1989

Characterization of Hereford and Two-Breed Rotational Crosses of Hereford With Angus and Simmental Cattle: Calf Production Through Weaning

D.M. Marshall
South Dakota State University

M. D. Monfore
South Dakota State University

C. A. Dinkel
South Dakota State University

CHARACTERIZATION OF HEREFORD AND TWO-BREED ROTATIONAL CROSSES OF HEREFORD WITH ANGUS AND SIMMENTAL CATTLE: CALF PRODUCTION THROUGH WEANING

D. M. Marshall[1], M. D. Monfore[2] and C. A. Dinkel[3]
Department of Animal and Range Sciences

CATTLE 89-16

Summary

Cow size, reproductive traits and calf performance through weaning were evaluated in a range environment for Simmental (S) x Hereford (H) and Angus (A) x H crosses in two-breed rotations and straightbred H. Data were grouped into seven dam breed categories: straightbred Hereford (H), crossbred F1 S x H cows (SH), S x H cows of low percentage H (SHS), S x H cows of high percentage H (HSH), F1 A x H cows (AH), A x H cows of low percentage H (AHA) and A x H cows of high percentage H (HAH). Hereford, SH, AH, SHS and AHA cows were mated to H bulls, HSH cows were mated to S bulls and HAH cows were mated to A bulls. Simmental-cross cows were heavier and taller and produced heavier calves at birth and weaning than A-cross or H cows. Pregnancy rate, calf preweaning survival rate, calf birth date and percentage of difficult births did not vary significantly among dam breed groups. Within the A x H and S x H rotations, dam breed group rankings for calf birth weight were inverse to rankings for proportion of H in the breed makeup of the calf. However, in comparisons of SHS vs HSH and AHA vs HAH dam breed groups, calf average daily gain to weaning averaged higher in matings where H was the sire breed (dams were of lower percentage H). Evaluation of different breed groups within the two-breed rotational crossbreeding systems suggested acceptable compatibility of both S with H and A with H in rotational breeding systems with regard to mature size and calving difficulty.

(Key Words: Beef, Breed Evaluation, Rotational Crossbreeding, Preweaning.)

Introduction

Selection of breeds or breed crosses is an important decision for cost efficient beef production. Since breeds may rank differently for different traits, it is important to characterize breeds for a wide spectrum of traits affecting net economic efficiency. While numerous cattle breed evaluation studies have been reported, relatively few have evaluated specific breed types in rotational crossbreeding systems.

A primary advantage of rotational crossbreeding is utilization of heterosis in all dams and progeny. In addition, replacement females are produced within a self-contained herd. However, since breed composition fluctuates over generations, utilization of complementarity is limited and compatibility of breeds is an important consideration. A common concern with compatibility is that use of breeds varying widely in mature weight might result in unacceptable levels of calving difficulty. Another concern is that use of breeds varying widely in mature size and(or) milk production might result in intergenerational differences in nutrient requirements, creating possible management difficulties since generations will generally be partially overlapping. Furthermore, since each breed used in a conventional rotational system will contribute over half of the genetic makeup of some of the dams and calves, it is important that all breeds perform adequately with respect to maternal and growth traits.

The present study is a portion of a comprehensive research project designed to investigate genetic aspects of efficiency of beef production. Production of

[1]Assistant Professor.
[2]Former Assistant in Animal Science.
[3]Professor Emeritus.

calves to weaning is an important component of total system efficiency. The objective of this study was to characterize performance of Simmental x Hereford and Angus x Hereford crosses in two-breed rotations and straightbred Hereford for calf production through weaning under western South Dakota range conditions.

Materials and Methods

Population Description. This analysis included data from straightbred Hereford (H), Simmental (S) x H cross and Angus (A) x H cross cows managed under range conditions at the Antelope Range Livestock Station in northwest South Dakota. Monfore (1984) summarized weaning production of this herd up through 1983, while Marshall and Dinkel summarized weaning production for calf crops born from 1984 through 1986. This paper includes calf crops from 1975 through 1987.

Formation of breed groups was initiated with a purchase of 50 H and 50 F1 S x H heifers after weaning in 1972. In 1975, 60 F1 A x H and 10 additional S x H heifers were added to the herd. Following these initial introductions, all additional replacement females were produced within the herd as offspring of the initial females or their descendants. The two crossbred groups were managed in traditional two-breed rotational crossbreeding systems, eventually resulting in various levels of H breeding and heterosis within each rotation from overlapping among generations. Selected sires were assumed to be representative of their respective breed, with emphasis on high growth rate relative to frame size. Cleanup sires were purchased from various seedstock producers throughout South Dakota. Semen used in artificial insemination was obtained through commercial outlets from bulls whose semen was widely available.

