Beef Production

in a Crisscross Breeding System Involving Angus, Brahman, and Hereford

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- INTRODUCTION -

Many researchers have reported results of crossbreeding beef cattle for increasing beef production (1)[2]. Much work is still being conducted along these lines. Most reports, however, deal with the first-cross (F_1) progeny or F_1 dam. Since a beef cattle breeding system is most efficient when it is self-sustaining, i.e., producing its own replacement females, it was necessary to measure the production of a continued crisscross system. How much heterosis or superiority is involved in the F_1 progeny and F_1 dam is not to be reported in this bulletin. Many times beef producers who are considering a crossbreeding plan have asked, "Where do we go from here?" The results reported here will give producers more information to use in making a decision. The purpose of this study was to determine only the sustained advantage of rotational backcrossing for several years. Data are presented here from a simple and efficient crossbreeding system.

- EXPERIMENTAL PROCEDURE -

The results reported were obtained from a beef cattle breeding study conducted at the Agricultural Research and Education Center, Belle Glade. The project was initiated in 1961 and terminated with the 1971 calf crop. The study was designed to compare the performance of progeny from Angus, Brahman, and Hereford cattle and from the three possible two-breed rotational crosses from these breeds. The foundation cattle were purebred Angus and Brahman cows, high grade Hereford cows, and F_1 females of Angus x Hereford breeding. The Angus x Brahman females did not enter the data until the 1962 calf

crop. Design of the study is shown in Table 1.

Table 1. Experimental Design.

	Breed and Number of Cows Used Each Year					
Breed of Sire	**Angus**	**Brahman**	**Hereford**	**BA**	**BH**	**HA**
Angus	40	-	-	30	-	30
Brahman	-	40	-	30	30	-
Hereford	-	-	40	-	30	30

At the start of the study the F_1 females were gate cut with one-half of each breed group assigned to a sire breeding herd representing one of the parent breeds, and the other half assigned to a sire breeding herd representing the other parent breed, i.e., one half B x A F_1's were bred to an Angus sire and the other half to a Brahman sire, etc. The female progeny of each breeding herd furnished replacement females for the other side of the cross. The first cross resulted in ¾ blood of breed of sire, the second cross resulted in $^5/_8$ blood of breed of sire, and the third and subsequent crosses progressively approached the equilibrium of $^2/_3$ blood of the sire breed. In this report all crossbreds are grouped according to cross and breed of sire without attempting to study each generation. The Angus, Brahman, and Hereford cows were straightbred in order to have contemporary comparisons of the parent breeds.

All breeding herds were managed alike, grazing Roselawn St. Augustinegrass pastures, with a stocking rate of approximately 0.85 acres per animal unit. Supplemental feed was given in the form of straight mill-run cane molasses at a rate of 4.5 pounds per head per day for approximately 100 days during the winter. Replacement heifers were managed similarly to the breeding herds. Cows were culled the first time open with the exception of the purebred Brahman which were culled after the second open season. Selected heifer replacements were bred to calve first at three years of age. The breeding season extended 90 days beginning February 15 and ending May 15, with the subsequent calf crop weaned the last week of July in the following year. The study included 2928 progeny born to 3404 dams.

The criteria used to measure the differences between the continued backcrosses vs. the purebred parents were: 1) birth rate; 2) survival rate, birth to weaning; 3) weaning rate; 4)birth weight; 5) weaning weight; and 6) production per cow. The values shown are actual and no adjustments have been made.

- RESULTS -

Since this report deals with preweaning and weaning data, the different traits related to these measures

of production will be reported and discussed separately. Also, in a crisscross breeding system there are two sides of the cross and for some traits the two sides may differ. For this reason the data are presented in two ways: 1) Table 2 consists of data of the average of the combined sides of the crosses, and 2) Table 3 consists of data of the average of each side of the crosses.

