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I am submitting herewith a thesis written by James Burkett Neel entitled "The effects of initial winter condition and level of winter feeding on beef cow and calf performance." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

C. S. Hobbs, Major Professor

We have read this thesis and recommend its acceptance:

James M. Anderson, John D. Smalling

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

July 26, 1966

To the Graduate Council:

I am submitting herewith a thesis written by James Burkett Neel entitled "The Effects of Initial Winter Condition and Level of Winter Feeding on Beef Cow and Calf Performance." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

Charles S. Hobbs
Major Professor

We have read this thesis and recommend its acceptance:

James M Anderson

John D. Smalling

Accepted for the Council:

Hilton A. Smith
Dean of the Graduate School

THE EFFECTS OF INITIAL WINTER CONDITION AND LEVEL OF WINTER FEEDING ON BEEF COW AND CALF PERFORMANCE

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

---

by

James Burkett Neel

August 1966

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CHAPTER I

INTRODUCTION

Wide variations exist in the types of beef enterprises in Tennessee. In general, the livestock enterprises being conducted are the ones which make the most efficient use of existing feed resources. The efficiency of an operation is measured by the degree of maximum production obtained under ideal production-cost conditions.

Divergent opinions concerning the optimum level of winter feeding for the beef cow herd are evidenced by the many extremes in condition of beef cows that may be observed in individual cow herds within the state.

Generally, the most economical gains are obtained with cattle grazing native pasture. Because of climatic conditions, year-round grazing is not always available in Tennessee. Therefore, most of the commercial cow herds are wintered entirely on roughages. The winter season is the most expensive portion of the year for the beef cow-calf producer.

Productivity of the breeding herd is measured by the calf crop percentage and the average weaning weight and quality grades of the calves. Thus, varying factors that influence the reproductive and lactating abilities of the cow and the growth of her suckling calf are of concern. Inadequate nutrition, as well as overfeeding, may influence the reproductive and lactating ability of the cow and growth of her calf.

When planning the winter management of the breeding herd, optimum production with maximum economy should be the principal thought. Production of feeder calves is conducted on a narrow margin of profit, and without careful management this profit can very easily be lost during the wintering season. Consequently, the cattleman should give major consideration to the best method of managing the cow herd during the winter months.

The nutritional needs of each cow are affected by the age, weight, and condition of the cow at beginning of winter, time of calving, the quality and quantity of feed available, and the length of the wintering period. For the most economical feeding programs, it seems that the cow herd should be divided into various groups based on their nutritional requirements for the wintering period.

The object of this study was to determine the performance of beef cows and calves as influenced by the level of winter feeding and condition of the cow at the beginning of the wintering period.

CHAPTER II

REVIEW OF LITERATURE

Pinney et al. (1962) and Zimmerman, Pope, and Stephens (1958) reported on long-term studies in which beef females were wintered over a period of 14 years on three different levels of winter supplement with free access to native Bluestem pasture. In late October of 1948, 120 weanling Hereford heifers, weighing approximately 475 lb. and ranging from 7 to 9 months in age, were started on the test. One-half of the heifers in each winter treatment were bred to calve first as 2-year-olds and the remainder calved first as 3-year-olds. All heifers were bred to calve in late February or March. Cows that failed to calve by 3 years of age or which failed to calve and raise a calf for 2 successive years were removed from the test, together with animals removed because of death, disease, or unsoundness which rendered them unfit for future production. The three feeding regimens imposed on native grass pastures from early November to mid-April each year were: low level, 1 lb. cottonseed meal pellets per head daily; medium level, 2.5 lb. cottonseed meal pellets per head daily; high level, 2.5 lb. cottonseed meal pellets and 3 lb. oats per head daily. The effects of continuous winter feed levels on cow survival and productivity to 14 years of age are shown in Table I. Fifty per cent more females were removed from the high level than the low level for failure to calve, and the disease rate was nearly twice as great for the cows on the high level. Females on the low level

TABLE I

LONG-TERM EFFECTS OF THREE WINTER FEEDING REGIMENS ON THE PERFORMANCE OF RANGE BEEF COWS

Winter feed level	Low 1.0 lb. CSM	Medium 2.5 lb. CSM	High 2.5 lb. CSM 3.0 lb. oats
Number females started on test (fall, 1948)	30	30	30
Number remaining, March, 1962	16	11	5
Reasons for removing from test:			
Open, or failing to calve in two successive years	6	9	9
Miscellaneous reasons, disease, cripple, etc.	8	11	16
Av. weight changes, lb.			
Initial wt., fall, 1948	476	476	476
First winter gain	22	58	88
Aug. 4-9th winter, mature cows	-104	-128	-79
Winter loss (1960-61)	-235	-166	-128
Mature weight, fall, 1956	1,142	1,147	1,194
Reproductive performance			
Av. calving date	3/15	3/10	3/9
% calf crop weaned[a]	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
Av. birth weight, lb.[b]	77.6	77.6	78.8

TABLE I (continued)

Winter feed level	Low 1.0 lb. CSM	Medium 2.5 lb. CSM	High 2.5 lb. CSM 3.0 lb. oats
Av. weaning weight, lb.			
1961 calf crop[b]	451	478	471
All calves[b]	479	482	483

[a]Based on number females exposed and calves weaned the following year.

[b]Corrected for sex by adding 5 lb. to birth weight and 24 lb. to weaning weight of heifers.

gained less, or lost more, during each winter than the other groups. Weight losses by cows on the low level were most severe during the first three winters. The weight difference between the low and high level treatments at 8-1/2 years of age was 52 lb. The low-level females calves somewhat later on the average than either the medium or high groups during the early calving periods. As the cows matured, this difference in time of calving became less pronounced. Cows on the low level weaned approximately 6.5 per cent more calves than the cows on the high level (the number of cows that weaned a calf compared to the number exposed to bull at breeding). This increase in calf crop was a result of more calves being saved by the low-level females from birth to weaning. Low-level cows lost only 3.9 per cent of their calves from birth to weaning, whereas, the cows on the high level lost 8.6 per cent. It was concluded that this advantage for the low level may have been the result of a more vigorous and active female due to the lighter body weights and better rustling tendencies. As shown in Table I, page 4, the planes of nutrition were not severe enough to significantly affect birth weights. During most years, weaning weights differed only slightly. As the cows advanced in age, the low-level group appeared to wean lighter calves, as indicated by the results of the 1961 calf crop shown in Table I, page 4. This might be due to sampling as a result of the large difference in number. It was concluded from these long-term studies that there is no necessity to feed the spring-calving beef cow more feed than is needed to maintain her in a relatively thin but strong, thrifty condition. The more liberal feed levels were actually slightly detrimental to production.

Wiltbank et al. (1962) studied the effect of level of energy on reproductive performance of mature Hereford cows. Eighty-eight pregnant cows were placed on experiment shortly after their calves were weaned in October, 1959. They were divided into four treatment groups designated as high-high, high-low, low-high, and low-low. Rations were changed at calving and these designations refer to pre-calving and post-calving treatment of each group. The total digestible nutrient (TDN) intake of the high groups approximates the requirements for mature cows given by the National Research Council (N.R.C.) (1958). Prior to calving the high-high and high-low groups received approximately 9.0 lb. of TDN per head daily, and the low-high and low-low groups received approximately 4.5 lb. of TDN per head daily. Following calving between February and April, the high-high group and the low-high group received approximately 16.0 lb. of TDN per head daily. Changes in body weight and body condition were influenced significantly differently by the different treatments (Table II). Prior to calving, cows in the high-high and high-low groups gained weight and maintained their condition score, while cows in the low-high and low-low groups lost weight and condition and were thin at calving time. Level of energy following calving had a marked effect on changes in body weight and condition scores. Treatment before calving had little or no effect on calving difficulty. The average birth weight of calves from cows in the low-low and low-high groups was 67 lb. while the birth weight of calves from cows in high-high and high-low groups was 78 lb.

TABLE II

EFFECT OF LEVEL OF ENERGY ON BODY WEIGHT AND CONDITION

Ration (TDN)	Cows (No.)	Beginning of experiment		Before calving		After calving							
						15-21 days		30 days		60 days		90 days	
		Lb.	Score[a]	Lb.	Score[a]	Lb.	Score[a]	Lb.	Score[a]	Lb.	Score[a]	Lb.	Score[a]
High-high	21	1,093	6.3	1,160	6.8	1,039	6.1	1,029	6.2	1,020	6.4	1,025	6.5
High-low	22	1,116	6.2	1,205	6.5	1,015	6.2	977	6.2	922	5.6	918	5.1
Low-high	20	1,108	6.1	990	4.4	932	4.5	915	4.6	919	4.9	954	5.2
Low-low	20	1,107	6.5	975	4.5	856	3.8	820	3.8	802	3.6	791	3.1

[a]One to 9, with 9 being the fattest.

Wiltbank et al. (1962) conducted an experiment with 69 Hereford cows fed 4.7 lb. of TDN daily before calving. The ration fed supplied approximately one-half the TDN recommended by the N.R.C. (1958) for wintering pregnant beef cows. The cows were allotted to the following ration treatments after calving: I. 3/4 maintenance (12.5 lb. of TDN); II. Maintenance (16.5 lb. of TDN); III. Free-fed (25.0 lb. of TDN); IV. Low followed by maintenance (8.5 lb. of TDN for 28 days, then 16.5 lb. of TDN thereafter); V. Low followed by free-fed (8.5 lb. of TDN for 28 days then 25.0 lb. of TDN thereafter). The cows averaged 1,111 lb. in weight and 6.8 in body condition score at the beginning of the experiment. Twenty-four hours following calving, weight had decreased to 862 lb. and body condition score to 3.7. Eighty-four days after calving the cows averaged 852 lb., 895 lb., 1,133 lb., 883 lb., and 1,033 lb. in weight, and body condition scores averaged 4.4, 5.0, 7.3, 4.5, and 5.8 for groups I through V, respectively. The interval from calving to first estrus varied from 49 days for group II to 82 days for group V. The percentages of cows conceiving on first service were 54, 31, 83, 46, and 87 while the percentages of cows diagnosed pregnant were 71, 78, 92, 69, and 100 for groups I through V, respectively.

Reid et al. (1964) studied the effects of the plane of nutrition imposed during early life on the performance of Holstein cows through the fifth calving. The levels of TDN supplied from birth to calving were equivalent to 62 per cent (low), 100 per cent (medium), and 146 per cent (high) of the upper level of Morrison's Feeding Standards. He reported that size of heifers at first calving (27 months of age) was

correlated with the level of nutrient intake provided; low- and high-level heifers weighed 80 per cent and 114 per cent (969 lb. and 1,353 lb., respectively) as much as the heifers reared on the medium plane (1,188 lb.). The average gains in body weight between the first and second calvings were: low, 390 lb., medium, 225 lb., and high, 183 lb. Heifers, small for their age according to current standards, made remarkable increases in size when provided liberal quantities of feed between 32 and 46 months of age. At the time of third calving, cows reared on the high level of TDN weighed 1,524 lb., 1,547 lb., and 1,636 lb. when subsequently fed the low, medium, and high levels, respectively. As late as the time of the fifth calving, the high-level cows weighed 53 lb. and 59 lb., respectively, more than the low- and medium-level cows (low, 1,624; medium, 1,631; high, 1,694). The average ages in weeks at the onset of puberty were: low, 88; medium, 49; and high, 40. Despite the differences in age, the body size of the heifers at the time of the first heat was about the same, regardless of the feeding level on which they had been reared. Body weights of both the male and female calves dropped at first parturition were directly correlated with the plane of nutrition on which their dams had been reared. The average weights of the calves expressed as a percentage of their respective dams' average weights were: low, 9.46; medium, 8.00; and high 7.51.

Sorensen et al. (1959) reported on the effects of three levels of feed intake on the growth of 60 Holstein heifers. The levels of feed intake represented 93 per cent (medium level) of TDN recommended by Morrison's Feeding Standards, a low level amounting to 61 per cent of

the medium level, and a high level amounting to 129 per cent of the medium level. The average heifer fed on the high level came in estrus initially at 37 weeks of age and weighed 596 lb. The average heifer on the medium level of feeding first came in heat at 49.1 weeks of age and weighed 597 lb. Heifers raised on the low level of feed did not experience first estrus until they were 70 to 80 weeks of age and weighed 566 lb. The heifers on the medium level of feeding weighed 919 lb., and those on the high level 1,125 lb. at 70-80 weeks of age.

Lindley et al. (1965) reported results of 2 years of study (1963, 1964) to determine the feasibility of feeding pregnant beef cows three times weekly instead of daily. Two groups of pregnant commercial Angus and Hereford cows at two locations (State College and Prairie) were used in this study. The two groups were divided into subgroups of approximately 30 cows each. One subgroup at each location was fed about 35.0 lb. of sorghum silage, 5.0 lb. of Johnson grass hay, and 1.0 lb. of cottonseed meal daily. The other group was fed the same total amount of feed on Monday, Wednesday, and Friday of each week. Cows were handled in a similar manner in 1964 as in 1963 with the exception that corn silage was substituted for sorghum silage. During 1963-64, the cows fed three times weekly at State College lost 70 lb. and the group fed daily lost 19 lb.; whereas, at Prairie the group fed daily gained 112 lb., and the group fed thrice weekly gained 120 lb., on the average. Two possible explanations were offered for the weight loss at State College and the gain at Prairie. The cows at State College were fatter going into the winter (925 lb., 927 lb. vs. 842 lb., 843 lb.) and the silage at Prairie

was perhaps of better quality. There was no difference in birth weights of calves from either group of cows. However, the 70 lb. loss in the weight of the cows in the group fed three times weekly at State College was explained as the cause of the 18 lb. lower weaning weight for calves from these cows compared to calves from the cows fed daily. During the 1964-65 winter, there was no real difference in the weight changes for the two groups. Neither was there any significant difference in birth or weaning weight of calves from the two groups.

Hobbs, Wilson, and Odom (1965) conducted a study with 105 spring-calved, 8-month-old, Angus heifers to study the effects of two levels of winter feeding. The heifers used in this experiment averaged grading Low Choice (12) in type, weighed approximately 466 lb., and had a condition score of Good (10) at weaning. The heifers were placed on two levels of winter feeding: I, corn silage, ad lib., plus 4.0 lb. of alfalfa hay per head daily; and II, same as I, plus 6.0 lb. corn, cob, and shuck meal per head daily. The heifers in treatment II had significantly higher ($P<.05$) average daily gain (1.39 lb. vs. 0.99 lb.) during the winter period and higher average condition scores at the end of the winter test (9.8 vs. 8.7) than those of treatment I. Average third fall weights as 4-year-olds were 968 lb. and 1,003 lb. for groups I and II, respectively. No significant treatment differences were observed for birth weights, number of calves born and weaned, or performance of calves to preweaning (120 days) and weaning (240 days).