Animal Management and Data Description. All purchased and home-grown replacement heifers were managed to calve first at 2 years of age. However, since many of these heifers produced their first calf in Brookings as part of another study, only data from 3- through 10-year-old cows calving at the Antelope Range Livestock Station were included in this analysis.

Cows were maintained on native pastures the entire year and supplemented, primarily with alfalfa hay during the winter when forage was sparse or unavailable. For calf birth years 1975 through 1979, two winter supplement levels were applied, stratified by breed groups. In subsequent years, all cows were managed as similarly as possible, although breed groups had to be maintained in separate pastures during part of the breeding season.

The total breeding season averaged about 8 weeks. In 1980, matings were by natural service only, whereas all other years included both artificial and natural matings. Cows were culled for failure to be pregnant, poor health or at random to provide space for replacements. Pregnancy rate was based on palpation since some of the cows were sold between breeding season and calving. For analysis of pregnancy rate and calf survival from birth to weaning, scores of 0 or 1 were assigned for failure or success, respectively. Calves were born in the spring and male calves were castrated at birth. Calving difficulty was closely observed by herdsmen and scored as 1 = no difficulty, 2 = minor assistance without use of mechanical puller, 3 = moderately difficult pull, 4 = hard pull and 5 = Caesarian birth. For purposes of analysis, each birth was coded as 0 (calving score of 1 or 2), or 1 (calving score of 3, 4 or 5). Calves were weaned in the fall when the entire group averaged approximately 7 months of age. Cow weights and hip height measurements were obtained near the end of calving season and at weaning.

Data from each rotation were sorted into three dam breed groups so that records within a group were from cows of similar breed composition (Table 1). Data collected from calf birth years 1975 through 1987 were categorized into a total of seven dam breed groups: straightbred H cows (H), F1 S x H cows (SH), S x H cows of low percentage H (SHS), S x H cows of high percentage H (HSH), F1 A x H cows (AH), A x H cows of low percentage H (AHA) and A x H cows of high percentage H (HAH). Calf sire breed was confounded with dam breed group. Hereford, SH, AH, SHS and AHA cows were mated to H bulls, HSH cows were mated to S bulls and HAH cows were mated to A bulls. Cows in the SHS and AHA groups were expected to range from 25 to 38% H and their calves from 62 to 69% H. Cows within the HSH and HAH groups were expected to range from 62 to 75% H and their calves from 31 to 38% H.

Results and Discussion

Least squares means (averages) are presented by dam breed group. However, it is important to keep in mind that dam breed group and sire breed are confounded, so dam breed group comparisons are actually comparisons among dam breed group-sire breed combinations. Stated differences were significant at the .05 probability level unless stated otherwise.

TABLE 1. MATING DESIGN AND BREED COMPOSITION OF BREED GROUPS[a]

Dam breed group	Dam breed composition % S	% A	% H	Sire breed	Calf breed composition % S	% A	% H
H	0	0	100	H	0	0	100
S x H Rotation							
SH	50	0	50	H	25	0	75
HSH	25 to 38	0	62 to 75	S	62 to 69	0	31 to 38
SHS	62 to 75	0	25 to 38	H	31 to 38	0	62 to 69
A x H Rotation							
AH	0	50	50	H	0	25	75
HAH	0	25 to 38	62 to 75	A	0	62 to 69	31 to 38
AHA	0	62 to 75	25 to 38	H	0	31 to 38	62 to 69

[a]H = Hereford, S = Simmental and A = Angus.

Least squares means by breed group for cow size traits and weight/height ratio are presented in Table 2. Significant differences among breed groups were observed for cow weight and height in both spring and fall and for spring weight/height ratio. Cow weights and weight/height ratios were consistently greater in fall than in spring, reflecting seasonal differences in nutrient availability. Averaged over spring and fall, cow weights averaged 1035, 1121 and 1007 lb for H, S-cross and A-cross cows, respectively. Cow heights averaged 49.6, 52.2 and 48.9 inches for H, S-cross and A-cross cows, respectively. Within the S x H rotation, SHS cows were 28 lb heavier and 2.2 inches taller than HSH averaged over spring and fall. Within the Angus rotation, HAH cows were slightly heavier and taller than AHA cows. Intergenerational variation for cow size within a rotation appeared sufficiently small so that cows of varying breed compositions within a rotation could be adequately managed as a single group.

