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To the Graduate Council:

I am submitting herewith a thesis written by William Thomas Swanks entitled "The Effects of Creep Feeding Hereford Heifers on Performance and Growth to Maturity." 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 Science.

John D. Smalling
Major Professor

We have read this thesis
and recommend its acceptance:

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THE EFFECTS OF CREEP FEEDING HEREFORD HEIFERS ON PERFORMANCE AND GROWTH TO MATURITY

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

William Thomas Swanks

December 1973

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ABSTRACT

A nine-year study, involving 28 cows and 153 progeny records, was conducted at the University of Tennessee Highland Rim Agricultural Experiment Station, Springfield, Tennessee.

This study was designed to evaluate the effects of creep feeding on Hereford heifers which were to become brood cows. Data studied involved preweaning weight, weaning weight, type score and condition score of these cows recorded while they were calves. Progeny data included weaning weight, type score and condition score. Also studied were dams mature weight, rate of maturity and calving interval. These values were calculated from life-time weight and calving records.

Treatment (creep or non-creep) had a significant effect on weaning weight, calfhood type score and calfhood condition score of the cows, but did not significantly affect their preweaning weight. Year of birth had no significant effect on preweaning weight, weaning weight, type score or condition score. Weaning weight and condition score were significantly affected by maturity status of dam while preweaning weight and type score were not significantly affected.

Analysis of progeny records showed that treatment and year of birth had no significant affect on calf weaning weight, type score, and condition score. Maturity status of dam did not significantly affect weaning weight and condition score, but type score was significantly affected. Sire had no significant effect on weaning weight but did significantly affect type score and condition score.

Although those dams which were creep fed as calves had higher mature weight and a slightly faster rate of maturity than those dams not creep fed as calves, no significant difference was found between treatments. Similar results were observed with respect to year of birth, but no significant difference was found.

Analysis of life-time calving intervals resulted in non-significant effects of treatment, year of birth and maturity status of dam.

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CHAPTER I

INTRODUCTION

Protein has become the most critical life sustaining food component throughout the world. One of the best sources of this protein is beef. It follows then that anything that could be done to promote increased efficiency in the total beef production system would be of utmost importance to the world population.

An obvious place to start improving on our inefficiencies is the ultimate source of beef, the brood cow. Geneticists are in general agreement that reproductive efficiency has a low heritability, and, thus, it is difficult to improve this trait by simple selection. This situation is complicated by such factors as disease, nutrition, and overall management, variation in which is responsible for most of the existing variation in reproductive efficiency.

The goal of all cattlemen is to wean and sell the most calves possible with maximum weights with the smallest possible imvestment. To achieve increased weights at weaning, the practice of supplemental feeding (creep feeding) has been employed.

Supplemental feeding or creep feeding is defined as a management practice which provides extra nutrients, particularly protein and energy, to calves above that which they may acquire from their dams and by grazing.

Calves being creep fed before weaning show increased gains leading to heaviest weaning weights. It is in general agreement that creep

feeding is necessary for high weaning weights, particularly from fall-born calves whose dams lack nutrition equal to that of dams of spring and summer born calves.

This study was designed to evaluate the effect of creep feeding on the following: dam's performance as a calf, mature size (as measured by weight) and her subsequent reproductive performance as indicated by calving interval. Calving interval is defined as the time period from the birth date of one calf until the birth date of the next calf.

CHAPTER II

REVIEW OF LITERATURE

The performance of creep-fed calves has been researched extensively. However, there is only limited information on the life-time effects of the creep feeding of dams before weaning on their record as brood cows and performance of their progeny. This review will be limited to the effect of creep feeding on the performance of the dam as a calf, her performance as a breeding female, on her mature size and calving interval.

Dam's Performance as a Calf

Kuhlman et. al. (1961) stated that the performance of a calf is influenced by many factors. These factors include the age and milk producing ability of the dam, season of calving, availability of pasture and the kind of creep feed used, if any.

They further stated that these factors along with the market outlook should determine whether calves are creep fed. In their comparison of different types of creep feeds fed for 220 days in Oklahoma, they found that creep-fed fall calves gained from 16 to 74 pounds more than those non-creep-fed fall calves. These results indicated that it was most profitable to creep feed calves only until spring pasture became available. Nelson et. al. (1955) reported that it was generally unprofitable to creep feed calves born in the spring of the year (February and March) if the calves had access to adequate amounts of

pasture in the summer months. In their study they found, however, that creep feeding spring calves could be beneficial if their dams were 2-year-old heifers grazing less than adequate pasture and the calves were to be sold at weaning. In an earlier portion of this same research, using mature cows, Nelson et. al. (1954) found that it was not profitable to creep feed spring calves from mature cows even though creep feeding did increase gains.