Totusek et al. (1959), in an experiment with 30, 8-year-old cows, found that cows fed at a high level (prairie hay ad lib. and 2.5 lb. of cottonseed meal and free access to milo from late summer to calving (February to April)) were much fatter prior to calving than those fed at a low level (prairie hay ad lib. and 2.5 lb. of cottonseed meal). Both groups were similar in performance before the test, the low-level cows weighing 1,046 lb. initially and 1,080 lb. at calving and the high-level cows, 1,061 lb. initially and 1,326 lb. at calving. A comparable experiment was conducted using 13 sets of twin heifers. The heifers were fed and managed in the same manner as the mature cows. Only three of the high-level heifers had calved at the time the report was made. One of the heifers gave birth to a dead calf, another gave birth to a 30 lb. calf, another required a Caesarean section, and another reabsorbed the fetus. Two of the low-level heifers calved normally without difficulty. A third dropped a dead calf of normal size. The low-level heifers averaged 828 lb. in weight at calving, but the three high-level heifers averaged as much as 420 lb. heavier. No important differences in average birth weight of calves from the treated cows were noted. Calves from the high-level cows averaged 11 lb. heavier at 112 days of age than calves from low-level cows. From these results it was concluded that a high degree of body fat during the growth period appeared to affect adversely the productive ability of heifers, while a high degree of fatness induced in mature cows had little influence on their productivity.

Witt et al. (1958) reported on a study of the effects of level of protein intake on beef cow gains. Eighteen 8-year-old and 18 3-year-old Brahman crossbred cows, pregnant for 6 months or more, were divided into three groups. The cows were fed a basal ration of Pangola grass hay, free choice. Group I received a ration containing 100 per cent protein requirements (N.R.C.). Group II received a ration containing 100 per cent protein intake which included 3.0 lb. daily of alfalfa meal. Group III was fed 50 per cent of the protein requirements with no alfalfa meal. Cows were on the rations 84 days before breeding and 84 days during the breeding season. The average weight losses during the 168 days were 38 lb., 15 lb., and 172 lb. for Groups I, II, and III, respectively. The interval from calving to first breeding in the 3-year-olds was 91 days, 56 days, and 160 days for Groups I, II, and III, respectively. The interval in the 8-year-olds was 64 days, 64 days, and 96 days for Groups I, II, and III, respectively.

Smithson et al. (1964) reported the results of alternating winter feed levels for weaner Hereford heifers. The prescribed levels on winter gain or loss were produced by varying the amounts of cottonseed meal and ground milo. Weanling heifer calves on the low level were fed to make no gain from November 1 to mid-April and to lose 50 to 75 lb. during the second winter up to calving with a further loss of 100 lb. (including calving) until grass was available. Heifers on the moderate regimen were fed 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 grass

was ample. The high-level heifers were to gain 1 lb. per day the first winter and sustain no loss during the entire second winter. The experiment was designed so that some of the heifers on the low and high levels as calves could be reversed to the opposite regimen the second winter as bred yearlings. 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 III and IV. Data in Table III show that the first winter at a low level for heifers delayed calving date, and in one case resulted in a lower percentage calf crop. In contrast, the better-fed heifers evidently cycled earlier and calved 2 to 3 weeks before those on the low level. The high level heifers that were switched to the low level the second winter tended to conceive later than heifers on the high level both years (high-high). There was a slight reduction in birth weight for the first calf crop out of the low-low heifers. This effect did not continue to the second calf crop. Weaning weights reflected the wintering regimen prior to calving. It was concluded that perhaps a poor wintering regimen for the first or second winter does not have a permanent effect on weaning weight and does not affect performance the second year if the heifer goes to a higher level during subsequent winters. The low level delayed the onset of puberty and average calving date as 2-year-olds.

Ross et al. (1948) reported on studies conducted with 40 commercial Hereford cows. The cows were divided into two groups and fed two different rations during the winter. Cows of one group (Lot I) grazed year-long and were fed 8.2 lb. of alfalfa during the winter months.

TABLE III

EFFECT OF WINTER FEED LEVEL ON COW WEIGHT CHANGES

1st winter 2nd winter	Low Low	Low High	Moderate Moderate	High High	High Low
Av. wt. changes, lb.					
Initial wt.	438	436	438	438	438
8 to 18 months of age					
Winter gain	-26	-28	97	147	164
Summer gain	355	346	314	277	270
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 months of age	991	958	1,000	1,022	1,034

TABLE IV

EFFECT OF WINTER FEED LEVEL ON REPRODUCTIVE PERFORMANCE AND CALF PERFORMANCE

1st winter 2nd winter	Low Low	Low High	Moderate Moderate	High High	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	2/1	3/24
Per cent calf crop					
1st calf	65	73	70	72	78
2nd calf	73	79	76	62	79
Av. birth wt., lb.					
1st calf	65	72	71	72	67
2nd calf	81	77	79	76	75
Av. weaning wt., lb.					
1st calf	388	409	408	412	383
2nd calf	444	432	424	425	387
Av. daily gain of calves, lb.					
1st calf	1.56	1.62	1.61	1.65	1.50
2nd calf	1.73	1.65	1.71	1.63	1.66

Pasture allowance for this group was 12.25 acres/cow. Another group (Lot II) was fed prairie hay ad lib. (17 lb.) and 5 lb. alfalfa hay in confinement. The cows of Lot I lost 32 lb., and those in Lot II lost 103 lb. during the experiment. Initial average weight of cows in Lots I and II was 968 lb. At the end of the summer grazing period, which was the conclusion of the experiment, Lot I cows weighed 937 lb. vs. 865 lb. for the Lot II cows. There was no significant difference between average birth weights of calves or calving dates. The calves from Lot I cows were heavier at weaning (413 lb.) than calves of Lot II (362 lb.).

Pope et al. (1955), in an extensive study with 90 females, reported that low levels of supplemental winter feed are less detrimental in terms of body weight loss after the cows reached maturity. The cows in this study were grouped into three levels of winter supplemental feeding: low level, 1.0 lb. cottonseed meal; medium level, 2.5 lb. cottonseed meal; high level, 2.5 lb. cottonseed meal plus 3.0 lb. whole oats. Approximately 10 to 12 acres of Bluestem pasture were allowed per cow yearly. They reported that weight losses suffered by growing heifers producing their first or second calf were the most severe. Weight losses suffered by 3-year-old heifers on this trial ranged from 214 lb. to 308 lb. on the low level. Winter weight losses of the cows just prior to calving (approximately January 27) to the end of the winter period (April 13) showed that this was the period in which adequate levels of supplemental feed were most needed. Cows on the low level lost an average of 202 lb. from calving to April. The cows on the medium level lost 185 lb. and those on the high level, 169 lb.

Cows on the low and medium levels gained more than cows on the high level during lactation. The total summer gains were 122 lb., 119 lb., and 65 lb. for low, medium, and high groups, respectively. Performance of the cows tended to equate after maturity.

Nelson et al. (1956) studied the effects of two levels of supplemental winter feeding and the value of creep-feeding. They allotted 68 fall-calving Hereford cows into four lots of 17 head each. The cattle were allowed to graze native pasture, and during the winter the cows and calves were fed as follows: Lot 1, not creep-fed, 1.5 lb. cottonseed meal; Lot 2, creep-fed, 1.5 lb. cottonseed meal; Lot 3, not creep-fed, 2.5 lb. pelleted cottonseed meal, 3 lb. ground yellow corn; Lot 4, creep-fed, 2.5 lb. pelleted cottonseed meal, 3 lb. ground yellow corn. The cows on the low level of wintering, Lots 1 and 2, lost 250 lb. and 246 lb., respectively, during the 192-day wintering period. Average initial weight of the cows of Lots 1 and 2 was 1,033 lb. Cows on the high level averaged losing 204 lb. of an initial 1,039 lb. during the winter compared to a loss of 248 lb. in Lots 1 and 2. From the beginning of the test until July 8, which was the date some of the calves were sold, the cows fed on the high level gained more than those on the low level. The yearly gain for Lots 3 and 4 was 22 lb. and 34 lb., respectively. Lots 1 and 2 lost 4 lb. and 23 lb., respectively, during the same period. The average weight of the calves in Lot 1 (408 lb.) was considerably less than the weight of the calves in the other lots on July 8. Calves of Lots 2, 3, and 4 were weighed and sold at 471 lb., 488 lb., and 496 lb., respectively.

Wallace and Raleigh (1964) conducted two trials to study the effect that limited winter feeding of mature pregnant cows would have on subsequent calf production. In the first trial 48 uniform cows were stratified by weight and age and randomly allotted to three groups of 16 animals each. Native meadow hay was fed daily to the three groups as follows: (1) all the hay they would clean up in a 24-hour period; (2) 75 per cent of the amount given group 1; (3) 50 per cent of the amount given group 1. In addition, one-half of the animals in each group were fed a supplement of 1.0 lb. cottonseed meal per head daily, while the other half received only hay. In the second trial 30 uniform cows were individually fed in a 2 x 3 factorial design experiment to study the effects of full and limited feeding with three combinations of energy and protein. One treatment had energy and protein in balance and the other treatments were high energy-low protein and low energy-high protein. In each trial, treatments were continued until calving at which time the animals were removed from the study and fed a common ration. Birth weights were not significantly influenced by experimental treatments in the first trial, but were significantly ($P<.01$) lower for calves from cows fed high energy-low protein rations in the second trial. There were no significant differences with respect to weaning weight, conception rate, or conception date in either trial. Losses in body weight of the cows during the nursing period were directly related to weight gains during the pregnancy period.

Langford, Douglas, and Buchannon (1958) reported on the results of cows wintered on a ration of corn silage and grass hay at 75 per cent

of the usual level (100 per cent N.R.C.). Cows on both rations lost from 41 to 66 lb. over the winter, but tended to make up on summer grass the weight lost during the winter. The total yearly gain per cow was not affected until the low winter ration was continued for 4 or more years. A control ration of corn silage and grass hay fed at 100 per cent N.R.C. level produced calves weighing 33 lb. more at weaning than calves from cows fed on the 75 per cent level.

Harris, Brown, and Anthony (1965) reported results of 7 years of restricted winter feeding on cow and calf performance. The restricted group received fair quality hay free-choice. The control or optimum-fed cows were fed good-quality coastal Bermuda hay, plus 2 lb. of 41 per cent cottonseed meal per animal daily. In addition, they had access to an improved Dallis grass pasture with white clover and a limited amount of fescue. Both groups of cows lost weight during the winter periods, but optimum-fed cows were fed an average of 17.8 lb. of hay plus 2 lb. of cottonseed meal daily from November 1 to April 1. The restricted-fed cows received an average of 24.7 lb. of hay but no cottonseed meal during this period. The 250-day weaning weights of calves, adjusted for sex of calf and age of dam differences, were 450 lb. vs. 420 lb. for optimum and restricted feeding levels, respectively. Not only were the calves from the better-fed dams heavier at weaning, but steer calves maintained a weight advantage of 43 lb. throughout a growing and finishing program.

Turman et al. (1964) reported on the effect of feed level before and after calving on the performance of 2-year-old heifers.

Sufficient amounts of milo and cottonseed meal were fed to produce the following weight changes: low, loss of 20 per cent or more of the fall weight through calving (including calving loss); high, loss of less than 5 per cent of fall weight through calving. At calving time one lot on each level was switched to the opposite level. The four lots and treatments were as follows: Lot 1 (low-low), low level prior to calving and continued after calving; Lot 2 (low-high), low level prior to calving and high level after calving; Lot 3 (high-low), high level prior to calving and low level after calving; Lot 4 (high-high), high level throughout the entire winter feeding period. The heifers grazed dry native pasture and were fed supplemental feed to produce the weight changes. Nutritional level of the heifers during gestation had a marked effect on birth weight ($P<.01$). Heifers on the low level dropped calves weighing 13 lb. less than calves from the high-level heifers. Heifers fed at a high level prior to calving returned to heat earlier, bred back earlier and had a higher conception rate (93 per cent and 100 per cent vs. 53 per cent and 75 per cent) than did heifers fed on the low level until the time of calving. Raising the low-level heifers to high at calving resulted in a 2-weeks-earlier breeding date, a higher conception rate (75 per cent vs. 53 per cent), and an 18 lb. heavier average weaning weight. Average weaning weights were as follows: high-high, 432 lb.; high-low, 408 lb.; low-high, 376 lb.; and low-low, 358 lb.

Ewing et al. (1965) reported on the influence of level of wintering on the lifetime performance of beef females through five calf crops. A total of 120 weaner 8-month-old heifer calves weighing 475 lb.

were started on test in the fall of 1957. The treatments employed were designed to result in winter weight changes as follows: Lot 1 (low), no gain during the first winter as calves, with a loss of approximately 20 per cent of fall weight during subsequent winters as bred females; Lot 2 (moderate), gain of 0.5 lb. per head daily the first winter as calves, with a loss of 10 per cent of fall weight during subsequent winters; Lot 3 (high), gain 1.0 lb. per head daily during the first winter as calves, then less than a 10 per cent weight loss from fall weight during the subsequent winters as bred females; Lot 4 (very high), self-fed a 50 per cent concentrate mixture during the first winter as calves and during subsequent winters as bred females. The above treatments were followed with the exception that one-half of the females in Lot 4 were reverted to the moderate level the fourth winter to study the effects of a very high level the first three winters followed by the moderate level during subsequent winters. The daily level of winter supplement consisting of cottonseed meal and milo was adjusted periodically to produce as nearly as possible the desired weight changes. The heifers were maintained on native pastures during the entire wintering period. Using the successive spring weights taken at the beginning of the grazing season to reflect the development patterns, the weights for the first three grazing seasons were: low level, 462 lb., 571 lb., 667 lb.; moderate level, 569 lb., 679 lb., 829 lb.; high level, 620 lb., 789 lb., 889 lb.; very high, 768 lb., 1,048 lb., 1,182 lb. After 5 years, 26 cows remained on the low and moderate levels, 24 on the high, and 12 out of 15 on the very high and very high to moderate levels. Each level of wintering

from low to high tended to result in earlier calving dates by about 1 week. The long-term average birth weight for calves produced by the different groups did not vary widely. The greatest difference observed was that birth weights of first calves produced by cows on the low level averaged about 10 lb. less than calves produced by cows in the other groups. Weaning weights over the 5-year period were: low, 320 lb., 360 lb., 400 lb., 440 lb., 450 lb.; moderate, 380 lb., 440 lb., 450 lb., 475 lb., 460 lb.; high, 380 lb., 440 lb., 450 lb., 475 lb., 480 lb.; very high, 390 lb., 420 lb., 440 lb., 450 lb., 420 lb.