- Birth Rate -

This trait is reported here as the percentage of calves born to all cows exposed to the bulls. Many workers (2, 3, 4, 7, 8, 9, 10) reported effects of crossbreeding on this trait; however, they were studying mostly F_1 dams rather than subsequent backcrosses. The reports show the crossbred dams to have a higher birth rate than the average of the parent breeds. The result of this study shows that Brahman x British crossbred dams, in a crisscross breeding system, have more than 5% greater birth rate than the average of the parental breeds of the cross. However, the Angus-Hereford crosses show only a 1.3% advantage (Table 2).

Recent work by Peacock et al. (5), in a study of Brahman, Shorthorn, and Brahman x Shorthorn reciprocal crosses, showed that dams of predominant Brahman breeding (¾ B, ¼ S) had a higher birth rate than dams of predominant Shorthorn (¾ S, ¼ B) breeding. The results of the study reported here also show the advantage for predominately Brahman dams. Data in Table 3 show that BA and BH dams (the first letter indicating breed of sire of dams where B=Brahman, A=Angus, and H=Hereford) had higher birth rates than the reciprocal AB and HB dams. When compared to the average of the parental breeds involved in the cross the BA and BH dams showed an advantage of 7.0% and 9.1%, respectively. In the same comparison AB and HB dams showed only 3.4% and 1.4%, respectively.

Table 2. Average of production traits of the two sides of each crossbred combined and the average of the straightbred parental breeds (Unadjusted data).

	Straightbred Average					
	A-B	**H-B**	**A-H**	**A x B**	**H x B**	**A x H**
No. cows bred, total	798	799	799	671	758	777
No. calves born, total	648	650	710	575	649	700
Birth rate, %	81.2	81.4	88.9	85.7	85.7	90.1
Survival rate, %	86.2	88.5	90.7	92.9	93.2	93.3
Weaning rate, %	70.2	72.4	80.6	79.6	79.7	84.1
Birth weight (lbs.)	57.3	62.3	56.6	67.7	72.2	55.8

Weaning weight (lbs.)	379	380	385	444	449	402
Age at weaning (days)	211	207	222	214	210	224
Production per cow (lbs.)	266	276	310	354	359	338
Advantage of both sides combined of crossbreds over average of parental breeds(%)						
Birth rate	-	-	-	5.5	5.3	1.3
Survival rate	-	-	-	7.8	5.3	2.9
Weaning rate	-	-	-	13.4	10.1	4.3
Birth weight	-	-	-	18.2	15.9	-1.4
Weaning weight	-	-	-	17.2	18.2	4.4
Production per cow	-	-	-	33.1	30.1	9.0

- Survival Rate -

This trait is expressed in the number of calves weaned to those born, on a percentage basis. A report by the National Academy of Sciences (4) indicates losses for stillbirths, congenital malformation, and mortality of calves during the postnatal period ranges from 9% to 31%. During this study, calf losses ranged from 4.5% for the BH dams to 16.0% for the straightbred Brahman dams. The Brahman-British crosses showed an advantage of 7.8% and 5.3% for A x B and H x B, respectively (Table 2). However, Table 3 presents data indicating the predominant Brahman dams had higher calf survival rates than the reciprocal crosses. The BA and BH dams showed an advantage of 10.2% and 7.9% over the average of the parental breeds, while the AB and HB dams showed only 5.3% and 2.6%, respectively. Table 3 also shows there is a difference between the reciprocal crosses of the British crosses, although not quite as pronounced as the Brahman-British crosses.

Table 3. Effect of breed on various production traits (Unadjusted data).

Breed	**Sire: Dam:**	**A A**	**B B**	**H H**	**A BA**	**B AB**	**B HB**	**H BH**	**A HA**	**H AH**	**All Breeds**
No. cows bred		399	399	400	346	325	383	375	393	384	3404

