## AN ABSTRACT OF THE THESIS OF


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Title: Evaluation of Creep Feeding and Two Different Postweaning Rations on Steers of Three Different Frame Types Relative to Growth, Carcass Traits and Economics.

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Sixty crossbred steer calves were randomized by breed of sire, age of dam, age of calf and anticipated yearling frame type (large, medium, small) to one of four management systems. The four management systems were designated +:H, +:M, -:H, and -:M.

+:H = Creep feeding: postweaning high energy ration.

+:M = Creep feeding: postweaning moderate energy ration for 153 days, then high energy ration.

-:H = No creep feeding: postweaning high energy ration.

-:M = No creep feeding: postweaning moderate energy ration for 153 days, then high energy ration.

Steers remained on the high energy ration until it was visually determined that each steer had 7 mm or more of backfat. The experiment was designed to determine the cumulative effect of creep feeding and accelerated postweaning gains on steer performance. Economic comparisons were also made on the main effects (preweaning treatment,

postweaning treatment and frame type) and the appropriate interactions to illustrate the magnitude of the differences found.

During the 98-day preweaning phase no significant difference was found between the creep fed and non-creep fed steers. Both the large and medium frame type steers had higher weight gains (P<.07) than the small frame steers during the preweaning period. No significant differences (P>.1) in growth were found in the interaction between preweaning treatment and frame type.

Non-creep fed steers had a small increase in ADG (P<.08) during the first 153 days in the feedlot and were heavier (P<.07) at slaughter than creep fed steers. Large (L) and medium (M) frame type steers were heavier (P<.11) than small (S) frame type steers during the entire feedlot phase. There were no statistical differences (P>.2) in average daily gain due to the postweaning treatment (H or M) in the feedlot phase. There were no statistical differences in growth in any of the one-way or two-way interactions during the feedlot phase.

No statistical differences were found in any carcass traits due to creep feeding. Large frame steers were heavier, required more days and had larger rib-eye areas (P<.05) than medium and small frame steers. The "H" were younger and required fewer days (P<.06) on feed than the "M" steers. Only kidney, heart and pelvic fat percent (KHP%) was statistically different (P<.01) in the postweaning x frame interaction.

Feed efficiency ratios were lower (P<.1) for the SxH steers in the final phase of the feedlot period.

Using typical values for feed, labor and interest costs, economic comparisons were done for the main effects and the one-way and two-way interactions. Non-creep fed steers returned $18.14 more than creep fed steers. The high energy postweaning steers returned 50.13 dollars more than the moderate energy steers. Medium frame steers returned 58.16 dollars compared to 56.58 dollars for large frame steers and 46.78 dollars for small frame steers.

The -H steers returned 98.39 dollars while the +H steers returned 51.83 dollars, the -M steers returned 30.63 dollars and the +M steers returned 15.65 dollars.

The economic comparison of the preweaning x frame type treatments were as follows: "-S", $64.36; "-L", $59.42; "+M", $56.14; "-M", $52.16; "+L", $42.32; and "+S", $19.76. The net return of the preweaning x postweaning x frame type interaction were as follows: "+HL", $59.88; "+ML", $28.86; "-HL", $84.18; "-ML", $40.36; "+HM", $75.12; "+MM", $54.83; "-HM", $84.10; "-MM", $33.72; "+HS", $59.41; "+MS", -$34.60; "-HS", $128.85; and "-MS", $42.90.

# Evaluation of Creep Feeding and Two Different Postweaning Rations on Steers of Three Different Frame Types Relative to Growth, Carcass Traits and Economics

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# EVALUATION OF CREEP FEEDING AND TWO DIFFERENT POSTWEANING RATIONS ON STEERS OF THREE DIFFERENT FRAME TYPES RELATIVE TO GROWTH, CARCASS TRAITS AND ECONOMICS

## STATEMENT OF THE PROBLEM

The introduction of new breeds of cattle in the 1960's to the U.S. has given cattle producers the opportunity to increase meat production at a rate that was not attainable previously. The increase in growth rate has resulted in heavier weaning weights, yearling weights and carcasses. Increases in growth rate and performance have been accompanied by an increase in days on feed in the feedlot to reach acceptable quality grades of low choice or higher. The positive contributions of increased average daily gain (ADG) have been offset by an increase in man hours, maintenance energy, and interest costs due to the extra days on feed large frame cattle require. The packing industry is becoming concerned about marketing carcasses weighing over 365 kg because the carcasses are too heavy to work into boxed beef programs. The potential exists for a price discount on these heavy carcasses.

It appears to be counterproductive to eliminate the problems of increased labor, maintenance energy requirement, added interest costs and large carcasses by selecting for slower growing, smaller, earlier maturing cattle. Adjustments in nutritional management schemes which affect growth and physiological maturity and which are economically viable would be more logical production alternatives.

Creep feeding has been reported to hasten the onset of marbling (Garrigus et al., 1969) as have high energy postweaning rations (Dikeman et al., 1985). The effect of these two management practices together on large frame cattle in terms of growth, efficiency, and carcass merit is not known. The research on creep feeding of large frame crossbred cattle is limited to one report by Anderson et al., 1978.

The objective of this experiment was to test the hypothesis that large frame, crossbred steers that are creep fed and weaned to a high energy finishing ration require fewer days on feed and less digestible energy to reach the low choice grade than do large frame steers which are raised without creep feed and weaned to a growing ration before being fed a high energy ration.

This trial was also designed to compare the response of creep feeding and postweaning treatments on three groups of steers having small, medium and large frame scores.

# REVIEW OF LITERATURE

## Introduction

Long-term sustained profitability is the cornerstone of a viable business enterprise in a capitalistic system. The beef industry is no exception to this concept. In order to remain viable in the 1990's and into the 21st century, beef producers will be challenged to evaluate their operations on a systems basis. To be successful these systems will be required to optimize inputs to produce a price competitive consumer preferred product.

A series of developments has given cattlemen the opportunity to increase pounds of product sold per cow. The introduction of germ plasm from Continental beef breeds to the U.S. cow herd in the 1960's has resulted in an increase in 205 day weaning weight (Willham, 1982) and slaughter weight (Koch et al., 1982). The rapid development of the Beef Improvement Federation has fostered the concept of improving beef cattle performance by establishing uniform criteria to record and report beef cattle growth and development (BIF, 1981). The evolution and refinement of the Best Linear Unbiased Prediction (BLUP) model has enhanced the application of genetics to promote animal growth as well as other traits (Quass and Pollak, 1980). These three concepts are responsible for increasing cattle growth rate and performance which have resulted in a cattle population that has a larger mature size and a faster growth rate. The average slaughter weight for steers during the first six months of 1985 was 501 kg (USDA, 1986) compared to 465 kg in 1960 (USDA, 1961).

The ability of producers to increase growth rate of young beef cattle has resulted in a reduction in cow costs per pound of product sold and an animal that has a higher percent lean in its carcass (Koch et al., 1979). These two components have significantly affected the beef industry by improving cow efficiency and by producing a product that is leaner which is preferred by many consumers (Dikeman, 1984).

These important improvements due to increased growth rate have also allowed some negative circumstances that the beef industry must consider. The negative aspects would include an increased number of days on high energy rations to reach a desired quality grade (Gregory, 1982), heavier carcass weights which reduce marketing options for packers and a decreased feed efficiency due to a higher maintenance requirement (Dikeman et al., 1985). An improved system would be one where beef cattle grow rapidly in the early stages of their life and reach a desired physiological maturity at a relatively young chronological age.

Therefore, a project was designed to investigate the effects of four management systems on three cattle groups with different genetic potentials for growth. It tested the hypothesis that large frame beef steers that are creep fed and weaned to a high energy ration are more efficient in terms of energy and time inputs when fed to an endpoint of 7 mm of backfat than steers raised in a traditional management regime. The traditional management regime is characterized by no creep feed and a postweaning growing ration followed by a 100-plus day finishing period.

The following literature review will focus on the effect of preweaning nutrition, postweaning nutrition and frame size as they relate to animal growth and development.

## Creep Feeding Effect on Preweaning Growth and Other Production Parameters

Creep feeding is the management practice where young nursing animals are provided additional nutrition without their dams having access to the diet (Black and Trowbridge, 1930; Knapp and Black, 1941). Creep rations usually contain a mixture of grains, protein supplements and molasses. However, it is likely that the most cost-effective creep feed would be the least-cost grain per unit of energy (Cross, 1983).

Numerous researchers have reported an increase in preweaning animal weight due to creep feeding. Information on animal performance due to creep feeding comes from trials where creep feeding was a variable or from breed improvement associations' data bases. The data from the experimental trials are presented in List 1 followed by breed improvement association data base summaries in List 2. All weight increases due to creep feeding fall between .07 and .27 kg per day except for reports made by Scarth et al. (1968), Prichard et al. (1989a) and Garrigus et al. (1969). The .378 kg gain per day reported by Scarth et al. (1968) is most likely higher because the calves in this work were weaned at 300 days of age whereas the calves in the remainder of those previously summarized were weaned between 200 and 240 days of age. The older calves were most likely growing at a faster rate and consuming more creep feed than calves that would be 60 days younger. A .406 kg per day weight gain was reported by Prichard et al. (1989a). This high daily gain was influenced by a shorter than average creep feeding period and an increased genetic potential for growth due to the influence of Brahman and Red Romana sires. The influence of sire breeds

List 1. Creep Feeding Trial Summaries

| Wgt. gain (kg) (due to creep feeding) | Prob. (P≤) | Days on creep | ADG creep kg | Breed* | Years | Sex | # Head | Researcher |
|---|---|---|---|---|---|---|---|---|
| 32.2 | .05 | 180 | .178 | H | 3 | M&F | 36 | Stricker et al. 1979 |
| 19.5 | .05 | 180 | .11 | A&H | 4 | F | 206 | Holloway & Totusek, 1973 |
| 25.0 | .05 | 133 | .188 | SxBxH | 1 | M&F | 20 | Rouquette et al., 1983 |
| 27.0 | .05 | 120 | .225 | A | 2 | M | 99 | Martin et al., 1977 |
| 17.0 | .01 | 90 | .189 | A | 10 | M | 436 | Martin et al., 1981 |
| 10.0 | .01 | 90 | .111 | A | 10 | F | 395 | Martin et al., 1981 |
| 13.6 | | 62 | .219 | A&H | 3 | M | 524 | Ochoa et al., 1981 |
| 34.0 | .01 | 90 | .378 | H&C x AxH | 1 | S&F | 53 | Scarth et al., 1968 |
| 26.0 | .001 | 64 | .406 | B&RR x A&AxBS | 2 | S&F | 134 | Prichard et al., 1989a |
| 33.0 | .001 | 154 | .214 | B&RR x AxAxBS | 2 | S&F | 130 | Prichard et al., 1989a |
| 12.0 | NS | 188 | .063 | A | 1 | S | 5 | Anderson et al., 1978 |

List 1. (Continued)

| Wgt. gain (kg) (due to creep feeding) | Prob. (P≤) | Days on creep | ADG creep kg | Breed* | Years | Sex | # Head | Researcher |
|---|---|---|---|---|---|---|---|---|
| 9.0 | NS | 188 | .048 | H&A | 1 | S | 4 | Anderson et al., 1978 |
| 50.0 | .05 | 188 | .26 | SxA | 1 | S | 5 | Anderson et al., 1978 |
| 40.0 | .05 | 188 | .212 | CxA | 1 | S | 4 | Anderson et al., 1978 |
| 13.0 | .01 | 55 | .236 | H | 2 | M&F | 276 | Hough & Benyshek, 1988 |
| 5.0 | NS | 140 | .035 | A | 1 | M | 50 | Garrigus et al., 1969 |
| 10.0 | .10 | 140 | .071 | A | 1 | M | 33 | Garrigus et al., 1969 |

* A - Angus
H - Hereford
S - Simmental
B - Brahman
RR - Red Romana
C - Chiannia
BS - Brown Swiss

List 2. Breed Improvement Association Data Base Summaries

| ADG creep (kg) | Prob. ($P\leq$) | Breed* | Years | Sex | # Head | Researcher |
|---|---|---|---|---|---|---|
| .14 | .1 | H | 5 | M&F&S | 11662 | Marlowe et al., 1965 |
| .08 | .1 | A | 5 | M&F&S | 17294 | Marlowe et al., 1965 |
| .15 | | H&A | 4 | M&F&S | 13937 | Cundiff et al., 1966 |

* A - Angus
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was also shown by Anderson et al. (1978). Anderson's work reported that the largest responses in the weaning weight were a 50 and 40 kg additional weight gain by Simmental and Chianina sire groups, respectively. The ADG in Anderson's et al. (1978) work is minimized because calves were given access to creep feed since birth. Calves did not begin to consume any measurable amount of creep feed until they were 82 days of age which resulted in a decrease in ADG due to the length of the creep feeding period. Prichard and coworkers (1989a), reported that starting calves on creep feed at 146 days of age versus 56 days of age resulted in weaning weight gains which were not significantly different (26 kg vs. 33 kg).