Arnett and Totusek (1963) reported on the results of an experiment in which 12 sets of twin heifers with an average initial age of 12 months were fed in dry lot. One heifer of each set was full-fed a high energy ration while the second heifer was fed a ration containing a moderate level of energy. Eight sets of twins remained intact through the third lactation. High-level heifers averaged 483 lb., 342 lb., and 273 lb. heavier than the moderate level at first, second, and third parturition. Average number of services required per conception was 1.43 for the moderate and 1.70 for the high level. High-level heifers required more assistance at calving. Average calf birth weights were 62.8 lb. for moderate level and 64.2 for high level. Weaning weights at 210 days of age for the moderate and high levels were 369 lb. vs. 338 lb., 389 lb. vs. 328 lb., 353 lb. vs. 364 lb. for first, second, and third calves.

Marion, Jones, and Riggs (1962) reported on the effects of feeding two groups of 36 cows at different levels of energy. One group grazed

native pasture, and the other group was fed silage in dry lot. The groups were divided into three lots, each on different levels of energy provided by cottonseed meal and sorghum grain. The daily rates of feeding were: low, 1.0 lb. cottonseed meal plus 1.0 lb. sorghum grain; medium, 3/4 lb. cottonseed meal plus 2.0 lb. sorghum grain; high, 3/4 lb. cottonseed meal plus 4.0 lb. sorghum grain. Winter losses were 125 lb., 77 lb., and 35 lb., respectively, for the cows on pasture and 49 lb., 70 lb., and 43 lb. for those in the feed lot. Percentages of calf crops weaned on pasture were 83, 92, and 83, respectively, and 82, 91, and 100 in the feed lot. Weaning weights were 436 lb., 427 lb., and 439 lb. on pasture and 492 lb., 467 lb., and 473 lb., respectively, in the feed lot. The three lots of cows on pasture averaged 957 lb. initially, and their final weight was 1,045 lb. after weaning their calves. Average initial weight of the dry lot group was 1,066 lb., and average final weight of the group was 1,110 lb.

Gregory, Blum, and Baker (1950) reported that the weight of the cows immediately after calving and the calf's birth weight were correlated (0.21). The coefficient of correlation was 0.32 between cow weight and calf weight immediately following calving. The coefficients of correlation for calf gain from birth to weaning and weight of the cow before calving were -.12 and -.34. They also reported that cows which were heavier than the mean weight at calving tended to give birth to calves that were heavier than the mean birth weight of all the calves. The negative correlations (-.11 and -.34) between the gain of the calf from birth to weaning and the gain of the cow from calving to weaning

indicated that the cows making the smallest gains during the nursing period tended to produce calves that made the greatest gains.

Joubert (1954) reported that growth in body weight of cows fed at a low level showed marked seasonal fluctuations. The heifers usually reached a peak at the end of summer and then dropped to a low weight at the end of the wintering period. Cows on the low plane of nutrition had a tendency to make greater increases in weight during the following summer than the groups on a high plane of nutrition. Weight increases by cows on a low plane during pregnancy were less than those by the cows on the high plane. However, loss in weight during parturition was less for cows on a low plane.

Hanson (1956) indicated that the intensity of feeding during rearing has a great influence on the rate at which an individual develops and this in turn influences the length of life. By retarding or accelerating the rate of body development, heredity seems to direct this development to the same end-point irrespective of the feeding intensity employed. The relationship between intensity of feeding during rearing and growth per unit of feed indicates that the principle of diminishing returns applies to the process of growth in cattle.

Coop (1950) conducted a study over 3 years involving a total of 1,750 ewes which was designed to determine the effects of high and low levels of nutrition during pregnancy and during lactation on grazing sheep. A high-quality pasture was the high level and a heavily over-stocked poor quality pasture was the low level. He concluded that the high level of feeding resulted in increased fatness and had no adverse effects unless practiced continuously.

Dean et al. (1958) reported that gilts which gained in condition during gestation weaned 4.9 pigs per litter as compared to 6.9 per litter weaned from gilts that maintained their condition throughout pregnancy. Also, the high condition resulted in a lowering of the number of pigs farrowed.

McKenzie (1928) reported generous feeding of sows losing weight rapidly while suckling large litters produced the heaviest pigs at weaning. It was concluded that the condition of the sows at farrowing time and amount of feed consumed during lactation greatly influenced the growth of the pigs.

CHAPTER III

EXPERIMENTAL PROCEDURE

In November of 1963 and 1964 the Angus cows at the Plateau Experiment Station, Crossville, Tennessee, were evaluated for their apparent condition by a member of the Animal Husbandry-Veterinary Science Department (AH-VS). Following rectal palpation to determine the pregnancy status of the cows, 54 pregnant cows were allotted into three groups based on their condition at the onset of winter. Fifty-three cows completed the test in 1965 and 40 in 1964. Cows were removed from the test if they did not produce a calf at weaning. An effort was made to keep the average production records about the same for each group. The groups were:

1. High Good and Above ("fat"). The cows in this group were judged to have more fat than necessary for optimum and economical performance. These cows possessed sufficient apparent condition to lose weight during the wintering period without materially interfering with optimum calf production.

2. Low to Average Good ("average"). The cows in this group were considered to be near ideal in condition at the beginning of winter. They should be in similar condition at the end of winter feed.

3. High Standard and Below ("thin"). The cows in this group were thinner than was felt desirable for optimum production. This group

was considered to be thin enough to need more than the average amount of winter feed.

These condition grades were designed to depict degrees of finish in adult beef cows similar to the corresponding slaughter grades for steers and heifers. The same numerical breakdown was used for the cow condition grades (6, 7, 8 = Standard; 9, 10, 11 = Good; 12, 13, 14 = Choice).

Cows within each condition group were divided into three uniform lots of six cows each. These lots were randomly assigned to one of the following N.R.C.'s recommended level of TDN intake for wintering pregnant beef cows:

1. 110 per cent
2. 100 per cent
3. 80 per cent.

The experimental design used during both years is shown in Table V.

The wintering ration consisted of various combinations of corn silage, alfalfa hay, and straw fed in confinement. The proportions were varied to obtain the desired TDN level while maintaining balance for dry matter and protein. The average daily rations for each group were as follows: 110-120 per cent, 41.00 lb. corn silage, 2.83 lb. alfalfa hay, 2.00 lb. straw; 100 per cent, 35.00 lb. corn silage, 3.83 lb. alfalfa hay, 1.50 lb. straw; 80 per cent, 23.84 lb. corn silage, 5.38 lb. alfalfa hay, 0.75 lb. straw. With extreme changes in weather, such as temperature below 10° F. the previous night, amounts fed all groups were altered accordingly.

TABLE V

EXPERIMENTAL DESIGN USED DURING 1963, 1964 STUDY

Initial condition	Feed levels[a] (per cent)	Number of animals/rep.
High Good and Above	110-120	6
	100	6
	80	6
Low Good-Average Good	110-120	6
	100	6
	80	6
High Standard and Below	110-120	6
	100	6
	80	6

[a]Expressed as percentage of N.R.C. requirements for wintering pregnant beef cows.

With pregnant mature cows of the dominant beef breeds a weight of not less than 1,050 lb. before calving is usually necessary to support consistently regular rebreeding and sufficient lactation to produce high weaning weights. The daily nutrient requirements recommended by the N.R.C. assume that cows in general are about the same size and that differences in weight are due largely to variations in condition. Cows weighing less than 1,050 lb. at the onset of the wintering period should be fed to gain weight according to N.R.C. standards. Heavier fat cows or heifers can lose some weight during the winter without reducing their productiveness, provided the ration is otherwise adequate (N.R.C., 1958). This is the basis for determining the wintering rations fed cows in this study. Each group of cows was fed at a level determined by their average weight.

To determine the TDN, dry matter, and protein for each lot, the N.R.C. recommendations were figured on a 100-lb. basis and then multiplied by the average weight of the lot to obtain the total requirements for each respective level of nutrient intake. Average composition values for each ration ingredient were utilized to determine the amounts required to satisfy the particular level under consideration.

The wintering period was from about December 1 until about April 15. Cows and calves were removed from confinement during April and placed on grass pastures of similar quality and composition.

Cow weights were recorded initially in December and at 28-day intervals during the winter. Weights of the cows were recorded three times during the grazing season (July, September, October).

Cows were graded for condition in November, April, July, and November of each year in accordance with the grading standards developed for this work.

Calves were weighed at birth, at 28-day intervals until mid-April, at preweaning (July), once between preweaning and weaning (September), and at weaning (November).

Adjusted average daily gains for the calves at preweaning and weaning were calculated by subtracting the birth weight from the preweaning and weaning weight and dividing by the proper number of days of age. These average daily gains from birth to preweaning or weaning were then multiplied by the appropriate correction factor to adjust for age of dam and sex of calf. Correction factors used are shown in Table VI. Weaning weights were adjusted to 205 days of age by multiplying the adjusted daily gain by 205 and adding birthweight to the product.

As many cows as possible were carried over from the 1963 test to the 1964 study. Cows were removed from the test when they failed to wean a calf the previous year or were pregnancy checked and considered to be open at the beginning of the 1964 wintering period. Cows carried over from 1963 were again placed on the same level of feeding. Cows that changed from one condition group to another were reassigned to the appropriate condition group within the same N.R.C. level.

These data were analyzed by the method of least squares outlined by Harvey (1960). Kramer's (1957) modification of Duncan's (1955) Multiple Range Test was applied to test the significance of difference between means where the "F" test was significant. The simple

TABLE VI

CORRECTION FACTORS FOR AGE OF DAM AND SEX OF CALF

Age of dam (years)	Correction factors	
	Male	Female
2	1.15	1.22
3	1.10	1.17
4	1.06	1.13
5	1.03	1.10
6	1.00	1.07
7	1.00	1.07
8	1.00	1.07
9	1.00	1.07
10	1.00	1.07
11	1.02	1.09
12	1.05	1.12
13	1.08	1.15

correlations were calculated on an over-all basis as outlined by Snedecor (1956).

CHAPTER IV

RESULTS AND DISCUSSION

I. WEIGHT AND CONDITION CHANGES OF COWS DURING THE WINTER

Weight Changes

Regardless of initial condition, cows wintered on the 80 per cent level lost an average of 190 lb. during the winter. This weight loss was highly significantly ($P<.01$) greater than the 113-lb. and 84-lb. average weight loss by the cows fed the 100 and 110 to 120 per cent levels (Tables VII and VIII). The lack of a significant difference between the weight loss of the 100 and 110 to 120 per cent groups could be due to the limitations imposed by the ration components used in the experiment. The amount of feed consumed by the cows on the 110 to 120 per cent level was nearer to the 110 per cent of the feed level than to 120 per cent. Consequently, there was only one-half as much difference between these two levels as between the 80 and 100 per cent feed levels. The results obtained in this study are in agreement with the work of Pinney *et al.* (1962), Zimmerman *et al.* (1958), Wiltbank *et al.* (1962), Nelson *et al.* (1956), and Harris, Brown, and Anthony (1965). These workers reported that cows wintered on a low level of feeding experienced greater weight losses than cows wintered on an excessive level.

Females in the High-Standard-and-Below ("thin") condition at the onset of the wintering period lost an average of 90 lb. which was highly

TABLE VII

LEAST SQUARE MEANS FOR THE WEIGHT AND GAINS IN WEIGHT AS AFFECTED BY INITIAL CONDITION OF THE COWS AND WINTER FEED LEVELS

	December weight	April weight	Weight change from Dec. to April	July weight	Gain from April to July	Sept. weight	Gain from July to Sept.	Nov. weight	Gain from Sept. to Nov.
					Pounds				
Year									
1964	1,066	931	-136	1,004	63	1,033	29	1,086	53
1965	1,062	941	-122	1,022	80	1,044	22	1,096	52
Initial condition scores									
High Good and Above	1,151[a]	992[a]	-159[b]	1,064[a]	72	1,079[a]	15	1,132[a]	53
Low to Average Good	1,085[a]	948[a]	-137[b]	1,044[a]	96	1,064[a]	20	1,122[a]	58
High Standard and Below	957	867	-90	932	65	972	39	1,018	46
Feed levels									
80	1,066	876	-190	986[a]	110	1,011[a]	25	1,067	56
100	1,061	948[a]	-113	1,008[a]	60[a]	1,042[a,b]	34	1,093	51
110-120	1,066	982[a]	-84	1,045	63[a]	1,061[b]	16	1,111	50

[a,b]Means not superscripted by the same letter are significantly different.
a = P<.01. b = P<.05.

TABLE VIII

ANALYSIS OF VARIANCE FOR THE EFFECTS OF FEED LEVEL AND INITIAL CONDITION ON COW WEIGHTS

		Mean square								
Source	d.f.	December[a] weight	April[b] weight	Gain Dec.-April	July[c] weight	Gain April-July	Sept.[d] weight	Gain June-Sept.	Nov.[e] weight	Gain Sept.-Nov.
Total	92									
Year	1	380.33	2,265.01	51,593.24**	6,732.08	2,404.99	2,729.88	1,008.94	2,224.74	43.44
Initial condition grade	2	304,367.71**	126,676.22**	42,775.91**	157,280.32**	7,571.82	106,318.13**	4,795.76	121,709.69**	887.24
Feed levels	2	225.88	82,043.85**	58,112.67**	25,224.51**	13,683.07**	18,001.15*	2,274.03	14,199.40	291.21
Year x initial condition grade	2	18,209.16	4,902.41	1,099.44	8,043.01	2,719.58	5,398.10	650.13	7,354.00	865.16
Initial condition x level	4	1,618.52	2,757.13	5,700.31	1,779.87	7,555.18	2,259.88	4,805.34	3,262.25	4,803.66
Year x feed level	2	70.03	1,804.12	3,423.74	809.25	972.64	567.70	778.53	3,692.69	1,815.79
Error	79	4,552.08	9,334.04	5,220.25	5,162.11	3,760.48	4,790.20	1,964.51	4,907.16	1,437.60

[a]Weight at the beginning of winter.

[b]Weight at the end of winter.

[c]Weight at preweaning.