No. calves born	354	294	356	302	273	316	333	355	345	2928
Birth rate (%)	88.7	73.7	89.0	87.3	84.0	82.5	88.8	90.3	89.8	86.0
Survival rate (%)	88.4	84.0/ td>	93.0	95.0	90.8	90.8	95.5	91.8	94.8	91.7
Weaning rate (%)	78.4	61.9	82.8	82.9	76.3	74.9	84.8	82.9	85.2	78.8
Birth weight (lbs.)	51.6	63.0	61.5	62.9	72.5	76.2	68.2	53.8	57.7	63.0
Weaning weight (lbs.)	383	374	386	448	440	441	457	392	411	411
Age at weaning (days)	226	196	217	220	208	206	213	226	222	215
Production per cow	300	232	320	371	336	330	388	325	350	324
Advantage of crossbreds over average of parent breeds (%)										
Birth rate	-	-	-	7.0	3.4	1.4	9.1	1.6	1.0	-
Survival rate	-	-	-	10.2	5.3	2.6	7.9	1.2	4.5	-
Weaning rate	-	-	-	15.1	6.0	3.5	17.1	2.9	5.7	-
Birth weight	-	-	-	9.8	27.0	22.3	9.5	-5.2	1.9	-
Weaning weight	-	-	-	18.2	16.1	16.1	20.3	1.8	6.8	-
Prod. per cow	-	-	-	39.5	26.3	19.6	40.6	4.8	12.9	-

- Weaning Rate -

Weaning rate is expressed on a percentage basis as a ratio of calves weaned to total cows exposed to the bulls and is a reflection of pregnancy rate, embryonic death loss, and postnatal death loss. It can be calculated by multiplying survival rate times birth rate. Data is presented in Table 2 showing crossbred dams weaned a higher percentage of calves than the average of the parental breeds with the A x B and H x B dams, showing an advantage of 13.4% and 10.1%, respectively. The predominant Brahman dams show an advantage over the reciprocal cross dams (Table 3).

- Birth Weight -

Data for birth weight of straightbred and cossbred progeny are presented in Tables 2 and 3. Birth weight

may be considered a function of the genetic makeup of the calf plus length of gestation. These data indicate that British crosses are approximately the same as the average of the parental breeds. The Brahman crosses show heavier birth weight than the average of the parental breeds used in the cross (Table 2); however, the predominant Brahman dams had calves lighter at birth than the reciprocal crosses (Table 3).

- Weaning Weight -

Numerous reports by other researchers (1) have presented data indicating the superiority of the first-cross progeny as well as the first-cross dams in weaning weights. This study does not report the first-cross progeny but only the production of F_1 and subsequent backcross dams. Table 2 presents data showing the Brahman crosses having an advantage of 17.2% to 18.2% compared to the average of the parental breeds involved, while the British crosses show only a 4.4% advantage over the average of their parental breeds. For weaning weight there is not as large a difference between the reciprocals of the Brahman crosses as there was for previous traits. The Brahman-Angus cross shows only an 8-pound advantage for BA dams compared to the AB dams. However, there is a 16-pound difference between BH and HB dams. In the British crosses the predominant Angus dams produced calves weaning 19 pounds heavier than predominant Hereford dams.

- Age at Weaning -

Age at weaning is a function of conception date, gestation length, and weaning date. Since all bulls were put in the breeding herds at the same time and removed on the same date, and weaning time was constant year to year, age at weaning should be comparable for all breed groups except for the straightbred Brahman, which have a longer gestation length (approximately 10 to 12 days) than British breeds. However, it is evident that the Brahman sire has some influence either on breeding date or length of gestation as shown in Table 3. The average age at weaning throughout the study was 215 days; the straightbred Brahman were the youngest (196 days), and the straightbred Angus and Angus sired calves from HA dams were the oldest (225 days). That the sire has an influence on gestation length or breeding date is obvious, since Angus- sired calves are the oldest and Brahman-sired calves are the youngest in all breed groups.

