

GENETIC PROGRESS THROUGH SELECTION FOR POSTWEANING GAIN IN  
ANGUS AND HEREFORD CATTLE

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SUMMARY

On a long-term study, where the selection criterion was superior postweaning gain, one line of each of the Angus and Hereford breeds was fed an 80% concentrate:20% roughage diet and the second line of each breed was fed a roughage diet. After 12 years of selection, progress was measured by comparing the progeny of selected bulls with those of foundation bulls. Significant progress was made for postweaning gain in both breeds, particularly on the concentrate diet. In the Angus, the advantage carried through to weight-per-day-of-age to end of test and final feedlot weight. Birth weights of selected Hereford lines had declined. Angus cows selected on the roughage diet had a significantly higher yield of milk, fat, solids-not-fat and protein than those tested on the concentrate diet. The trend was similar in the Herefords.

Key words: Beef Cattle, Selection, Diet, Postweaning Gain

INTRODUCTION

Prewaning and postweaning calf growth rates are known to be influenced by a number of genetic and environmental factors. In total, these factors can add up to a major source of economic loss or gain to the beef cattle industry. Calf birth weights and weaning weights are influenced by the genes received from the sire and dam (direct effects), by the pre- and post-parturition maternal environment, by the sex of the calf and by interactions among the above effects. During the postweaning feedlot period, such traits as body weight gain and weight-per-day-of-age are influenced by breed type and level of energy in the feedlot diet (Cundiff et al. 1984; Price et al. 1984). The objectives of the present report were (1) to assess the effects of direct selection for postweaning gain; (2) to determine the extent selection is affected by different planes of nutrition; (3) to determine the effect of selection and plane of nutrition on correlated traits.

MATERIALS AND METHODS

Experimental Herd and Management.

In June, 1963, 216 registered cows within each of the Aberdeen-Angus and Hereford breeds were assigned at random within cow age group and herd of origin to two lines within each breed. Lines were designated 1 and 2 in the Hereford breed and 3 and 4 in the Angus breed. Each 108-cow line was comprised of equal numbers of females within each age group from one to six years. In 1964, an additional 18 yearling helpers were assigned at random to each line to replace the oldest age group. Twelve bulls of each breed were designated for breeding use in each of the first three years (1963-65) and six in the fourth year (1966). Two bulls of each breed were replaced during the first three years. The above-described 504 cows and 28 bulls made up the foundation herd. Each year, each foundation bull was mated to 18 cows, nine from each

line within a breed so that progeny within the two lines would have a similar genetic base before selection began (Bailey and Lawson, 1985). The selection criterion was outstanding postweaning gain during the 168-day period immediately following weaning.

Only the calves of the two lines within a breed were treated differently. The calves from one line of each breed were fed a concentrate diet (60% barley, 10% oats, 10% beet pulp; 20% chopped alfalfa hay; 3106 kcal DE/kg) intended to promote a rapid growth rate during the 168-day postweaning test period (Lawson, 1966). Calves from the second line of each breed were self-fed a chopped alfalfa diet (2095 kcal DE/kg) intended to promote a much slower growth rate but still allow animals to achieve sufficient growth to be used for breeding at 14 months of age. Cows of all four lines were run together year-round, except during the 42-day breeding season, beginning on July 5, when they were in adjacent Russian wildrye pastures. Calves were grazed with their mothers on range from calving to weaning, November 1, and were not creep fed.

#### Interim Test (1977-78).

Following 12 years of selection, an estimate of genetic progress due to selection was made by comparing the performance of the progeny of selected bulls used in natural service to those of foundation sires (designated L 5 in Hereford and L 7 in Angus when fed concentrate diet and L 6 in the Hereford and L 8 in the Angus when fed roughage diet) used through artificial insemination. The selection project cows were used as the test herd. Each bull was randomly allotted a breeding group with equal representation from each age group and line within a breed. Over two years, progeny of both sexes were individually fed in the test facilities at Lethbridge. Each calf, starting at weaning, November 1, was placed in a 4 x 2 m pen with access to water and a self feeder for 168 days.

Analyses, run separately on interim test data within each breed, determined the effects of Line of sire (1 vs 2 vs foundation Hereford or 3 vs 4 vs foundation Angus), year of birth, sire, dam, sex of calf, plus interactions for each of birth weight (BW), weaning weight adjusted to 200 days (WW200) and average daily gain (ADG) as well as the regressions of dam age and birth date on the above traits.

Additional analyses considered the effects on FG, FWT and WPDA of age of dam, year of birth, sire, and sex within each line (1 vs 5 and 2 vs 6; 3 vs 7 and 4 vs 8) and the effect of diet, age of dam, year of birth, sex, sire, and sire x sire. Regressions of dam age and calf birth date were included in the analyses of postweaning traits. The analyses were repeated without the interactions when they were found to be non-significant.

#### Milking Test.

Data on the weaning performance of the four lines of cattle identified a tendency for progeny of cows tested and selected on the roughage diet to have lower weight, but consistently higher gains to weaning than those from cows tested and selected on the concentrate diet. Twelve cows in each of the 2-, 3-, and 4-year age groups from each line were milked twice (following oxytocin injection) 8 hrs apart on one day in each of early June, mid-August, and mid-October. Estimates from the second milking of the day were made for daily milk yields and the percentages and yield of fat, solids-not-fat, and protein. Comparisons were made only between lines within a breed.

