

Selection of Cows for the Breeding Herd.

II. Consistency of Cow Productivity as Measured by Calf Weaning Weights

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Story in Brief

Several studies have indicated that the weaning weight of a cow's first calf was a better indicator of a cow's future productivity than the cow's own early growth performance. The purpose of this study was to determine the relationship between a cow's early productivity and her subsequent productivity as measured by the weaning weight of her calves. To examine this relationship, the weaning weight records of 2,664 Angus calves from 680 cows and 634 Hereford calves from 183 cows were analyzed.

The repeatability of calf weaning weights from the same cow were found to be 0.27 and 0.50 for Angus and Hereford cows, respectively. This significantly higher repeatability for Hereford cows indicated that Hereford cows were more consistent in their level of productivity as measured by calf weaning weights. Regression coefficient of the weaning weight of a later calf on the weaning weight of an earlier calf indicated a degree of relationship of approximately the same magnitude as the repeatabilities for the two breeds for those calf weaning weights 4 years or less apart. Regression coefficients between weaning records 5 or more years apart were considerably lower. These results indicate that calf weaning weight would be a good indicator of a cow's subsequent productivity for up to 4 years and would have limited value as a predictor of a cow's productivity 5 or more years in the future.

Introduction

The economic contribution of the cow-calf enterprise to Oklahoma's economy is highly dependent on the weaning weight and grade of the calves produced by the approximately 2.2 million beef cows in the state. Total production can be substantially increased if the proportion of cows consistently producing heavy weaning weight calves every year of their productive lives can be increased. Cow-calf production testing programs have made cattlemen aware of the need for improved techniques and breeding plans that will increase cow productivity.

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Improvement of weaning weights is dependent upon increasing pre-weaning growth potential of calves and the mothering ability (mainly milk production) of the cows. If selection for weaning weight is to be most effective, cow productivity must be accurately estimated at an early age. Although helpful, a cow's own weaning weight and yearling weight performance do not provide very accurate predictions of her future productivity (See preceding article). A more accurate estimate of cow productivity is provided by the weaning performance of the first calf. The purpose of this study was to determine the relationship of a cow's early productivity (early lactations) with her subsequent productivity as measured by the weaning weight of her later calves.

Experimental Procedure

Data from two beef cattle selection projects collected from 1958 to 1971 were used in this study. These projects included cattle at both the Lake Carl Blackwell Range west of Stillwater and the Fort Reno Livestock Research Station at El Reno. Weaning weights from 2,664 Angus calves from 680 cows and 634 Hereford calves from 183 cows were analyzed. The cattle in this study were considered to be representative samples of both breeds and constituted a broad enough genetic base to provide information characteristic of these breeds.

The cow herds were managed similar to local progressive beef herds under a native range grazing program. Wheat pasture was grazed in the winter when available. Alfalfa and/or prairie hay was fed as needed in the winter. Up to 3 lbs. per head daily of cottonseed cake or equivalent protein supplement was fed during the winter with the actual amount being determined by location, year and condition of the cattle. A special effort was made to maintain uniform grazing conditions for all animals at each location.

The females in each herd were allotted to 15 to 30 cow single sire breeding groups. The breeding season ran from May 1 to July 31. All calves were spring born with the majority coming in February and March. Only calving records of cows 11-years-old and younger which calved first as a 2-year-old were included in this study.

All calves were identified and weighed at birth. Approximately 35 percent of the male calves were castrated at about 3 months of age and the other 65 percent were raised as bulls. All calves were raised by the cows on native range without any creep feed and were weaned and weighed at an average age of 205 days, which normally occurred in late September.

Measured differences in calf weaning weights are due mainly to genetic and environmental causes. Genetic merit can be more accurately estimated when cattle are managed under similar environmental con-

ditions and when their weights have been corrected for known non-genetic or environmental factors. The calf weaning weights were corrected by appropriate procedures for differences in age at weaning, age of dam, sex, year and herd. The weaning weights were corrected to a 205-day mature dam and female basis. Sires were considered a random source of variation in this study, and thus, were not corrected for.

Results and Discussion

The average 205-day weaning weights adjusted for age of dam, sex and year effects for 2,664 Angus calves and 634 Hereford calves were 426 and 435 lbs., respectively. The standard deviations for weaning weight were 42 and 49 lbs. for the Angus and Hereford calves, respectively.

The beef cow influences her calves both by the genetic material she contributes to them and by the mothering environment (mostly level of milk production) she provides for them. Thus, calf weaning weight is the measurable expression of these two traits of the cow, and a cow's productivity is measured every time she weans a calf. If a cow tends to produce similar weight calves each year, the first calf would be a reliable measure of future cow productivity. In this case, culling cows based on the weaning weights of her first few calves would be an effective practice for increasing the level of cow productivity in the herd. On the other hand, if the weaning weight of calves produced by the same cow are not very consistent from year to year, then culling cows on the basis of the performance of the first one or two calves would not be an overly effective practice in terms of increasing the average level of cow productivity in the herd.

The degree of consistency or repeatability of cow productivity can be measured by determining the relationships among weaning weight records of calves produced by the same cow. These relationships were determined by the statistical procedures of intraclass correlation (statistically determined as a ratio of variance components which measure the correlation among calves produced by the same cow) and linear regression coefficients. In both cases, larger coefficients indicate a stronger relationship and, thus would indicate a higher degree of consistency in cow productivity from year to year.

