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A COMPARISON OF CALVES BY CHAROLAIS AND HEREFORD BULLS

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CROSSBREEDING HAS ONLY RECENTLY been widely accepted by commercial cattlemen. Further, since the first published reports of the positive relationship between rate and efficiency of gain in beef cattle, only the more progressive cattlemen have made an effort to improve growth rate.

Of the large breeds, only the Charolais has been used widely enough in experiments to characterize with respect to various traits of economic importance. Damon *et al. (2)* reported in 1959 the first research in the United States involving the use of Charolais bulls. They found that crossbred calves sired by Charolais bulls were heaviest at weaning and, with one exception, gained faster post-weaning than steers sired by bulls of other breeds. Carcasses from Charolais cross steers had less fat and more lean and were more tender than those of the other breed crosses *(3)*.

Lasley *(8)* reported that Angus, Hereford, and Charolais cows weaned a lower percentage calf crop when bred with semen from Charolais bulls than when semen from Angus and Hereford bulls was used. However, other reports *(2, 6, 13, 17)* suggest that Charolais cattle compare favorably with other breeds in percentage calf crop weaned. Mason *(10)*, Rowden *(14)*, and Sagebiel *et al. (15)* reported an increase in dystocia (calving difficulty) associated with the use of bulls of the larger breeds. Patterson *et al. (13)*, on the other hand, reported no evidence of dystocia when Charolais bulls were bred to mature Hereford cows.

More recent studies *(6, 10, 11, 13, 14, 17)* have confirmed the early report of Damon *et al. (2)* that Charolais sired calves grow faster than calves sired by bulls of British breeding. Reports by

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[2] The authors gratefully acknowledge the assistance of John A. McGuire in analysis of the data.

Jain *et al. (5)* and Pahnish *et al. (12)* show a significant difference in post-weaning gain between reciprocal crosses where Charolais was one of the breeds involved. In a study of the relationship between cow weights and calf weaning weights, Urick *et al. (16)* found that Charolais cows tended to produce more calf weight for each unit increase in cow weight than Angus or Herefords, but the differences were not significant.

In general, carcasses from Charolais cross heifers and steers have less fat, more lean, and lower quality grades than carcasses from crosses among the British breeds *(3, 9, 13, 18)*. However, these same reports indicate that Charolais carcasses compare favorably in tenderness, juiciness, and flavor with carcasses from British breeds and crosses.

Results from a previous Black Belt Substation crossbreeding study *(1)* showed that the average adjusted weaning weight for all calves was 492 pounds. The most productive cows were Angus x Hereford back-crossed to Hereford bulls. These cows produced calves that averaged 505 pounds at weaning, or 482 pounds of calf per cow bred. Because of the high productivity of these cows, this cow herd was used in the experiment to determine the influence of Charolais bulls on calf weaning weight.

EXPERIMENTAL PROCEDURE

The results reported in this publication were from a 4-year study at the Black Belt Substation, Marion Junction, Alabama. The existing herds of mature Hereford and Angus x Hereford cows were divided into similar groups on the basis of breed, age, and previous records. One group was bred to a Hereford bull and the other group to a Charolais bull. Bulls were used for 2 years and the cows re-allotted the second year to further minimize differences between breeding groups. A second set of bulls was obtained for the last 2 years and the process repeated. Following this procedure, four groups of calves were produced in each of 4 years, namely: (1) Hereford, (2) ¾ Hereford-¼ Angus, (3) ½ Charolais-½ Hereford, and (4) ½ Charolais-¼ Angus-¼ Hereford. These calves were born in late fall and winter.

The first Charolais bull became crippled during the first breeding season. A replacement was obtained and used for the remainder of the season. The first bull apparently recovered and was placed with the herd at the beginning of the second season. It soon became obvious that he had become crippled again, and

a replacement was obtained and used for the remainder of the season. A third Charolais bull was placed with the herd as a 2 year old at the beginning of the third year. Immaturity prevented this young bull from breeding, so a replacement was used for the remainder of the season. The young bull was used as a 3 year old during the final year. Thus, five Charolais bulls were used rather than the two as originally planned.

During the winter months brood cows were fed 2 pounds of 41 per cent cottonseed meal or equivalent per head daily plus johnsongrass hay *ad libitum.* Caley (wild winter) peas were grazed for approximately 50 days in early spring and permanent pasture of primarily dallisgrass with some white clover was grazed from late spring until late fall.

A high protein creep feed was provided all calves during the winter. Also all calves were fed in late summer, if necessary, as a supplement to the dam's milk and pasture.