[d]Weight September 1st.

[e]Weight at weaning.

*P<.05.

**P<.01.

significantly different from the average of 137 lb. and 159 lb. lost by the cows in Low-to-Average-Good ("average") and High-Good-and-Above ("fat") condition groups. The weight losses of the "fat" and "average" cows were not significantly different.

The greater weight loss by the "fat" cows can be attributed in part to the fact that the standards were designed to cause the heavier cows to lose weight. The weights of the "average" and "fat" cows were greater than 1,050 lb. at the beginning of the winter period. The smaller weight loss experienced by the "thin" cows can be attributed to the design of the winter feeding programs which allowed lighter weight cows a greater nutrient allowance per 100 lb. than was allowed the heavier cows.

The difference in the weight losses by the cows indicated that the visual evaluation of the condition of the cows was accurate in separating the cows on the basis of condition at the onset of winter.

Cows lost an average of 136 lb. during the winter of 1964 compared to 122 lb. in 1965. The greater weight loss during 1964 may be attributed partially to the 15-day longer wintering period, the conduct of the feeding program, and the heavier weights of the cows at the onset of the 1963-64 wintering period.

Cows in the "thin" group at the beginning of the wintering period weighed 975 lb. which was highly significantly different from the 1,085 lb. and 1,151 lb. weights of the "average" and "fat" cows. The difference between the weights of the "average" and "fat" cows was not significant. The general trend toward increased weight with increased

condition scores substantiates the fact that differences in weight can be attributed at least in part to condition. The smaller differences between the weights of the "average" and "fat" cows may have been due to the "average" condition cows being the heavier boned and larger framed cows. Therefore, they would appear in the visual estimate to have less condition but weigh about the same as the "fat" cow.

Although of less magnitude, similar differences in weight were observed at the end of the wintering period. "Thin," "average," and "fat" cow groups averaged 867 lb., 948 lb., and 992 lb., respectively, at the end of winter. The smaller difference in weight could be attributed to the fact that the "fat" cows possessed a greater amount of fat initially which would be lost at a faster rate than the thinner cows. Cow weight changes by periods and years are shown in Table IX.

Condition Score Changes During the Winter

The average initial condition values assigned at the beginning of winter to the cows wintered on the various feed levels reflect the allotment procedures. Condition scores and condition changes are presented in Table X.

Differences in winter feed levels produced significant differences in the condition scores of the cows at the end of winter (Table XI). End-of-winter condition scores averaged 7.80, 9.10, and 9.50 for cows on the 80, 100, and 110-120 per cent levels, respectively (Table XII). The nutrient intake provided the 80 per cent cows was sufficiently low to allow a significantly greater reduction of apparent body finish

TABLE IX

SUMMARY OF COW WEIGHTS BY PERIODS AND YEARS

Condition groups	Feed levels	December[a]		April[b]		Preweaning[c]		September[d]		Weaning[e]	
		1963	1964	1964	1965	1964	1965	1964	1965	1964	1965
		Pounds									
High Good and Above	110-120	1,159	1,145	1,037	1,020	1,114	1,124	1,116	1,148	1,167	1,184
	100	1,158	1,162	1,018	990	1,072	1,087	1,087	1,095	1,130	1,141
	80	1,182	1,159	924	889	994	1,042	1,009	1,048	1,080	1,114
Low to Average Good	110-120	1,111	1,068	977	938	1,073	1,046	1,078	1,064	1,162	1,128
	100	1,096	1,006	954	934	1,022	1,042	1,088	1,071	1,140	1,120
	80	1,089	1,062	911	874	1,042	1,015	1,140	1,038	1,125	1,090
Medium Standard and Below	110-120	947	991	916	902	945	978	984	983	1,022	1,014
	100	934	980	867	870	938	938	980	1,090	1,036	1,112
	80	945	987	790	847	896	941	947	982	976	1,056

[a]Weights at the beginning of the wintering periods, 12-3-63 and 12-11-64.

[b]Weights at the end of winter, 4-21-64, 4-2-65.

[c]Weights at preweaning, 6-25-64, 7-1-65.

[d]Weights at 9-1-64, 9-1-65.

[e]Weights at weaning, 11-1-64, 11-1-65.

TABLE X

SUMMARY OF COW CONDITION SCORES[a] BY PERIOD AND YEARS

Condition groups	Feed levels	Initial[b]		April[c]		Preweaning[d]		Weaning[e]	
		1963	1964	1964	1965	1964	1965	1964	1965
High Good and Above	110-120	11.2	11.5	10.5	10.5	11.3	12.2	11.0	11.2
	100	11.3	11.8	10.8	10.7	11.2	11.7	11.2	11.0
	80	11.2	11.7	9.3	9.3	9.8	11.7	9.2	11.0
Low to Average Good	110-120	9.3	9.5	8.6	9.7	10.5	11.2	10.6	10.2
	100	9.3	9.3	8.9	9.2	10.5	11.7	10.0	11.0
	80	9.3	9.7	8.3	7.3	10.3	11.0	10.6	10.7
Medium Standard and Below	110-120	7.2	7.5	8.2	9.3	10.0	10.8	8.7	8.8
	100	7.2	7.7	7.6	7.7	9.3	9.7	9.2	8.3
	80	7.2	7.3	6.8	6.2	9.0	9.8	9.3	8.0

[a]The condition scores were designed to depict degrees of finish in adult beef cows similar to the corresponding slaughter grades for steers and heifers. The same numerical breakdown was used for the cow condition grades (6, 7, 8 = Standard; 9, 10, 11 = Good; 12, 13, 14 = Choice).

[b]Average condition grade of the cows at the beginning of the winter feeding period, 12-3-63, 12-11-64.

[c]Average condition grades of the cows at the end of the winter feeding period, 4-21-64, 4-15-65.

[d]Average condition grade of the cows at preweaning, 6-25-64, 7-1-65.

[e]Average condition grades of the cows at weaning, 11-1-64, 11-1-65.

TABLE XI

ANALYSIS OF VARIANCE FOR THE EFFECTS OF WINTER FEEDING AND INITIAL CONDITION GRADE UPON CONDITION SCORES

Source	d.f.	Mean square							
		Initial	April	June	November	Condition change from initial-April	Condition change from April-June	Condition change from June-Nov.	Condition change from Nov.-Nov.
Total	92								
Year	1	1.45	1.82	22.42**	3.30	0.53	13.94**	11.20**	0.38
Initial condition grade	2	132.87**	55.83*	22.50*	47.07**	14.10**	9.34**	3.85**	28.89**
Feed levels	2	0.05	20.29	3.78*	3.79*	17.78**	8.01**	0.26	2.22
Year x condition groups	2	0.47	0.08	1.21	1.21	2.32	0.43	1.89	1.57
Year x feed levels	2	0.13	2.98	0.28	0.59	3.76	9.60	0.80	0.87
Group x feed levels	4	0.12	2.73	2.08	0.96	3.46	2.01	0.48	1.12
Error	79	0.32	1.40	0.86	0.97	1.46	1.20	1.01	1.18

*P<.05. **P<.01.

TABLE XII

LEAST SQUARE MEANS FOR THE CONDITION SCORES AND CHANGES AS AFFECTED BY THE INITIAL CONDITION OF THE COWS AND WINTER FEED LEVELS

	Initial[a] condition	April[b] condition	Condition change initial-April	July[c] condition	Condition change April-July	November[d] condition	Condition change July-Nov.	Condition change initial-November
Year								
1964	9.25[e]	8.72[e]	-.53	10.11	1.39	9.61	-.50	0.36
1965	9.50[e]	8.92[e]	-.58	11.14	2.22	10.00	-1.14	0.50
Initial condition								
High Good and Above	11.40	10.21	-1.19[e]	11.39	1.18	10.72[e]	-.67	-.68
Low to Average Good	9.44	8.94	-.50[e]	10.75	1.81[e]	10.30[e]	-.45	0.86[e]
Medium Standard and Below	7.28	7.55	0.27	9.71	2.16[e]	8.41	-1.30	1.20[e]
Feed levels								
80	9.49[e]	7.85	-1.64	10.28[e]	2.42	9.53[f]	-.75	0.04
100	9.37[e]	9.11[e]	-.26	10.60[e]	1.49[e]	9.91[e,f]	-.69	0.54
110-120	9.33[e]	9.50[e]	0.17	11.00[f]	1.50[e]	9.98[e]	-1.02	0.65

[a]Condition at the onset of winter.

[b]Condition at the end of winter.

[c]Condition at preweaning.

[d]Condition at weaning.

[e,f]Means not superscripted by the same letter are significantly different.
e = P<.01. f = P<.05.

than was the case with the other levels. The results obtained in this study are in general agreement with Wiltbank et al. (1962) who stated that cows fed 9.0 lb. of TDN daily experienced losses in condition during the feeding period.

Although the different winter feed levels influenced changes in condition differently during the winter, the changes did not alter the groupings set at the onset of winter. The "thin" cows graded 7.28 in condition at the beginning of winter and 7.55 at the end of winter. "Average" cows graded 9.44 at the onset of winter and 8.94 at the end of winter. "Fat" cows scored 11.40 in condition at the beginning of winter and 10.21 at the end of winter. The loss in condition by the "fat" and "average" cows and the gain in condition by the "thin" cows was expected since the wintering rations were designed to reduce the condition of the "fat" cows and increase the condition of the "thin" cows. Table XII, page 43, shows that the average difference of 2.60 between the condition values of the "fat" and "thin" cows at the termination of the wintering period was less than the average difference of 4.10 between the condition scores at the beginning of winter.

II. PERFORMANCE OF CALVES DURING THE WINTERING PERIOD

Calving Dates

Calves were born primarily during February and March while the cows were still in confinement and under the influence of the various wintering rations. The calving dates discussed in this study are a comparison of the cows that calved during both 1964 and 1965 calving season.

Cows maintained during the 1964 wintering period on the 80 per cent maintenance ration calved approximately 8 days earlier than cows fed either the 100 or 110-120 per cent rations (Table XIII). These results contradict the reports of Pinney et al. (1962), Zimmerman et al. (1958), Smithson et al. (1964) who reported that cows provided a low level of supplemental feed during the winter and allowed free access to Bluestem pasture calved somewhat later than cows fed an increased amount of supplemental feed. The earlier calving date for the cows wintered on the 80 per cent rations can be attributed to an earlier conception made possible by a "flushing" effect when the cows were placed on a lush, fast growing pasture. The "flushing" effect was probably not realized by the cows wintered on the low level in the work reported on by Penney et al. (1962), Zimmerman et al. (1958), and Smithson et al. (1964) since the cows were allowed access to pasture the year-round and the rapid increase in energy was not realized. From the results obtained in this study it would seem that the 80 per cent level, or a comparable level of energy intake, would not adversely affect subsequent calving dates, provided the cows were allowed to graze a lush, fast growing pasture at the beginning of the breeding season.

Birth Weights

Calves from cows in the "thin," "average," and "fat" condition groups weighed 66 lb., 67. lb., and 64 lb., respectively, at birth. The cows wintered on the 80 per cent level, 100 per cent, and 110 to 120 per cent level of feeding gave birth to calves with average birth weights of

TABLE XIII

SUMMARY OF CALF WEIGHTS, GAINS, AND TYPE AND CONDITION SCORES BY PERIODS AND YEARS

Condition groups	Feed levels	Birth day			Birth weight		Gain from birth to April		Gain from April to prewean		Preweaning gains		Gains from prewean to Sept.		Gains from Sept. to weaning		Weaning gains		Adj. 205-day weight		Preweaning condition		Weaning condition		Preweaning type		Weaning type	
		1964	1965	1966	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965	1964	1965
		Pounds																										
High Good and Above	110-120	50.0	60.0	64.0	63.20	68.66	1.54	1.56	1.69	2.02	1.64	1.87	2.13	2.28	1.87	1.61	1.84	2.01	441	481	9.10	9.66	10.00	10.33	12.10	11.75	12.80	12.33
	100	45.0	58.0	37.0	72.40	79.33	1.60	1.51	1.80	1.74	1.68	1.91	2.21	2.42	2.11	1.99	1.87	2.03	456	495	8.30	8.58	9.30	10.16	12.10	12.66	12.30	13.66
	80	47.0	43.0	52.0	56.00	69.33	1.82	1.34	1.52	1.78	1.77	1.70	2.20	1.92	1.80	1.46	1.97	1.75	470	428	8.16	9.00	10.00	10.66	11.00	11.25	12.33	13.16
Low to Average Good	110-120	55.0	50.5	66.0	75.00	62.83	1.69	1.48	1.90	2.05	1.81	1.75	2.52	2.70	2.04	1.58	2.05	2.00	495	473	9.16	8.75	10.16	10.16	14.33	12.66	13.50	12.66
	100	59.1	52.8	47.0	65.40	73.20	1.33	1.04	1.49	1.37	1.50	1.57	2.33	2.20	1.95	1.52	1.86	1.72	447	425	7.66	8.50	9.00	9.20	11.91	11.50	12.16	12.00
	80	61.5	45.3	49.0	61.50	67.33	1.25	1.39	1.50	1.43	1.50	1.66	1.97	2.12	1.28	1.47	1.74	1.69	418	414	7.50	8.40	9.25	9.30	12.25	11.91	12.50	12.50
High Standard and Below	110-120	72.8	57.5	67.0	66.60	68.16	2.21	1.43	1.46	1.52	1.70	1.46	2.45	2.23	1.86	1.42	1.98	1.67	423	411	8.66	8.25	9.16	9.80	10.66	11.30	12.41	12.50
	100	45.0	59.8	50.0	63.50	66.83	1.89	1.52	1.82	1.89	2.01	1.76	2.35	2.45	2.25	1.84	2.04	1.98	482	473	8.37	8.75	10.12	10.10	12.00	11.40	13.00	12.50
	80	59.6	55.6	46.0	61.30	68.66	1.60	1.46	1.63	1.92	1.55	1.87	2.29	2.25	1.80	1.58	1.92	1.91	455	460	8.75	8.66	9.50	9.33	12.75	11.80	12.91	12.30

64 lb., 66 lb., and 65 lb., respectively (Table XIV). The nonsignificant effect of differences in feed levels (Table XV) on birth weights is in general agreement with Pinney et al. (1962), Zimmerman et al. (1958), Hobbs, Wilson, and Odom (1965), and Totusek et al. (1959). These workers reported that birth weights of the calves were not influenced by the differences in level of winter feeding provided the cows. The nonsignificant effect of differences in the level of winter feeding and initial condition on the birth weight of the calves indicated that all feed levels met the demand for fetal development or that the deficiencies were met from use of body stores of fat.