Conflicting reports on the effect of creep feeding on weaning frame score are found in the literature. Prichard et al. (1988a) did not find a significant change in hip height due to creep feeding when measured at 205 days of age. Contrary to this report is a finding by Stricker et al. (1979) of a 4.3 cm increase ($P \leq .05$) in adjusted shoulder height in creep fed treatments. Holloway and Totusek (1973) reported a 1.3 cm increase ($P \leq .01$) in adjusted shoulder height in creep fed heifers at 240 days of age.

Martin et al. (1981) and Marlowe et al. (1965) agreed that creep fed calves had higher ($P \leq .1$) type scores (+.5 and +.6, respectively) than non-creep fed calves. This advantage in type score may be highly correlated to an increase in body fat of creep fed calves. Condition scores of 11.1 and 10.0 for creep fed and non-creep fed calves, respectively, were listed by Prichard et al. (1989b). This increase in condition score of 1.1 was significant ($P \leq .1$). Body fat measurements at weaning determined by the $K_{40}$ whole-body counter were higher ($P \leq .05$) in creep fed calves (12.44 vs. 10.26 percent) (Stricker et al., 1979) than in non-creep fed calves.

Sex and breed differences within creep feeding treatments for growth response have been noted. According to a 10-year summary, Angus bull calves had a higher ($P \leq .01$) ADG by .078 kg over Angus heifer calves (Martin et al., 1981). Anderson and coworkers (1978) reported that creep fed Angus, Simmental and Chianina sired calves weighed 210 kg, 283 kg and 297 kg, respectively. Non-creep fed calves from the same sire groups (Angus, Simmental and Chianina) weighed 198 kg, 233 kg and 257 kg, respectively. In Anderson's et al. (1978) work the average weights of the Simmental and Chianina sired calves were compared to the Angus sired calves, the weight increase in the creep fed treatment was 80 kg and 47 kg in the non-creep treatment. Evidently calves with a greater potential for growth realized an enhanced response to creep feeding. However, no difference in weaning weight between a control line and a line selected for growth in Hereford cattle was noted by Hough and Benyshek (1988) when non-creep fed and creep fed means were compared.

No references were found of the interaction between the dam's milk producing ability and creep feed consumption. Reports, however, stated that creep feeding increased weaning weights more in first calf heifers (Marlowe et al., 1965; Cundiff et al., 1966; Ochoa et al., 1982) and during times of limited feed resources (Cundiff et al., 1966; Marlowe et al., 1965). Apparently beef calves will consume larger amounts of creep feed when its nutritional resources are limited. This observation is consistent with work done by Stricker et al. (1979). Stricker et al. (1979) found that calves on a fescue-ladino clover pasture which received no nitrogen fertilizer consumed 337 kg of creep feed per calf.

This is compared to 296 kg of creep feed per calf which grazed pastures that had 112 kg nitrogen per hectare. Calves on the fertilized pasture consumed 41 kg less ($P<.05$) creep feed.

Feed efficiencies related to creep feeding have been reported as 6.7:1 and 5.3:1 (kg of creep feed/kg of gain) (Prichard et al., 1989a & b); 8.6:1 (Scarth et al., 1968); 15:1 (Andersen et al., 1978); 18:1 and 14:1 (Garrigus et al., 1969); 7:1 (Rouquette et al., 1983); 21:1 (Holloway and Totusek, 1973); 6.11:1 (Burns et al., 1966); 9.3:1 (Stricker et al., 1979); 11.36:1 (Anonymous, Beef Cattle Feeding Investigation, 1960-1961); and 13.4:1 (Frischknecht and Nelson, 1977). Requirement for a 150 kg calf to increase its weight gain from .2 kg to .4 kg per day is .46 Mcal of net energy (NRC, 1984). One kg of barley contains 2.06 Mcal of net energy. Therefore, to increase body weight of a 150 kg calf by 1 kg requires 2.3 Mcal of net energy or 1.1 kg of barley on a 100% dry matter basis. The feed efficiencies reported and net energy data from the Nutritional Research Council do not agree. It may be that calves are replacing milk and/or available forage with creep feed. Supporting this concept are findings of Prichard et al. (1989b) who stated that dams whose calves were creep fed gained more weight ($P\leq.09$) during the breeding season, and had a higher condition score ($P\leq.02$) at the end of the breeding season than dams in non-creep fed treatments. Pregnancy rate, however, was not affected by creep treatment. Creep feeding has also affected carrying capacity during the summer grazing season. Carrying capacity was increased .9 animal unit month (AUM)/ha and .3 AUM/ha due to two different creep feeding treatments according to Stricker et al. (1979). Prichard et al. (1989b) and Stricker et al. (1979) both report that creep feeding beef calves affects not only calf growth but also other factors.

Martin and his associates (1981) in their ten year evaluation reported that creep feeding improved ($P \leq .05$) weaning weight in seven out of 10 years. The variation in weaning weight response due to creep feeding during the ten year trial ranged from a 6 kg disadvantage to a 41 kg advantage for creep fed calves. An explanation for the negative 6 kg response was related to feeder placement in an area which was not proximal to shade, forage or water.

Preweaning growth responses due to creep feeding are dependent on sex of calf, age of calf, genetic growth potential of the calf, feed conditions, age of dam and management.

## Preweaning Nutrition: Effect on Postweaning Performance

Contradicting reports are found concerning the effect of preweaning nutritional levels on postweaning growth. Holloway and Totusek (1973) reported that creep fed heifers gained less ($P \leq .01$) weight and height from 8 months of age to 18 months of age than non-creep fed contemporaries. The creep fed heifers in this work maintained their preweaning weight gain advantage over non-creep fed heifers until 18 months of age and their height advantage until 24 months of age. These findings agree with those of Martin et al. (1981) who reported that creep feeding reduced ($P \leq .01$) post weaning gain in heifers. Creep fed heifers lost their preweaning weight advantage by 12 months of age in the Holloway and Totusek (1973) work. The effect of preweaning nutrition levels on postweaning gain can be evaluated also in trials where the dam's milk production level was a variable rather than creep feeding. Neville et al. (1962) reported that increased consumption of milk resulted in higher weaning weights and a slight negative effect on post weaning gain in Hereford cattle. Clutter and Nielsen (1987) found a 16.9 kg advantage in 205 day weaning weight in high milking versus low milking dams. After a 280 day postweaning feeding period the calves from high milking females maintained a 10.6 kg advantage. The calves from low milking dams had a superior ($P \leq .05$) postweaning ADG.

Several trials (Anderson et al., 1978; Garrigus et al., 1969; Hunsley et al., 1967; Martin et al., 1977; Hough and Benyshek, 1988) produced no significant decrease in postweaning growth due to creep feeding. These contradicting reports concerning postweaning growth rate may be due to the experimental designs. In the trials in which creep feeding produced a negative response in postweaning performance, the calves had been placed on high forage rations following weaning. Calves which were weaned to high energy rations did not experience a decrease in postweaning ADG.

Calves that have high condition scores which often include creep fed calves are usually discounted in price at weaning (Cross, 1983). However, based on ADG performance data presented, a price discount for creep fed calves which are placed in feedlots and receive high energy rations cannot be justified. References are limited on post weaning feed efficiency of creep fed calves. Anderson and his coworkers (1978) reported no difference in postweaning feed efficiency in creep fed calves who were being fed high energy rations in the post weaning period. If there is no decrease in postweaning feed efficiency, the present discount in the market price for fleshy creep fed calves may not be justified.

## Effects of Preweaning Nutrition on Carcass Traits and Body Composition

Carcass traits and body composition can be influenced by creep feeding. Rib-eye area, cutability and percent protein in the 9-10-11 rib section were reduced ($P \leq .05$) by creep feeding in steers which graded choice (Anderson et al., 1978; Garrigus et al., 1969). Higher marbling scores ($P \leq .05$) were found in creep fed steers while no significant difference was seen in the thirteenth rib back fat (Garrigus et al., 1969). Scarth et al. (1968) and Hunsley et al. (1967) reported an advantage in slaughter weight per day of age due to creep feeding. This weight per day of age advantage was a result of reaching the desired quality end point at a younger age.

The decrease in age at slaughter may be due to a change in adipocyte metabolism caused by preweaning nutritional status. Preweaning nutrition has been shown to have both short- and long-term effects on adipocyte size and number depending on fat deposit location and species. The adipocyte number hypothesis developed by Hirsch and Knittle (1970) states that overfeeding during infancy in humans is associated with the formation of an excessive number of adipocytes. Limited nutrition during the preweaning phase has resulted in lower body and fat pad weights and adipocyte size and number in rats (Faust et al., 1977; Johnson et al., 1973; Knittle and Hirsch, 1968; Sjostrom, 1980) and mice (Eisen and Leatherwood, 1978; Martin, 1974). Smith et al. (1983) determined that in mice, adipose tissue characteristics were determined primarily by genotype, whereas most of the nutritional restriction effects were temporary. In the baboon, overfed nursing offspring at 18 weeks of age were 38% heavier ($P < .001$) and had 87 percent more ($P \leq .01$) fat mass than the baboons fed diluted nursing formula according to Lewis et al. (1983). The difference in fat mass was due to an increase in mean adipocyte volume ($P \leq .01$). There was no significant difference in adipocyte number in eight out of the ten fat depots measured.

Limited information is available regarding the interaction between preweaning nutrition and adipocyte hyperplasia and hypertrophy in meat animal species. In lambs, Haugebak et al. (1974) found that intramuscular fat depots are much more dependent on preweaning nutritional levels than are subcutaneous and perirenal fat depots. Hyperplasia and hypertrophy occurred in intramuscular fat tissue of Hereford x Angus steers (Hood and Allen, 1973) as late as eighteen months of age. An increase in intramuscular adipocyte number and volume due to creep feeding may be responsible for the increase in marbling and decrease in percent protein in lean samples reported by Garrigus et al. (1969). Correlation between adipocyte number with percent intramuscular lipid was high (.81 - .94) in bovine muscle (Hood and Allen, 1973). Moody and Cassens (1968) found that adipocyte cells increased in size as marbling increased.

Creep feeding has been demonstrated to increase ($P \leq .04$) udder and subcutaneous adipocyte volume in creep fed females (Prichard et al., 1989b). This change in udder fat metabolism may be responsible for creep fed heifers developing into poorer lactating cows with progeny that have lower 205 day adjusted weaning weights (Martin et al., 1981).

Creep feeding appears to have a greater effect on fat metabolism than on muscle or bone metabolism. Also, postweaning growth responses are influenced to a larger extent by postweaning energy level rather than creep feeding according to the literature that was reviewed.

## Effects of Postweaning Energy Level on Growth

The advantage of replacing forages with grain in beef cattle finishing rations has been well documented with research beginning in the 1930's and continuing to the present. Animal growth performance is enhanced when daily energy intake is increased (Garrett et al., 1959). Brennan et al. (1987) reported that ADG and daily metabolizable energy intake were increased ($P<.05$) when 2.79 kg of corn silage dry matter was replaced with 2.4 kg of corn grain dry matter in an ad libitum feeding regimen. An increase in digestible energy level in rations produced similar increases in ADG and daily metabolizable energy intake according to Ferrel et al. (1978), Lipsey et al. (1978), Young and Kaufman (1978), and Prior et al. (1977).

Reports on feed efficiency (dry matter (DM)/gain) or energetic efficiency (ME or NE/gain) are variable and sometimes in contradiction. Much of the inconsistency is due to the influence of body composition and/or body weight on feed or energy efficiency values. Caution needs to be used when comparing efficiency data from beef cattle with differing physiological maturities, weight and/or condition scores (Lofgreen and Garrett, 1968). Efficiency of metabolizable energy (ME) for gain was greater ($P<.05$) in grain diets compared to forage diets according to Lemieax et al. (1988). This advantage was due to a reduction in the percent of ME that was used for maintenance rather than growth. Efficiency of ME was found by Old and Garrett (1987) to be lower ($P<.05$) in terms of Mcal ME/kg of live weight gain in beef steers fed ad libitum versus steers fed 70 or 80 percent ad libitum. This reduction in ME efficiency was because the ad libitum steers grew at a faster rate and therefore developed a larger maintenance requirement. In cattle with similar sizes and compositions, NE efficiencies were very similar regardless of diet according to Rampala and Byers (1978) until protein deposition rates approached physiological limits of .7 to 1.0 kg/d. The literature is consistent in reporting a reduction in total lifetime net energy requirement for steers fed high energy rations postweaning (Dikeman et al., 1985; and McCarthy et al., 1985). This reduction is due to cattle reaching a desired end point at a younger chronological age which reduces the lifetime maintenance energy demand.

