winter gain or loss	— 26	— 28	97	147	164
Summer gain	355	346	314	277	270
Net yearly change	329	318	411	424	434
19 to 30 months of age					
Winter gain	—193	9	—128	— 67	—230
Summer gain	237	153	187	141	243
Net yearly change	44	162	59	74	13
31 to 43 months of age					
Winter gain	—120	—193	—166	—207	—185
Summer gain	205	242	251	257	263
Net yearly change	85	49	85	50	78
Fall weight 43 mo. of age	991	958	1000	1022	1034
Winter supplement/head (lbs.)					
1st winter					
C.S. meal	92	92	240	289	289
Grd. milo	79	79	384	949	949
2nd winter					
C.S. meal	89	289	211	289	89
Grd. milo	30	823	126	823	30
Av. winter supplemental feed cost/head ($)*	8.52	34.38	25.99	52.17	33.81

* All lots were fed the same amount during the third winter.

High level (lot 4) gained almost 1.0 per day during the winter. Summer gains were inversely related to winter performance which is a rather typical response. Nevertheless after a summer on good grass, at 18 months of age the difference in total yearly gain was more than 100 lb. in favor of the High vs. the Low heifers.

Reversing the level of wintering for lots 2 and 5 resulted in a pattern of weight loss as bred yearlings similar to that observed for lots 1 and 4, which were wintered each year at the same level. Fall body weights at 30 and 43 months of age reflect the previous winter's feeding regime, although the differences are less than might be expected, and are indicative of good summer recovery on pasture. Marked differences in supplemental feed costs can be seen in table 2. However, the differences between savings with respect to feed cost and overall returns as influenced by reproductive efficiency and weaning weight must be considered.

Table 3. Effect of Winter Feed Level on Reproductive Performance.

Lot No. and Winter Feed Level 1st Winter 2nd Winter	1 Low Low	2 Low High	3 Moderate Moderate	4 High High	5 High Low
Calf production data					
Av. calving date					
1st calf	4/3	3/27	3/19	3/12	3/8
2nd calf	4/6	3/5	3/26	3/1	3/24
% calf crop					
1st calf	65	73	70	72	78
2nd calf	73	79	76	62	79
Av. birth weight (lbs.)					
1st calf	65	72	71	72	67
2nd calf	81	77	79	76	75
Av. weaning weight (lbs.)					
1st calf	388	409	408	412	383
2nd calf	444	432	424	425	387
Av. daily gain of calves (lbs.)					
1st calf	1.56	1.62	1.61	1.65	1.50
2nd calf	1.73	1.65	1.71	1.63	1.66
Av. daily milk production (lbs.)					
1st calf	7.62	7.84	7.40	7.33	6.41
2nd calf	10.67	10.70	11.45	8.75	9.72

Data in table 3 show that the first winter at a Low level for heifers of lots 1 and 2 delayed calving date, and in the case of lot 1 resulted in a much lower percentage calf crop. In contrast, the better-fed heifers on the Moderate regime (lot 3) or High levels (lots 4 and 5) during the first winter evidently cycled earlier and calved 2 to 3 weeks before those on the Low level. Raising the level of energy during the second winter (lot 2) however, nullified the effects of a Low plane as a weaner calf. During the second calf crop while under the influence of the Moderate regime, the heifers of lot 2 tended to conceive as early as lots 3 and 4. In contrast the High level heifers that were switched to the Low level the second winter (lot 5) tended to conceive later than heifers in lot 4 but not as late as heifers in lot 1.

The effect of feed level on conception time is highly important and is one of the most significant patterns shown in this study. The first winter's feed level evidently sets the pace at which the heifer matures sexually, and will influence first conception. However, these effects are apparently not permanent in a seasonal calving program, and can be overcome by good feeding following the first winter.

Trends in percentage calf crop are less meaningful because of small numbers and high death loss, for various reasons, at calving. There is some indication of a lowered percentage calf crop and reduced birth weight for the first calf crop out of the Low-Low heifers (lot 1). Again, this was not a permanent effect, once these heifers were advanced to the Moderate regime after weaning their first calves.

Weaning weights of first calves reflected the wintering regime prior to calving (lots 1 and 5 vs. 2 and 4). Average daily milk production indicates that the high level of energy during the first winter resulted in lower milk production values for the first and second lactations. Perhaps the most important observations are that a poor wintering regime for either the first or second winter does not have a permanent effect on milk production or weaning weight and does not affect the second years performance if the heifer goes to a higher level during subsequent winters.

SUMMARY

Two trials were conducted to study the effects of varying the level of winter feed and varying this level from Low to High and vice versa during the first winter as weaner calves or the second winter as bred yearlings on subsequent performance of replacement beef females. In one trial, all the heifers were continued on the Moderate level for the second calf crop.

The results show that the main effect of the first winter at a Low level is to delay the onset of puberty and, as a result, delay conception and average calving date as two-year-olds. Other than this, the effects on growth and later performance appear negligible, providing good pasture and adequate feed levels are provided thereafter. There appears to be no permanent effect of a Low level during one winter as a calf.

Of the two winter periods, low level feeding the second winter as a bred yearling appears to be most damaging. Here the heifer, while still continuing to grow and develop must undergo the strain of calving and early lactation on inadequate feed supplies. The results are to delay re-breeding for the second calf, and a sharp reduction in milk flow. Naturally, this reduces the weaning weight of the calf.

Neither the Low-High or High-Low sequence appears to be as beneficial as an adequate feed level (Moderate) each winter in terms of growth and reproductive performance.