- Production Per Cow -

This is the most important single criteria for measuring beef cattle production, since it is a combination of weaning rate and weaning weight. It measures the total production efficiency of a cow herd. Production per cow was calculated as the product of weaning weight and weaning rate. In this study production per cow ranged from an advantage of 28 pounds for British crosses to 83 to 88 pounds for Brahman crosses when compared to the average of the parental breeds involved in the cross. This is an average increase of 9.0% for Angus-Hereford crosses and 33.1% and 30.1% for Angus-Brahman and Hereford- Brahman, respectively, as shown in Table 2. However, when each side of the reciprocal crosses are measured, it is evident that one side of each cross is superior to the other side (Table 3). In the Brahman-Angus crosses, BA dams are superior to the average of the parental breeds by 105 pounds

(39.5%), while the AB dams are superior by 70 pounds (26.3%). The BH dams are superior to the average of their parental breeds by 112 pounds (40.6%), while HB dams are superior by only 64 pounds (19.6%). In the British crosses AH dams are more productive (12.9% to 4.8%) than the HA dams. Since this trait represents total production, it is interesting to note that the combined production for both sides of the Brahman-Angus and Brahman-Hereford crossbreds show only a 4.7% and 6.2% advantage, respectively, over the combined sides of the Hereford-Angus crosses.

- Summary and Conclusions -

Eleven years of calf production data from a crossbreeding project at the Agricultural Research and Education Center, Belle Glade, FLorida, were studied to measure the performance of beef cattle in a rotational crisscross breeding system compared to a straightbreeding system. The breeds involved were Angus, Brahman, and Hereford and the three possible two-breed rotation crosses the these breeds.

Since a beef cattle breeding system is considered most efficient when it is self-sustaining by producing its own replacement females, the production characteristics of a continued rotational crisscross system were determined. In this system, females produced from one side of the cross are replacements for the opposite side. The project was designed to measure the production of continued backcross dam as compared to production of the contemporary straightbred parent breeds.

The project continued through three backcross generations, and production in the latter generation was still superior to the original parent breeds. It was evident that there was a distinct advantage for total production in a continued backcrossing system over a straightbreeding system, as measured by production per cow. This was an advantage of 88 pounds (33.1%), 83 pounds (30.1%), and 28 pounds (9.0% for Brahman-Angus, Brahman-Hereford, and Hereford-Angus crossbreds, respectively. There was only a slight advantage in total production in crosses involving the Brahman breed when compared to the Hereford-Angus crossbreds (5.5%). Since it is possible for the Hereford-Angus crossbred steer calves to command a higher price at weaning time than some of the Brahman crossbred calves, it may be that the Hereford- Angus cross is more economically feasible.

- Literature Cited -

1. Cunha, T.J., M. Koger, and A.C. Warnick. 1962. Crossbreeding Beef Cattle. Univ. of Fla. Press, Gainesville, Florida.

2. Gaines, J.A., W.H. McClure, D.W. Vogt, Carter, and C.M. Kincaid. 1966. Heterosis from crosses among British breeds of beef cattle: fertility and calf performance to weaning. J. Animal Sci. 25:5.

3. Knapp, B., Jr., A.L. Baker, and R.T. Clark. 1949. Crossbred beef cattle for the Northern Great Plains. USDA Circ. 810.

4. National Academy of Sciences. 1968. Prenatal and Postnatal Mortality in Cattle. Publication 1685, National Academy of Sciences, Washington, D.C.

5. Peacock, F.M., M. Koger, W.G. Kirk, E.M. Hodges, and A.C. Warnick. 1971. Reproduction in Brahman, Shorthorn and crossbred cows on different pasture programs. J. Animal Sci. 33:458

6. Turner, J.W., B.R. Farthing, and G.L. Robertson. 1968. Heterosis in reproductive performance of beef cows. J. Animal Sci. 27:336.

7. Warnick, A.C., J.H. Meade, and M. Koger. 1960. Factors influencing pregnancy rate in Florida beef cattle. Fla. Agr. Exp. Sta. Bul. 623.

8. Wiltbank, J.N., E.J. Warwick, E.H. Vernon, and B.M. Priode. 1961. Factors affecting net calf crop in beef cattle. J. Animal Sci. 20:409.

9. Wiltbank, J.N., K.E. Gregory, J.A. Rothlisberger, J.E. Ingalls, and C.W. Kasson. 1967. Fertility in beef cows bred to produce straight-bred and crossbred calves. J. Animal Sci. 26:1005.

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