Reports from by Guenther et al. (1965), Waldman et al. (1971), Garrett (1979), Danner et al. (1980) and Loveday and Dikeman (1980) indicate that body composition at a particular weight may be changed by varying the energy intake during the postweaning phase when calves are fed high energy rations. Contrary to this concept are studies done by Preston (1971), and Crickenberger et al. (1978) which show that only body size and not composition is influenced by postweaning energy levels. A partial explanation for this differing opinion is that dietary energy level densities were different in the trials. Byers (1980) has stated that energy levels above 2.7 Mcal ME/kg dry matter result in mostly fat deposition. Smith et al. (1977) and Byers (1980) reported that the maximum protein gain in steers was .75 kg/day. Energy level of the ration impacts not only rate of gain but also composition of gain.

## Effects of Postweaning Energy Level on Carcass Traits

Increasing the grain in postweaning feedlot rations resulted in increased (P<.05) dressing percent, carcass weights, backfat amounts, marbling scores, quality grade and final body fat percent (Lofgreen, 1968). When cattle are slaughtered at similar chronological ages, grain feeding increased (P<.05) the percent of KPH fat, numerical yield grade and whiteness in fat (Newsome et al., 1985; Harrison et al., 1978).

When steers are compared at similar compositional end points, grain feeding reduced (P<.05) time on feed with no significant changes in carcass traits according to work reported by Brennan et al. (1987) and Dikeman et al. (1985).

Preslaughter growth rate and length of time on high energy feed have been shown to have important influences on organoleptic attributes of beef. Cattle which are gaining rapidly before slaughter have increased rates of protein synthesis and degradation (Millward and Waterlow, 1978). Increased rates of protein synthesis and degradation have been shown to affect collagen solubility and myofibril fragmentation (Wu et al., 1981; Hall and Hunt, 1982; Miller et al., 1983). Aberle and coworkers (1981) discovered that grain feeding for 70 or 120 days produced similar increases in (P<.05) myofibril fragmentation index scores and percent soluble collagen over restricted gaining (.68 kg/day) steers. Myofibril fragmentation index scores correlate closely with tenderness changes in beef muscle (Olson et al., 1976; Culler et al., 1978). Goll et al. (1964) and Hill (1966) have shown that increased tenderness is associated with a corresponding increase in collagen solubility.

Fishell and coworkers (1985) stated that sensory panel scores were higher (P<.05) for tenderness and juiciness when comparing muscle from steers gaining 1.45 kg/day versus .34 kg/day when fed for 120 days. Parrett et al. (1985) reported that increasing days on feed past 113 to 167 to 208 days increased (P<.01) quality grades from low good to low choice to average choice. However, no differences were reported in sensory panel scores for flavor, juiciness, tenderness or overall acceptability between the three length of feeding treatments. The finding that days on feed up to 113 days had a greater impact on sensory scores than quality grade is in agreement with Marchello et al. (1979), Tatum et al. (1980), Campion et al. (1975) and Zinn et al. (1970).

The interaction between age, composition and quality grade in young beef steers was not discussed in the literature. Twelve-month-old steers had lower (P<.05) marbling scores than 15-month-old steers even though both groups were fed high energy rations for similar lengths of time (Dikeman et al., 1985). Simmental bulls slaughtered at 12 and 13.8 months of age had lower (P<.05) quality grades and backfat amounts than 15.7 and 17.4-month-old bulls according to Unruh et al. (1986). These findings indicate a relationship between age and marbling that is independent of nutritional history.

Trained sensory panel evaluations (Dikeman et al., 1985; Tatum et al., 1980) and a National Consumer Retail study (Savell et al., 1987) have detected no differences in acceptability between carcasses grading high select and low choice. Producers will still need to market low choice cattle due to the price discount usually paid for select grade carcasses until a system is developed to market cattle successfully other than by marbling scores. This will require steers to be on feed for a longer time and be less efficient in converting dietary energy to lean.

## Effect of Frame Size on Weight Gain and Efficiency

Frame score and rate of gain are highly correlated. As frame score increases, so does growth rate (Cundiff et al., 1981; Tatum et al., 1986, 1988; McCarthy et al., 1985; Kempster et al., 1988; Young et al., 1978; Koch et al., 1979; Pond and Oltjen, 1988). Williams et al. (1987) reported that small frame and large frame steers were similar in their rate of gain. This inconsistency may be due to the use of cattle with an average frame score of 2.8 and only a difference of 1.23 frame score units between treatments (2.17 vs. 3.5). The difference in growth rate between large frame and small frame cattle is reduced as energy level of the diet decreases (Tatum et al., 1988; Geay and Robelin, 1979; Crouse et al., 1985; Scott and Prior, 1980).

Daily dry matter intake is higher in large frame cattle than small frame cattle (McCarthy et al., 1985; Crouse et al., 1985; Cundiff et al., 1984). Efficiency ratios relative to dietary inputs and weight gain are highly influenced by the time at which the observations are made. When large frame steers are compared to small frame steers at similar ages, large frame steers are heavier, leaner, and physiologically less mature (Taylor, 1965; Berg and Butterfield, 1966). Large frame steers have a greater ($P<.05$) maintenance requirement, greater ($P<.05$) metabolizable energy intake ($P<.05$) and tend to have a reduced feed efficiency (Mcal ME/kg gain) as reported by Cundiff and coworkers (1981). When large and small frame steers are evaluated at a similar weight, large frame steers are younger, leaner and physiologically less mature (Koch et al., 1976, 1979, 1982). Large frame steers also have a reduced ($P<.05$) lifetime $NE_m$ requirement, and similar Mcal, ME consumed and feed efficiency values according to Cundiff et al. (1981). When large and small frame steers are compared at similar physiological maturities, larger steers are older, heavier and have similar marbling scores (Koch et al., 1976, 1979, 1982; Butts et al., 1980a,b). Large frame steers will have consumed more ($P<.05$) Mcal of ME, more Mcal of $NE_m$ and have a significant ($P<.05$) reduction in feed efficiency (Cundiff et al., 1981).

The reduction in feed efficiency in large frame steers observed at similar marbling levels is due to two important factors. The increase in $NE_m$ is due to the increase in body weight and corresponding increase in metabolic size. Lofgreen and Garrett (1968) estimated the maintenance requirement in beef cattle to be 77 kcal/$W^{0.75}$ (W is body weight in kilograms). Reid et al. (1980) reported differences in the efficiency of ME for protein and fat deposition. Efficiency of ME utilization was reported as 34 percent for protein and 69 percent for fat in cattle ranging from 121 to 706 kg. Similar reports were made by Rattay and Joyce (1976) using sheep as the model. In growing sheep, ME utilization was 10-20 percent for protein and 79 to 92 percent for fat. The fact that large frame cattle have a greater metabolic size and a larger amount of protein in their body results in an increase in ME/gain ratios, when large and small frame cattle are killed at similar endpoints.

## Effect of Frame Size on Carcass Traits

As frame size increases within similar compositional endpoints, carcass weight, bone weight, and fat weight increase ($P<.05$), fat percentage and muscle to bone ratios decrease ($P<.05$) (Tatum et al., 1988; Rouse et al., 1985). At similar compositional endpoints large frame steers will have higher ($P<.05$) maturity scores, darker lean (Crouse et al., 1985) and lower ($P<.05$) sensory panel scores for tenderness (Koch et al., 1976). Large frame steers had a higher ($P<.05$) dressing percent than small frame steers due to a smaller percent of body organs, non-carcass parts and digestive tract components (Jones et al., 1985).

When large and small frame steers were killed at similar ages, large frame steers had heavier carcasses, larger loin eyes, lower numerical yield grades, marbling scores, quality grades, sensory panel scores and fat percentages (Crouse et al., 1985; Nour and Thonney, 1987; LeVan et al., 1979; Armbruster et al., 1983).

# MATERIALS AND METHODS

Sixty crossbred steer calves were randomized by breed of sire, age of dam, age of calf and anticipated yearling frame type (large, L; medium, M; small, S) to one of four management systems (treatments). The four management systems were designated +:H, +:M, -:H, and -:M.

+:H = Creep feeding: postweaning high energy ration.

+:M = Creep feeding: postweaning moderate energy ration for 153 days, then high energy ration.

-:H = No Creep feeding: postweaning high energy ration.

-:M = No Creep feeding: postweaning moderate energy ration for 153 days, then high energy ration.

This protocol leads to an analysis of variance in a 2x2x3 factorial design (preweaning treatment x postweaning treatment x frame type). The experiment was started in July, 1986.

## Live Animal Procedures

All of the steers were obtained from the Oregon State University commercial cow herd. The cow herd is represented by varying percentages of Hereford, Angus, Simmental, Tarentaise and Pinzgauer breeding. The steers were sired by Angus, Simmental, Tarentaise and Pinzgauer bulls. Cows were bred to breeds of bulls which would maximize heterosis. First calf heifers were bred to Angus bulls to calve at two years of age. Calves were born between February 18, 1986 and May 16, 1986. The average date of birth was April 4, 1986. Calves were weighed and eartagged within 24 hours of birth. On July 28, 1986 all steers were vaccinated for IBR, $PI_3$ and clostridium-related diseases.

The calves and their dams were pastured on the Soap Creek Ranch. The forage resource has been characterized by Bedell (1966) as containing the following:

Grasses

| Scientific Name | Common Name |
|---|---|
| Aira carophylla | Silver hairgrass |
| Bromus inermis Leyss. | Smooth bromegrass |
| Dactylis glomerata | Orchardgrass |
| Deschampsia caespitosa | Tufted hairgrass |
| Elymus glaucus | Blue wild rye |
| Festuca rubia | Red fescue |
| Lolium multiflorum | Italian ryegrass |
| Phalaris tuberosa | Harding grass |
| Phleum pratense | Timothy |
| Poa pratensis | Kentucky bluegrass |
| | |
| Bromus mollis | Soft chess |
| Bromus ridigus | Ripgut brome |
| Festuca arundinacea | Tall fescue |
| Festuca myuros | Rat-tail fescue |
| Holcus lanatus | Velvet grass |
| Lolium perenne | Perennial ryegrass |

Forbs

| | |
|---|---|
| Anthemis cotula | Dog fennel |
| Centaurea cyanus | Bachelor's buttons |
| Chrysanthemum leucanthemum | Ox-eyed daisy |
| Cirsium arvense | Canada thistle |
| Circium vulgare | Bull thistle |
| Echinocystis oreganas | Western wild cucumber |
| Erodium botrys | Broadleaf filaree |
| Galium parisiense | Wall bedstraw |
| Geranium dissectum | Cut-leaf geranium |
| Hypochoeris radicata | Hairy cat's ear |
| Medicago lupulina | Black medic |
| Medicago sativa | Alfalfa |
| Plantago lancelolata | English plantain |
| Pteridium aquilinum | Bracken fern |
| Rumex acetosella | Sheep sorrel |
| Rumex crispus | Curley-leaved dock |
| Trifolium pratense | Red clover |
| Trifolium repens | White clover |
| Trifolium subterraneum | Subterranean clover |

Precipitation was 90 percent of normal between September 1, 1985 and April 1, 1986 measuring 882 mm. Temperature and precipitation means for the preweaning period were as follows:

| | Temperature (°C) | | Precipitation (mm) | |
|---|---|---|---|---|
| Month | $\overline{X}$ | Departure from long-term ave. | Amount | Percent of long-term ave. |
| April | 9.5 | +.1 | .71 | 75 |
| May | 12.8 | +.2 | .98 | 130 |
| June | 17.9 | +2.1 | .12 | 26 |
| July | 17.3 | -1.3 | .44 | 371 |
| August | 20.9 | +2.3 | 0 | 0 |
| Sept. | 15.1 | -1.3 | 1.4 | 241 |

The period from June 1, 1986 to September 1, 1986 was the twentieth warmest out of the last 94 summers and the 32nd driest out of the last 98 summers on record.

The +:H and +:M calves were separated from the -:H and -:M on day 1 (July 2, 1986). From Day 1 to weaning on Day 98 (October 8, 1986) the two groups were allowed to graze with their dams but in separate pastures that were fairly equal in terms of quality and quantity of forage. During this time the +:H and +:M calves were given access to a self-feeder. The dimensions of the feeder were 1.2 m x 1.8 m x 6 m and it was placed in areas close to shade and water. Steel panels were modified with two openings that measured .6 m wide by 1.2 m. The 3.6 x 1.5 m modified steel panels were placed to exclude cows from the feeder while calves had access to the feeder by way of the modified openings. The +:H and +:M calves were fed ad libitum a 90 percent rolled barley

(IFN 4-00-549) and 10 percent molasses (4-04-696) ration for 98 days at which time all calves were weaned. Calf weights and feed consumption were recorded regularly.

Calves were weaned, weighed and measured for hip height on Day 98. From Day 98 to Day 114 (October 24, 1986) all calves were confined in a common lot at the Soap Creek Ranch and fed mixed grass hay. Hay amounts fed were not recorded.