The level of nutrition of the dam while nursing a calf was stated by Kuhlman et. al. (1961) to be an important factor to be considered in determining the feasibility of creep feeding. Nelson et. al. (1956) found that dams receiving 1.5 pounds of cottonseed meal daily and whose calves were creep-fed weaned calves were 63 pounds heavier than those of dams which were fed the same ration whose calves were not creep-fed. Dams receiving 2.5 pounds of cottonseed meal and 3 pounds of milo daily and whose calves were creep-fed weaned calves 8 pounds heavier than calves which were not creep-fed. Nelson et. al. (1957), using the same ration, except containing 3 pounds of corn instead of milo, obtained similar results. Creep-fed calves whose dams received 1.5 pounds of cottonseed meal were 37 pounds heavier at weaning than calves which were not creep-fed. Among calves whose dams were fed 2.5 pounds of cottonseed meal and 3 pounds of corn, creep-fed calves were 16 pounds heavier at weaning than non-creep-fed calves. Other reports of increased gains from creep-feeding are those of McCroskey et. al. (1964), Scarth et. al. (1968), Nelson et. al. (1953), and Brown (1961).

Dam's Performance from Weaning to Puberty

Turman et. al. (1963), from research at Fort Reno, Oklahoma, stated that the most important single factor in the performance of heifers after puberty is the nutritional level on which those heifers are maintained from weaning until puberty. They further stated that if heifers are to be bred to calve at two years of age, they must have reached sexual maturity and established a regular estrual cycle by 15 months of age. They pointed out that this is particularly true of heifers to be bred in the spring, for they must have reached puberty during the preceding winter. Joubert (1954) showed the onset of puberty to be hastened by feeding beef heifers supplementary feed during the previous winter. Morris (1958) reported that a daily supplement of one pound of crushed grain sorghum fed to a group of heifers increased their ovarian activity as compared to that of heifers on an otherwise similar ration.

Turman et. al. (1963) reported that heifers placed on three different levels of nutrition reached puberty at different ages. The average ages at which first estrus occurred in heifers of the various levels were high, 353 days; moderate, 373 days; and low, 386 days. All heifers on the high level had reached puberty by 15 months of age, as compared to 90 percent on the moderate level and only 70 percent on the low level. In a study using 54 heifers in both Louisiana and Maryland, Wiltbank et. al. (1965) reported that heifers which were fed varied levels of protein and energy in combination tended to show first estrus in groups receiving higher energy levels. They pointed

out, however, that not all heifers on high-energy rations came in heat and that puberty seemed to be more closely related to amount of feed consumed than to energy level of the ration fed.

Dam's Performance During Puberty-to-Maturity Period

The development of heifers on different levels of nutrition to first and seconding calving has been researched. The results of Totusek et. al. (1960) from 13 sets of twin heifers developed on low and high levels of nutrition indicated that breeding efficiency was not affected by the high degree of body fat induced in the twin fed on the high nutritional level. Calves dropped by heifers on the high level of nutrition were heavier at birth than those dropped by their low-level twins. However, more calving difficulty and a higher death loss of both calves and dams were experienced with the high level. The effect on milk production was unclear. Joubert (1955) found that low levels of nutrition during development delayed conception but did not increase the number of services per conception. The work of Short and Bellows (1971) confirmed this finding. In developing heifers on three levels of nutrition, low, medium and high, the number of services per conception were 1.1, 1.2 and 1.3, respectively. Short and Bellows (1971) stated that few low-level heifers were bred, fewer heifers conceived; those conceiving tended to do so later and there was a higher pregnancy loss than among heifers developed on medium and high planes of nutrition. Wiltbank et. al. (1965) reported that heifers developed on high energy and medium or high protein experienced excessive calf losses at the time of calving.

