

## Replacement Heifer Selection in A Beef Cattle Herd

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**Abstract:** The relationship between a heifer's weaning weight and her fertility and weaning weight of her calves was studied. Also investigated was the effect of dam amount of fat (DAF=dam weaning weight/weaning height) on heifers' ability to breed and rebreed. This is similar to Body Mass Index (BMI) calculated for humans. The relationship of dam's average daily gain from birth to weaning and from weaning to finishing and DAF to calf weaning weight was studied also. These determine which heifers should be kept as replacements. Data were collected from 816 heifers. Heavier animals had higher conception rates. Average daily gain of the dam from birth to weaning and DAF had adverse effects on calf weaning weight. This suggests that over-conditioned heifers are likely to have lighter calves. In addition, the cubic model of dam weaning weight showed that after a weight of 272 kg, calf weaning weights no longer increased with increasing dam weaning weights.

**Key words:** Beef, Replacement, Conception, Dam Amount of Fat, Weaning Weight

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### INTRODUCTION

Selection of heifer calves which will perform best as replacement determines the net income of many beef producers. The heifer's weaning weight is considered the main criterion for prediction of replacement heifers by organizations such as BIF [1] and North Carolina Cow Calf Handbook [2]. However, there is a controversy in the literature as to how effectively weaning weight indicates future production. High weaning weights for heifers might be detrimental to the maternal environment they will provide, thus providing lighter calves in the next generation.

Milk provided by the cow is the main feature of the maternal environment; it has a great influence on calf weight [3]. Sejrsen *et al.* [4] showed that dairy heifers experiencing accelerated growth have lower milk production later. The same idea was also shown in beef cattle [5]. In addition, females selected for increased weight have lower fertility and longevity [6]. In contrast, Segert *et al.* [7] reported a positive effect of high backfat thickness on milk yield in dairy cows.

The major objective of this study was to determine the relationship between a heifer's weaning weight and her fertility and weaning weight of her calves. Also investigated was the effect of dam amount of fat (DAF) on her fertility, the ability to breed and rebreed. In addition, the relationship of dam's average daily gain from birth to weaning and from weaning to finishing and DAF to calf weaning weight was studied. These will determine which heifers should be kept as replacements.

### MATERIALS AND METHODS

Data used in this study were supplied by the Roman L. Hruska Meat Animal Research Center, Clay center, Nebraska. The breeds used were Angus, Hereford, Charolais, Brown Swiss, Limousin, Simmental and Red Poll. A total of 816 heifers were used.

All females born were retained for breeding and excess females were removed based on nonperformance criteria, such as age, color or atypical anatomy. Yearling heifers were bred by natural service for about 45 days and heifers that are two years old were bred AI for 26 days and then exposed to a cleanup bull for 30 days. All "normal" females found to be open at palpation time were retained for another breeding season before they were removed from the project. Only the animals that have a female calf were used since only the performance of female offspring was studied. Every effort was made to have each calf reared by its own dam. A foster dam was used only when there was a high probability of loss of the calf. The weaning age was around 200 days for all calves.

Regressions were developed to explain the physiological relationship of dam's weaning weight, dam's average daily gain from birth to weaning and from weaning to finishing and dam amount of fat (DAF) to calf weaning weight. DAF was calculated by dividing an animal's weaning weight by its weaning height. This value is similar to the BMI calculated for humans in the way it is calculated. The only difference between the two values is that height is not squared when calculating DAF. Groth *et al.* [8] crossed Black-

and-White (BW) cows with bulls of Belgian Blue (BB) and Charolaise (Ch) and calculated BMI for these crosses.

Three different models were used to analyze 200 day weight of calves. Weaning weight and birth weight was adjusted for the effect of age of dam. The first model included fixed effects calf birth year, calf birth month, breed and frame score. Dam's average daily gain from birth to weaning and from weaning to the end of breeding season and dam weaning weight were included as covariate. The second model regressed calf weaning weight on dam amount of fat (DAF), dam weaning weight, dam's average daily gain from weaning to the end of breeding season and dam's average daily gain from birth to weaning. The third model regressed calf weaning weight on dam weaning weight, dam weaning weight in quadratic and cubic form, dam's average daily gain from birth to weaning and dam's average daily gain from weaning to the end of breeding season. The model also included fixed effects calf birth year, calf birth month, breed and frame score.

## RESULTS AND DISCUSSION

Regressions with calf weaning weight as the dependent variable were developed to explain physiological relationships. Weaning weight of the dam was positively (0.18) related to calf weaning weight ( $p < .05$ ). This suggests that increasing dam's weaning weight will increase the returns to the producer by increasing the calf's weight. However, the increase in revenue would come with the increased maintenance costs due to having a larger cow. Pala *et al.* [9] reported that the desired method of evaluation differs if major costs are associated with number of cows as compared with major costs being associated with mature weight of cows maintained.