On Day 114 all steers were transported to the Oregon State University Beef Center. Five steers were allotted to each of 12 pens. Pens are 2469 $m^2$ with a bedded 823 $m^2$ shed at one end and a 4.6 m long feed bunk on the opposite end. The steers were fed twice daily such that fresh feed was available at all times. Steers were treated for grubs with Neguvon* on Day 120 (October 30, 1986).

The +:H and -:H treatments were fed a high energy ration (Table 1). The +:M and -:M treatments were fed a moderate energy ration (Table 2) for 153 days before being switched to the high energy ration. Feed amounts were recorded daily. Cattle had access to a free-choice trace mineral salt supplement. Body weights were taken on Day 114 (October 24), Day 156 (December 5), Day 195 (January 13) and Day 266 (March 25). On Day 266 hip heights were also recorded.

Removal of individual steers from the feedlot commenced when it was determined by visual appraisal that a steer had between .7 and .9 millimeters of backfat. An unshrunk weight was taken as steers were loaded to be taken to the Oregon State University Clark Meat Science Lab for processing.

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* Cutter Animal Health, Bayuet Division, Shawnee, Kansas.

## Carcass Procedure

Steers were slaughtered and shrouded using typical industry procedures. Chilled carcass weights were recorded 24 to 48 hours after slaughter by OSU Meat Science Laboratory personnel. Marbling and maturity scores, backfat and rib-eye measurements as well as kidney, pelvic and heart fat (KPH) percent were recorded by trained USDA graders and Animal Science Department staff.

## Statistical Analysis

The General Linear Models procedure from SAS (1984) was used to test for significant differences in means for growth, carcass traits and feed efficiency. The main effects of the model were preweaning treatment, postweaning treatment, frame type and the appropriate interactions.

Table 1. High Energy (+) Ration.

| International Feed Number | Item | Percent of diet as fed |
|---|---|---|
| 4-00-549 | Rolled barley | 80 |
| 1-00-063 | Ground alfalfa | 15 |
| 4-04-696 | Molasses | 5 |

NRC Values for + Ration (as fed basis)

| | |
|---|---|
| Digestible energy | 3.05 Mcal/kg |
| Crude protein | 10.94% |
| Ether extract | 1.94% |
| Ash | 1.90% |

Table 2. Moderate Energy (M) Ration.

| International Feed Number | Item | Percent of diet as fed |
|---|---|---|
| 4-00-549 | Rolled barley | 40 |
| 1-00-063 | Ground alfalfa | 54 |
| 4-04-696 | Molasses | 5 |
| 6-03-707 | Tripoly phosphate | .01 |

NRC Values for + Ration (as fed basis)

| | |
|---|---|
| Digestible energy | 2.72 Mcal/kg |
| Crude protein | 12.91% |
| Ether extract | 2.22% |
| Ash | 1.84% |

# RESULTS AND DISCUSSION

Mean squares for live animal and carcass variables are presented in Table 3. Means, standard errors and probability values for live animal and carcass variables are presented in Tables 4 and 5. Feed efficiency values are presented in Table 6.

## Preweaning Treatment Effects

Steers were successfully randomized to the "+" (creep fed) and "-" (non-creep fed) preweaning treatments. There were no differences (P>.4) (Table 4) in average birth date, age of dam, birth weight, weaning or yearling frame score between the "+" and "-" treatments. The "+" treatment steers tended to gain more weight during the preweaning phase (79.0 kg vs. 75.31 kg) than the "-" treatment (Table 4). This 3.69 kg weight increase the "+" treatment had is equal to a .04 kg average daily gain (ADG). The "+" treatment weight gain and ADG are below the majority of weight gains reported in the literature due to creep feeding. However, the .04 kg ADG increase is nearly equal to the results of Anderson et al. (1978) and higher than the results reported by Garrigus et al. (1969) and Martin et al. (1981). Steers in the "+" treatment consumed .58 kg of creep ration per head per day. The resulting feed to gain ratio was 14.5:1. A feed efficiency of 14.5:1 is lower (and more efficient) than values reported by Garrigus et al. (1969) and Holloway and Totusek (1973). The 14.5:1 feed to gain ratio is higher (less efficient) than results reported by Prichard et al. (1989a), Rouquette et al. (1983), and Burns et al. (1966) (8.6:1, 7.0:1, 6.11:1, respectively) and nearly equal to the results of Anderson et al.

(1978) and Frischknecht and Nelson (1977) (15:1 and 13.4:1, respectively).

The "+" treatment steers had a lower (P<.08) weight gain of .08 kg per day during the initial 153 days (Day 114 to Day 266) of the feedlot phase (Table 4). The reduction in postweaning average daily gain of creep fed calves is consistent with findings reported by Holloway and Totusek (1973) and Martin et al. (1981), but in contradiction to work done by Anderson et al. (1978), Garrigus et al. (1969), Hunsley et al. (1967), Martin et al. (1977) and Hough and Benyshek (1988). The "+" steers approached significance (P<.15) (Table 6), and tended to require more megacalories of digestible energy (DE) per kg of live weight gain than did the "-" steers (21.18 Mcal of DE versus 19.50 Mcal of DE) during the initial feedlot period.

In the final phase of the feedlot period (Day 266 to slaughter) the "+" steers, although not significant (P<.27), gained .23 kg per day more than the "-" steers (Table 4). The increase in average daily gain during the final feedlot phase by the "+" treatment compensated for the decrease in weight gain in the initial feedlot phase. The reason for this increase in weight gain is not known. During the entire postweaning feedlot phase (Day 114 to slaughter) the "+" and "-" steers had a nearly equal average daily gain (1.30 kg vs. 1.33 kg) which is in agreement with work reported by Anderson et al. (1978), Garrigus et al. (1969), Hunsley et al. (1967), Martin et al. (1977) and Hough and Benyshek (1988).

The final slaughter weight was lower (P<.1) (Table 4), in the "+" steers by 32 kg than the "-" steers. Quality grades were equal (P>.3) (Table 5) between the "+" and "-" treatments. The "+" steers, although

Table 3. Source of variation, degrees of freedom and mean squares for live animal and carcass variables.

| Item | Source and df | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | F type<br>2 | Pretrt.<br>1 | Posttrt.<br>1 | Pre x Post<br>1 | Pre x F type<br>2 | Post x F type<br>2 | Pre x Post x F type<br>2 | Error<br>48 |
| Birthdate | 28.85 | 11.21 | 264.63 | 1500.0 | 116.32 | 19.95 | 818.15 | 718.67 |
| Birthweight | 354.45** | 53.18 | 31.02 | 1.48 | 110.90 | 179.54 | 59.54 | 78.18 |
| Dam Age | .06 | 0 | 0 | .06 | .20 | 0 | .06 | .85 |
| Weight Day 1 | 2582.0 | 40.74 | 314.83 | 1413.0 | 17.95 | 415.68 | 1242.70 | 2242.0 |
| Weight Day 27 | 2582.0 | 40.74 | 314.83 | 472.00 | 57.66 | 311.22 | 535.30 | 1121.0 |
| Weight Day 67 | 3126.0* | 43.78 | 237.19 | 524.26 | 30.55 | 426.24 | 461.36 | 1253.0 |
| Weight Day 98 | 3407.0* | 51.04 | 94.49 | 118.63 | 129.85 | 419.28 | 85.68 | 1162.0 |
| ADG Day 1 to Day 98 | .385* | .189 | .259 | .189 | .070 | .041 | .228 | .139 |
| Weight Day 114 | 3403.0* | 42.25 | .033 | 130.39 | 311.60 | 239.50 | 9.47 | 1280.0 |
| Weight Day 156 | 2810.0 | 3.87 | 39.29 | 29.55 | 373.12 | 112.17 | 373.90 | 1258.0 |
| Weight Day 195 | 4498.0* | 45.84 | 775.94 | 536.43 | 512.27 | 177.55 | 918.69 | 1591.0 |
| ADG Day 114 to Day 195 | .039 | .107* | .130* | .086 | .128 | .00 | .011 | .033 |

Table 3. (Continued)

| | Source and df | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Item | F type<br>2 | Pretrt.<br>1 | Posttrt.<br>1 | Pre x Post<br>1 | Pre x F type<br>2 | Post x F type<br>2 | Pre x Post x F type<br>2 | Error<br>48 |
| Slaughter weight | 12420.0* | 15689.0* | 1656.0 | 1996.0 | 654.0 | 10012.0 | 4974.0 | 4582.0 |
| ADG Day 195 to slaughter | .705 | .893 | .183 | .928 | .628 | .679 | .281 | .53 |
| ADG Day 114 to slaughter | .021 | .014 | .003 | .046 | .082 | .077 | .021 | .038 |
| Days in feedlot | 5349.0* | 1239.0 | 3328.0* | 517.09 | 2067.0 | 1138.0 | 1144.0 | 945.17 |
| Age at slaughter | 4205.0** | 565.21 | 2139.0 | 118.41 | 1426.0 | 537.62 | 1875.0 | 935.33 |
| Hot carcass weight | 11054.0*** | 1932.0 | 6.82 | 322.25 | 1727.0 | 1326.0 | 792.22 | 798.65 |
| Quality grade | 1.91 | 3.87 | 2.21 | 8.66 | 3.88 | 7.00 | .850 | 4.78 |
| Rib eye area | 335.46** | 108.61 | 12.63 | 24.84 | 95.37 | 164.25 | 62.16 | 97.11 |
| Backfat | .158 | .016 | .048 | .053 | .031 | .037 | .095 | .125 |
| KPH % | 0 | 0 | .132 | .021 | .286 | .682** | .067 | .140 |

Table 3. (Continued)

| Item | Source and df | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | F type<br>2 | Pretrt.<br>1 | Posttrt.<br>1 | Pre x Post<br>1 | Pre x F type<br>2 | Post x F type<br>2 | Pre x Post x F type<br>2 | Error<br>48 |
| Yield grade | .242 | 0 | .003 | .125 | .083 | .077 | .851 | .372 |
| Weaning frame score | 4.59*** | .25 | .006 | .004 | .87* | .37 | .07 | .37 |
| Yearling frame score | 5.9*** | .094 | .001 | 1.21* | .300 | .469 | .414 | .382 |

*** P < .01
** P < .05
* P < .1

Table 4a. Least square means, standard error and probability levels for frame type, preweaning and postweaning treatments.

| TREATMENT | Birth Date | | Weaning BIF Frame Score | | Yearling BIF Frame Score | | Dam Age (Yrs) | | Birth Weight (KG) | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| <u>Frame Type</u> | | | | | | | | | | |
| Large (L) | 97.6 | ±5.99 | $5.3^{b}$ | ±.13 | $5.4^{c}$ | ±.14 | 3.3 | ±.20 | $46.09^{b}$ | ±1.33 |
| Medium (M) | 95.8 | | $5.1^{b}$ | | $4.7^{b}$ | | 3.4 | | $41.53^{a}$ | |
| Small (S) | 98.1 | | $4.4^{a}$ | | $4.3^{a}$ | | 3.4 | | $41.14^{a}$ | |
| <u>Preweaning</u> | | | | | | | | | | |
| - Creep (+) | 96.7 | ±4.89 | 4.9 | ±.11 | 4.8 | ±.11 | 3.4 | ±.17 | 42.2 | ±1.09 |
| + Creep (+) | 97.6 | | 5.0 | | 4.8 | | 3.4 | | 43.5 | |
| <u>Postweaning</u> | | | | | | | | | | |
| Mod. Energy (M) | 95.1 | ±2.39 | 5.0 | ±.11 | 4.7 | ±.11 | 3.4 | ±.17 | 43.4 | ±1.09 |
| High Energy (M) | 99.3 | | 5.0 | | 4.7 | | 3.4 | | 42.3 | |

[a,b,c] Means within the same column with different superscripts differ (P<.01).

Table 4b. Least square means, standard errors and probability levels for creep feeding period.

| | Day 1 Wgt. (kg) | | Day 27 Wgt. (kg) | | Day 67 Wgt. (kg) | | Day 98 Wgt. (kg) | |
|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| <u>Preweaning</u> | | | | | | | | |
| - Creep | 136.6 | ±5.8 | 158.5 | ±6.11 | 194.1 | ±6.4 | 211.9 | ±6.2 |
| + Creep | 134.7 | | 156.8 | | 192.4 | | 213.7 | |
| <u>Frame</u> | | | | | | | | |
| Large (L) | 143.5 | ±7.12 | 167.5 | ±7.4 | $203.2^{b}$ | ±7.9 | $221.0^{b}$ | ±7.6 |
| Medium (M) | 138.5 | | 160.3 | | $197.2^{b}$ | | $218.0^{b}$ | |
| Small (S) | 126.4 | | 145.3 | | $179.2^{a}$ | | $197.0^{a}$ | |
| <u>Interaction</u> | | | | | | | | |
| Creep x Frame | | | | | | | | |
| - L | 145.6 | ±10.13 | 169.6 | ±10.59 | 204.6 | ±11.19 | 222.9 | ±10.7 |
| - M | 139.9 | | 161.8 | | 198.9 | | 218.8 | |
| - S | 126.6 | | 144.1 | | 178.6 | | 194.1 | |
| + L | 143.1 | | 165.5 | | 201.7 | | 220.6 | |
| + M | 137.2 | | 158.8 | | 195.5 | | 219.1 | |
| + S | 126.2 | | 146.4 | | 179.8 | | 201.6 | |

$^{a,b}$ Means within the same column with different superscripts differ (P<.10).