Although these calves were born dead or died shortly after birth, birth weight and gestation period in these groups were average for the experiment. Calving difficulty appeared to be related to condition of the heifers. Pinney et. al. (1961) also reported that fatter heifers had a higher incidence of calving difficulty. Wiltbank et. al. (1965) stated that heifers on the low-energy ration failed to return to estrus after calving until an increased-energy ration was fed. Heifers on low-protein diets also showed delayed return to estrus. These results confirmed those of Joubert (1954). In research in which heifers were developed for two years under the following feeding regimes: Low-Low, Low-High, Medium-Medium, High-Low and High-High, Smithson et. al. (1963) reported most adverse effects on heifers in the High-Low and Low-Low or Low-High groups. They stated also that, although heifers developed under high levels of nutrition as calves showed high gain and did conceive early when placed on the low feeding regimes, these heifers had little body reserve for milk production. They further stated that low levels of nutrition as a calf are very critical because of the retarding effect on body and skeletal development. Smithson et. al. (1964) stated that the first winter's feed level evidently set the pace at which the heifers matured sexually and that nutrition as a yearling was of less importance since the detrimental effect of low nutrition during this period was overcome by good feeding practices following the heifer's first parturition.

Effect of Dam's Age on Birth Weight

Koone and Dillard (1967) reported that, in over 1300 observations of Herford cow-calf units, calving intervals were not affected by age of dame but that birth weights were increased. Similar results were reported by Reynolds et. al. (1965) and Lasley et. al. (1966a, 1966b), Pinney et. al. (1960) reported that, in data containing three years of birth weights, birth weight of calves increased as age of dam increased.

Effect of Dam's Age on Preweaning and Weaning

Marlow and Gaines (1958) found in an analysis to assess the effects of age, sex, season of birth and age of dam on preweaning growth rate of calves, that age of dam was the most important source of variation. They further stated that the largest differences in preweaning gains were among calves from the younger dams and maximum gains were obtained from cows in the six to ten-year-old age groups. Results of Gifford (1953) were in agreement with these findings. Gifford (1953) reported also that cows in the two and three-year-old classes produced less milk and that, after this age, milk production increased with age until about six years of age at which time milk production plateaued.

Brown (1958) reported that dams in the two and three-year-old classes had calves with 240-day weaning weights that were 51 and 44 pounds lighter, respectively, than those of calves from mature cows (ages four to ten years). Results of Riggs et. al. (1967) and Singh et. al. (1970 agreed with those of Brown (1958).

Effect of Dam's Weight on Progeny Performance

Vaccaro and Dillard (1966) reported that birth weight was increased as weight of dam increased. They reported that for every 100-pound increase in average dam weight, average calf birth weight increased 2.5 pounds. Klosterman et. al. (1968) reported similar results. Neville (1962) found that a 100-pound increase in average dam weight was accompanied by a seven-pound increase in average weaning weight of the calf. Sawyer et. al. (1963) reported that a 100-pound increase in average weight of dam at 18 months and 5.5 years was accompanied by average increases of 20 and 15 pounds, respectively, in weaning weight of calf. Tanner et. al. (1965) reported for each increase of 100 pounds in weight of Hereford cows, weaning weights of their calves increased an average of 4.9 pounds. In a study of Angus, Charolais and Hereford cows, Urick et. al. (1971) found a four-pound increase in average weaning weight of calf for each 100-pound increase in dam weight.

The relationship between cow weight and yearling performance of her calf has been studied. Meiske et. al. (1964) found this relationship to be positive but non-significant. Similar results were reported by Absher (1969), Brown (1969) and Brown and Shrode (1971).

CHAPTER III

EXPERIMENTAL PROCEDURE

Source of Data

Data were collected from the cows and calves in the purebred Hereford herd owned by the University of Tennessee located at the Highland Rim Experiment Station (HRES) near Springfield, Tennessee.

Selection and Management of Cows

Cows used in this study were born in 1963 and 1964 and were the replacement heifers selected from a 2 x 2 factorial creep-feeding experiment. This experiment was designed to compare beef production of fescue and orchardgrass pastures for Hereford brood cows nursing calves that were either creep-fed or non-creep-fed.

In the groups in which heifers were creep-fed, creep feeding began on May 4, in 1963, and April 2, in 1964. This supplemental feeding continued from those dates until weaning time each year. Initially, in both years, as the calves were started on creep rations, a commercial feed mixture containing molasses was used until the calves were accustomed to eating. Then a ration composed of 67 percent cracked shelled corn and 33 percent crimped oats was fed in 1963. In 1964, a ration consisting of 75 percent cracked shelled corn and 25 percent crimped oats was used. These rations were self-fed in portable metal feeders. Average daily creep feed consumption was 3.7 and 3.2 pounds per head per day in 1963 and 1964, respectively. In early

November when the heifers were about eight months old, they were weaned from their dams each year. After they were weaned, the heifers were placed on small grain pastures and fed hay and grain when necessary to achieve average gains of 1.25 to 1.5 pounds per head per day.