All calves were numbered and male calves castrated within 24 hours after birth. Sex, birth weight, birth date, and dam's number were recorded. Two weaning dates were selected each year so that average weaning age of each group of calves would be approximately 250 days. All calves were weighed and assigned slaughter and stocker grades at weaning.

Steer calves went directly into the feedlot where they were full-fed by breed groups for an average of 171 days. The ration was a blended mixture containing 30 per cent roughage. Finished steers were slaughtered and data obtained on carcass weight, ribeye area, fat thickness, kidney fat, and USDA yield and quality grade. Rib samples from all carcasses were evaluated at the Auburn University Meats Laboratory for tenderness by Warner-Bratzler shear and for tenderness and juiciness by taste panel.

ANALYSIS OF DATA

The data were analyzed by using the method of least squares as described by Harvey *(4).* Tests of significance among individual least squares means were made with Kramer's *(7)* modification of Duncan's range test.

Separate analyses were made for percentage calf crop born and weaned, birth weight, weaning weight, average daily gain (ADG), weight per day of age (WDA), and weaning grade. In addition, analyses were made for post-weaning traits of steers including final weight, feedlot gain, final age, final WDA, and

TABLE 1. REPRODUCTIVE PERFORMANCE[1] BY BREEDING GROUPS

Year	Hereford X Hereford			Hereford X Angus-Hereford			Charolais X Hereford			Charolais X Angus-Hereford		
	Cows	Calved	Weaned	Cows	Calved	Weaned	Cows	Calved	Weaned	Cows	Calved	Weaned
	No.	*Pct.*	*Pct.*	*No.*	*Pct.*	*Pct.*	*No.*	*Pct.*	*Pct.*	*No.*	*Pct.*	*Pct.*
1967	18	88.9	88.9	13	92.3	92.3	14	85.7	78.6	17	64.7	64.7
1968	13	92.3	84.6	20	100.0	100.0	14	78.6	64.3	11	100.0	90.9
1969	13	84.6	84.6	18	94.4	88.9	10	70.0	70.0	10	90.0	70.0
1970	12	83.3	83.3	11	90.9	90.9	11	72.7	72.7	18	88.9	77.8
Total or average	56	87.5ab	85.7ab	62	95.2a	93.5a	49	77.6b	71.4b	56	83.9ab	75.0b

[1] Means followed by different letters differ at $P<0.05$.

slaughter grade. Steer carcass characteristic analyses were made for hot carcass weight, dressing percentage, carcass WDA, rib fat, kidney fat, ribeye area, USDA yield grade, conformation score, and USDA quality grade. Separate analyses for eating qualities of steaks included marbling score, Warner-Bratzler shear, taste panel tenderness, and taste panel juiciness. These analyses are given in the Appendix.

RESULTS AND DISCUSSION

Reproductive Performance

Cows bred to Hereford bulls dropped and weaned a higher percentage of calves than cows bred to Charolais bulls, Table 1 and Appendix Table 1. Only two Hereford and five Charolais bulls, which includes replacements described in the procedures, were used in the 4-year test. Therefore, conclusions regarding breed differences are not warranted. Hereford and Charolais bulls performed similarly at the Upper Coastal Plain Substation in Alabama *(13)* and elsewhere *(2, 6, 17)*. Crossbred Angus-Hereford cows dropped and weaned a higher percentage of calves than straight Hereford cows, Table 1. However, these differences were not significant.

Calf Birth Weights, Weaning Weights, and Grades

Calves by Charolais bulls were heavier at birth, gained faster from birth to weaning, and were heavier at weaning than calves by Hereford bulls, Table 2.

The values for 250-day weight per cow bred were not analyzed since they represent the product of per cent calf crop weaned and 250-day adjusted weaning weight. However, these values indicate the importance of high percentage calf crop regardless of breed of bulls and breeding of cows.

TABLE 2. LEAST-SQUARES MEANS[1] FOR PRE-WEANING TRAITS OF CALVES

Breeding of calf	Number	Birth weight	250-day ADG	250-day WDA	250-day weight	250-day weight/ cow bred	Stocker grade[2]
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Lb.*	
H x H	48	69.1a	1.79a	2.04a	515.0a	441.3	13.5a
H x AH	58	66.5a	1.94b	2.18b	550.0a	514.2	13.7a
C x H	35	80.2b	2.05b	2.33b	591.2b	422.1	14.0ab
C x AH	42	80.6b	2.24c	2.50c	632.1b	474.1	14.3b

[1] Means followed by different letters differ at $P<0.01$.
[2] Grade code: 13 = average Choice; 14 = high Choice, etc.