Table 4b. (Continued)

| | Day 1 - Day 98 Total Gain (kg) | | Day 1 - Day 98 ADG (kg) | |
|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE |
| <u>Preweaning</u> | | | | |
| - Creep | 75.31 | ±2.26 | .77 | ±.023 |
| + Creep | 79.0 | | .81 | |
| <u>Frame</u> | | | | |
| Large (L) | 78.2[b] | ±2.77 | .80[b] | ±.028 |
| Medium (M) | 81.2[b] | | .83[b] | |
| Small (S) | 72.2[a] | | .74[a] | |
| <u>Interaction</u> | | | | |
| Creep x Frame | | | | |
| - L | 78.1 | ±3.91 | .79 | ±.0396 |
| - M | 79.7 | | .81 | |
| - S | 68.2 | | .69 | |
| + L | 78.3 | | .79 | |
| + M | 82.7 | | .84 | |
| + S | 76.2 | | .78 | |

[a,b] Means within the same column with different superscripts differ (P<.1).

Table 4c. Least square means, standard errors, and probability levels for feedlot performance.

| | Day 114 Wgt. (kg) | | Day 156 Wgt. (kg) | | Day 195 Wgt. (kg) | | ADG Day 114 - Day 266 Wgt. (kg) | |
|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Feedlot Treatment | | | | | | | | |
| H | 222 | ±6.5 | 274 | ±6.4 | 326 | ±7.4 | 1.30 | ±.036 |
| M | 222 | | 272 | | 333 | | 1.39 | |
| Frame Size | | | | | | | | |
| L | $230^{b}$ | ±8.0 | 284 | ±8.0 | $342^{b}$ | ±9.1 | 1.37 | ±.042 |
| M | $229^{b}$ | | 274 | | $334^{b}$ | | 1.36 | |
| S | $207^{a}$ | | 261 | | $313^{a}$ | | 1.29 | |
| Creep | | | | | | | | |
| - | 221 | ±6.5 | 274 | ±6.5 | 329 | ±7.3 | $1.38^{b}$ | ±.033 |
| + | 223 | | 272 | | 330 | | $1.30^{a}$ | |

[a,b] Means within the same column with different superscripts differ (P<.1).

Table 4c. (Continued)

| | Day 266 Wgt. (kg) | | Final weight Wgt. (kg) | |
|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE |
| <u>Feedlot Treatment</u> | | | | |
| H | 421 | ±8.4 | 541 | ±12.3 |
| M | 435 | | 530 | |
| <u>Frame Size</u> | | | | |
| L | $441^{b}$ | ±10.3 | $559^{b}$ | ±15.1 |
| M | $437^{b}$ | | $538^{a,b}$ | |
| S | $405^{a}$ | | $510^{a}$ | |
| <u>Creep</u> | | | | |
| - | 434 | ±8.3 | $552^{b}$ | ±12.3 |
| + | 422 | | $520^{a}$ | |

$^{a,b}$ Means within the same column with different superscripts differ ($P<.05$).

Table 4c. (Continued)

| | Day 266 - Killday ADG (kg) | | Feedlot Phase ADG (kg) | |
|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Feedlot Treatment | | | | |
| H | 1.42 | ±.136 | 1.31 | ±.036 |
| M | 1.31 | | 1.32 | |
| Frame Size | | | | |
| L | 1.25 | ±.166 | 1.28 | ±.044 |
| M | 1.26 | | 1.34 | |
| S | 1.59 | | 1.32 | |
| Creep | | | | |
| - | 1.25 | ±.166 | 1.33 | ±.036 |
| + | 1.48 | | 1.30 | |

Table 4d. Least square means, standard errors, and probability levels for feedlot performance.

| One-Way Interactions | Day 114 Wgt. (kg) $\bar{X}$ | SE | Day 156 Wgt. (kg) $\bar{X}$ | SE | Day 195 Wgt. (kg) $\bar{X}$ | SE | ADG Day 114 - Day 266 Wgt. (kg) $\bar{X}$ | SE |
|---|---|---|---|---|---|---|---|---|
| Frame x Feedlot | | | | | | | | |
| L x M | 228 | ±11.3 | 285 | ±11.3 | 346 | ±12.8 | 1.34 | ±.059 |
| M x M | 228 | | 278 | | 329 | | 1.31 | |
| S x M | 211 | | 260 | | 311 | | 1.25 | |
| L x H | 232 | | 284 | | 336 | | 1.42 | |
| M x H | 231 | | 271 | | 339 | | 1.41 | |
| S x H | 203 | | 262 | | 314 | | 1.34 | |
| Frame x Pre Treatment | | | | | | | | |
| - x L | 231 | ±11.3 | 290 | ±11.3 | 346 | ±12.8 | 1.40[b] | ±.059 |
| - x M | 231 | | 271 | | 329 | | 1.33[b] | |
| - x S | 202 | | 259 | | 311 | | 1.42[b] | |
| + x L | 229 | | 279 | | 336 | | 1.35[b] | |
| + x M | 228 | | 277 | | 339 | | 1.39[b] | |
| + x S | 213 | | 263 | | 314 | | 1.17[a] | |
| Pre x Post Treatment | | | | | | | | |
| - x M | 223 | ±9.2 | 275 | ±9.2 | 328 | ±10.5 | 1.30 | ±.048 |
| + x M | 220 | | 272 | | 330 | | 1.47 | |
| - x H | 222 | | 274 | | 323 | | 1.29 | |
| + x H | 225 | | 273 | | 337 | | 1.31 | |

[a,b] Means within the same column with different superscripts differ (P<.05).

Table 4d. (Continued)

| One-way Interactions | Day 266 Wgt. (kg) $\bar{X}$ | SE | Final weight Wgt. (kg) $\bar{X}$ | SE |
|---|---|---|---|---|
| Frame x Feedlot | | | | |
| L x M | 432 | $\pm$14.4 | 583[c] | $\pm$21.4 |
| M x M | 427 | | 519[a,b] | |
| S x M | 402 | | 522[a,b] | |
| L x H | 450 | | 536[a,b] | |
| M x H | 447 | | 558[b,c] | |
| S x H | 408 | | 498[a] | |
| Frame x Pre Treatment | | | | |
| - x L | 446 | $\pm$14.4 | 574 | $\pm$21.4 |
| - x M | 435 | | 550 | |
| - x S | 420 | | 532 | |
| + x L | 436 | | 545 | |
| + x M | 439 | | 527 | |
| + x S | 391 | | 487 | |
| Pre x Post Treatment | | | | |
| - x M | 422 | $\pm$11.9 | 551 | $\pm$17.5 |
| + x M | 445 | | 552 | |
| - x H | 419 | | 531 | |
| + x H | 425 | | 509 | |

Table 4d. (Continued)

| | Day 266 - Killday ADG (kg) | | Feedlot Phase ADG (kg) | |
|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Frame x Feedlot | | | | |
| L x M | 1.37 | ±.235 | 1.34 | ±.062 |
| M x M | 1.23 | | 1.32 | |
| S x M | 1.33 | | 1.26 | |
| L x H | 1.13 | | 1.22 | |
| M x H | 1.29 | | 1.36 | |
| S x H | 1.84 | | 1.39 | |
| Frame x Pre Treatment | | | | |
| - x L | 1.27 | ±13.8 | 1.34 | ±.06 |
| - x M | 1.21 | | 1.28 | |
| - x S | 1.26 | | 1.37 | |
| + x L | 1.23 | | 1.22 | |
| + x M | 1.30 | | 1.40 | |
| + x S | 1.91 | | 1.28 | |
| Pre x Post Treatment | | | | |
| - x M | 1.31 | ±.192 | 1.29 | ±.05 |
| + x M | 1.18 | | 1.36 | |
| - x H | 1.31 | | 1.32 | |
| + x H | 1.65 | | 1.28 | |

Table 4e. Least square means, standard errors, and probability levels for feedlot performance.

| Two-Way Interactions | Day 114 Wgt. (kg) | | Day 156 Wgt. (kg) | | Day 195 Wgt. (kg) | | Day 114 - Day 266 Wgt. (kg) | |
|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| - x M x L | 230 | ±16.0 | 285 | ±15.9 | 339 | ±18.0 | 1.32 | ±17.2 |
| - x M x M | 231 | | 277 | | 332 | | 1.27 | |
| - x M x S | 208 | | 261 | | 313 | | 1.32 | |
| + x M x L | 232 | | 294 | | 354 | | 1.49 | |
| + x M x M | 231 | | 265 | | 326 | | 1.39 | |
| + x M x S | 196 | | 256 | | 309 | | 1.53 | |
| - x H x L | 226 | | 284 | | 337 | | 1.36 | |
| - x H x M | 224 | | 278 | | 322 | | 1.36 | |
| - x H x S | 215 | | 259 | | 311 | | 1.18 | |
| + x H x L | 232 | | 274 | | 336 | | 1.34 | |
| + x H x M | 231 | | 277 | | 356 | | 1.42 | |
| + x H x S | 210 | | 267 | | 317 | | 1.15 | |

Table 4e. (Continued)

| Two-way Interactions | Day 266 Wgt. (kg) $\bar{X}$ | SE | Final weight Wgt. (kg) $\bar{X}$ | SE |
|---|---|---|---|---|
| - x M x L | 432 | ±20.3 | 573 | ±30.2 |
| - x M x M | 426 | | 533 | |
| - x M x S | 410 | | 548 | |
| + x M x L | 461 | | 574 | |
| + x M x M | 444 | | 567 | |
| + x M x S | 430 | | 517 | |
| - x H x L | 434 | | 592 | |
| - x H x M | 428 | | 504 | |
| - x H x S | 395 | | 495 | |
| + x H x L | 439 | | 497 | |
| + x H x M | 450 | | 549 | |
| + x H x S | 387 | | 479 | |

Table 4e. (Continued)

| | Day 266 - Killday ADG (kg) | | Feedlot Phase ADG (kg) | |
|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE |
| - x M x L | 1.42 | ±.33 | 1.33 | ±.08 |
| - x M x M | 1.26 | | 1.26 | |
| - x M x S | 1.29 | | 1.29 | |
| + x M x L | 1.34 | | 1.34 | |
| + x M x M | 1.30 | | 1.30 | |
| + x M x S | 1.45 | | 1.45 | |
| - x H x L | 1.34 | | 1.34 | |
| - x H x M | 1.38 | | 1.38 | |
| - x H x S | 1.23 | | 1.23 | |
| + x H x L | 1.09 | | 1.09 | |
| + x H x M | 1.42 | | 1.42 | |
| + x H x S | 1.32 | | 1.32 | |

Table 5a. Least square, standard errors, and probability levels for carcass traits and feeding length.

| | Days on feed (days) | | Kill age (days) | | Carcass Wgt. (kg) | |
|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| <u>Treatments</u> | | | | | | |
| <u>Creep</u> | | | | | | |
| - | 249 | ±5.7 | 449 | ±5.41 | 334 | ±5.31 |
| + | 240 | | 442 | | 322 | |
| <u>Frame</u> | | | | | | |
| L | $262^{b}$ | ±6.9 | $462^{b}$ | ±6.6 | $349^{c}$ | ±6.50 |
| M | $241^{a}$ | | $442^{a}$ | | $334^{b}$ | |
| S | $229^{a}$ | | $432^{a}$ | | $301^{a}$ | |
| <u>Post Feed Lot</u> | | | | | | |
| M | $252^{c}$ | ±5.7 | 453 | ±5.4 | 329 | ±5.31 |
| H | $237^{d}$ | | 438 | | 327 | |

$^{a,b}$ Means within the same column with different superscripts differ (P<.01).
$^{c,d}$ Means within the same column with different superscripts differ (P<.10).

