

Inheritance of Mothering Ability in Beef Cattle

Charles A. Pratt, J. A. Whalley, Jr., and Doyle Chambers

In Oklahoma, the production of feeder calves is one of the major enterprises of the beef cattle industry. Oklahoma farms and ranches are estimated to have 1½ million head of beef cows and heifers that are two years old and older. Studies of cow and calf operations reveal that approximately \$1000 in capital is invested or managed for each brood cow maintained in a breeding herd. With the high capital requirement of the beef cow and with the trend to slaughter younger cattle, Oklahoma stockmen are finding that mothering ability is one of the more important traits in their herds.

Commercial cattlemen have recognized the importance of this trait for many years. Breeders have culled open cows and cows that raise "dogie" calves. As a result, cows which spend their lifetime in a herd have raised a calf regularly and none were "dogie". Before these old cows were removed from the herd, their last heifer calves would be retained for replacement purposes.

With the technological changes that research has brought about in beef cattle breeding, many stockmen are now maintaining production records on their herds to add precision to their selection. This increased accuracy in selection is the result of our increased knowledge of the heritability of many important traits.

Many traits in beef cattle are so strongly influenced by environment that a particular trait in a rather uniform environment (or ranch), would appear highly heritable while this same trait in another more variable environment (or ranch), would appear to have a low heritability. Due to this feature, we cannot expect selection to be equally effective for a given trait under all environmental conditions.

Procedure and Results

The purpose of this study was to estimate the heritability of mothering ability in beef cattle, using the adjusted weaning weights and weaning scores of calves produced by groups of paternal half-sisters. The data used in this study were secured during a five year period from five registered and commercial herds located in the northeastern part of the state. Three were Hereford herds and two were Angus herds.

Weaning weights of all calves were adjusted to a standard age of 205 days; the records of heifer and steer calves were adjusted to a bull equivalent; and the weights of calves from cows of all ages were ad-

justed to a mature dam equivalent of six and seven years. The correction factors used were those of the Oklahoma Extension Division's beef cattle program.

Table I shows the extreme variations that were observed between different sire progeny groups of daughters at four of the ranches. These sire differences may be more extreme than found in some herds, but the point is that sire differences do exist. Selections that are based on sound records of performance should prove effective in improving this trait.

Table I.—Intra-herd Production Differences Between Groups of Daughters by Several Sires.

Ranch	Mgt. of calves	Sire	Number daughters	Total records of daughters	Average Weaning wt., lbs.	Average Weaning score ¹
1	Non-creep fed	M1	13	44	420	85
		M4	11	21	350	82
2	Creep fed	P4	11	29	432	88
		P2	8	18	414	88
3	Non-creep fed	B5	4	8	452	85
		B9	10	20	437	87
		B1	16	24	409	83
4	Creep fed	L11	9	22	504	87
		L17	16	22	451	85
		L10	11	25	448	85

¹Weaning score code: 91 — up very top herd replacement.
86 - 90 average herd replacement.
81 - 85 Low end of herd replacements.

The records of 680 calves produced by a total of 368 daughters sired by 130 bulls were used to make these heritability and repeatability estimates. These estimates were obtained from intraclass correlations computed from two statistical designs. From the hierarchical design with a single classification, the heritability estimates as measured by the adjusted weaning weights and weaning scores of calves were .19 and .30, respectively. From the cross classification, where records on the sire's daughters' production were available for three consecutive years (1956, 57, and 58), heritability estimates were .22 and .40 for weaning weights and weaning score, respectively.

Table 2 summarizes various heritability and repeatability estimates of mothering ability in beef cows as measured by the weaning weights of their calves. The estimates for repeatability range from .29 to .52. The estimates for heritability range from .19 to .39. However, the high estimate of .39 was obtained by the use of the average of several records on each cow. This use of average production on individuals will naturally increase the heritability of a trait as compared to single record measurements.

Table 2.—Summary of Estimates of Heritability and Repeatability of Mothering Ability in Beef Cattle as Measured by Weaning Weight of the Calf.

Source	Heritability	Repeatability
Botkin and Whatley (1953) J. Animal Sci. 12:552		.43
Chambers <i>et al.</i> (1956) Okla. Agri. Exp. Sta. MP-45:30		.30
Chambers <i>et al.</i> (1958) Okla. Agri. Exp. Sta. MP-51-69	.28	
Dawson <i>et al.</i> (1954) J. Animal Sci. 13:556	.19	
Kieffer (1959) PhD thesis, Okla. State Univ.	.39	
Koch (1951) J. Animal Sci. 10:768		.52
Koger and Knox (1947) J. Animal Sci. 6:461		.49
Present data	.19 .22	.29

In Table 3 the heritability of .2 is used to estimate the progress to be expected in a herd with a given amount of selection in the dams of heifer replacements and in the selection of dams of the sires of replacement heifers. More selection pressure can be applied on the sire's side, but this effect is diluted by the fact that we cannot select the sire directly for this trait and must normally select on his dam's production, at least, until such time as he has daughters whose production can be measured. Then we can apply progeny test selection. This can be illustrated by referring to Table 1. At Ranch 1 the daughters of sire M1 weaned calves averaging 70 lbs. heavier than the daughters of sire M4. This 70 lb. difference in favor of sire M1 is a difference in the transmitted ability of these sires for this trait. Note that the expected progress by selection in Table 3 is not exceptionally large because of the rather low heritability of the trait and the fact the sire selection is on dam's production which is two generations from the response to this selection in her paternal granddaughters.

Progress from selection on the sire's side can be improved by selection of sires from dams with superior lifetime production. If the dams of selected bulls have high average production records on three to five calves, the heritability of the lifetime productivity would be greater than that of single records. If, for example, the dams of the bulls in

Table 3.—Example of Rate of Improvement Expected Per Generation From a Given Amount of Selection for Cow Productivity (Weaning Weight of Calves).

Selection in dams	
Avg. production of dams of selected heifers	460 lbs.
Avg. production of all cows in herd	430 lbs.
Selection differential	30 lbs.
Heritability	.2
Genetic superiority of dams of selected heifers	6.0 lbs.
Fraction of genetic superiority transmitted to daughters	$\frac{1}{2}$
Expected increase in daughter's production from selection on dam's production	3.0 lbs.
Selection in Paternal Granddams	
Avg. production of sire's dam	530 lbs.
Avg. production of all cows in herd	430 lbs.
Selection differential	100 lbs.
Heritability	.2
Genetic superiority of sire's dam	20 lbs.
Fraction of genetic superiority transmitted from paternal granddam to granddaughter	$\frac{1}{4}$
Expected increase in daughter's production from selection of sires on their dam's production	5.0 lbs.
Total expected increase in one generation from selection in both parents above	8.0 lbs.

Table 3 were 100 lbs. above herd average and each had records of five calves, the heritability would be about 50 percent higher than the .2 used in the example; and perhaps a $7\frac{1}{2}$ lb. increase in their daughter's production would be expected instead of the 5 lb. increase as shown in Table 3. This would increase the overall expected improvement in production per generation from 8 lbs. to $10\frac{1}{2}$ lbs. This extra selection refinement might well be worth going after. This is especially true when the relative economic value of this trait is considered.

Summary

Mothering ability in beef cows can vary greatly within a herd. Differences can be recognized if a good set of records is kept. This study and others indicate that if genetic improvement in this trait is desired, replacement heifers should be selected from top producing dams. Bulls should also be selected from top producing dams and this offers the greater opportunity because fewer bulls are needed and they leave many more daughters in a herd than is true for individual females.