Calf Gains

Calves from the "thin" cows gained 1.66 lb. per day from birth to the end of winter which was highly significantly greater than the 1.56 lb. and 1.36 lb. per day gains made by the calves from the "fat" and "average" cows. These differences may be explained by the following observations:

1. Differences in the calf gains may be attributed partially to the more liberal amount of feed supplied the thinner cows.

2. The greater condition possessed by the "fat" cows may have provided an added source of nutrients above that provided in the ration.

3. Possibly the "fat" cows possessed an accumulation of fat in the udder which lowered the milk production resulting in slower gaining calves. Swanson (1960) reported that heavy feeding produced growth and fattening which resulted in poor subsequent lactations.

TABLE XIV

LEAST SQUARE MEANS FOR CALF PERFORMANCE AS AFFECTED BY INITIAL CONDITION OF THE COWS AND WINTER FEED LEVELS

	Birth wt.	Adj. ADG birth-April	Adj. ADG April-prewean	Adj. ADG prewean	Adj. ADG prewean-Sept.	Adj. ADG Sept.-weaning	Adj. ADG weaning	Adj. 205-day wt.	Prewean type score	Weaning type score	Prewean condition	Weaning condition	Type gain prewean to wean	Gain in condition prewean to weaning
	Pounds													
Year														
1964	65.00	1.67	1.68	1.67	2.29	1.91	1.91	459.32	12.35	12.64	8.45	9.61	0.34	1.10
1965	66.25	1.38	1.91	1.71	2.33	1.62	1.87	446.96	11.70	12.63	8.76	9.90	0.87	1.14
Initial condition														
High Good and Above	63.84	1.56	1.84	1.72	2.24	1.85	1.89	448.41	11.85	12.77	8.84	10.08	1.01	1.15
Low to Average Good	66.88	1.36	1.90	1.63	2.34	1.65	1.86	451.19	12.40	11.82	8.36	9.52	0.14[a]	1.15
High Standard and Below	66.16	1.66	1.75	1.73	2.35	1.77	1.91	459.81	12.20	12.68	8.59	9.67	0.54[a]	1.05
Feed levels														
80	64.45	1.42	1.83	1.66	2.15	1.62	1.85	438.69	11.07	12.53	8.48[a]	9.70	0.57	1.16
100	66.59	1.50	1.77	1.70	2.35[a]	1.94[a]	1.90	459.47	11.92	12.50	8.40[a]	9.57	0.67	1.21
110-120	65.52	1.65	1.81	1.72	2.43[a]	1.90[a]	1.93	461.25	12.30	12.88	8.94	9.92	0.64	0.98

[a] Means not superscripted by the same letter are significantly different.
a = P<.01.

TABLE XV

ANALYSIS OF VARIANCE FOR THE EFFECTS OF INITIAL CONDITION AND FEED LEVEL ON CALF PERFORMANCE

		Mean square													
Source	d.f.	Birth wt.	Adj. ADG birth-April	Adj. ADG April-June	Adj. ADG p-wean	Adj. ADG p-wean-Sept.	Adj. ADG Sept.-wean	Adj. ADG at wean	Adj. 205-day weight	P-wean type score	P-wean cond. score	Wean type score	Wean cond. score	Change in cond. p-wean-wean	Change in type p-wean-wean
Total	92														
Year	1	33.81	1.73**	1.13**	0.03	0.06	1.83**	0.08	3,291.13	7.64**	2.11	0.001	1.88	0.03	6.11
Initial condition grade	2	72.35	0.68**	0.08	0.06	0.11	0.26	0.03	1,106.34	2.30	1.59	0.380	2.42	0.11	5.25*
Feed levels	2	32.27	0.40	0.02	0.09	0.51*	0.74*	0.07	4,275.73*	1.34	2.67	1.36	0.66	0.48	0.10
Year x feed levels	2	277.87	0.03	0.08	0.11	0.01	0.05	0.002	320.84	2.00	0.72	0.19	0.11	0.787	2.91
Year x initial condition grade	2	69.59	0.25	0.02	0.05	0.08	0.03	0.06	693.23	0.90	0.83	2.45	0.53	0.672	0.10
Initial condition grade x feed level	4	37.35	0.15	0.36**	0.21**	0.32	0.16	0.14**	5,719.78**	4.50**	1.34	1.44	0.24	1.73	2.14
Error	79	156.83	0.73	0.12	0.06	0.11	0.19	0.03	1,401.77	1.48	1.12	1.87	1.34	1.12	1.24

*P<.05.

**P<.01.

4. Analysis of variance (Table XVI) implies that cows which lost a great amount of weight during the winter were the ones producing slower gaining calves. The "thin" cows lost the least amount of weight during the winter and produced the fastest gaining calves. "Fat" cows lost the greatest amount of weight yet produced calves that gained faster than calves from the "average" cows which were intermediate in weight loss.

Average calf gains during the wintering period were greater in 1964 (1.67 lb. per day) than in 1965 (1.38 lb. per day). This may be due in part to the fact that the 1964 wintering period was 15 days longer than the wintering period in 1965.

III. GAINS IN WEIGHT AND CONDITION OF THE COWS FROM THE TERMINATION OF THE WINTERING PERIOD TO PREWEANING

Weight Gains from the End of Winter to Preweaning

Cows wintered on the 80 per cent level increased an average of 110 lb. in weight from the end of winter to preweaning which was highly significantly greater than the 60-lb. and 63-lb. average gains made by the cows fed at the 100 and 110 to 120 per cent wintering levels.

Cow Weights at Preweaning

Average cow weights at preweaning were 1,045 lb., 1,008 lb., and 986 lb. for cows wintered on the 110 to 120, 100, and 80 per cent levels, respectively. The difference between the 100 and 80 per cent levels was not significant.

TABLE XVI

ANALYSIS OF VARIANCE EFFECT OF COW WEIGHT GAIN AND LOSS OF CALF GAINS[a]

Source	d.f.	Mean square					
		Calf gain from birth to end of winter	Calf gain from end of winter preweaning	Prewean	Gain from prewean-Sept.	Gain from Sept.-wean	Weaning
Total	92						
Cow weight loss during the winter	1	1.1284*	0.1764	0.0567	0.2857	0.2141	0.04586
Cow weight gain from end of winter to preweaning	1	0.0034	0.7865*	0.3222*	0.2714	1.7540**	0.0685
Cow weight gain from preweaning to September	1	0.3132	0.0883	0.0499	0.1594	0.2566	0.0031
Cow weight gain from September to weaning	1	0.2583	0.0094	0.0360	0.0089	0.9476*	0.0177
Error	88	0.1544	0.1261	0.0615	0.1081	0.1857	0.0335

[a]Gains are adjusted for age of dam and sex of calf.

*P<.05.

**P<.01.

These findings are in general agreement with those reported by Reid et al. (1964) and Langford, Douglas, and Buchannon (1958) who found that cows with the greatest weight loss during a period of nutrient retardation made compensatory gains when allowed a free choice intake of nutrients. Osborne and Mendel (1915) have shown that, following a period of nutrient retardation, growth in weight can be resumed at a more rapid rate than normally exhibited at any other time during life. They stated that in stunting, cells may be depleted yet remain in outline capable of being filled later without complete rebuilding. The rapid increase in weight which follows retardation may be due to replacement of lost fat in cells that are already prepared, and this process may take place more rapidly than true growth.

Condition Scores

The cows averaged scoring 10.11 and 11.14 in condition at preweaning in 1964 and 1965, respectively. This year difference was highly significant. The greater condition score at preweaning in 1965 may be attributed partially to the fact that the wintering period was 15 days shorter in 1965, allowing for a longer recovery period on pasture in 1965.

"Thin" cows scored an average 9.71 in condition at preweaning which was significantly less than the 10.75 and 11.39 average condition scores of the "average" and "fat" cows. Condition scores of the "fat" and "average" cows were not significantly different. The nonsignificant difference between the "average" and "fat" cows can be explained on the

basis that the "fat" cows lost more in condition during the winter and gained less from the end of winter to preweaning as compared to the "average" cows.

Cows wintered on the 80 per cent feed levels averaged 10.60 and 11.00 in condition at preweaning and 9.11 and 9.50 at the end of winter. These results indicate that losses in condition caused by a deficient nutrient intake were compensated for by faster gains in condition when the cows were placed on pasture. Therefore, the condition of the cows at the end of the pasture period was essentially the same. These results imply that when cows are fed a nutrient-deficient ration such as the 80 per cent level used in this study, no adverse effects on the cow condition would be realized if the cows were allowed to graze a lush, fast growing pasture following the winter period.

IV. CALF PERFORMANCE FROM THE END OF THE WINTERING PERIOD TO PREWEANING

Gain from End of Winter to Preweaning

The 1.91 lb. per day gain made by the calves in 1965 from the end of winter to preweaning was highly significantly greater than the 1.70 lb. per day gain made by the 1964 calf crop during the same period. These gains correspond with the year difference in cow condition and weight gains. The average daily gain of the calves from birth to the end of winter was less in 1965 (1.40 lb. per day) than in 1964 (1.70 lb. per day). Therefore, greater compensatory gains could be expected from the end of winter to preweaning in 1965.

Variation in adjusted average daily gain of calves from the end of winter to preweaning and at preweaning reflected a significant interaction between initial condition of the cows and level of winter feeding. The gains of the calves from the "fat" cows exhibited a downward trend with decrease in feeding level and the calves from the "thin" cows tended to increase in gain with decrease in feeding level (Figures 1 and 2). There is a possibility that different feed levels provided the cows during the winter could interfere with the established metabolic rate of the cows and affect their milk production resulting in the trends observed in calf gains.

Interaction is the failure of differences (such as those associated with initial condition of the cows) to be consistent, either in direction or magnitude when the comparison is made in conjunction with different levels of another factor (such as feed levels).

Analysis of variance (Table XVI, page 51) implies that cows which made the greatest gains in weight from the end of winter to preweaning produced the faster gaining calves from the end of winter to preweaning as well as the preweaning gains. Calves from the "average" cows gained 1.90 lb. per day from the end of winter to preweaning compared to 1.84 lb. and 1.75 lb. per day gain made by the calves from the "fat" and "thin" cows, respectively. The greater gains by the calves from the "average" cows may partially be attributed to compensatory gains since these calves gained slowest from birth to the end of winter.

All calves gained about the same (1.77 lb. to 1.83 lb. per head daily) from the end of winter to preweaning regardless of the level of

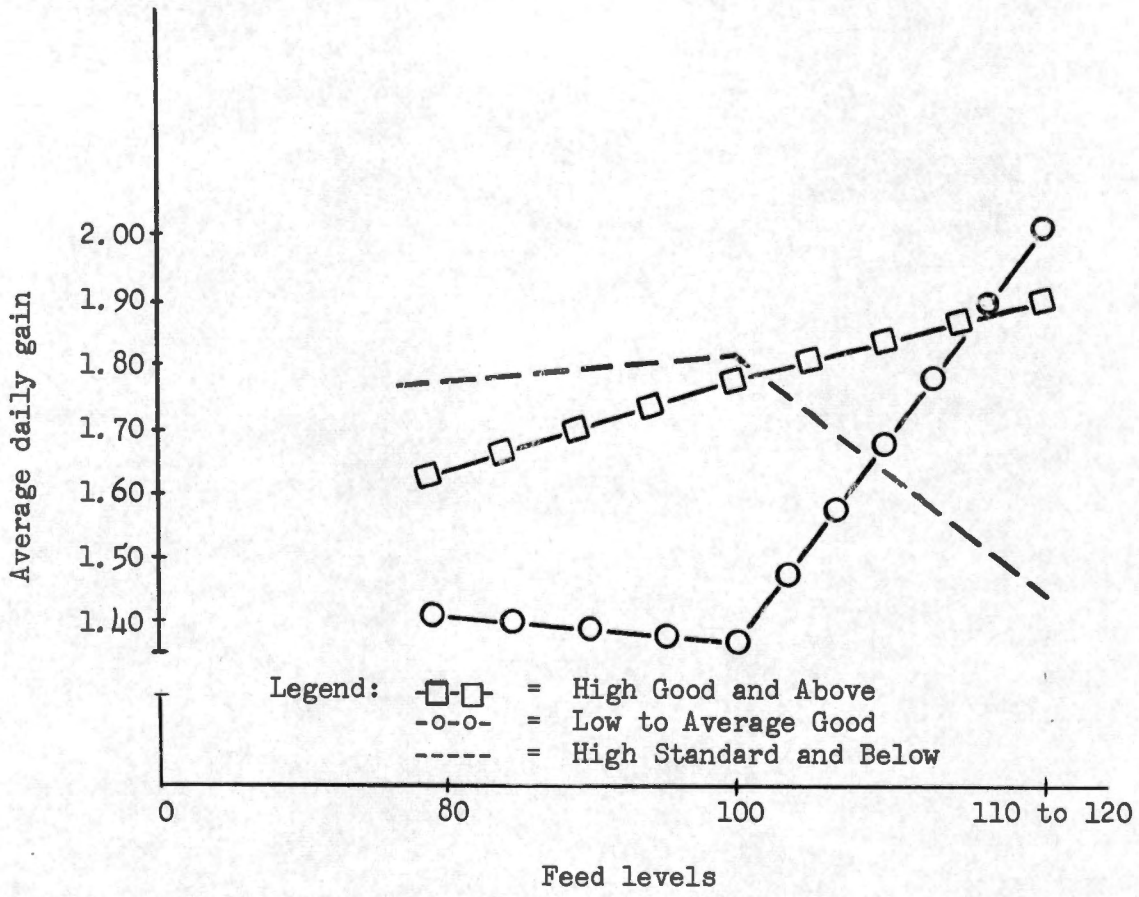


Figure 1. Influence of interaction between initial condition of the cows and winter feed levels on adjusted calf gains from the end of winter to preweaning.