In the spring, the heifers were placed on fescue and orchardgrass and ladino clover pastures with the remainder of the breeding herd. Heifers born in 1963 were placed in the breeding herd as two-year-old heifers and those born in 1964 were placed in the breeding herd as yearlings. Therefore, all heifers were pasture exposed to bulls for the first time in the spring of 1965. Bulls were placed with breeding females in mid-April and remained with the herd until mid-July each year for a breeding season of approximately 90 days. Heifers were wintered on high quality hay and/or corn silage with protein supplement when necessary to provide 100 percent of the NRC requirement for wintering pregnant brood cows and heifers. Feed supply during grazing season consisted of fescue, orchardgrass, and ladino clover pastures at a rate of approximately two acres per cow-calf unit. After the first breeding season, the heifers remained with the breeding herd for the remainder of their productive lives. Cows were removed from the herd when they failed to produce a calf for two consecutive calving periods.

Each year during early fall, the cows were examined for pregnancy and vaccinated for Leptospirosis and the calves were vaccinated for Brucellosis and Malignant Edema.

Management of Calves

Calves were born in late January through mid-April. Each calf was weighed and ear tagged at birth. Calves nursed their dams until weaning around the first of November. Male calves were castrated when they were two to three months of age. All calves were weighed and scored for type and condition at 120 days of age (preweaning) and again at weaning in November.

Description of Data

The 28 cows involved were selected from a former research project (H222-H2). Ten of these cows were creep-fed as calves, and 18 were not creep-fed as calves. After they were weaned both groups were treated in a similar manner until placed in breeding pastures. At this time the cows were placed in the same breeding herd and remained together the rest of their productive lives. Calving data were collected over a 7-year period from 1965 to 1971.

Included in the study were 13 cows born in 1963 and 15 cows born in 1964. From these 28 cows a total of 153 calf records were analyzed. Data available on cows included birth weight, sire and dam, treatment (creep-fed or non-creep-fed as a calf), preweaning age, preweaning weight, weaning age, weaning weight, weaning type and condition score, life-time fall and spring weights since weaning, number of calves born to each dam, number of calves weaned by each dam, cow age in days at each weighing, cow age in days at each calving and calving interval (time period in days from the birth of one calf until the birth of the next calf). Data on the 153 calves from these

dams included: birth weight, sire number, sex, year calved, preweaning calf age, weight, type and condition scores, and when available, weaning age, weight, type and condition scores. Calf weight records used in the analyses were adjusted for differences in age of dam, age of calf and sex of calf. Preweaning weights were adjusted to a standard age of 120 days, and weaning weights were adjusted to a standard age of 205 days.

Statistical Analysis

Conventional linear models formed the basis for analyses of variance of the dependent variables measured during calfhood considered in this study. In Analysis I the independent variables (effects) considered were treatment (creep versus non-creep), year of birth 1963 versus 1964), and age of dam. Model 1 included treatment only, model 2 included treatment and year of birth and model 3 included treatment, year of birth and age of dam. These models formed the basis for analysis of each of the four dependent variables: preweaning weight, weaning weight, type score and condition score. Percent of variation (R^2) explained by each model was calculated. Analyses of variance were conducted and overall means calculated for all variables.

In Analysis II the effects of dam variable on progeny performance were assessed by analyses of variance based on conventional linear models which included one or more the the independent variables (effects), treatment, year of dam's birth, maturity status of dam (pre-maturity, mature, post-maturity) and sire. The maturity-status variable was included after a preliminary analysis had shown no significance of the

conventional age-of-dam effect estimated with one degree of freedom. A conventional age-of-dam effect would be completely confounded in these data with year of dam's birth. Model 1 included treatment only, model 2 included treatment and year of dam's birth, model 3 included treatment, year of dam's birth and maturity status of dam and model 4 included the same variables as model 3 as well as a sire effect.

In Analysis III procedures outlined by Brody (1964) were used to calculate individual values for mature weight, rate of maturity and a constant (b) in the equation for the individuals growth curve based on bi-annual weights over the cow's lifetime. This constant (b) is a value closely associated with the Y-intercept (Brown et. al., 1972). The difference between mature weight and (b) closely approximates birth weight. Two conventional linear models were used to describe the analyses of variance of mature weight, rate of maturity and the (b) value in the growth curve equation. One model included treatment only as an independent variable, and the other included both treatment and year of birth.