## RESULTS

### Interim Test.

Preweaning Traits. In the Angus progeny, 12 yrs of selection did not change birth weights or weight gain during the preweaning period. However, Hereford progeny from foundation bulls had heavier birth weights than calves sired by L 1 or L 2 bulls. Coefficients of variation were 12.0, 13.2 and 11.4% for Angus and 10.6, 15.9 and 13.0% for Hereford calves for BW, ADG and WW200, respectively. Fixed effects and dam effects were significant for BW, ADG and WW200 except for year, which was not significant for BW. The regression of birth date on weaning weight indicated that as cow age increased, WW200 increased and calves born early in the spring grew slightly faster (+ .56 kg/day) than did calves born late. Weaning weights showed no differences between progeny from selected or foundation sires. In all lines, bulls exceeded heifers for all preweaning traits ( $P < 0.01$ ), averaging 6% heavier at weaning.

Postweaning Traits. For feedlot gain, on the concentrate diet, L 1 > L 5 (Table 1) and L 3 > L 7 ( $P < 0.01$ ) whereas on the roughage diet, the trend was for the progeny of the selected Angus bulls to exceed the progeny of foundation bulls (L 4 > L 8,  $P < 0.10$ ). Bull calves on both diets gained more weight and had a higher WPDA than heifers. Overall, bulls on the concentrate diet averaged 49 kg heavier than heifers on the same diet and 75 kg heavier than bulls fed the roughage diet. Coefficients of variation for FG, FWT and WPDA were 19.2, 10.2, and 10.2% for Angus calves and 20.9, 11.7 and 11.8% for Hereford calves, respectively. The effects of sex, year, and diet were generally significant for all traits. Diet x sex interactions were significant for FG and WPDA in the Angus calves but only showed a trend ( $P < 0.15$ ) in the Hereford calves. No other two-factor or any three-factor interactions were significant.

Milking Traits. Angus 2-, 3-, and 4-year-old cows tested and selected on the roughage diet exceeded those on the concentrate diet in yield of milk (5.1%), fat (7.6%), solids-not-fat (7.8%) and protein (12.5%). The estimates represented a period of 120 days and therefore underestimated both the yield and the line differences. Not included were the 45-50 days between parturition and the first sampling which occurred shortly after expected maximum milk production would have been achieved, and the 20-30 day period between last sampling and weaning. The trend was identical for the Hereford lines for all four traits, although the differences were not significant.

## DISCUSSION

### Interim Test.

Preweaning. Birth weights in the selected Hereford lines were lighter than progeny from the foundation Hereford sires, although WW200 did not differ. Possibly selection for postweaning gain has in fact lowered the birth weights in the selected lines of Hereford calves. In the Angus cattle, birth weights were similar yet the weaning weights of L 3 calves tended ( $P < 0.10$ ) to be higher than progeny from L 4 and foundation sires. Our results for preweaning gain and WPDA indicate a similar performance among the lines within each breed. Interactions involving diet x dam effects were significant for several traits (Gain, WPDA and WW200) in the Hereford breed only. Thus, progeny of L 2

Hereford dams mated to either L 1 or L 2 sires consistently had higher preweaning ADG and WW200 than the progeny from L 1 dams. On the basis of observations noted above, it is assumed that L 2 dams must be providing a better milk supply to their offspring and thus higher values for ADG and WW200. Possibly the reason for the lack of a significant diet x dam interaction in the Angus breed is the higher initial preweaning values in the progeny of both foundation and selected bulls.

Postweaning. Postweaning gain of Angus progeny fed the concentrate diet showed a definite ( $P < 0.01$ ) response to selection, indicating the existence of much genetic variation for this trait within the breed. The combination of selection and a relatively high dietary energy have resulted in impressive gains on this diet. The response by Hereford progeny was similar, although not at as high a level as that obtained by the Angus calves (L 3). In both breeds, selection on the concentrate diet has been effective in increasing the rate of gain during the postweaning period. Although the response from progeny on the roughage diet has been less dramatic (in both breeds) than those fed the concentrate diet, the trend is certainly the same. The corresponding WPDA and FWT support the results for FG. Bull calves gained considerably more than heifers on the corresponding diets during the 168-day feedlot period. The large differences between bulls and heifers, where Angus and Hereford bulls gained 49.0 and 38.6 kg more than heifers and grew 25-35% faster during the 168-day test, are in the range that would be explained by sex effects alone.

#### Milking Test.

Although milk yield was underestimated and selection had been practised for just over 10 years, there was evidence that milk production had already responded to selection. Speculation is that the response to selection has been different in the two diets (perhaps the cows selected on the roughage diet are more efficient) or that the concentrate diet has had a deleterious effect on the udder so that genetic potential cannot be expressed. The answers will be sought in 1986 to 1988 when, after 19 years of selection, 2-year-old heifers from each line, half of which have been tested on concentrate and half on roughage, will be assessed for yields of milk and milk constituents and udder morphology and histology.

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Table 1. Least squares means, by line, for postweaning traits

Trait	Hereford				Angus			
	Concentrate		Roughage		Concentrate		Roughage	
	1	5	2	6	3	7	4	8
Gain (kg)	158.9b	150.3b	95.7	92.8	170.5a	153.8a	104.5	6.1
WPDA (g/day)	903.2	878.4	733.4	735.1	977.6a	917.6a	784.8	1.5
FWT (kg)	325.2	315.5	263.6	264.5	353.7a	332.5a	284.2	5.1

Within breed and diet, comparisons with the same letter are significant different (a = P < 0.01; b = P < 0.05).