Table 1 presents the analysis of variance from which the repeatability of calf weaning weights were calculated. The repeatability estimates (statistically intraclass correlation coefficients) measure the proportion of the total variation (differences) among the calf weaning weights that were caused by permanent (mostly genetic) differences between cows. The total variation is the permanent cow effects plus the temporary differences which are independent and vary from calf to calf

produced by the same cow. The important data in Table 1 are the repeatability estimates for Angus and Hereford cows, which were 0.27 and 0.50, respectively.

The 0.50 repeatability estimate obtained for Hereford cows was quite significantly¹ higher than the 0.27 value obtained for Angus. There was apparently more permanent variation (larger differences) among Hereford than Angus cows. A possible factor contributing to these differences as measured by weaning weight is a greater tendency for Angus cows to permit nursing by other calves in addition to her own. A calf's weaning weight is influenced by total milk consumption which, in the case of Angus calves, may not have necessarily been all attributable to its dam. The higher repeatability in Hereford cow performance does indicate a more consistent pattern of productivity. Thus, culling cows on the basis of the weaning weight performance of her first calf or two would be expected to be more effective in Hereford than in Angus cattle.

The very significant¹ differences among cows within herds indicates a substantial amount of genetic differences for cow productivity within each herd and also within each breed (mean square column of Table 1).

Table 2 presents regression coefficients of later calf weaning weight records on earlier weaning weight records from the same cow. These regression coefficients involve pairs of weaning weight records that are separated by different amounts of time, ranging from successive records one year apart to pairs of records eight years apart. Whereas, the intra-

¹ Statistically significant effects or differences indicate the evidence is strong that the estimated effects or differences are real rather than caused by chance variation.

Table 1. Analysis of Variance and Repeatability Estimates of Calf Weaning Weights¹

Source of Variation	df	Mean Square	Component of Variance
Angus:			
Among herds	4	12841**	18.0
Among cows within herds	675	2777**	422.6
Among calves within cows	1984	1129	1129.4
Repeatability ² = 0.272 ± .021			
Hereford:			
Among cows	182	4512**	1014.2
Among calves within cows	451	1005	1005.4
Repeatability ² = 0.502 ± .040			

¹ Average number of calves per cow was 3.91 for Angus and 3.46 for Herefords. There were 5 herds of Angus but only one herd of Herefords.

² Repeatability is the intraclass correlation estimate (\pm its standard error) of the relationship among calf weaning weight records of the same cow. These repeatability estimates were significantly different ($P < .001$).

** $P < .01$.

class correlation estimates of the repeatability of cow productivity considered all weaning weight records of a cow at once, these regression coefficients examine the relationship between specific pairs (years of separation) of weaning weights of calves produced by the same cow. There was a consistent reduction in the magnitude of the regression coefficients as the time interval between records increased for both breeds. For weaning records four years or less apart, the relationship between paired records in the Herefords was significantly higher than in the Angus. When members of the pair of records were separated by five or more years, the relationship was somewhat lower and similar for both breeds. This decreasing trend in the regression coefficients as the time interval between records increased was perhaps due to several factors: (1) changes in management and nutrition practices, (2) weather conditions, (3) genetic quality of sires used, (4) nature of the permanent cow effects due to varying rates of aging and (5) selection of cows which reduces the permanent differences in the cows kept in the herd. These regression coefficients generally indicated that early cow productivity is probably at best only a poor basis for estimating cow productivity more than four years in the future.

The significantly higher repeatabilities of cow productivity of the Hereford cows over the Angus cows for weaning weight records four years or less apart were similar to the differences in repeatability observed between the two breeds using intraclass correlations (Table 1). Probably the most reasonable explanation for the lower relationship among calf weaning weight records of the same cow in Angus than Herefords is

Table 2. Regression Estimates of the Relationship Between Calf Weaning Weight Records of the Same Cow Calculated From Pairs of Records Having Different Years of Separation

Years of Separation ¹	No. of Pairs	Angus		Hereford		
		Regression ¹ Coefficient	Standard Error	Regression ¹ Coefficient	Standard Error	
1	1859	0.29**	0.02	408	0.53**	0.04
2	1417	0.26**	0.03	283	0.44**	0.06
3	1043	0.24**	0.03	197	0.47**	0.07
4	748	0.24**	0.04	137	0.42**	0.08
5	501	0.27**	0.04	82	0.28**	0.10
6	309	0.12*	0.05	48	0.17	0.13
7	172	0.13	0.07	19	0.04	0.22
8	72	0.14	0.10	7	0.12	0.30

¹ The linear regression coefficient for later on earlier calf of the same cow.

* P < .05.

** P < .01.

the previously discussed community nursing behavioral trait in Angus cows. It is generally accepted among cattlemen that Angus cows are more willing to let bum or foster calves nurse than are Hereford cows. Several Angus cows involved in this study have been observed nursing more than one calf at a time even though it was known that they only had one. This behavioral trait tends to cover up permanent differences between cows for calf weaning weight productivity, thus resulting in a lower level of consistency in weaning weight performance of calves from the same cow.

Results from other studies are in agreement with those of this study, and generally, they indicate that weaning weight of a cow's first calf would be a better indicator of her future productivity than either her own weaning weight or yearling weight (see preceding article).

Results from this study clearly show that the weaning weights of a Hereford cow's early calves would be a more accurate indicator of future productivity than would those of Angus cows. Thus, culling Hereford cows whose first calf has a low weaning weight should be more effective in increasing the average level of productivity of the herd than would be the case with Angus. Breeders may be justified in keeping some Angus cows with low initial records (so long as they are not extremely below average) for a second or third calf and cull on the basis of average performance.