Calves by Charolais bulls tended to have higher stocker grades than calves by Hereford bulls.

Feedlot Performance

Steers by Charolais bulls were heavier initially, gained faster in the feedlot, and therefore were heavier at the end of the feeding period than steers by Hereford bulls, Table 3. There was no difference in average age among the breed groups and no difference in slaughter grade. Charolais x Angus-Hereford steers required more feed, causing them to have higher cost per hundredweight gain than the other three groups of steers, Table 4. This weighted difference of 98 pounds more feed and $1.62 higher feed cost per hundredweight gain cannot be explained by differences in gain in the feedlot or entirely by maintenance requirements for heavier steers, since the Charolais x Hereford steers gained at approximately the same rate and weighed approximately the same at the end of test, Table 3.

TABLE 3. LEAST-SQUARES MEANS[1] FOR POST-WEANING TRAITS OF STEERS

Breeding of steer	Number	Initial weight[2]	Final weight	Total gain	Feedlot ADG	Final age	Final WDA	Slaughter grade[3]
		Lb.	*Lb.*	*Lb.*	*Lb.*	*Days*	*Lb.*	
H x H	20	595.7	1000.6a	404.9a	2.48a	428	2.34a	11.9
H x AH	26	607.7	1024.8a	417.1a	2.47a	433	2.35a	12.6
C x H	24	650.9	1138.3b	487.4b	2.74b	439	2.60b	12.0
C x AH	22	691.7	1133.3b	441.6ab	2.71b	424	2.67b	12.4

[1] Means followed by different letters differ at $P<0.01$.
[2] Unadjusted weaning weight.
[3] Grade code: 11 = high Good; 12 = low Choice, etc.

TABLE 4. AVERAGE[1] FEED CONSUMED AND COST PER HUNDREDWEIGHT FOR STEERS

Breeding of steer	Feed per hundredweight gain	Feed cost per hundredweight gain	Return per steer above feed cost
	Pounds	*Dollars*	*Dollars*
H x H	920	23.72	15.83
H x AH	913	24.34	27.60
C x H	895	22.87	40.01
C x AH	1007	25.28	31.49

[1] Fed by breeding groups; 4-year average.

Carcass Data

All steers were slaughtered as they reached the estimated live grade of Choice. Charolais sired steers had heavier carcasses,

TABLE 5. LEAST-SQUARES MEANS[1] FOR STEER CARCASS CHARACTERISTICS

Breeding of steer	Number	Hot carcass weight	Dressing percentage	Carcass WDA	Rib fat	Kidney fat	Ribeye area	Yield grade[2]	Carcass grade	
									Conformation[3]	Quality[3]
		Lb.	*Pct.*	*Lb.*	*In.*	*Pct.*	*Sq. In.*			
H x H	20	587.6a	58.7a	1.37a	0.52b	3.3a	10.7a	3.3b	13.8bc	11.6a
H x AH	26	605.0a	59.0a	1.40a	0.63b	3.5b	11.1a	3.5b	14.0c	12.5b
C x H	24	689.3b	60.6b	1.57b	0.38a	3.2a	13.2b	2.4a	12.7a	11.7ab
C x AH	22	686.5b	60.6b	1.62b	0.43a	3.3a	13.3b	2.6a	13.5ab	12.3ab

[1] Means followed by different letters differ at $P<0.01$.
[2] Lower values more desirable.
[3] Grade code: 11 = high Good; 12 = low Choice; 13 = average Choice; 14 = high Choice; etc.

higher dressing percentage, higher carcass WDA, less fat, larger ribeye areas, and better yield grades than steers sired by Hereford bulls, Table 5. There were no differences in carcass characteristics of steers from Hereford and Angus-Hereford cows.

Analyses of rib samples from each carcass by the Auburn University Meats Laboratory showed no consistent differences among any of the traits contributing to eating qualities, Table 6. These results are in general agreement with other reports in the literature *(3, 9, 13, 18)*.

TABLE 6. LEAST-SQUARES MEANS[1] FOR EATING QUALITIES OF STEAKS

Breeding of steer	Number	Marbling score[2]	Warner-Bratzler shear[3]	Taste panel	
				Tenderness score[4]	Juiciness score[4]
H x H	20	4.7a	18.9	6.2	5.9a
H x AH	26	5.6c	17.7	6.4	6.6b
C x H	24	4.9ab	18.1	6.4	6.8b
C x AH	22	5.4bc	18.1	6.0	6.2ab

[1] Means followed by different letters differ at $P<0.05$.
[2] Higher values more desirable, 5 = small, etc.
[3] Lower scores = more tenderness.
[4] Higher values more desirable.