Table 5a. (Continued)

| | Backfat | | Rib eye area ($cm^2$) | | KPH % | | Quality grade | | Yield grade | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Treatments | | | | | | | | | | |
| Creep | | | | | | | | | | |
| - | .92 | ±.066 | 85.6 | ±1.85 | 2.76 | ±.70 | 10.9 | ±.40 | 2.51 | ±.11 |
| + | .88 | | 82.7 | | 2.76 | | 10.4 | | 2.52 | |
| Frame | | | | | | | | | | |
| L | .80 | ±.08 | $88.3^{b}$ | ±2.27 | 2.76 | ±.086 | 10.6 | ±.50 | 2.38 | ±.14 |
| M | .96 | | $84.6^{a,b}$ | | 2.75 | | 11.0 | | 2.60 | |
| S | .94 | | $79.5^{a}$ | | 2.75 | | 10.3 | | 2.76 | |
| Post Feed Lot | | | | | | | | | | |
| M | .87 | ±.066 | 83.8 | ±1.85 | 2.81 | ±.70 | 10.9 | ±.41 | 2.52 | ±.114 |
| H | .93 | | 84.5 | | 2.71 | | 10.5 | | 2.51 | |

[a,b] Means within the same column with different superscripts differ (P<.05).

Table 5b. Least square, standard errors, and probability levels for carcass traits and feeding length.

| One-way Interaction | Days on feed (days) $\bar{X}$ | SE | Kill age (days) $\bar{X}$ | SE | Carcass Wgt. (kg) $\bar{X}$ | SE |
|---|---|---|---|---|---|---|
| Pre x Post Weaning | | | | | | |
| - x M | 253 | ±8.0 | 461 | ±7.6 | 332 | ±7.55 |
| - x H | 244 | | 437 | | 336 | |
| + x M | 250 | | 445 | | 325 | |
| Preweaning x Frame | | | | | | |
| - x L | 255 | ±9.8 | 457 | ±9.35 | 352 | ±9.27 |
| - x M | 247 | | 446 | | 333 | |
| - x S | 243 | | 444 | | 318 | |
| + x L | 269 | | 468 | | 346 | |
| + x M | 235 | | 437 | | 335 | |
| + x S | 215 | | 420 | | 285 | |
| Postweaning x Frame | | | | | | |
| M x L | 267 | ±9.9 | 469 | ±9.37 | 351 | ±9.19 |
| M x M | 243 | | 444 | | 326 | |
| M x S | 245 | | 446 | | 310 | |
| H x L | 258 | | 455 | | 347 | |
| H x M | 240 | | 439 | | 342 | |
| H x S | 213 | | 418 | | 293 | |

Table 5b. (Continued)

| One-way Interaction | Backfat (mm) | | Rib eye area ($cm^2$) | | KPH % | | Quality grade | | Yield grade | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Pre x Post Weaning | | | | | | | | | | |
| - x M | .92 | ±.09 | 84.5 | ±2.6 | 2.83 | ±.99 | 11.5 | ±.58 | 2.57 | ±.164 |
| - x H | .92 | | 86.7 | | 2.70 | | 10.4 | | 2.46 | |
| + x M | .82 | | 83.1 | | 2.79 | | 10.2 | | 2.47 | |
| + x H | .94 | | 82.2 | | 2.72 | | 10.5 | | 2.56 | |
| Preweaning x Frame | | | | | | | | | | |
| - x L | .82 | ±.114 | 91.1 | ±3.2 | 2.90 | ±.121 | 11.1 | ±.71 | 2.32 | ±.198 |
| - x M | .93 | | 83.5 | | 2.70 | | 10.8 | | 2.61 | |
| - x S | 1.00 | | 82.2 | | 2.70 | | 11.0 | | 2.61 | |
| + x L | .77 | | 85.5 | | 2.60 | | 10.2 | | 2.61 | |
| + x M | .98 | | 85.7 | | 2.80 | | 11.2 | | 2.44 | |
| + x S | .89 | | 76.9 | | 2.80 | | 9.7 | | 2.51 | |

Table 5b. (Continued)

| One-way Interaction | Backfat (mm) | | Rib eye area ($cm^2$) | | KPH % | | Quality grade | | Yield grade | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Postweaning x Frame | | | | | | | | | | |
| M x L | .73 | ±.114 | 87.5 | ±3.2 | 2.60 | ±.121 | 10.8 | ±.71 | 2.35 | ±1.98 |
| M x M | .92 | | 81.5 | | 2.90 | | 10.6 | | 2.67 | |
| M x S | .96 | | 82.4 | | 2.90 | | 11.2 | | 2.55 | |
| H x L | .86 | | 89.1 | | 2.90 | | 10.5 | | 2.43 | |
| H x M | 1.00 | | 87.7 | | 2.60 | | 11.4 | | 2.54 | |
| H x S | .93 | | 76.7 | | 2.60 | | 9.5 | | 2.58 | |

Table 5c. Least square, standard errors and probability levels for carcass traits and feeding length.

| Two-way Interaction | Days on feed (days) | | Kill age (days) | | Carcass Wgt. (kg) | |
|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Pre x Post Weaning x Frame | | | | | | |
| - x M x L | 258 | ±14.1 | 463 | ±13.1 | 345 | ±13.1 |
| - x M x M | 238 | | 451 | | 322 | |
| - x M x S | 264 | | 468 | | 330 | |
| - x H x L | 253 | | 450 | | 360 | |
| - x H x M | 256 | | 442 | | 343 | |
| - x H x S | 223 | | 420 | | 307 | |
| + x M x L | 275 | | 475 | | 358 | |
| + x M x M | 248 | | 437 | | 329 | |
| + x M x S | 227 | | 424 | | 289 | |
| + x H x L | 263 | | 461 | | 334 | |
| + x H x M | 223 | | 437 | | 341 | |
| + x H x S | 204 | | 416 | | 280 | |

Table 5c. (Continued)

| Two-way Interaction | Backfat (mm) | | Rib eye area (cm) | | KPH % | | Quality grade | | Yield grade | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Pre x Post Weaning x Frame | | | | | | | | | | |
| - x M x L | .71 | ±.161 | 91.6 | ±4.7 | 2.7 | ±.169 | 11.4 | ±1.02 | 2.09 | ±.276 |
| - x M x M | .99 | | 79.2 | | 2.9 | | 11.0 | | 2.83 | |
| - x M x S | 1.06 | | 82.8 | | 2.9 | | 12.1 | | 2.78 | |
| - x H x L | .94 | | 90.7 | | 3.1 | | 10.8 | | 2.56 | |
| - x H x M | .89 | | 87.9 | | 2.5 | | 10.6 | | 2.39 | |
| - x H x S | .94 | | 81.7 | | 2.5 | | 9.8 | | 2.44 | |
| + x M x L | .76 | | 83.4 | | 2.5 | | 10.2 | | 2.61 | |
| + x M x M | .85 | | 83.8 | | 2.8 | | 10.25 | | 2.52 | |
| + x M x S | .86 | | 82.0 | | 3.0 | | 10.2 | | 2.31 | |
| + x H x L | .79 | | 87.6 | | 2.75 | | 10.25 | | 2.29 | |
| + x H x M | 1.11 | | 87.5 | | 2.8 | | 12.1 | | 2.68 | |
| + x H x S | .92 | | 71.8 | | 2.6 | | 9.25 | | 2.72 | |

Table 6a. Least squares, standard errors and probability level for feed efficiency by main effects.

| Treatments | Day 114 to Day 266 Mcal DE Energy/kg of Gain | | Day 266 to Kill Day Mcal DE Energy/kg of Gain | |
|---|---|---|---|---|
| | $\bar{X}$ | SE | $\bar{X}$ | SE |
| Post-Treatment | | | | |
| M | 21.13 | ±.53 | 27.65 | ±.48 |
| H | 19.55 | | 27.74 | |
| Pre-Treatment | | | | |
| - | 19.50 | ±.53 | 28.22 | ±.49 |
| + | 21.18 | | 27.17 | |
| Frame Type | | | | |
| L | 20.57 | ±.65 | $28.95^{b}$ | ±.59 |
| M | 20.15 | | $28.59^{b}$ | |
| S | 20.31 | | $25.54^{a}$ | |

[a,b] Means within the same column with different superscripts differ ($P<.1$).

Table 6b. Feed efficiency.

| One-Way Interactions | Day 114 to Day 266 Mcal Energy/kg of Gain $\bar{X}$ | SE | Day 266 to Kill Day Mcal Energy/kg of Gain $\bar{X}$ | SE |
|---|---|---|---|---|
| Pre x Post | | | | |
| - x M | 20.52 | ±.76 | 28.01 | ±.69 |
| + x M | 18.47 | | 28.43 | |
| - x H | 21.75 | | 27.29 | |
| + x H | 20.62 | | 27.05 | |
| Frame Type x Pre Treatment | | | | |
| L x - | 19.6 | ±.93 | 29.70 | ±.84 |
| L x + | 21.5 | | 28.2 | |
| M x - | 20.2 | | 28.7 | |
| M x + | 20.0 | | 28.5 | |
| S x - | 18.6 | | 26.3 | |
| S x + | 22.0 | | 24.7 | |
| Frame Type x Post Treatment | | | | |
| L x M | 21.9 | ±.92 | 27.0[b] | ±.85 |
| L x H | 19.2 | | 30.9[b] | |
| M x M | 20.8 | | 28.6[b] | |
| M x H | 10.5 | | 28.6[b] | |
| S x M | 20.7 | | 27.3[b] | |
| S x H | 19.9 | | 23.8[a] | |

not significant, tended to require fewer days on feed (240 days vs. 249 days) than the "-" steers (P<.25) (Table 5). Lewis et al. (1983) and Haugebak et al. (1974) also reported that creep feeding resulted in animals reaching a specified physiological endpoint at a younger age. There were no differences (P>.5) (Table 5) between treatments in backfat amounts, rib-eye area, KPH percent or USDA numerical yield grade. The lack of differences is likely due to the steers being slaughtered at equal compositional end points.

Postweaning Treatment Effects

There was no difference (P>.75) in postweaning growth due to either postweaning treatment of high energy or medium energy diets (H or M) (Table 4). The lack of increased weight gain in the initial 153 day feedlot phase may be partially explained by a 6 percent decrease in feed consumption by the "H" treatment. The reason for the decrease in feed consumption by the steers consuming the high energy diet is not understood.

The H steers required less (P<.1) (Table 5) days on feed (237 days vs. 252 days) than the M steers. The H steers were also younger (P<.1) by 15 days at slaughter than the M steers (Table 5). The reduction of days on feed and age at slaughter to reach a common compositional endpoint is believed to be due to an increase in caloric density of the postweaning diet. This finding is consistent with work completed by Brennan et al. (1987) and Dikeman et al. (1985). No differences were noted in carcass measurements due to postweaning treatments. This is consistent with the experimental design which required steers to be slaughtered at similar endpoints.

No differences (P>.1) (Table 6) were found in energy to gain ratios between postweaning treatments. The "H" treatment, while not significant (P<.2) required 1.58 less Mcals of DE per kg of live weight during the initial feedlot phase. Most likely this trend is because the "H" ration contained 11 percent more DE which resulted in a reduction of the proportion of maintenance energy to net energy in comparison to the "M" ration.

Frame Type Effects

Large frame and medium frame steers were larger (P<.01) than small frame steers at weaning (5.3 and 5.1 vs. 4.4) (Table 4). As yearlings, differences (P<.05) (Table 4) were noted in frame scores for all three frame types (L, M and S). Large frame type steers were heavier (P<.05) (Table 4) than medium or small frame type steers at birth which is compatible with the findings of Cundiff et al. (1981).

Large and medium frame type steers grew at a faster (P<.1) (Table 4) rate than small frame steers during the preweaning phase (.8 kg ADG and .83 kg ADG vs. .74 kg ADG, respectively). During the postweaning feedlot phase all three frame types grew at a nearly equal rate. The L and M frame type steers remained heavier (P<.1) (Table 4) during the postweaning phase due to their higher preweaning increase in growth rate. Similar growth patterns have been reported by Cundiff et al. (1981), Tatum et al. (1988) and Kempster et al. (1988).

Large (L) steers were heavier, older, required more days on feed and had larger rib-eye areas (P<.1) than S steers (Table 5a,b). Similar increases in these parameters have been reported by Crouse et al. (1985), Nour and Thonney (1987), LeVan et al. (1979) and Armbruster et al. (1983).

In the final phase of the feedlot period, S steers required 25.54 Mcal per kg of gain compared to 28.95 Mcals and 28.59 Mcals per kg of gain for L and M steers, respectively (Table 6). This advantage in efficiency (P<.1) in S frame steers is consistent with reports made by Lofgreen and Garrett (1968) which indicated larger cattle have greater maintenance requirements. This advantage in efficiency is also supported by the work of Reid et al. (1980) which stated that larger frame cattle have a higher percent lean in their body.