In Analysis IV three models formed the basis for analysis of variance of calving interval, the first including treatment as an independent variable, the second including both treatment and year of dam's birth as independent variables and the third including treatment, year of dam's birth and maturity status of the dam as independent variables.

CHAPTER IV

RESULTS AND DISCUSSION

The objective of the primary analysis was to evaluate the effect of creep feeding while calves on dams used in this study. Overall means and standard errors, by treatment and year of birth for each variable studied in Analysis I are shown in Table I. Variation due to differences in both treatment and year of birth was observed in preweaning weight and weaning weight. In 1963, heifers that were creep-fed had average preweaning weights and weaning weights that were 35.0 and 81.5 pounds greater than those of non-creep fed heifers, respectively. In 1964, similar results were observed with respect to the differences being 14.5 pounds in preweaning weight and 73.5 pounds in weaning weight in favor of creep-fed heifers. Year differences also were observed with respect to both preweaning weight and weaning weight, and these were attributable to obvious differences between the years in abundance and quality of pasture for grazing by both the calves and their dams. The means of type score and condition score in both years were greater for creep-fed heifers. The type-score differences in favor of creep-fed heifers were 1.11 in 1963, and 2.10 in 1964, and the condition-score advantages were 1.57 in 1963, and 4.62 in 1964. The trends shown in these data are in general agreement with those reported by Anderson and Safley (1967).

The percent of variation in preweaning weight, weaning weight, type score and condition score explained was calculated on the basis

TABLE I

OVERALL MEANS AND STANDARD ERRORS FROM ANALYSIS I

Variable	1963 Creep-Fed		1963 Non-Creep		1964 Creep-Fed		1964 Non-Creep	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Number of observations	5		4		7		12	
Preweaning weight	375.00	43.19	340.00	37.06	323.75	17.39	309.23	13.39
Weaning weight	538.40	46.81	456.86	39.00	555.00	21.51	481.54	26.27
Type score	13.40	0.51	12.29	0.56	14.25	0.48	12.15	0.44
Condition score	10.00	0.45	8.43	0.64	11.00	0.31	6.38	0.86

of those linear models incorporating various combinations of effects. The models used, percent of variation explained and increase in variation explained with the addition of each effect are shown in Table II. The percent of variation explained by the effect of treatment was 5.42, 14.64, 24.84, and 24.34 for preweaning weight, weaning weight, type score and condition score, respectively. With the addition of the effect of year of birth to the analysis, the increases in explained variation (ΔR^2) in preweaning weight, weaning weight, type score and condition score were 8.00, 1.46, 0.39 and 7.40, respectively. When the effect of age of dam was added to the analysis, ΔR^2 values for preweaning weight, weaning weight, type score and condition score were 5.17, 20.14, 8.94 and 17.21, respectively.

These results suggest that variation in preweaning weight can best be explained by a combination of all three effects, while year of the calf's birth explained the most variation in this variable. Weaning weight was explained to the greatest extent by age of dam (ΔR^2 = 20.14).

It appears that milk producing ability of a cow and consequent weaning weight of her calf is related to her age. This agrees with results reported by Brown (1958), Brown (1961), and Gifford (1953). The R^2 values for type score and condition score were largest when all three independent variables were included in the model. Those values were 34.17 and 48.95, respectively (Table II). Table III contains the results of the analysis based on the complete model.

TABLE II

THE PERCENT OF VARIATION IN PREWEANING WEIGHT, WEANING WEIGHT, TYPE SCORE, AND CONDITION SCORE EXPLAINED BY VARIOUS COMBINATIONS OF EFFECTS

Model No.	Effects (X indicates inclusion)			% Variation Explained[a]				Increase in % Variation Explained			
	Treatment	Yr of Birth	Age of Dam	PWWT	WNWT	Type	Condsc	PWWT	WNWT	Type	Condsc
1	X			5.42	14.64	24.84	24.34	--	--	--	--
2	X	X		13.42	16.10	25.23	31.74	8.00	1.46	0.39	7.40
3	X	X	X	18.59	36.24	34.17	48.95	5.17	20.14	8.94	17.21

[a]PWWT = preweaning weight, WNWT = weaning weight, type = type score, condsc = condition score.

