

## Beef Cattle Selection Studies

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Selection is the judgement exercised in the choice of individuals allowed to reproduce. Such selection, along with natural selection operating on reproductive capacity, has been responsible for most of the genetic change in livestock. Selection is the only directional force at the disposal of the stockman to change the genetic composition of his herd. Thus, in any breeding program, selection is the primary tool employed.

Although of primary importance, the theoretical study of selection is limited, due to mathematical problems. Genetic progress achieved by selection has long been predicted using the equation that response equals heritability times the selection differential. For single trait selection, this prediction has been surprisingly accurate. But for predicting genetic progress from selection as presently practiced, answers are necessary from actual selection studies involving several economic characters in beef cattle. Selection experiments not only give numerical estimates of genetic change that are of immediate practical use to breeders but they test current selection theory and focus attention on genetic problems that can be incorporated into existing theory.

This study is designed to measure the genetic change that results from selection for increased weight and grade of Hereford and Angus cattle both at weaning and as yearlings. What follows is a brief description of this study and some data on early selections.

### PROCEDURE

Table 1 gives the plan of the experiment being conducted at the Ft. Reno Station. Foundation animals comprising the lines are a broad genetic sample of the breeds. Approximately 40 spring dropped calves within each line or herd are produced yearly. The cows and calves summer on native grass pasture. The calves are weaned in late September or early October. The seven month or 210 day weight is calculated as follows: Actual weaning weight minus birth weight divided by actual age in days times 210 plus birth weight. This weight is then adjusted for

Table 1. Plan of Experiment

Line Number	5	6	7	8	9	10
Breed: H = Hereford, A = Angus	H	H	A	A	A	A
Selection:						
Traits: Month of weight and grade	7	12	7	12	12	12
Criteria: I = Individual, P = Progeny	I	I	I	I	P	P
Generation Interval: years	4	4	4	4	6	6
Number Males Selected per year:	2	2	2	2	5	5
Mating System: C = closed, O = open	C	C	C	C	C	O

age of dam and also sex when necessary. Feeder grades (fancy, choice, good, etc.) are put on the calves at weaning. A score of 1 to 15 is used with 11 being average choice.

Immediately after weaning, the bull calves are self-fed in groups a 40% roughage ration for 154 days. The ration fed is made up of the following ingredients:

- 35 percent ground whole ear corn
- 20 percent cottonseed hulls
- 10 percent ground alfalfa hay
- 10 percent whole oats
- 10 percent wheat bran
- 10 percent cottonseed oil meal
- 5 percent molasses

Twelve month weight of the bulls is as follows: The adjusted weaning weight plus 154 days times the average daily gain in the feedlot. This gives a 364 day weight. Feedlot daily gain is obtained by averaging the 142, 154 and 168 day weights minus the unadjusted weaning weight divided by 154. All weights are taken after the animals have been off water for 12 hours.

The heifer calves are wintered on dry native grass and winter small grain pasture. They normally will gain from 75 to 125 pounds from fall to spring. They are exposed to the bull when approximately 15 months of age and weigh around 600 pounds. Eighteen month rather than twelve month weights are taken on heifers. Gains during the grazing season permit greater expression of genetic differences at 18 rather than 12 months. Eighteen month weight is the adjusted weaning weight plus 330 days times the average daily gain from weaning to 18 months. This regime gives a 540 day weight for heifers and it allows them to express their subsequent maternal ability without the danger of too high feed levels at an early age.

Both bulls and heifers are graded at the end of their respective tests. A score of 1 to 15 is again used; however, this score is not precisely a slaughter grade because soundness and muscling are of more concern. All calves regardless of line are measured for all characters even though selection in a given line is either for weaning or yearling characters.

As shown in Table 1, one Hereford and one Angus line (5 and 7) are selected for weaning weight and grade at seven months. Selections are made on the performance of the individuals. Weaning weight and grade are the most important traits cow herd owners are dealing with a cow-calf operation since they represent a quality and quantity combination of marketable products. Weaning weight and grade are complex characters in that they are due in part to the genes of the calf and to the genes of the cow for maternal performance. A study of this selection response will be of both practical and theoretical importance. The two lines serve as replication or to make the project more reliable. With such different genetic background, it will not be surprising to find different



rates of response in the two lines to selection pressure for these traits. This possibility, even within a species, makes it important to study beef cattle rather than use results from laboratory species.

As indicated in Table 1, one Hereford and one Angus (6 and 8) are selected for yearling weight and grade. These characters are of obvious economic importance. Since weaning weight is 7/12ths of yearling weight, selection pressure will still be directed toward weaning weight. But post-weaning gain and grade are also included. The heritability or the relative amount of genetic variance for yearling weight has been reported as 60%. This indicates that selection for yearling weight should be effective. Verification of this potential for genetic change and the possibility that not only growth rate but maturity differences are involved make it extremely necessary to conduct such controlled selection studies. This empirical evidence is essential in the construction of more comprehensive selection theory and to help answer the critical question of mature size for the pure-bred and commercial beef cattle industry.