Interaction Effects

There were no differences (P>.1) (Table 1) in any parameters measured in this work due to any one-way or two-way interactions, except for feed efficiency (Table 6) during the final portion of the feedlot phase and KPH%. The small frame x high energy (S x H) treatment required less energy per unit of gain than any other treatment. The large frame x high energy treatment required the most energy per unit of gain. It may be that the smaller body size and greater tendency to fatten at a lighter weight allowed the S x H steers to be more efficient than the L x H steers. The L x H steers approached significance (P<.12) (Table 4) and tended to be smaller than L x M steers (536 kg vs. 583 kg), M x H steers tended to be smaller than M x M steers (P<.12) (Table 3) (519 kg vs. 558 kg) and S x H steers tended to be smaller than S x M steers (498 kg vs. 522 kg) at slaughter. These findings are consistent with reports by Dikeman et al. (1985). They found that feeding high energy postweaning rations reduced the weight at which steers reached the choice grade. The increase (Table 5) in KPH% in the MxM, MxS, HxL treatments is not understood or large enough to have any practical impact.

Days on feed approached significance (P<.12) (Table 5). The difference may be due to the preweaning treatment x frame type interaction. The + x S treatment required fewer days on feed than the - x S treatment (215 days vs. 243 days). The + x M treatment required 12 days less on feed than the - x S treatment. Conversely, the + x L treatment required 269 days on feed vs. 255 days for the - x L treatment. The reason for this inconsistency between preweaning treatments for S and M frame type and L frame type is not known. No references were found to evaluate this situation. The + x S steers had the lowest (P<.05) (Table 4) ADG (1.17 kg $\cdot$ day$^{-1}$) during the initial period of the feedlot phase. This may be due to a lack of growth performance or a reduction in compensatory gain due to creep feeding. Similar growth responses in small frame type cattle have been reported by Martin et al. (1981).

No significant differences (P>.3) (Table 3) were found in any variable due to the interaction between preweaning treatment x postweaning treatment x frame type.

## GENERAL DISCUSSION

The hypothesis tested in the current experiment was: large frame cattle that are creep fed and weaned to a high energy finishing ration require fewer days on feed and less digestible energy to reach the low choice grade than large frame steers which are raised without creep feed and weaned to a growing ration before being fed a high energy finishing ration. The results of the trial conducted does not allow the hypothesis to be accepted because significant differences were not found in growth rate in either the pre- or post-weaning treatments nor in days on feed.

A reevaluation of the experimental procedures identifies an inadequate sample size as contributing to the lack of significant differences in preweaning ADG, postweaning ADG and days on feed. At a 90 percent confidence level, sample sizes of 105, 118 and 170 would have been necessary to detect significant differences in preweaning and postweaning ADG and days on feed considering the appropriate standard deviation of this experiment. The trial reported here had 60 observations. The impact of creep feeding on the Soap Creek cow herd may have been minimized because of above average forage resources in terms of quantity and quality. The cow herd has an above average potential for milk production while the genetic potential for growth of the progeny is average (Hohenboken and Weber, 1989). The management of the Soap Creek cow herd may be to the point where calves are already expressing their entire genetic potential for growth even without creep feed being consumed.

Further adjustments in the protocol may have been appropriate in evaluating the effects of frame size and postweaning growth. A greater range in cattle frame size would have allowed this trial to have greater potential application. Also a larger difference in the caloric density between the two postweaning rations would have allowed for greater difference in the postweaning treatments ADG.

Using arithmetic means the nonsignificant trends found in animal performance can be compared with estimated costs and returns. These comparisons allow for the economic impact of this trial's treatments to be evaluated.

Table 7 compares the costs and returns associated with the two creep feeding treatments. Tables 7 through 12 make the following assumptions: creep feed expense during the 98 day preweaning period was $6.24; the postweaning rations cost 3.34 cents per Mcal of digestible energy; yardage and labor during the postweaning period were calculated at 20 cents per head per day. Cattle values were estimated at $2.75 per kg for steers weighing 115 to 145 kg; $2.60 per kg for steers weighing 196 kg to 225 kg and $2.20 per kg of carcass weight. The creep feed expense was derived from amount of creep feed consumed during the trial. Creep feed cost was figured at 3.34 cents per Mcal of digestible energy.

Creep feeding resulted in an increase in net return of $10.78 at weaning. The cost to produce this increase was $6.24 for the creep feed. Creep fed steers required 1.06 more Mcals of digestible energy per kg of live weight gain during the postweaning period. This decrease in postweaning feed efficiency for creep fed steers resulted in an increased feed cost of 3 cents per kg of postweaning gain. Creep fed steers due to their reduced number of days in the feedlot required $1.80 less yardage and interest expense. Non-creep fed steers returned $18.17 more than creep fed steers at slaughter.

For creep fed steers to have returns equal to non-creep fed steers, changes in feed costs, yardage and interest or carcass values would need to occur. Yardage and labor would need to increase to nearly $2.00 per head per day or feed costs would need to increase by over 97 percent. Both situations are unlikely to occur. If carcasses were being discounted for being over a target weight, creep fed steers would have an advantage up to 12 kg. The magnitude of this discount would depend on the size of the price adjustment. It appears more likely that for creep fed steers to be economically competitive with non-creep fed steers larger discounts must be given to heavy carcasses rather than having increases in fixed costs.

Steers in the H treatment were nearly equal to steers in the M treatment in feed efficiency, and they required 15 fewer days in the feedlot (Table 8). Feed costs were $32.38 less, and yardage and labor were $3.00 less in the "H" steers than the "M" steers. The added weight gain performance of the "H" steers resulted in an additional return of $19.25 during the preweaning period. The "H" steers ultimately returned $50.13 more than the "M" steers. This economic advantage is largely due to a .006 kg increase in carcass weight per Mcal of digestible energy consumed.

The economic performance of large, medium and small frame steers is compared in Table 9. Large and medium frame steers returned more dollars ($56.85 and $58.16) than small frame steers ($46.78). This dollar return advantage is due to a .06 kg increase in carcass weight per day of age for the large and medium frame steers. Part of the economic advantage of large and medium frame steers is offset by a reduced yardage and labor expense for small frame steers.

Table 7. Economic comparisons of creep fed versus non-creep fed treatments.

| | + Creep Fed | - Non-creep Fed |
|---|---|---|
| Creep Period | | |
| 1. Initial wgt. (kg) | 134.0 | 136.0 |
| 2. Cost of calf (1 x 2.75/kg) | 368.50 | 374.60 |
| 3. Gain during creep feeding (kg) | 79.0 | 75.3 |
| 4. Creep feed cost (1 mcal/DE=$.11) | 6.24 | 0.00 |
| 5. Weaning weight (kg) | 213.7 | 211.9 |
| 6. Cost of calf (5 x 2.60/kg) | 555.62 | 550.94 |
| 7. Return during creep period | 187.12 | 176.34 |
| 8. Return per dollar of creep feed | 1.72 | 0.00 |
| Post Weaning Period | | |
| 9. Mcal of DE/kg gain | 23.39 | 22.63 |
| 10. ADG (kg) | 1.30 | 1.33 |
| 11. Days on feed | 240 | 249 |
| 12. Feed cost @ 3.34¢/mcal DE | 243.74 | 250.31 |
| 13. Yardage and interest 20¢/day | 48.00 | 49.80 |
| 14. Total direct post weaning costs | 291.74 | 300.11 |
| 15. Cost per kg of gain | .93 | .90 |
| Return | | |
| 16. Carcass wgt. (kg) | 322 | 334 |
| 17. Carcass value @ $2.20/kg | 708.40 | 734.80 |
| Cash Flow | | |
| 18. Net return 17 - [14+4+2] (dollars) | 41.92 | 60.09 |
| Efficiencies | | |
| 19. Carcass wgt./day of age (kg) | .72 | .74 |
| 20. Carcass wgt./mcal DE | .044 | .044 |

Table 8. Economic comparisons of high energy and moderate energy postweaning treatments.

| | Post Weaning Treatments | |
|---|---|---|
| | High Energy | Moderate Energy |
| <u>Creep Period</u> | | |
| 1. Initial wgt. (kg) | 132.0 | 139.0 |
| 2. Cost of calf (1 x 2.75/kg) | 363.00 | 382.25 |
| 3. Gain during creep feeding (kg) | 90.0 | 83.0 |
| 4. Creep feed cost (1 mcal/DE=$.11) | 3.12 | 3.12 |
| 5. Weaning weight (kg) | 222.0 | 222.0 |
| 6. Cost of calf (5 x 2.60/kg) | 577.20 | 577.20 |
| 7. Return during creep period | 214.20 | 194.95 |
| 8. Return per dollar of creep feed | -- | -- |
| <u>Post Weaning Period</u> | | |
| 9. Mcal of DE/kg gain | 22.27 | 23.70 |
| 10. ADG (kg) | 1.31 | 1.32 |
| 11. Days on feed | 237 | 252 |
| 12. Feed cost @ 3.34¢/mcal DE | 230.93 | 263.31 |
| 13. Yardage and interest 20¢/day | 47.40 | 50.40 |
| 14. Total direct post weaning costs | 278.33 | 313.71 |
| 15. Cost per kg of gain | .90 | .94 |
| <u>Return</u> | | |
| 16. Carcass wgt. (kg) | 327 | 329 |
| 17. Carcass value @ $2.20/kg | 719.40 | 723.80 |
| <u>Cash Flow</u> | | |
| 18. Net return 17 - [14+4+2] (dollars) | 74.85 | 24.72 |
| <u>Efficiencies</u> | | |
| 19. Carcass wgt./day of age (kg) | .72 | .75 |
| 20. Carcass wgt./mcal DE | .047 | .041 |

Table 9. Economic comparisons of large, medium and small frame type steers.

| | Frame Type | | |
|---|---|---|---|
| | Large | Medium | Small |
| **Creep Period** | | | |
| 1. Initial wgt. (kg) | 143.0 | 138.0 | 126.0 |
| 2. Cost of calf (1 x 2.75/kg) | 393.25 | 379.50 | 346.50 |
| 3. Gain during creep feeding (kg) | | | |
| 4. Creep feed cost (1 mcal/DE=$.11) | | | |
| 5. Weaning weight (kg) | 221.0 | 218.0 | 197.0 |
| 6. Cost of calf (5 x 2.60/kg) | 574.60 | 566.80 | 512.20 |
| 7. Return during creep period | | | |
| 8. Return per dollar of creep feed | | | |
| **Post Weaning Period** | | | |
| 9. Mcal of DE/kg gain | 23.71 | 23.08 | 22.10 |
| 10. ADG (kg) | 1.28 | 1.34 | 1.32 |
| 11. Days on feed | 262 | 241 | 229 |
| 12. Feed cost @ 3.34¢/mcal DE | 265.57 | 248.94 | 223.12 |
| 13. Yardage and interest 20¢/day | 52.40 | 48.20 | 45.80 |
| 14. Total direct post weaning costs | 317.97 | 297.14 | 268.92 |
| 15. Cost per kg of gain | .94 | .91 | .88 |
| **Return** | | | |
| 16. Carcass wgt. (kg) | 349 | 334 | 301 |
| 17. Carcass value @ $2.20/kg | 767.80 | 734.80 | 662.20 |
| **Cash Flow** | | | |
| 18. Net return 17 - [14+4+2] (dollars) | 56.58 | 58.16 | 46.78 |
| **Efficiencies** | | | |
| 19. Carcass wgt./day of age (kg) | .75 | .75 | .69 |
| 20. Carcass wgt./mcal DE | .044 | .044 | .045 |

Table 10. Economic comparisons of preweaning x postweaning treatments.

| | Preweaning x Postweaning Treatments | | | |
|---|---|---|---|---|
| | +H | +M | -H | -M |
| **Creep Period** | | | | |
| 1. Initial wgt. (kg) | 135.0 | 135.0 | 130.0 | 143.0 |
| 2. Cost of calf (1 x 2.75/kg) | 371.25 | 371.25 | 357.50 | 393.25 |
| 3. Gain during creep feeding (kg) | 78.0 | 78.0 | 79.0 | 72.0 |
| 4. Creep feed cost (1 mcal/DE=$.11) | 6.24 | 6.24 | 0 | 0 |
| 5. Weaning weight (kg) | 213.0 | 213.0 | 209.0 | 215.0 |
| 6. Cost of calf (5 x 2.60/kg) | 553.80 | 553.80 | 543.40 | 559.00 |
| 7. Return during creep period | 182.55 | 182.55 | 185.9 | 165.75 |
| 8. Return per dollar of creep feed | n/a / 2.69 | n/a / 2.69 | | |
| **Post Weaning Period** | | | | |
| 9. Mcal of DE/kg gain | 22.81 | 23.94 | 21.80 | 23.47 |
| 10. ADG (kg) | 1.28 | 1.36 | 1.32 | 1.29 |
| 11. Days on feed | 230 | 250 | 244 | 253 |
| 12. Feed cost @ 3.34¢/mcal DE | 224.28 | 271.86 | 234.51 | 255.92 |
| 13. Yardage and interest 20¢/day | 46.00 | 50.00 | 48.80 | 50.60 |
| 14. Total direct post weaning costs | 270.28 | 321.86 | 283.31 | 306.52 |
| 15. Cost per kg of gain | .92 | .94 | .88 | .94 |
| **Return** | | | | |
| 16. Carcass wgt. (kg) | 318 | 325 | 336 | 332 |
| 17. Carcass value @ $2.20/kg | 699.60 | 715.00 | 739.20 | 730.4 |
| **Cash Flow** | | | | |
| 18. Net return 17 - [14+4+2] (dollars) | 51.83 | 15.65 | 98.39 | 30.63 |
| **Efficiencies** | | | | |
| 19. Carcass wgt./day of age (kg) | .72 | .73 | .76 | .72 |
| 20. Carcass wgt./mcal DE | .047 | .040 | .048 | .043 |