SUMMARY

Comparisons were made among calves sired by Charolais and Hereford bulls and out of both Hereford and Angus-Hereford cows. The following results were obtained during a 4-year study:

1. Breeding problems with two Charolais bulls resulted in a lower percentage calf crop weaned by these bulls than by the two Hereford bulls.

2. Angus-Hereford cows weaned a higher percentage calf crop than straight Hereford cows.

3. Calves by Charolais bulls were heavier at birth and at weaning than calves by Hereford bulls.

4. Steer calves by Charolais bulls gained faster in the feedlot than steers by Hereford bulls.

5. Carcasses from Charolais sired steers were heavier and leaner than Hereford sired steers.

6. There were no differences among quality grades or for any other trait that contributes to eating qualities that could be associated with the breeding of the steer.

LITERATURE CITED

(1) COLLINS, J. C., T. B. PATTERSON, W. M. WARREN, L. A. SMITH, AND HAROLD GRIMES. 1972. Crossbreeding Beef Cattle. Auburn Univ. (Ala.) Agr. Exp. Sta. Bull. 433.

(2) DAMON, R. A., JR., S. E. MCCRAINE, R. M. CROWN, AND C. B. SINGLETARY. 1959. Performance of Crossbred Beef Cattle in the Gulf Coast Region. J. Ani. Sci. 18:437.

(3) ———, R. M. CROWN, C. B. SINGLETARY, AND S. E. MCCRAINE. 1960. Carcass Characteristics of Purebred and Crossbred Beef Steers in the Gulf Coast Region. J. Ani. Sci. 19:820.

(4) HARVEY, WALTER R. 1960. Least Squares Analyses of Data with Unequal Subclass Numbers. USDA, ARS 20-8.

(5) JAIN, J. P., J. F. LASLEY, BOB SIBBIT, L. LANGFORD, J. E. COMFORT, A. J. DYER, G. F. KRAUSE, AND H. B. HEDRICK. 1971. Growth Traits of Reciprocally Crossed Angus, Hereford, and Charolais Heifers. J. Ani. Sci. 32:399.

(6) KLOSTERMAN, EARLE W., V. R. CAHILL, AND C. F. PARKER. 1968. A Comparison of the Hereford and Charolais Breeds and Their Crosses Under Two Systems of Management. Ohio Agr. Res. and Dev. Center Res. Bull. 1011.

(7) KRAMER, C. Y. 1957. Extension of Multiple Range to Group Correlated Adjusted Means. Biom. 13:13.

(8) LASLEY, J. F. 1969. Crossbreeding in Beef Cattle. The Shorthorn World. Aug. 15.

(9) ———, G. F. KRAUSE, J. P. JAIN, H. B. HEDRICK, BOB SIBBIT, L. LANGFORD, J. E. COMFORT, AND A. J. DYER. 1971. Carcass Quality Characteristics in Heifers of Reciprocal Crosses of the Angus, Charolais and Hereford Breeds. J. Ani. Sci. 32:406.

(10) MASON, I. L. 1971. Comparative Beef Performance of the Large Cattle Breeds of Western Europe. Ani. Br. Abstrs. 39:1.

(11) PAHNISH, O. F., J. S. BRINKS, J. J. URICK, B. W. KNAPP, AND T. M. RILEY. 1969. Results from Crossing Beef x Beef and Beef x Dairy Breeds: Calf Performance to Weaning. J. Ani. Sci. 28:291.

(12) ———, B. W. KNAPP, J. J. URICK, J. S. BRINKS, AND F. S. WILSON. 1971. Results from Crossing Beef x Beef and Beef x Dairy Breeds: Post-Weaning Performance of Heifers. J. Ani. Sci. 33:736.

(13) PATTERSON, T. B., W. W. COTNEY, AND R. A. MOORE. 1972. Brown Swiss, Charolais, and Hereford Breeding in a Grade Beef Herd: Effect on Performance and Carcass Characteristics. Auburn Univ. (Ala.) Agr. Exp. Sta. Bull. 430.

(14) ROWDEN, W. 1970. Progress Report – Germ Plasm Evaluation Program. U.S. Meat Animal Research Center Beef Cattle Field Day.

(15) SAGEBIEL, JOE A., G. F. KRAUSE, B. SIBBIT, L. LANGFORD, J. E. COMFORT, A. J. DYER, AND J. F. LASLEY. 1969. Dystocia in Reciprocally Crossed Angus, Hereford, and Charolais Cattle. J. Ani. Sci. 29:245.