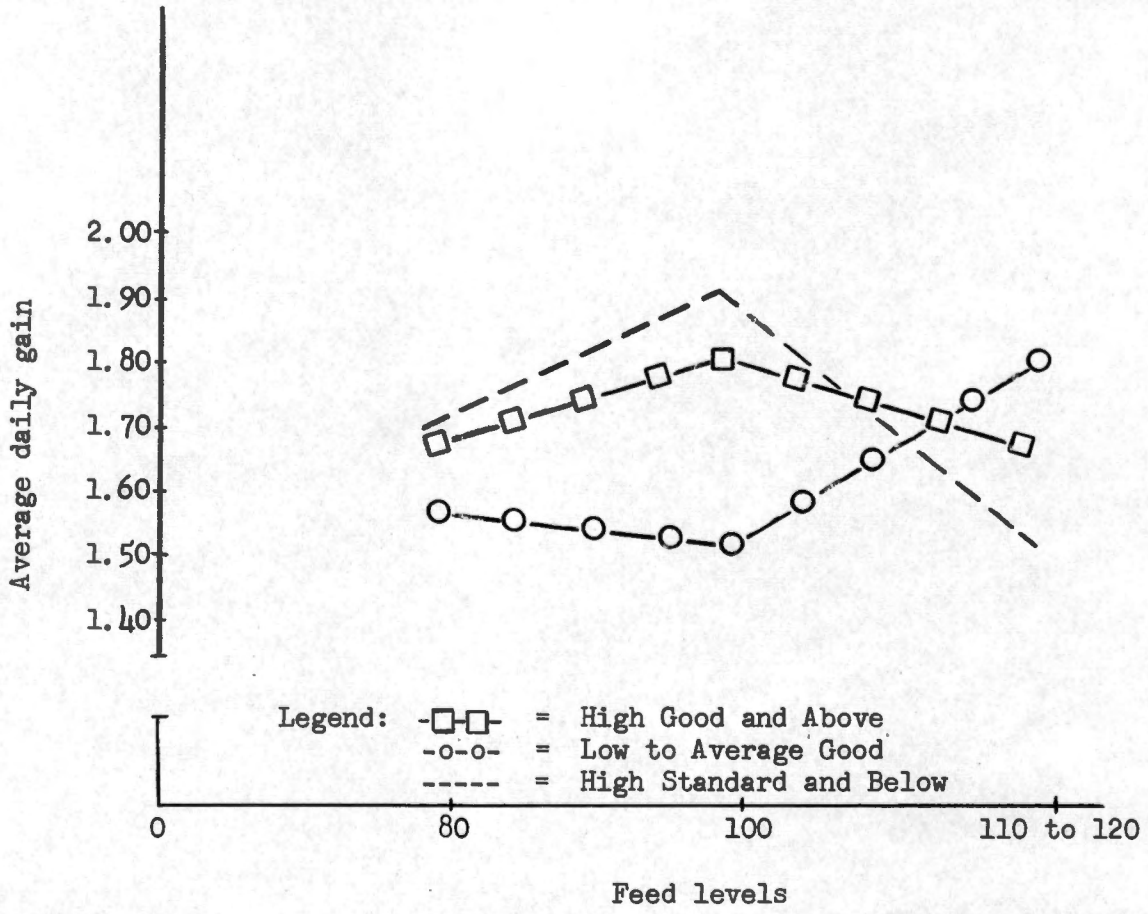


Figure 2. Influence of interaction between initial condition of the cows and winter feed levels on adjusted calf gains at preweaning.

winter feed provided the cows.

These results indicate that gains in weight by the cows following a period of deficient nutrient intake had no adverse effects on calf gains during the same period, and the recovery of lost weight by the cows may actually result in increased milk production and faster calf gains.

Type Scores

Variation in preweaning type score of the calves reflected a significant interaction between initial condition of the cows and level of winter feeding as shown in Figure 3. Calves from the "average" cows exhibited a downward trend as the winter feed levels decreased. Calves from the "thin" cows exhibited an increase in preweaning type score when their dams were provided with the 80 per cent wintering level.

Condition Scores

Calves from the cows fed the 110 to 120 per cent wintering rations scored 8.94 in condition which was significantly greater than the 8.40 and 8.48 scores of the calves from the cows fed at the 100 and 80 per cent levels. The same calves were also the faster gaining calves at preweaning. Condition scores of the calves from the calves from the cows fed the 80 and 100 per cent levels were not significantly different.

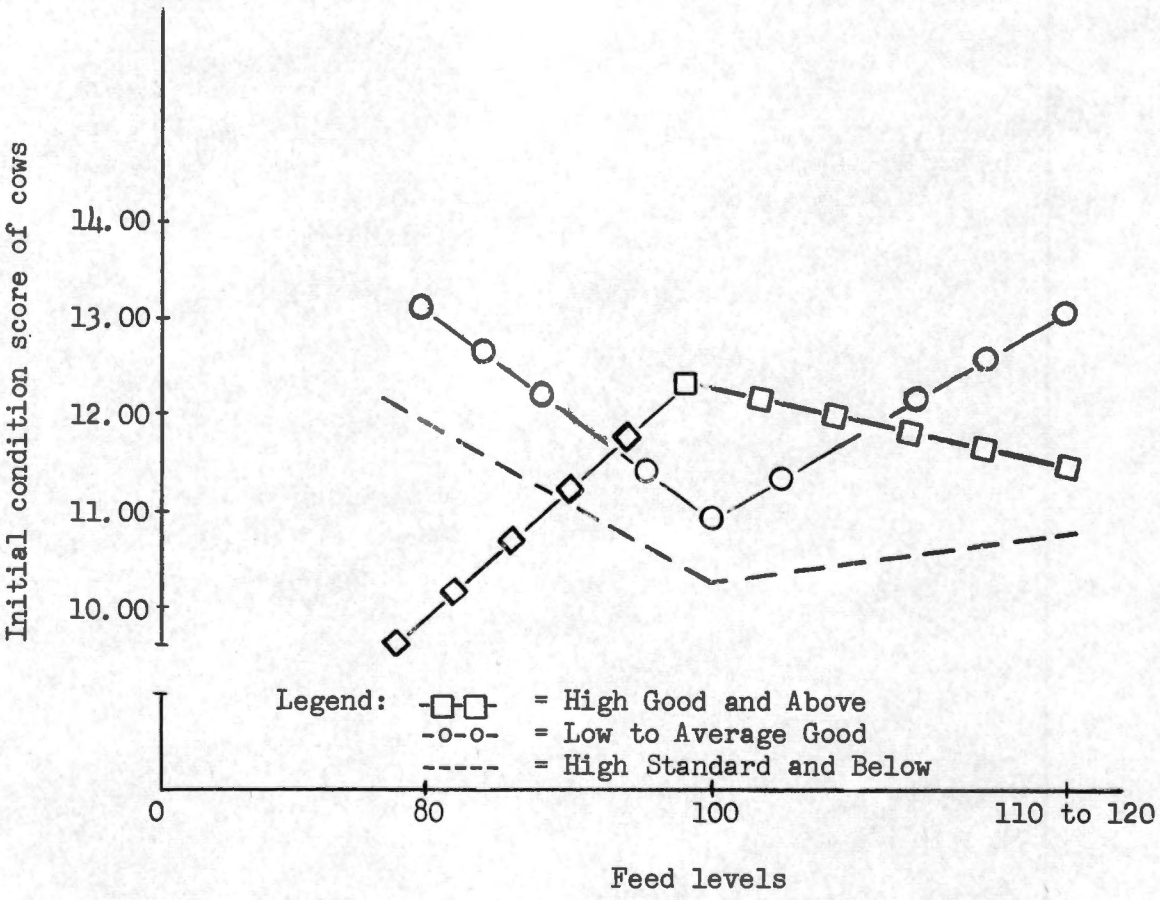


Figure 3. Influence of interaction between initial condition of the cows and winter feed levels on preweaning type scores.

V. COW WEIGHT AND CONDITION CHANGES FROM PREWEANING TO SEPTEMBER AND WEANING

Weight Changes from Preweaning to September 1

Weight gains from preweaning to September 1 were not significantly influenced differently by differences in either the initial condition of the cows or level of winter feeding. The lack of significance here can probably be attributed to the compensatory gains made during the pasture period.

Cow Weights on September 1

On September 1, cows graded "thin" at the beginning of winter weighed 972 lb. on the average, which was highly significantly less than the 1,064 lb. and 1.079 lb. average weights of the "average" and "fat" cows. The difference in the weight of the "fat" and "thin" cows was 194 lb. at the onset of winter and 107 lb. at the September weigh date. Even though the differences in weight were smaller, the effect of the apparent finish possessed by the cows at the onset of winter on cow weights was not changed by the pasture period to September 1.

Cows fed the 80 per cent feed level weighed 1,010 lb. on September 1, highly significantly less than the 1,061 lb. weight of the cows fed the 110 to 120 per cent levels. Cows fed the 100 per cent level averaged 1,042 lb. in weight on September 1.

Weight Changes from September 1 to Weaning

Differences in gains of the cows from September 1 to weaning were not significantly influenced by either level of winter feeding or

condition of the cows at the beginning of winter. Gains by the cows during this period were probably influenced greatest by the quality and quantity of forage available and the gains of the calves.

Cow Weights at Weaning

"Thin" cows weighed 1,017 lb. at weaning, significantly less than the 1,122 lb. and 1,131 lb. weights of the "average" and "fat" cows. Average weights of the "fat" and "average" cows were not significantly different at any time throughout the year. Cows considered "fat" and "average" at the beginning of winter were the heaviest, and "thin" cows weighed the least at the beginning of winter and at each weigh date throughout the year.

Cow Condition Change from Preweaning to Weaning

Changes in condition experienced by the "fat" and "average" cows from preweaning to weaning were not significantly different. "Thin" cows lost from a condition grade of 9.71 at preweaning to a grade of 8.41 at weaning. "Fat" cows decreased in condition grade from 11.39 to 10.72, and the "average" cows lost from 10.75 to 10.30 during the same period. The greater gain of the calves nursing the "thin" cows probably resulted from increased milk production which prevented any deposition of fat and actually reduced the amount of body fat stored by the cows.

Cow Condition Scores at Weaning

Final condition evaluation of the cows was made at weaning in November. Cows classified "thin" at the onset of winter averaged

scoring 8.41 in condition which was significantly less than the 10.30 and 10.72 condition scores of the "average" and "fat" cows. Condition scores of the "fat" and "average" cows were not significantly different.

"Fat" cows lost more condition during the 11-month period, changing from 11.40 to 10.72. Both "average" and "thin" cows gained in condition, the "average" cows increasing in condition from 9.44 at the beginning of winter to 10.30 at weaning and the "thin" cows changing from 7.28 to 8.41. The changes were not great enough to alter the pattern set at the beginning of the wintering period when the cows were visually evaluated and assigned various condition values. Cows classified as "thin" 11 months earlier were again in the "thin" group, and the "fat" cows were once more assigned to the "fat" classification. The difference between the condition grades of the "fat" and "thin" cows was less at weaning (2.31) than it had been at the beginning of winter (4.12).

Cows allotted to the 80 per cent wintering level scored 9.49 in condition at the beginning of winter and 9.53 at weaning. Cows fed the 100 and 110 to 120 per cent levels graded 9.37 and 9.33 at the beginning of winter and scored 9.91 and 9.98 in condition at weaning. The small change in condition over the 11-month period was undoubtedly due to the effects of the winter feed levels on the condition of the cows being overcome during the grazing season on excellent pasture. The pasture season was longer than the period of winter feeding and the cows had an opportunity to reduce the differences produced by differences in winter feed levels.

VI. CALF GAINS FROM PREWEANING TO WEANING

Calf Gains from Preweaning to September 1

The most prominent gains made by the calves occurred during the period from preweaning to September 1. Calf gains increased consistently from birth to September.

Gains made by the calves from the cows provided the 80 per cent level of winter feed averaged 2.15 lb. per day. This gain was significantly less than the 2.35 lb. per day and 2.42 lb. per day gain made by calves from cows fed the 100 and 110 to 120 per cent wintering levels.

The following statements are offered as possible explanations for the gains made during the period following preweaning to September 1:

1. The altitude of the experiment station (about 2,000 feet above sea level) provides a climate that is excellent for both pasture growth and calf production. During this period, temperatures are lower and average rainfall amounts are greater than at other locations in the state.

2. The calves were sufficiently mature at this time of the year to utilize both the milk production of their dams and the available pasture.

3. The moisture content of the grass was lower and provided for increased consumption of total pounds of dry matter.

4. Rate of growth of calves is at a maximum during this period of life.

Calf Gains from September 1 to Weaning

Calves from cows fed the 100 and 110 to 120 per cent wintering levels gained 1.94 lb. and 1.90 lb. per day from September 1 to weaning. These gains were significantly greater than the 1.62 lb. per day gained by the calves from cows wintered on the 80 per cent level. Analysis of variance (Table XVI, page 51) shows that differences in gains made by the calves from September 1 to weaning were highly significantly influenced by differences in gains made by the cows from the end of winter to preweaning. Data in Table XVI, page 51, indicate that cows making significantly greater gains in weight from the end of winter to preweaning produced calves which made less gain from September 1 to weaning.

Weaning Gains

Variation in adjusted daily gain of the calves at weaning reflected a significant interaction between initial condition of the cows and level of winter feeding. The gains of calves from the "average" cows exhibited a downward trend with a decrease in feeding level (Figure 4). Since there was no definite trend indicated, the cause of the interaction was not readily apparent.