The cubic model of dam weaning weight showed that after a weight of about 272 kg, calf weaning weights no longer increased with increasing dam weaning weights (Fig. 1). Heifers over 272 kg could have underdeveloped mammary glands due to being fed on too high a plane of nutrition and could provide less milk for their calves. Buskirk *et al.* [10] used crossbred heifers to determine the effects of dietary energy on subsequent heifer productivity. They reported that high dietary energy decreased subsequent milk production, calf weaning weight and mammary dry fat free tissue ( $p < .05$ ).

Effect of dam's average daily gain from birth to weaning on calf's weaning weight was negative but small ( $P > 0.10$ ) in all three models. The effect of dam's average daily gain from weaning to end of breeding season on calf's weaning weight was positive and large ( $p < .0001$ ) in all three models. A heifer receiving a high plane of nutrition from her dam through the maternal environment (i.e. milk production) may deposit fat in

her udders causing poor labuleaveolar system development [10]. Thus, she would not have high milk production and would provide a poor maternal environment to her calf. Consequently, the calf could undergo compensatory growth after weaning, when removed from the poor maternal environment [11]. This would be shown as an increase in weight during the heifer's period between weaning and end of breeding

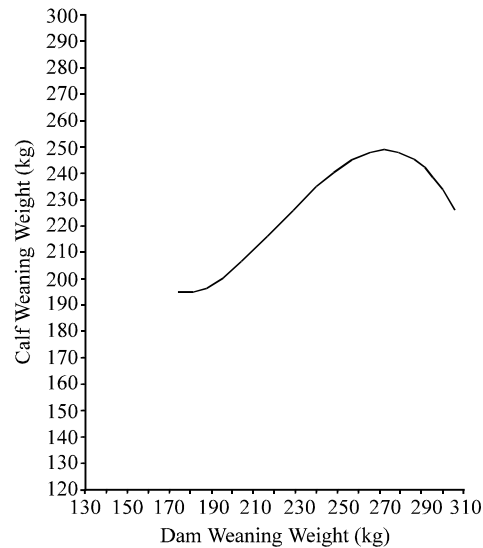


Fig. 1: Dam Weaning Weight on Calf Weaning Weight, Cubic (kg)

season. In addition, since the heifer does not have an inhibited labuleaveolar system, she should provide a good maternal environment to her calf, increasing the calf's weaning weight.

Effect of dam's amount of fat on calf's weaning weight was negative and large ( $p < .0001$ ). This suggests that over-conditioned heifers are likely to have lighter calves. A heifer that weighs more when compared to her height would not be a good choice as a replacement. Effects of amount of fat (AMF=calf weaning weight/weaning height) on pregnancy and the effects of calf weaning weight on the ability to breed and rebreed was investigated since low fertility is one of the main culling criteria. The effects of AMF on pregnancy and calf weaning weight on the breeding and rebreeding ability was large ( $p < .01$ ).

To study the effect of amount of fat on conception, the herd was divided into three groups. The first group was composed of heifers with the amount of fat measurement (adjusted 200 day weight/weaning height) 12.83 or greater. The next group included those with a measurement between 12.82 and 8.90. The last group was made up of those measuring less than 8.90. The percentage of heifers bred was 73.08, 66.94 and 52, respectively for the three groups. This indicates that the amount of fat does not adversely affect a heifer's ability to breed as some of the literature suggests [6]. On the other hand, these results might show that the heavier

animals reach puberty earlier and, thus, have more chances to conceive.

Weaning weight of a heifer may be an important factor in her fertility. The heifers were divided into three groups according to their weaning weights, with the top group having a weaning weight of 267.17 kg or greater. The middle group included those with weights between 267.17 and 167.38 kg. The last group weighed less than 167.38 kg. Those with the highest weaning weights had the largest conception rate (80 %). The middle group followed with 76.15 % and the lightest heifers had only 39.29 %. This suggests that the heavier a heifer is at weaning, the more likely she is to conceive. This is probably because they reach puberty sooner and therefore have more chances to get bred.

The effect of weaning weight on rebreeding was investigated also. The first group animals were either equal to or heavier than 265.35 kg, followed by the animals between 265.35 and 168.28 kg and animals lighter than 168.28 kg. Ninety two % of the animals in the first group were rebred. The middle group followed with 85.68 % rebred and the lightest group had rebreeding percentage of 66.67. This does not agree with some literature which suggests that animals with heavier weights do not rebreed as well as the animals of normal weight [12]. This study shows that heavier heifers have a higher percentage of conception rate and they hold on to this advantage later in life-at least for the second pregnancy.

### CONCLUSION

Increased weights of heifers may help producers to have higher conception rates and heavier calves. However, increasing dam weaning weights over 272 kg have no advantages in terms of the succeeding calf weights. Heifers with high weight/height ratios (fatter heifers) may result in lighter calf crop.

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