(16) URICK, J. J., B. W. KNAPP, J. S. BRINKS, O. F. PAHNISH, AND T. M. RILEY. 1971. Relationships Between Cow Weights and Calf Weaning Weights in Angus, Charolais and Hereford Breeds. J. Ani. Sci. 33:343.

(17) WALLACE, J. D., R. J. RALEIGH, AND W. H. KENNICK. 1966. Performance of Hereford and Charolais x Hereford Crossbred Cattle in Eastern Oregon. Ore. Agr. Exp. Sta. Bull. 603.

(18) ZIEGLER, J. H., L. L. WILSON, AND D. S. COBB. 1971. Comparisons of Certain Carcass Traits of Several Breeds and Crosses of Cattle. J. Ani. Sci. 32:446.

APPENDIX

APPENDIX TABLE 1. MEAN SQUARES FOR REPRODUCTIVE PERFORMANCE OF COWS

Source of variation	d.f.	Per cent calving	Per cent weaned
Year	3	0.0850	0.0721
Breed of sire	1	0.5647*	1.4583**
Breed of dam	1	0.2692	0.0875
Age of dam	10	0.1017	0.2269
Sire x dam	1	0.0029	0.0211
Year x sire	3	0.0384	0.0437
Year x dam	3	0.2120	0.1677
Year x sire x dam	3	0.0955	0.0436
Error	197	0.1154	0.1423

* $P<0.05$.
** $P<0.001$.

APPENDIX TABLE 2. MEAN SQUARES FOR PRE-WEANING TRAITS OF CALVES

Source of variation	d.f.	Birth weight	250-day ADG	250-day weight	Stocker grade
Year	3	86.89	0.348**	23,723.9**	1.209
Age of dam	10	83.99	0.086**	6,217.0**	1.164
Breed of calf	3	1,562.34**	0.893**	72,297.3**	4.213**
Sex of calf	1	1,333.25**	1.497**	117,664.8**	24.241**
Year x breed	9	110.42	0.017	1,193.5	1.273
Year x sex	3	90.45	0.091*	7,014.9*	0.461
Breed x sex	3	128.96	0.027	2,451.5	0.127
Year x breed x sex	9	49.32	0.078*	5,024.0*	0.840
Sire/breed-year	6	136.52	0.027	2,254.2	0.819
Regression on date of birth					
Linear	1	4.91	0.002	225.5	0.214
Quadratic	1	0.03	0.005	232.3	0.274
Cubic	1	3.04	0.012	687.8	0.291
Error	132	73.662	0.035	2,440.11	0.694

* $P<0.05$.
** $P<0.001$.

APPENDIX TABLE 3. MEAN SQUARES FOR POST-WEANING TRAITS OF STEERS

Source of variation	d.f.	Final weight	Total gain	Feedlot ADG	Final WDA	Slaughter grade
Year	3	19,283.9*	8,974.9	0.032	0.306**	41.233**
Breed of calf	3	107,215.3**	29,335.6**	0.439*	0.595**	0.224
Year x breed	9	7,870.4	3,873.6	0.283*	0.074	3.736**
Error	76	7,301.9	4,340.3	0.128	0.051	1.071

* $P<0.05$.
** $P<0.01$.

APPENDIX TABLE 4. MEAN SQUARES FOR CARCASS CHARACTERISTICS OF STEERS

Source of variation	d.f.	Hot carcass weight	Dressing percentage	Carcass WDA	Rib fat	Kidney fat	Ribeye area	Yield grade	Carcass conformation	Carcass quality
Year	3	6,648.3	6.077	0.091**	0.025	0.518**	3.384**	0.189	4.475	11.334**
Breed of calf	3	59,337.7**	21.239**	0.308**	0.285**	1.506**	39.120**	6.283**	6.927*	3.914
Year x breed	9	2,113.5	3.002	0.014	0.012	0.142	0.447	0.115	4.267	1.478
Error	76	3,111.1	2.939	0.017	0.012	0.096	0.778	0.230	2.200	1.653

* $P<0.05$.
** $P<0.01$.

APPENDIX TABLE 5. MEAN SQUARES FOR EATING QUALITIES OF STEAKS

Source of variation	d.f.	Marbling score	Warner-Bratzler shear	Taste panel tenderness	Taste panel juiciness
Year	3	10.911**	81.859**	10.319**	7.436**
Breed of calf	3	4.397**	4.994	0.784	3.107*
Year x breed	9	0.866	18.530	4.969**	1.491
Error	76	1.187	10.485	1.450	0.941

* $P<0.05$.
** $P<0.01$.