Table 11. Economic comparisons of preweaning x frame type treatments.

| | Preweaning x Frame Treatments | | | | | |
|---|---|---|---|---|---|---|
| | +L | -L | +M | -M | +S | -S |
| Creep Period | | | | | | |
| 1. Initial wgt. (kg) | 143.0 | 145.0 | 137.0 | 140.0 | 126.0 | 127.0 |
| 2. Cost of calf (1 x 2.75/kg) | 393.25 | 398.75 | 376.75 | 385.00 | 346.50 | 349.25 |
| 3. Gain during creep feeding (kg) | | | | | | |
| 4. Creep feed cost (1 mcal/DE=$.11) | 6.24 | 0 | 6.24 | 0 | 6.24 | 0 |
| 5. Weaning weight (kg) | 220.0 | 223.0 | 219.0 | 219.0 | 202.0 | 194.0 |
| 6. Cost of calf (5 x 2.60/kg) | 572.00 | 579.80 | 569.40 | 569.40 | 525.20 | 504.40 |
| 7. Return during creep period | 178.75 | 181.05 | 192.65 | 184.40 | 178.70 | 225.00 |
| 8. Return per dollar of creep feed | | | | | | |
| Post Weaning Period | | | | | | |
| 9. Mcal of DE/kg gain | 24.23 | 23.24 | 22.83 | 23.30 | 23.01 | 21.35 |
| 10. ADG (kg) | 1.22 | 1.34 | 1.40 | 1.28 | 1.28 | 1.37 |
| 11. Days on feed | 269 | 255 | 235 | 247 | 215 | 243 |
| 12. Feed cost @ 3.34¢/mcal DE | 265.59 | 265.23 | 250.87 | 246.04 | 211.50 | 237.39 |
| 13. Yardage and interest 20¢/day | 53.80 | 51.00 | 47.00 | 49.40 | 43.00 | 48.60 |
| 14. Total direct post weaning costs | 319.39 | 316.23 | 297.87 | 295.44 | 254.50 | 285.99 |
| 15. Cost per kg of gain | .97 | .89 | .91 | .93 | .92 | .86 |
| Return | | | | | | |
| 16. Carcass wgt. (kg) | 346 | 352 | 335 | 333 | 285 | 318 |
| 17. Carcass value @ $2.20/kg | 761.20 | 774.40 | 737.00 | 732.60 | 627.00 | 699.60 |
| Cash Flow | | | | | | |
| 18. Net return 17 - [14+4+2] (dollars) | 42.32 | 59.42 | 56.14 | 52.16 | 19.76 | 64.36 |
| Efficiencies | | | | | | |
| 19. Carcass wgt./day of age (kg) | .74 | .77 | .76 | .74 | .67 | .71 |
| 20. Carcass wgt./mcal DE | .043 | .044 | .044 | .045 | .045 | .045 |

Table 12. Economic comparisons of preweaning x postweaning x frame type treatments.

| | Preweaning x Postweaning x Frame Type Treatments | | | |
|---|---|---|---|---|
| | +HL | +ML | -HL | -ML |
| <u>Creep Period</u> | | | | |
| 1. Initial wgt. (kg) | 142.0 | 143.0 | 144.0 | 145.0 |
| 2. Cost of calf (1 x 2.75/kg) | 390.50 | 393.25 | 396.00 | 398.75 |
| 3. Gain during creep feeding (kg) | | | | |
| 4. Creep feed cost (1 mcal/DE=$.11) | 6.24 | 6.24 | 0 | 0 |
| 5. Weaning weight (kg) | 223.0 | 218.0 | 226.0 | 219.0 |
| 6. Cost of calf (5 x 2.60/kg) | 579.80 | 566.80 | 587.60 | 569.40 |
| 7. Return during creep period | 189.30 | 173.55 | 191.60 | 170.65 |
| 8. Return per dollar of creep feed | | | | |
| <u>Post Weaning Period</u> | | | | |
| 9. Mcal of DE/kg gain | 23.56 | 24.72 | 23.07 | 23.41 |
| 10. ADG (kg) | 1.09 | 1.34 | 1.34 | 1.33 |
| 11. Days on feed | 263 | 275 | 253 | 258 |
| 12. Feed cost @ 3.34¢/mcal DE | 225.58 | 304.25 | 261.22 | 268.29 |
| 13. Yardage and interest 20¢/day | 52.60 | 55.00 | 50.60 | 51.60 |
| 14. Total direct post weaning costs | 278.18 | 359.25 | 311.82 | 319.89 |
| 15. Cost per kg of gain | .97 | .97 | .92 | .93 |
| <u>Return</u> | | | | |
| 16. Carcass wgt. (kg) | 334 | 358 | 360 | 345 |
| 17. Carcass value @ $2.20/kg | 734.80 | 787.60 | 792.00 | 759.00 |
| <u>Cash Flow</u> | | | | |
| 18. Net return 17 - [14+4+2] (dollars) | 59.88 | 28.86 | 84.18 | 40.36 |
| <u>Efficiencies</u> | | | | |
| 19. Carcass wgt./day of age (kg) | .72 | .75 | .80 | .75 |
| 20. Carcass wgt./mcal DE | .049 | .039 | .046 | .043 |

Table 12. (Continued)

| | Preweaning x Postweaning x Frame Type Treatments | | | |
|---|---|---|---|---|
| | +HM | +MM | -HM | -MM |
| **Creep Period** | | | | |
| 1. Initial wgt. (kg) | 142.0 | 130.0 | 126.0 | 151.0 |
| 2. Cost of calf (1 x 2.75/kg) | 390.50 | 357.50 | 346.50 | 415.25 |
| 3. Gain during creep feeding (kg) | | | | |
| 4. Creep feed cost (1 mcal/DE=$.11) | 6.24 | 6.24 | 0 | 0 |
| 5. Weaning weight (kg) | 221.0 | 216.0 | 214.0 | 223.0 |
| 6. Cost of calf (5 x 2.60/kg) | 574.60 | 561.60 | 556.40 | 579.80 |
| 7. Return during creep period | 184.10 | 204.10 | 209.90 | 164.55 |
| 8. Return per dollar of creep feed | | | | |
| **Post Weaning Period** | | | | |
| 9. Mcal of DE/kg gain | 22.10 | 23.74 | 23.12 | 21.15 |
| 10. ADG (kg) | 1.42 | 1.30 | 1.38 | 1.26 |
| 11. Days on feed | 223 | 248 | 256 | 238 |
| 12. Feed cost @ 3.34¢/mcal DE | 233.74 | 255.63 | 272.80 | 211.83 |
| 13. Yardage and interest 20¢/day | 44.60 | 49.60 | 51.20 | 47.60 |
| 14. Total direct post weaning costs | 278.34 | 305.23 | 324.00 | 259.43 |
| 15. Cost per kg of gain | .88 | .95 | .92 | .86 |
| **Return** | | | | |
| 16. Carcass wgt. (kg) | 341 | 329 | 343 | 322 |
| 17. Carcass value @ $2.20/kg | 750.20 | 723.80 | 754.60 | 708.40 |
| **Cash Flow** | | | | |
| 18. Net return 17 - [14+4+2] (dollars) | 75.12 | 54.83 | 84.10 | 33.72 |
| **Efficiencies** | | | | |
| 19. Carcass wgt./day of age (kg) | .78 | .75 | .78 | .71 |
| 20. Carcass wgt./mcal DE | .049 | .043 | .042 | .050 |

Table 12. (Continued)

| | Preweaning x Postweaning x Frame Type Treatments | | | |
|---|---|---|---|---|
| | +HS | +MS | -HS | -MS |
| **Creep Period** | | | | |
| 1. Initial wgt. (kg) | 119.0 | 131.0 | 119.0 | 132.0 |
| 2. Cost of calf (1 x 2.75/kg) | 327.25 | 360.25 | 327.25 | 363.00 |
| 3. Gain during creep feeding (kg) | | | | |
| 4. Creep feed cost (1 mcal/DE=$.11) | 6.24 | 6.24 | 0 | 0 |
| 5. Weaning weight (kg) | 196.0 | 206.0 | 186.0 | 201.0 |
| 6. Cost of calf (5 x 2.60/kg) | 509.60 | 535.60 | 483.60 | 522.60 |
| 7. Return during creep period | 182.35 | 175.35 | 156.35 | 159.60 |
| 8. Return per dollar of creep feed | | | | |
| **Post Weaning Period** | | | | |
| 9. Mcal of DE/kg gain | 20.27 | 23.10 | 19.07 | 23.50 |
| 10. ADG (kg) | 1.32 | 1.45 | 1.23 | 1.29 |
| 11. Days on feed | 204 | 227 | 223 | 264 |
| 12. Feed cost @ 3.34¢/mcal DE | 182.30 | 258.51 | 174.70 | 267.30 |
| 13. Yardage and interest 20¢/day | 40.80 | 45.40 | 44.60 | 52.80 |
| 14. Total direct post weaning costs | 223.10 | 303.91 | 219.30 | 320.10 |
| 15. Cost per kg of gain | .83 | .92 | .80 | .94 |
| **Return** | | | | |
| 16. Carcass wgt. (kg) | 280 | 289 | 307 | 330 |
| 17. Carcass value @ $2.20/kg | 616.00 | 635.80 | 675.40 | 726.00 |
| **Cash Flow** | | | | |
| 18. Net return 17 - [14+4+2] (dollars) | 59.41 | -34.60 | 128.85 | 42.90 |
| **Efficiencies** | | | | |
| 19. Carcass wgt./day of age (kg) | .67 | .68 | .71 | .71 |
| 20. Carcass wgt./mcal DE | .051 | .038 | .058 | .041 |

The economic results of the interaction between preweaning and postweaning treatments are shown in Table 10. The "-H" steers had the largest net return ($98.39) followed by "+H" ($51.83) then "-M" ($30.63) and "+M" ($15.65) steers. The "-H" steers returned the most dollars due to their high carcass weight per day of age and also Mcal of digestible energy. The "+M" steers had the lowest net return because these steers had the lowest carcass weight per Mcal of digestible energy and required an above average amount of time on feed.

The relationship between preweaning treatment and frame type relative to economic performance is shown in Table 11. The "-S" steers had the highest net return ($64.36) followed by steers from the "-L" ($59.42), "+M" ($56.14), "-M" ($52.16), "+L" ($42.32) and "+S" ($19.76) treatments. The "-S" steers had the lowest cost per kg of postweaning gain ($.86) which improved their economic return. The lower net return of the "+S" steers ($19.76) is due to a reduced carcass weight per day of age.

The economic comparisons for the interaction between preweaning and postweaning treatments and frame type are in Table 12. The "-HS" steers had the highest net return ($128.85) followed by steers from the "-HL" ($84.18), "-HM" ($84.10), "+HM" ($75.12), "+HL" ($59.88), "+HS" ($59.41), "+MM" ($54.83), "-MS" ($42.90), "-ML" ($40.36), "-MM" ($33.72), "+ML" ($28.86) and "+MS" (-$34.60) treatments. The "-HS" steers had the highest net return due to their .058 kg carcass weight gain per Mcal of digestible energy. The "+MS" steers had the lowest net return due to their lowest carcass weight gain per Mcal of digestible energy and because they had the second lowest increase in carcass weight per day of age.

Creep feeding affected carcass weight more than any other variable measured. The effect of creep feeding was to lower carcass weight. The postweaning treatment of high energy levels versus moderate energy level rations affected feed efficiency and days on feed more than any other variable measured. The variation in frame size affected preweaning gain, days in the feedlot, carcass weight, and rib eye area and feed efficiency in the final phase of the postweaning period. Large frame steers showed increases in all carcass measurements and postweaning feed efficiency over small frame steers.

Creep feeding may be a management alternative to increase preweaning calf growth and reduce carcass weight at acceptable quality grades. This experiment was not able to specifically answer these questions due to a small sample and/or high standard deviations in each sample. The trends observed indicate that a high energy post weaning ration has a greater impact on efficiency and profitability than creep feeding. If creep feeding is a management practice then cattle should be weaned to a high energy ration rather than a growing ration in order to take advantage of the growth response due to creep feeding. These two trends were consistent regardless of the frame type of cattle.

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