TABLE III

ANALYSIS OF VARIANCE OF PREWEANING WEIGHT, WEANING WEIGHT, TYPE SCORE AND CONDITION SCORE

Source	DF	Mean Square			
		Preweaning weight	Weaning Weight	Type Score	Condition Score
TOTAL	28[a]				
Treatment	1	4186.916	40861.832*	16.744**	19.175**
Year of birth	1	13593.550	84.921	0.055	1.110
Maturity status	1	6147.218	45356.647**	5.561	10.466**
Error	25	3873.604	5742.966	1.638	1.242

*P <.05.

**P <.01.

[a]This analysis included one cow not included in certain other analyses.

In Analysis II the effect of creep feeding and not creep feeding dams was studied to see if increased weaning weights, type score and condition score of dams were accompanied by progeny increases in these. Four different statistical models were used to perform this analysis using different combinations of the effects of treatment, year of dam's birth, maturity status and sire on weaning weight, type score, and condition score of the dam's calf. The percent variation explained and increase in variation explained by the addition of each effect to the model are shown in Table IV. Largest values for percent variation explained were obtained when all four main effects were included in the model. Values for weaning weight, type score, and condition score were 12.0, 27.34 and 22.38 percent, respectively. Increases in variation explained by the addition of the effect of sire to treatment, year of birth and maturity status gave largest values for ΔR^2. The values of ΔR^2 for weaning weight, type score and condition score were 11.14, 16.74 and 19.27, respectively. On the basis of these results, an analysis of variance was performed to test the effects of treatment, year of birth, maturity status as well as the effect of sire on weaning weight, type score and condition score. The results of this analysis are shown in Table V. Treatment and year of birth were found to have no significant effect on the dependent variables weaning weight, type score, and condition score. Maturity status did not significantly affect weaning weight and condition score but had a highly significant ($P < .01$) effect on type score. Although the addition of sire to the model gave greatest increases in ΔR^2, sire had no significant effect

TABLE IV

THE PERCENT OF VARIATION IN WEANING WEIGHT, TYPE SCORE AND CONDITION SCORE OF DAM'S PROGENY EXPLAINED BY VARIOUS COMBINATIONS OF EFFECTS

Model No.	Effects (X indicates inclusion)				% Variation Explained[a]			Increase in % Variation Explained		
	Treatment	Yr. of Birth	Age of Dam	Sire	WNWT	Type	Condsc	WNWT	Type	Condsc
1	X				0.08	1.08	0.38	--	--	--
2	X	X			0.44	1.08	1.13	0.36	0.00	0.75
3	X	X	X		0.86	10.60	3.11	0.42	3.80	1.98
4	X	X	X	X	12.00	27.34	22.38	11.14	16.74	19.27

[a] WNWT = weaning weight, type = type score, condsc = condition score.

TABLE V

ANALYSIS OF VARIANCE OF WEANING WEIGHT, TYPE SCORE AND CONDITION SCORE OF DAM'S PROGENY

Source	DF	Mean Square		
		Weaning Weight	Type Score	Condition Score
TOTAL	141			
Treatment	1	0.041	3.286	0.746
Year of Birth	1	2190.536	0.186	0.317
Maturity Status of Dam	2	3752.0328	8.9772*	0.1079
Sire	11	4750.2074	4.8026*	2.4873*
Error	126	3286.101	229.196	0.875

*$P < .01$.

on weaning weight. Type score and condition score, however, were found to be significantly affected by sire.

In the third analysis, the effect of creep feeding dams was tested to ascertain if this management practice increased the rate of growth to maturity, (b) value and mature weight. Procedures and methods outlined by Brody (1964) were the basis for this analysis of weight-age relationships. Least-squares means and constants for mature weight, (b) value and rate of maturity are shown in Table VI. The overall mean mature weight was 1150.86 pounds. Creep-fed dams were found to be an average of 16.66 pounds heavier at maturity while those dams not creep-fed as calves were 16.66 pounds lighter. Thus, dams who were creep-fed as calves were 33.3 pounds heavier at maturity than those who were not creep-fed. While differences did exist between treatments, larger differences between years of birth were found. Cows born in 1963, were 64.3 pounds heavier at maturity than cows born in 1964. These results are in general agreement with those of Brown et. al. (1972) who reported that year of dam's birth had a highly significant affect on mature weight. The mean (b) value was 1079.0159. Least-squares constants for treatment and year of birth were $\pm$16.0928 and $\pm$53.6075, respectively, yielding differences of 32.1 and 104.2 pounds between treatments and between years of birth, respectively. This large difference between years of birth is in agreement with that reported by Brown and Brown (1972. Differences in rate of maturity were larger with respect to treatment than with respect to year of birth, the least-squares constants being 0.00001472