Variation among breed groups was significant for gestation length but not for the other reproductive traits presented in Table 3. The H mean for gestation length was intermediate compared to crossbred groups. Simmental crosses averaged 2.4 days longer for gestation length than A crosses. Within the S x H rotation, gestation length was .8 days longer for HSH cows producing S-sired calves than for SHS cows producing H-sired calves. Within the A x H rotation, gestation length was .8 days (P = .07) longer for AHA cows producing H-sired calves than for HAH cows producing A-sired calves. Compatibility between breeds within each rotation was quite acceptable with regard to calving difficulty. Of particular interest was the comparison of HSH cows producing S-sired calves vs SHS cows producing H-sired calves, for which the difference was nonsignificant.

Breed group was a significant source of variation for each of the birth and preweaning traits presented in Table 4. Calf birth weights averaged 8.0 lb heavier for crossbred groups than for straightbred H calves. Birth weights of S-cross calves averaged 6.9 lb heavier than those of A-cross calves. Within the S x H rotation, calves from HSH cows mated to S sires averaged 3.8 lb heavier at birth than calves from SHS cows mated to H sires. Within the A x H rotation, calves from HAH cows mated to A sires averaged 2.0 lb heavier at birth than calves from AHA cows mated to H sires.

Average daily gains from birth to weaning were .28 lb/day greater for calves from crossbred dams than for straightbred H calves. Preweaning gains of S-cross calves averaged .18 lb/day greater than those of A-cross calves. Within the S x H rotation, calves from SHS cows mated to H sires gained .13 lb/day more than calves from HSH cows mated to S sires. In the comparison of SHS vs HSH, it is interesting to note heavier calf weaning weights were attained in matings where the service sire was of the breed of smaller mature size (dams were of higher percentage S). Within the A x H rotation, calves from AHA cows mated to H sires gained .06 lb/day more than calves from

TABLE 2. LEAST SQUARES MEANS AND CONTRASTS FOR COW WEIGHT AND HEIGHT TRAITS

Dam breed group[a]	No. records	Cow wt, lb		Cow ht, in.		Cow wt/ht, lb/in.	
		Spring	Fall	Spring	Fall	Spring	Fall
H	211	974	1095	49.5	49.7	19.9	20.9
SHS	120	1065	1196	53.4	53.6	19.4	21.5
SH	252	1086	1173	51.9	51.9	20.8	21.3
HSH	262	1029	1176	51.2	51.4	19.8	22.1
AHA	123	933	1108	48.7	49.3	19.2	22.1
AH	251	914	1015	48.0	47.8	19.5	20.0
HAH	230	950	1121	49.6	50.0	19.2	21.4
Avg SE of mean		20.1	25.9	.28	.31	.37	.63
Contrasts							
H vs 1/2 ($\bar{S}$ + $\bar{A}$)[b]		-22**	-36**	-.9**	-1.1**	NS	NS
$\bar{S}$ vs $\bar{A}$		128**	100**	3.4**	3.3**	.7**	.7**
SHS vs HSH		36**	20**	2.2**	2.2**	NS	NS
AHA vs HAH		-17**	-13*	-.8**	-.7**	NS	NS

[a] H = Hereford, S = Simmental and A = Angus. Hereford, SHS, SH, AHA and AH dams were mated to H sires, HSH dams were mated to S sires and HAH dams were mated to A sires.
[b] Straightbred vs crossbred.
*P<.05.
**P<.01.

HAH cows mated to A sires. The sign of contrast values for calf weaning weight was the same as for preweaning ADG.

It is interesting to note that rankings of SHS and HSH dam breed groups were different for calf birth weight than for calf rate of gain from birth to weaning. Calf birth weights were higher in matings where S was the sire breed. On the other hand, rankings of SHS and HSH for calf ADG were the same as rankings for proportion of S in the dam.

Based on other studies, one might expect S to have a positive individual additive effect for prenatal growth and positive individual additive and maternal environmental effects for growth from birth to weaning relative to H. Assuming such was the case in the present study, then different rankings among the S-cross groups for birth weight vs preweaning ADG might result if the importance of maternal environmental effects compared to individual effects were larger for calf preweaning ADG than for prenatal growth. Grandmaternal effects could have also played a role, assuming higher milk production for dams of higher percentage S and recognizing that HSH cows were daughters of SHS or SH dams. Also, the range environment might not have provided sufficient available energy to S-sired calves to make up for any lack of energy from milk production of lower percentage S dams. Previous studies have suggested a negative relationship sometimes exists between maternal and grandmaternal effects for some preweaning traits, particularly those related to lactation. A possible explanation for the results of the present study is that a relatively large negative relationship between maternal and grandmaternal effects existed for ADG and a smaller (not necessarily negative) relationship existed for birth weight. Breed group rankings of AHA and HAH for calf birth weight and ADG to weaning were related to proportion of H in a similar manner to that of the S-cross groups, although the magnitudes of differences between groups were less for A crosses.