As indicated in Table 1, two additional lines are selected on yearling weight and grade. In these lines (9 and 10) selection is based on the progeny test of sires rather than individual performance. Each year, five young bulls are selected on their own performance and then progeny tested on some 25 commercial cows each. In line 10, young bulls can be introduced from the breed while all other lines are closed to outside blood. Selection of bulls will be made by using the average carcass grade and carcass weight per day of age of their steer progeny. Thus, selection will be more precise since it is based on the progeny of the individual and on the carcass weight rather than live weight. This extra precision costs an extra two years in terms of generation interval. Selection progress must be compared on some time interval to be realistic. The reason for having progeny test lines is to develop the procedures for such selection since it may be essential for locating genetic differences in the future.

By comparing the response of weaning weight and grade in the lines selected for yearling weight and grade and also the reverse, estimates can be obtained of the genetic correlations between them. This will answer the industry question of whether a producer can confine his selection to weaning data when his calf crop is ordinarily sold or whether some selection must be placed on weight and grade after a short feeding test. Theoretically these genetic correlations are of interest since they involve the relationship between growth and maternal performance.

## METHOD OF SELECTION

The main selection pressure is on the bulls. What little selection can be practiced on the females is done on similar criteria. The selection procedure is that of independent culling levels for weight and grade. Primary consideration is given weight. The heaviest bull is

selected provided he is in the upper 25% for grade. Only one bull per year out of approximately twenty is selected on his own phenotype in lines 5 through 8. Table 2 and 3 are constructed to illustrate the procedure of bull selection in the two Hereford lines. The four Angus lines are still in the foundation phase of the experiment.

Table 2 gives the selection chart for weaning weight and grade in line 5 for 1963. The fact that weaning weight and grade are correlated is evidenced in the table. Calf 311 had an adjusted weaning weight of 545 pounds. The difference between his weight and the average of line 5 bulls was 66 pounds which is the selection differential. Thus, if heritability is 30% one would expect the progeny of this bull to average 10 pounds above the herd average. ( $\frac{1}{2} \cdot 66 \cdot .30 = 10$ )

Table 3 does not indicate a strong correlation between weight and grade as yearlings. Calf 332 was selected even though calf 301 was heavier by 22 pounds. The restriction that the calf must be in the top

Table 2. Selection chart for weaning weight and grade in Line 5 for 1963.

Weight	8	9	Grade 10		11	12
575 — 550						
549 — 525					311	313
524 — 500		328	331	336	304	
499 — 475		330	335	322	305	
474 — 450		310		324	312	
449 — 425		317		308		
424 — 400						
399 — 375	306*	301				

\* The numbers in the body of the table represent the bulls.

Table 3. Selection chart for yearling weight and grade in Line 6 for 1963.

Weight	7	8	9	Grade 10		11	12
1000 — 975			301	332			
974 — 950	310					304	
949 — 925		326	327	303			336
924 — 900		314		308			324
899 — 875			309	317	305	315	
874 — 850			313				
849 — 825		307		333		312	
824 — 800	318						
799 — 775							
774 — 750							
749 — 725							
724 — 700							
699 — 675			321				
674 — 650							



25% for grade limited the selection for yearling weight in this instance. The yearling weight of calf 332 was 975 pounds being 81 pounds above the average weight of his contemporaries. If heritability of yearling weight is 60% his progeny should average 24 pounds above herd average. ( $\frac{1}{2} \cdot 81 \cdot 60 = 24$ )

## MEASURES OF GENETIC CHANGE

Genetic progress is measured by using each selected sire two years. Each year two sires are mated to a comparable half of the females in each line. The difference between the average performance of progeny by the new sire when compared with the progeny average of the repeat sire constitutes the measure of genetic gain from selection. The comparison of the progeny averages of a sire from the first year to the second year gives the environmental change from one year to the next. Also semen is being frozen from foundation sires used over all lines. This semen will be stored for five years and used in comparison with the sires currently in use for another measurement of genetic change.

## SUMMARY

This selection study involving beef cattle is designed to measure the genetic change resulting from selection for increased weaning weight and grade or yearling weight and grade. The experimental procedure is briefly outlined. The method of selection is illustrated using data from the 1963 season.

## Effect of High or Low Winter Feed Levels in Alternate Years on Growth and Development of Beef Heifers

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Due to the significance of the cow-calf operation to the agricultural economy of Oklahoma, we must be intensely concerned with proper feeding and management to bring out the inherent producing ability in the beef female. Extensive studies at the Ft. Reno station since 1949 have explored different winter feed levels and systems of feeding to get maximum production, yet reduce supplemental feed costs as much as possible.