TABLE VI

LEAST-SQUARES MEANS AND CONSTANTS FOR MATURE WEIGHT, B, AND RATE OF MATURITY

	Number	Mat. Wt.[a]	b[a]	Rt. Mat.[a]
Mean	30[b]	1140.8639	1079.0159	0.075063710
Treatment				
1	10	16.6559	16.0928	0.00001472
2	20	-16.6559	-16.0938	-0.00001472
Year				
1963	13	32.6644	53.6075	0.00000937
1964	17	-32.6644	-53.6075	-0.00000937

[a]Mat. wt. - Mature weight, b = constant in growth curve equation, Rt. Mat. = rate of maturity.

[b]This analysis included two cows which were not included in certain other analyses.

and 0.00000937, respectively. The mean rate of maturity was 0.075063710. This rate of maturity is different from that reported by Brown et. al. (1972), a value of 0.0437 $\pm$.0117 on 287 observations. This higher value for rate of maturity could be due to differences in season and management conditions between the two sets of data. An analysis of variance was performed to test the effects of treatment and year of birth on the dependent variables, mature weight, (b) value and rate of maturity. The results of that analysis are shown in Table VII. Treatment was found to have no significant effect on mature weight, (b) value or rate of maturity. Year of birth had no significant effect on mature weight or rate of maturity but did significantly ($P < .05$) affect (b) value.

In the final analysis lifetime calving intervals of all dams were analyzed to test the effects of treatment, year of birth and maturity status of dam on that variable. Results of this analysis are shown in Table VIII. Treatment (creep-fed as a calf versus non-creep-fed) had no significant effect on calving interval. The effect of year of birth also was non-significant. Maturity status of dam did not affect calving interval in any significant manner which is in agreement with Stone (1968) who found no significant effect in a study involving 828 calving intervals.

TABLE VII

ANALYSIS OF VARIANCE OF MATURE WEIGHT, B VALUE AND RATE OF MATURITY

Source	DF	Mean Square		
		Mt. Wt.[a]	b[a]	Rt. Mat.[a]
Total	29			
Treatment	1	6958.862	6471.341	0.000
Year of birth	1	29644.934	79976.270*	0.000
Error	27	15141.147	16174.754	0.000

*P < .05.

[a]Mt. wt. = Mature weight, b = constant in growth curve equation, Rt. mat. = rate of maturity.

TABLE VIII

ANALYSIS OF VARIANCE OF CALVING INTERVAL

Source	DF	Mean Square
Total	114	
Treatment	1	17048.111
Year of birth	1	19231.564
Maturity status of dam	2	3301.965
Error	110	6050.065

CHAPTER V

SUMMARY

Data collected from life-time records of 28 cows and 153 progeny records were studied to determine the effect of creeping feeding replacement heifers. Ten of these cows were creep-fed as calves and 18 were not creep-fed as calves. Thirteen were born in 1963 and firteen were born in 1964.

Objectives of this study were to determine the effects of calf-hood creep feeding of dams on progeny performance, on dam's mature weight and rate of maturity and life-time reproductive performance as measured by calving interval.

Treatment (creep-fed versus non-creep-fed) had a significant affect on dam's own weaning weight, type score and condition score, but did not significantly affect preweaning weight. Year of birth had no significant effect on preweaning weight, weaning weight, type score or condition score. Weaning weight and condition score were significantly affected by maturity status of dam while preweaning weight and type score were not significantly affected.

Analysis of progeny records showed that treatment and year of birth had no significant effect on weaning weight, type score and condition score. Maturity status of dam did not significantly effect weaning weight and condition score, but type score was significantly affected. Sire had no significant effect on weaning weight but did significantly affect type score and condition score.

Although cows which were creep-fed as calves had higher mature weights and a slightly faster rate of maturity than those which were not creep-fed as calves, no significant difference was found between treatments. Similar results were observed with respect to differences between years of birth, but no significance of difference was found.

Analysis of life-time calving intervals showed non-significant effects of treatment, year of birth and maturity status of dam.

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