Weaning Type Scores

Differences in type scores of the calves at weaning were apparently influenced by differences in initial condition of the cows or winter feed levels given the cows. Variation in type scores at this stage of maturity would be influenced by variations in the environmental

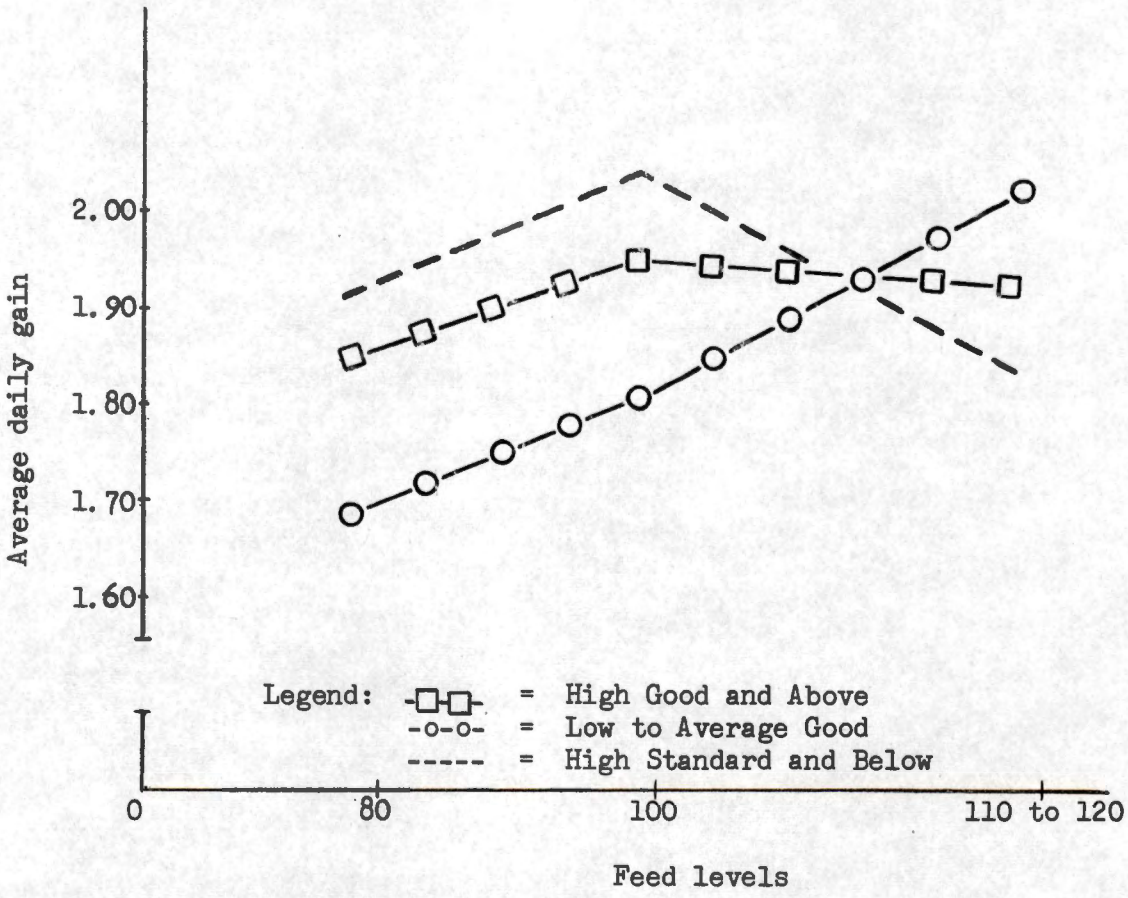


Figure 4. Influence of interaction between initial condition of the cows and winter feed levels on adjusted calf gains at weaning.

conditions as well as variations in the genetic potential of the dams and the calves.

Calves from the "fat" cows gained 1.01 in type score from preweaning to weaning. Type-score changes made by calves from the "fat" were significantly greater than the increase of 0.14 and 0.54 made by the calves from the "average" and "thin" cows. The reasons for this greater gain in type of the calves from the "fat" cows were not apparent.

Weaning Condition Scores

Differences in winter feeding level or initial condition score of cows did not produce significant differences in condition score of calves at weaning.

The calves gained in condition from preweaning to weaning due to the outstanding pastures which resulted in excellent milk production. Also, the calves were mature enough to utilize grass during the period from preweaning to weaning.

VII. FEED REQUIREMENTS AND COSTS

The total feed costs and the daily requirements used in the 2 years are shown in Tables XVII and XVIII.

From a feed cost standpoint, the 80 per cent level was the most economical. During the winter of 1963-64 the 80 per cent level was approximately $7.00 and $9.00 per head more economical than the 100 and 110 to 120 per cent levels, respectively. Cost of the 80 per cent was

TABLE XVII

FEED REQUIREMENTS AND COSTS FOR WINTERING BEEF COWS (1963-64)

	Winter feed cost per head[a]	Pounds of feed required per head daily (140 days)		
		Hay	Corn silage	Straw
110-120 per cent				
High Good and Above	$33.32	2.80	40.75	2.60
Low to Average Good	33.18	2.80	40.78	2.40
High Standard and Below Average	34.34 $33.61	3.57	42.10	1.44
110 per cent				
High Good and Above	$30.87	3.50	34.96	1.94
Low to Average Good	30.98	3.53	35.00	1.45
High Standard and Below Average	32.63 $31.49	4.22	36.64	1.27
80 per cent				
High Good and Above	$26.62	4.83	24.32	0.83
Low to Average Good	26.85	5.05	23.78	0.83
High Standard and Below Average	28.77 $24.41	5.77	24.46	0.67

[a]Feed costs: alfalfa hay, $35.00/ton; corn silage, $8.00/ton; straw, $20.00/ton.

TABLE XVIII

FEED REQUIREMENTS AND COSTS FOR WINTERING BEEF COWS (1964-65)

	Winter feed cost per head[a]	Pounds of feed required per head daily (125 days)		
		Hay	Corn silage	Straw
110-120 per cent				
High Good and Above	$29.13	2.31	43.62	1.97
Low to Average Good	30.11	2.54	43.90	2.08
High Standard and Below Average	30.66 $30.03	3.18	44.28	1.23
110 per cent				
High Good and Above	$27.42	3.54	34.72	1.45
Low to Average Good	28.04	4.03	34.78	1.45
High Standard and Below Average	28.86 $28.11	4.18	36.18	1.30
80 per cent				
High Good and Above	$24.00	5.18	23.36	0.79
Low to Average Good	24.74	5.55	23.44	0.70
High Standard and Below Average	25.65 $24.80	5.92	23.72	0.66

[a]Feed costs: alfalfa hay, $35.00/ton; corn silage, $8.00/ton; and straw, $20.00/ton.

approximately $4.00 and $6.00 per head less than the cost of the 100 and 110 to 120 per cent levels used during the winter period of 1964-65.

These results indicate that the commercial cow and calf producer should consider condition scoring his cows at the beginning of winter and feeding accordingly. From these results, it does not seem necessary to group cows into more than two condition groups at the onset of winter. Two groups would also lower the labor costs of winter feeding as compared to those incurred with three groups.

VIII. CORRELATION AMONG TRAITS

Correlation Among Cow Weight and Weight Changes

Variation in weight of cows at the beginning of the wintering period accounted for 46 per cent of the variation in weight of cows at the end of winter. Generally, the cows ranked the same in weight at the end of winter as they did at the beginning of winter.

The heavier cows tended to lose weight at a faster rate than lighter weight cows as reflected by the correlation of 0.28 between initial weight and winter weight loss (Table XIX).

Coefficients of correlation of 0.68, 0.79, 0.80, and 0.79 were observed between initial weight and cow weights at the end of the winter period, at preweaning, on September 1, and at weaning, respectively. The lower relationship with weight at the end of winter indicates that the level of winter feeding had a temporary effect on the rank of the cows by weight. This fact is further substantiated by coefficients of correlation ranging from 0.85 to 0.91 of cow weights at preweaning with

TABLE XIX

CORRELATIONS BETWEEN COW WEIGHTS AND WEIGHT CHANGES AND CONDITION SCORES AND CONDITION CHANGES

		9	8	7	6	5	4	3	2
1	Weight of the cows at the beginning of winter	0.04	0.79**	-.19	0.79**	-.01	0.80**	0.28**	0.68**
2	Weight of the cows at the end of winter	-.04	0.74**	-.32**	0.77**	-.52**	0.85**	0.45**	
3	Weight loss during the winter	-.10	0.09	-.22*	0.05	0.60**	0.15		
4	Cow weight at preweaning	-.07	0.84**	-.41**	0.89**	-.02			
5	Weight gain from the end of winter to preweaning	0.17	-.03	-.01	-.03				
6	Cow weight on September 1	-.17	0.91**	0.05					
7	Weight gain from preweaning to September 1	-.20	-.03						
8	Weight of the cows at weaning	0.26**							
9	Weight gain from September 1 to weaning								

**P<.01. *P<.05.

weight at September 1 and with weight at weaning.

Gains made by the cows from the end of winter to preweaning were negatively associated ($r = -.60$) with the loss in weight during the wintering period and were negatively associated ($r = -.52$) with the weight of the cows at the end of winter. These two associations indicate that the lighter weight cows at the end of the wintering period made a more rapid gain in weight from the end of the wintering period to preweaning.

Correlations Among Cow Weights and Condition Grades

Coefficients of correlation between weight and condition scores of the cows were 0.80, 0.82, 0.64, and 0.63 at the beginning of winter, end of winter, preweaning, and weaning, respectively. The apparent influence of initial weight at the beginning of winter on condition scores continued throughout the year as reflected by coefficients of correlation of 0.60, 0.47, 0.56, and 0.61 between these measures at the end of winter, at preweaning, on September 1, and at weaning, respectively. It is readily apparent that the visual appraisal results in assignment of the higher condition scores to the heavier cows.

The negative relationship ($r = -.36$) between condition grade of the cows at the end of winter and weight gained from the end of winter to preweaning indicated that cows scoring low in condition at the end of winter made the greatest weight increases from the end of winter to preweaning. This observation parallels the relationship observed between end of winter weight and cow gain during this period. This same trend

continued during the period from preweaning to weaning with a coefficient of correlation of -.33 observed between end of winter condition score and weight gains during this period (Table XX).

Condition change and weight change during the wintering period were closely related. Variation in weight loss during the wintering period accounted for approximately 42 per cent of the variation in loss in condition during the winter. A similar relationship continued from the end of winter to preweaning with a coefficient of correlation of 0.55 observed between weight change and condition change.

Cows weighing the least at the end of winter were generally the ones making the greatest gain in condition ($r = -.60$) when placed on pasture following the winter period. This is similar to the relationship observed earlier between cow weight at the end of winter and weight gain during this period.

Cows that lost the greatest amount of both condition and weight during the winter responded with the greatest increases in condition and weight from the end of winter to preweaning.

The weight of the cows at the beginning of winter was negatively associated ($r = -.43$) with the change in condition from the beginning of winter to weaning the following year. Generally, the heavy cows lost in condition and the lighter cows increased in condition from the beginning of winter to weaning. The effects of the loss of condition by the heavier cows during the winter were not overcome during the pasture period. The lighter weight cows made slight gains in condition during the winter and outgained the heavier cows on pasture.

TABLE XX

CORRELATIONS AMONG COW WEIGHTS AND CONDITION SCORES

	Weight gain Sept.-weaning	Weight of the cows at weaning	Weight gain from preweaning-to weaning	Cow weight on Sept. 1	Weight gain from end of winter-preweaning	Cow weights at preweaning	Weight loss during the winter	Weight of the cows at end of winter	Weight of cow at onset of winter
Condition of the cows at the onset of winter	0.08	0.58**	-.25*	0.56**	0.05	0.63**	0.29**	0.51**	0.80**
Condition of the cows at the end of winter	-.09	0.58**	-.33**	0.63**	-.36**	0.73**	0.36**	0.82**	0.60**
Condition of the cows at preweaning	-.19	0.46**	-.31**	0.55**	0.08	0.64**	0.11	0.51**	0.47**
Condition change during the winter	-.17	-.01	-.09	0.06	-.49**	0.09	0.66**	0.33**	-.24*
Condition change from end of winter to preweaning	-.30**	-.32**	0.15	-.31**	0.55**	-.36**	-.30**	-.60**	-.34**
Condition change from preweaning to weaning	0.27**	0.30**	0.06	0.19	-.15	0.15	-.25*	0.04	-.19
Condition change from onset of winter to weaning	-.10	-.10	0.13	0.06	0.15	-.11	-.26*	-.18	-.43**
Condition of the cows at weaning	0.06	0.63**	0.19	0.64**	0.21	0.68**	0.12	0.47**	0.61**

*P<.05.

**P<.01.

Correlations Among Cow Condition Scores and Condition Changes

Coefficients of correlation between initial condition scores and subsequent condition scores at the end of the wintering period, at preweaning, and at weaning were 0.62, 0.59, and 0.69, respectively (Table XXI). The wintering levels did influence the change in condition as indicated by the correlation of -.42 between condition of the cows at the beginning of winter and condition change from beginning to end of winter. The cows scoring higher on condition tended to decrease in condition, and those scoring lower either maintained their condition or increased during the winter period. The cows that were thinnest following the winter period made their greatest gains in condition from the end of the winter period to preweaning. Approximately 49 per cent of the variation in condition score at preweaning was accounted for by condition changes occurring from the end of the wintering period to preweaning.

Coefficient of correlation of -.61 between condition of the cows at the beginning of winter and the change in condition of the cows from the beginning of winter to weaning indicates that the "fat" cows lost in condition during the 11-month period as compared to gains in condition made by the "thin" cows.

Correlations Among Cow Weights, Weight Changes, and Calf Weights, Gains of Calves

Weight of the cows at the onset of winter was not significantly associated with any of the calf traits observed in this study (Table XXII).

TABLE XXI

CORRELATIONS AMONG COW CONDITION SCORES AND CONDITION CHANGES

		8	7	6	5	4	3	2
1	Condition scores of the cows at the beginning of winter	-.61**	0.19	-.27**	-.42**	0.69**	0.59**	0.62**
2	Condition scores of the cows at the end of winter	-.18	0.05	-.70**	0.43**	0.61**	0.66**	
3	Condition scores of the cows at preweaning	0.01	-.22*	0.08	0.06	0.72**		
4	Condition scores of the cows at weaning	0.15	0.46**	-.12	-.17			
5	Condition change from the beginning of winter to the end of winter	0.45**	-.16	-.51**				
6	Condition change from end of winter to preweaning	0.23*	-.27**					
7	Condition change from preweaning to weaning	0.22*						
8	Condition change from beginning of winter to weaning							

*P<.05.
**P<.01.