TABLE 3. LEAST SQUARES MEANS AND CONTRASTS FOR COW REPRODUCTIVE TRAITS AND CALF SURVIVAL

Dam breed group[a]	No. births[b]	Pregnancy rate,%	Survival rate to weaning, %	Gestation length, days	Birth date	Calving diffi- culty, %
H	215 (194)	88.8	96.3	285.1	87.6	.76
SHS	124 (101)	84.7	94.3	286.9	87.4	1.44
SH	261 (238)	84.7	94.2	286.4	88.0	2.17
HSH	265 (184)	88.4	94.9	287.7	87.9	4.16
AHA	122 (90)	94.0	97.2	285.1	82.7	1.32
AH	255 (180)	91.3	95.8	284.5	88.0	.02
HAH	232 (185)	87.4	95.9	284.3	87.1	3.14
Avg SE of mean		3.07	1.50	.8	1.7	1.39
Contrasts						
$H - 1/2(\bar{S} + \bar{A})^b$				$-.7^+$		
$\bar{S} - \bar{A}$				2.4^{**}		
SHS - HSH				$-.8^+$		
AHA - HAH				$.8^+$		

[a] H = Hereford, S = Simmental and A = Angus. Hereford, SHS, SH, AHA and AH dams were mated to H sires, HSH dams were mated to S sires and HAH dams were mated to A sires.
[b] Number in parentheses is the number of observations for gestation length.
[c] Straightbred vs crossbred.
$^+$ P<.10.
** P<.01.

In conclusion, differences in cow size and calf weaning production characteristics are important to consider when attempting to match cow biological type to environmental conditions. Acceptable cow reproductive performance was attained across breed groups under the northern plains range environment. Significant differences among straightbred Hereford and crossbred Simmental x Hereford and Angus x Hereford for cow size and calf growth to weaning were observed. It is important to keep in mind that differences between crossbreds and straightbred Hereford were due at least in part to hybrid vigor of the crossbreds. Performance of the crossbred groups was quite desirable and indicates consideration of Hereford for use in crossbreeding is certainly warranted. The Simmental x Hereford rotation produced heavier average weaning weights than the Angus x Hereford rotation, but cow size was larger as well for Simmental x Hereford. Studies conducted in drylot at Brookings indicate that differences between these breed-types in efficiency of feed utilization for weaned calf production seem to be quite small. Evaluation of different breed groups within the two-breed rotational crossbreeding systems suggest acceptable compatibility of Simmental with Hereford and Angus with Hereford in rotational breeding systems with regard to mature cow size and calving difficulty. In general, desirable performance for production through weaning was attained within both rotations.

Literature Cited

Marshall, D. M. and C. A. Dinkel. 1987. Evaluation of varying levels of Hereford, Simmental and Angus breeding for calf production through weaning. S.D. Agr. Exp. Sta. Beef Report CATTLE 87-15:55.

Monfore, M. D. 1984. Effect of breed group and mating system on weaning production in beef cattle. S.D. Agr. Exp. Sta. COW-CALF 84-2:20.

TABLE 4. LEAST SQUARES MEANS AND CONTRASTS FOR CALF GROWTH TRAITS

Dam breed group[a]	No. calves weaned	Calf birth wt, lb	Calf preweaning ADG, lb/day	Calf weaning wt, lb
H	207	79.6	1.77	448
SHS	116	90.6	2.22	547
SH	245	88.2	2.13	530
HSH	252	94.4	2.09	526
AHA	119	85.3	2.00	499
AH	245	80.0	1.95	483
HAH	222	87.3	1.94	487
Avg SE of mean		1.5	.037	8.2
Contrasts				
$H - 1/2(\bar{S} + \bar{A})$[b]		-8.0**	-.28**	-64**
$\bar{S} - \bar{A}$		6.9**	.18**	45**
SHS - HSH		-3.8**	.13**	21**
AHA - HAH		-2.0*	.06**	12**

[a] H = Hereford, S = Simmental and A = Angus. Hereford, SHS, SH, AHA and AH dams were mated to H sires, HSH dams were mated to S sires and HAH dams were mated to A sires.

[b] Crossbred vs straightbred.

* P<.05.

** P<.01.