TABLE XXII

CORRELATIONS AMONG COW WEIGHTS, WEIGHT CHANGES, AND CALF PERFORMANCES

	Cow weights and weight changes								
	Gain Sept.-weaning	Weight at weaning	Gain from preweaning-weaning	Weight on Sept. 1	Gain end of winter to preweaning	Weight at preweaning	Weight loss during winter period	Weight at end of winter	Weight at onset of winter
Calf weights, gains, and grades									
Birth weight	-.15	0.17	0.13	0.25*	-.11	0.16	0.06	0.20	0.18
Gain birth-end of winter	0.07	-.07	0.11	-.10	0.49**	0.14	0.65**	-.36**	0.14
Adj. ADG birth-end of winter	-.15	-.25*	0.08	-.18	-.10	-.21*	0.14	-.13	-.13
Gain end of winter-preweaning	-.02	-.05	-.09	-.40**	0.31**	0.00	0.13	-.16	0.05
Adj. ADG end of winter-preweaning	-.00	-.40**	-.05	-.30**	0.31**	-.00	0.29**	-.19	0.12
Preweaning gains	0.03	-.08	0.02	-.09	0.53**	-.09	0.52**	-.36**	0.01
Adj. ADG at preweaning	0.07	-.07	0.04	-.10	0.22*	-.11	0.23*	0.18	0.12
Gain preweaning-Sept. 1	-.09	0.06	0.11	-.22*	-.21*	0.05	0.20	0.16	0.02
Adj. ADG preweaning-Sept. 1	-.08	0.04	0.13	0.08	0.25*	0.01	0.28*	0.15	-.05
Gain Sept. 1-weaning	0.24*	0.07	-.06	-.04	-.32**	-.01	0.07	0.18	0.08
Adj. ADG Sept. 1-weaning	0.25*	0.03	0.00	-.08	-.34**	-.07	0.03	0.13	0.05
Adj. ADG at weaning	0.05	-.06	-.03	-.09	-.23*	-.06	0.06	0.05	-.03
Adj. 205-day weight	0.03	-.00	-.00	-.01	-.31*	-.01	0.14	0.14	0.00

TABLE XXII (continued)

	Cow weights and weight changes								
	Gain Sept.-weaning	Weight at weaning	Gain from preweaning-weaning	Weight on Sept. 1	Gain end of winter to preweaning	Weight at preweaning	Weight loss during winter period	Weight at end of winter	Weight at onset of winter
Preweaning type score	0.26*	0.07	-.09	-.04	-.13	0.01	-.02	0.60**	0.03
Preweaning condition score	0.06	0.01	-.17	-.01	-.01	0.06	-.08	0.40**	0.03
Weaning type score	0.07	0.13	-.00	-.10	-.11	0.09	0.01	0.13	0.13
Weaning condition score	0.08	0.17	-.10	0.14	-.10	0.17	0.08	0.20	0.17
Change in condition preweaning-weaning	0.01	0.17	0.06	0.60**	-.09	0.17	0.12	0.17	0.14
Change in type preweaning-weaning	-.20	0.87**	0.08	0.17	0.01	0.12	0.02	0.10	0.14

*P<.05.

**P<.01.

Coefficients of correlation between weight lost by the cows during the winter and adjusted calf gains from birth to the end of winter, adjusted preweaning gains, and weaning gains were -.13, 0.23, and 0.06, respectively.

The weight lost by the cows during the winter was correlated 0.29, 0.23, and 0.28 with the adjusted calf gains made from the end of winter to preweaning, preweaning, and adjusted gains from preweaning to September 1, respectively.

The difference in the coefficients of correlations for the unadjusted and adjusted calf gains implies that when the gains of the calves were adjusted, the apparent effects of the winter feed levels and other environmental conditions were altered. Probably, the younger cows were effected more by the feeding levels than were the older cows and the adjustment would tend to mask this effect.

Gain by the cows from the end of winter to preweaning was positively correlated (0.31, 0.22, and 0.25, respectively) with the adjusted calf gains from the end of winter to preweaning, from preweaning to September to weaning, and with the adjusted weaning gains.

Correlations Among Cow Condition Scores, Changes, and Calf Performance

Condition of the cows at the beginning of winter was not significantly associated with any of the calf performance traits observed in this study (Table XXIII).

Condition score of the cows at the end of winter was negatively associated (-.22) with the adjusted calf gain at preweaning. These results imply that the thinner cows produced the faster gaining calves.

TABLE XXIII

CORRELATIONS BETWEEN COW CONDITION SCORES, CONDITION CHANGES, AND CALF PERFORMANCE TRAITS

	Cow condition scores and condition changes							
	Change from beginning of winter-weaning	Change from preweaning-weaning	Change from end of winter-preweaning	Change from beginning to end of winter	Condition at weaning	Condition at preweaning	Condition at end of winter	Condition at beginning of winter
Calf weights, gains, and grades								
Birth weight	0.17	-.06	-.05	0.21*	0.03	0.09	0.10	-.10
Gain from birth to end of winter	-.10	0.12	0.26**	-.40**	0.07	-.06	-.25*	0.13
Adj. ADG from birth to the end of winter	-.08	0.02	-.12	0.09	-.25*	-.22*	-.07	-.13
Gain from end of winter to preweaning	-.17	-.22*	0.32**	-.35**	-.01	0.11	-.17	0.12
Preweaning gain	-.18	-.05	0.37**	-.50**	0.05	0.03	-.26*	0.17
Adj. ADG at preweaning	-.20	-.12	0.18	-.30**	-.15	-.11	-.22*	0.03
Gain from preweaning-Sept. 1	0.04	0.06	-.15	0.10	-.07	-.12	0.03	-.08
Adj. ADG from preweaning to Sept. 1	0.00	0.04	-.12	0.12	-.12	-.09	0.03	-.09
Gain from Sept. 1 to weaning	-.17	0.17	-.31**	0.08	0.02	-.06	0.19	0.13
Adj. ADG from Sept. 1 to weaning	-.17	0.21*	-.35**	0.12	-.03	-.15	0.17	0.09
Adj. ADG at weaning	0.25**	-.02	-.24*	0.03	-.24*	-.24*	0.01	-.01
Adj. 205-day weight	-.15	0.01	-.25**	0.12	-.23*	-.24*	0.02	-.08

TABLE XXIII (continued)

	Cow condition scores and condition changes							
	Change from beginning of winter-weaning	Change from preweaning-weaning	Change from end of winter-preweaning	Change from beginning to end of winter	Condition at weaning	Condition at preweaning	Condition at end of winter	Condition at beginning of winter
Preweaning type score	0.02	0.22*	-.10	-.02	0.01	-.15	-.01	0.02
Preweaning condition scores	-.20	-.09	-.00	-.08	0.03	0.13	0.08	0.17
Weaning type scores	-.08	0.18	-.17	-.01	0.11	-.02	0.12	0.14
Weaning condition scores	-.20	0.00	-.21	0.02	0.10	0.11	0.24*	0.23*
Change in condition from preweaning to weaning	0.01	0.08	-.21*	0.14	0.07	-.01	0.17	0.05
Change in type from preweaning to weaning	-.08	-.03	-.10	0.00	0.13	0.15	0.17	0.16

*P<.05.

**P<.01.

The condition change by the cows during the 11-month period (from beginning of winter to weaning) was positively associated (0.25) with adjusted average daily gain at weaning.

Correlation Among Calf Performance

Birth weight of the calves was negatively associated (-.17 and -.13) with adjusted average daily gains of the calves from birth to the end of winter and at preweaning (Table XXIV).

Adjusted average daily gain at preweaning was correlated 0.42 and 0.71 with adjusted gain made by the calves from birth to the end of winter and from the end of winter to preweaning.

Calves that weighed the heaviest at birth scored the lowest in condition at preweaning as implied by the negative association (-.24) between birth weight of the calves and condition score of the calves at preweaning (Table XXV). The negative association can probably be explained on the basis that calves which weighed heavy at birth were the larger framed animals at preweaning and would probably score lower in condition.

Adjusted calf gains at preweaning was associated (r = 0.60) with the adjusted weaning gains. The relationship implies that calves having the genetic potential for faster rate of growth at preweaning tended to maintain this advantage at weaning.

The relationship (r = 0.58) between the preweaning and weaning type score indicates that scoring the highest in type at preweaning tneded to carry this advantage on to weaning (Table XXVI).

TABLE XXIV

CORRELATIONS AMONG PREWEANING CALF PERFORMANCE TRAITS

	9	8	7	6	5	4	3	2
1 Birth weight	0.01	0.01	-.13	0.22*	0.06	0.05	-.17	0.23*
2 Gain from birth to end of winter	0.06	0.02	0.42**	0.79**	0.32**	0.17	0.32**	
3 Adj. ADG from birth to end of winter	0.08	0.18	0.40**	0.19	0.11	0.02		
4 Gain from end of winter to preweaning	0.05	-.01	0.62**	0.74**	0.90**			
5 Adj. ADG from end of winter to preweaning	0.05	0.02	0.71**	0.78**				
6 Preweaning gains	0.01	0.01	0.67**					
7 Adj. ADG gain at preweaning	0.15	0.14						
8 Gain from preweaning to Sept.	0.89**							
9 Adj. ADG preweaning to Sept.								

*P<.05.

**P<.01.

TABLE XXV

CORRELATIONS AMONG VARIOUS CALF PERFORMANCE TRAITS--I

	Adj. ADG from preweaning-Sept.	Gain grom preweaning-Sept.	Adj. ADG preweaning	Preweaning gains	Adj. ADG from end of winter to preweaning	Gain from end of winter to preweaning	Adj. ADG from birth to end of winter	Gain from birth to end of winter	Birth weight
Gain from Sept.-weaning	0.02	0.09	0.11	-.02	0.04	0.06	0.14	-.06	0.11
Adj. ADG from Sept.-weaning	0.01	0.09	0.12	-.07	-.04	-.10	0.22*	0.00	0.07
Adj. ADG at weaning	0.53**	0.57**	0.60**	0.25*	0.40**	0.33**	0.46**	0.06	-.09
Adj. 205-day weight	0.53*	0.58**	0.51**	0.15	0.34**	0.28**	0.36**	-.03	0.18
Preweaning type score	0.12	0.21	0.16	0.04	0.11	0.06	0.16	0.00	0.00
Preweaning condition score	-.04	-.12	0.51**	0.35**	0.46**	0.42**	0.23*	0.11	-.24*
Weaning type score	0.04	0.01	0.20	0.11	0.22*	0.15	0.10	0.00	-.11
Weaning condition score	0.13	-.03	0.24*	0.13	0.29**	0.20	0.12	-.00	-.09
Change in condition from preweaning to weaning	0.20	0.11	-.24*	-.23*	-.13	-.19	-.10	-.16	0.14
Change in type from preweaning to weaning	-.07	-.19	0.07	0.08	0.12	0.09	-.07	0.10	-.10

*P<.05.

**P<.01.

TABLE XXVI

CORRELATIONS AMONG VARIOUS CALF PERFORMANCE TRAITS--II

	10	9	8	7	6	5	4	3	2
1 Gain from Sept.-weaning	0.09	-.07	0.05	0.27*	0.14	0.21	0.47**	0.42**	0.96**
2 Adj. ADG Sept.-weaning	0.08	-.04	0.07	0.27*	0.13	0.22	0.46**	0.43**	
3 Adj. ADG weaning	0.01	-.04	0.30**	0.31**	0.40**	0.33**	0.92**		
4 Adj. 205-day weight	-.03	-.01	0.25*	0.28**	0.31**	0.34**			
5 Preweaning type score	-.41**	-.03	0.20	0.58**	0.23**				
6 Preweaning condition scores	0.16	-.37**	0.57**	0.37**					
7 Weaning type scores	0.41**	0.23*	0.54**						
8 Weaning condition scores	0.16	0.54**							
9 Condition gain from preweaning-weaning	0.49**								
10 Type gain preweaning-weaning									

*P<.05.

**P<.01.

Association ($r = 0.54$) between the type and condition score at weaning implies that calves scoring the highest in condition tended also to be the ones making the greatest type scores.

CHAPTER V

SUMMARY

In November of 1963 and 1964 the Angus cows at the Plateau Experiment Station, Crossville, Tennessee, were visually evaluated for their apparent condition by a member of the Animal Husbandry-Veterinary Science Department. Each year 54 pregnant cows were allotted into the following groups on the basis of their condition grade at the onset of the wintering period:

1. High Good and Above ("fat" group).
2. Low Good and Average Good ("average" group).
3. High Standard and Below ("thin" group).

The numerical condition grades were designed to depict degrees of apparent finish in mature beef cows which would be similar to the corresponding slaughter grades for steers and heifers, which are 14, 13, 12 = Choice; 11, 10, 9 = Good; 8, 7, 6 = Standard.

Cows within each condition group were divided into three uniform lots of six cows each and randomly assigned to one of the following N.R.C.'s recommended TDN allowances for wintering pregnant beef cows:

1. 110 to 120 per cent
2. 100 per cent
3. 80 per cent.

The wintering ration for these cows, fed in confinement, was made up of alfalfa hay, corn silage, and straw. The rations were varied to

obtain the desired TDN level while maintaining balance for dry matter and protein.

The purpose of this study was to determine the performance of beef cows and calves as influenced by or related to the condition of the cows at the beginning of the wintering period and level of winter feeding.

It is apparent from the results obtained that cows can be grouped by visual appraisal with a reasonable degree of accuracy into the various condition groups at the beginning of winter.

The variation in the weight of the cows at the beginning of winter can be attributed partly to the variation in the amount of finish possessed by the cows. "Fat" cows were the heaviest at the onset of winter, "average" cows were intermediate in weight, and "thin" cows weighed the least. This rank in weight was present at each weighing from the beginning of winter to weaning the following year.

Gain in weight and condition by the cows from the beginning of winter to weaning the following year was indirectly related to the condition of the cows at the beginning of winter and directly related to the winter feed level.

At weaning, the cows classified as "thin" at the onset of winter were again assigned to the "thin" group. The range in condition between the "fat" cows and "thin" cows was less at weaning (2.31) than it had been at the beginning of the wintering period (4.12) 11 months earlier.

Cows wintered on the 80 per cent feed level during the 1963-64 winter calved earlier in 1965 than cows maintained on the 100 or 110 to

120 per cent feed levels. The earlier calving date was attributed to an earlier conception made possible by a "flushing" effect resulting from the cows being placed on spring pasture at the onset of the breeding season.

The winter feed at all levels used in this study adequately met the requirements for fetal growth and development.

The interaction between initial condition of the cows and level of winter feeding significantly influenced the adjusted calf gains made from the end of winter to preweaning, at preweaning, and weaning. The preweaning type score was also effected by the interaction.

Calves from the "thin" cows outgained calves from both the "average" and "fat" cows from birth to the end of winter, at preweaning and weaning. Calves produced by the "fat" cows made the greatest gains from September 1 to weaning.

Gains made by the calves from birth to the end of winter, at preweaning, from preweaning to September 1, and from September 1 to weaning were directly related to the level of winter feeding irrespective of condition score of the cows. Calves from the cows wintered on the 80 per cent level had the greatest gains from the end of winter to preweaning.

Condition scores of the calves at preweaning from cows fed the 110 to 120 per cent wintering ration were slightly greater than the condition scores of the calves from cows fed either the 100 or 80 per cent wintering rations.

Variation in condition and type scores of the calves at weaning were apparently not influenced by differences in initial condition of the cows or the level of winter feeding.

Adjustment of the calf gains for sex of calf and age of dam apparently masked the effects of the environment on calf performance.

From a feed cost standpoint, the 80 per cent feed level was the most economical.

Neither initial weight nor initial condition of the cows was significantly correlated with any of the calf traits observed in this study.

Changes in condition of the cows from the beginning of winter to weaning the following year were positively correlated with the gains of the calves at weaning.

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