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Effects of Heterosis on Longevity in Beef Cattle

Rafael Nunez-Dominquez, Larry V. Cundiff, Gordon E. Dickerson, Keith E. Gregory, and Robert M. Koch[1]

Introduction

Longevity can be important to the economic efficiency of beef production. The longer cows remain productive in a herd, the fewer the number of replacement heifers needed and the greater the calf output per cow maintained. In this way, more heifers can be sold for feeding and slaughter, and the cost of growing out replacement females to a productive age is reduced. Less culling of infertile cows also increases output per cow exposed. This study was conducted to determine effects of heterosis on longevity and associated factors in crosses of the Hereford, Angus, and Shorthorn breeds.

Procedure

Data were studied on 328 cows produced from 1960 through 1963 at the Fort Robinson Beef Cattle Research Station, Crawford, Nebraska, in a crossbreeding experiment comparing all possible reciprocal crosses and straightbreds of the Hereford, Angus, and Shorthorn breeds. The 155 females born in 1960 and 1961 were managed to calve first as 3-year-olds, and the 173 females born in 1962 and 1963 were managed to calve first as 2-year-olds. The cows were transferred to MARC in 1972, and the experiment was continued until 1975. At this time, the cows ranged from 12 to 15 years of age. Table 1 shows the number of females for each breed group assigned to breeding pastures to initiate the experiment in 1962-1964 and the mating plans followed from 1963 until 1975.

The cows were wintered on native range with the protein requirement provided by feeding either alfalfa hay or a 40 percent protein supplement. Hay was fed *ad libitum* when needed during storm periods prior to calving and during the calving seasons. All cows calved in the spring. The length of the breeding season was about 75 days, commencing in late May or early June each year. Cows were diagnosed for pregnancy in the fall each year.

Cows were culled because of reproductive failure or severe unsoundness. Heifers diagnosed as not pregnant at the end of their first breeding season were culled. After the first breeding season and until they were 10 years of age, only cows failing to conceive in two successive years or sick or injured cows were culled. Cows 10 years old and older were culled the first time they were open. Other than reproductive failure, cows were removed for the following reasons: death, crippled, unsound udder, cancer eye, lump jaw, prolapse, emaciation, and unknown.

Longevity was measured as the age of the cow at disposal, which is the difference between date of disposal (or date at the end of the experiment) and birth date. In addition to this "actual" culling policy (A), an "imposed" culling policy (I) was studied in which all open cows would be removed at their first year of failure to conceive. This procedure differed from the actual policy only for cows from their second breeding season through 9 years of age, when in actual practice only those cows failing to conceive in two successive years were culled for being open. Under the imposed culling policy, date of disposal was considered to be October 27 of the year when the cow failed to conceive.

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Information on teeth of cows was recorded at weaning time in the last three years of the experiment (1973 through 1975). Size of each of the eight incisors was scored 0 for no tooth, 1 for a tooth less than .08 in, 2 for a tooth .08 in to .3 in, and 3 for a tooth longer than .3 in. Data are presented on the total score for all eight incisors. In addition, condition of incisors was classified as: 1 = good condition, 2 = broken, 3 = loose, 4 = broken and loose, and 5 = missing.

Results

Longevity, or the age at disposal from the herd, is shown in Table 2 for each breed group under the actual and imposed culling policies. In actual practice, crossbred cows survived 1.4 years longer than straightbred cows, a heterosis effect of 16 percent. If females were culled the first time they were open, crossbred cows would have survived 1.0 year longer than straightbred cows, a heterosis effect of 15 percent. The range of longevity among breed groups was 3.75 years, with Hereford-Angus reciprocal crosses at the upper limit and Shorthorn straightbred cows at the lower limit. Among straightbreds, Angus survived longer than Shorthorns, but neither differed significantly from Herefords. Angus crosses (A-X = average of AH, HA, AS, and SA) also exceeded Hereford and Shorthorn crosses in longevity under both the actual (A-X = 10.2, H-X = 9.8, S-X = 9.2 yr) and imposed (A-X = 8.3, H-X = 7.8, S-X = 7.0 yr) culling policies.

Survival was estimated as the proportion of cows exposed in each successive breeding season relative to the initial number of cows (Fig. 1). Survival of crossbred cows was greater than that for straightbreds throughout life under both the actual and imposed culling policies. Heterosis for survival of cows tended to increase with age and became statistically significant at 11 and 12 years of age.

Reasons for disposal and average age at disposal under the actual culling policy are presented in Table 3 for crossbred and straightbred cows. The main reason for disposal was infertility, which accounted for more than 50 percent in both breed groups, but the mean age at disposal for this reason was older for crossbred (7.9 yr) than for straightbred (6.5 yr) cows. The reason of second importance was mortality (death) in which straightbreds (19.9 pct) had greater losses than crossbreds (10.5 pct). Problems of poor body condition (emaciation) were more frequent in straightbred (7.1 pct) than crossbred (4.1 pct) cows, and these removals occurred at older ages (12 and 13 yr, respectively). Losses of crippled cows were similar for straightbred and crossbred cows but occurred at older ages (10.5 and 11.4 yr, respectively) in crossbreds. Unsound udders developed more frequently in crossbred cows than in straightbreds but at a relatively old average age of 12.8 years. Only four cows were culled for cancer eye, and they were all straightbred Herefords (2.6 pct at an average age of 11.1 yr). One Hereford cow was culled for lump jaw at 8.6 years of age, and two Hereford and one Angus exhibited prolapse at an average age of 3.9 years. At the end of the experiment, a higher proportion of crossbred (19.2 pct) cows were pregnant and in good condition than straightbreds (6.4 pct). In general, mortality and survival at the end of the experiment were the main reasons for differential disposal rates in favor of crossbred cows over straightbred cows.

Length of teeth was studied using the sum of the incisor size scores for all eight incisors. Incisor length decreased with age from 10 to 15 years for all breed groups, and the wear rate appeared to be higher during the younger ages (Fig. 2). The differences in sum of incisor length scores between 10- and 11-year-old cows was approximately 4, or more than a com-

plete tooth, and the difference between 14- and 15-year-old cows was about 1, or less than 2 mm. Apparently, younger cows have more and longer teeth that may be affected more by wear than older cows. Crossbred cows had significantly longer incisors than straightbred cows.

Condition of teeth: Frequency of normal, broken, loose, broken and loose, and missing incisors is presented in Figure 3 for each breed group. Frequency of normal teeth ranged from 71 percent in the Hereford to 99 percent in Angus-Hereford

crosses. On the average, crossbred cows had 88.9 percent normal teeth compared to 83.3 percent normal teeth for straightbred cows. Missing teeth accounted for most of the variation among breed groups in condition of incisors. Hereford cows had the most and Angus-Hereford cows had the fewest missing teeth. Variation among breed groups in broken teeth, loose teeth, or broken and loose teeth were small and generally not significant.

Table 1.—Number of females per breed group and mating plans to produce calf crops from 1963 through 1975

		Years						
		1963-1968[a]			1969-1972[b]			1973-1975
		Sires						
Dams	Number	H[c]	A	S	H	A	S	R
H	53		X	X	X			X
A	51	X		X		X		X
S	52	X	X				X	X
HA	29		X	X	X	X	X	X
AH	24		X		X	X	X	X
HS	30		X		X	X	X	X
SH	32		X		X	X	X	X
AS	25	X			X	X	X	X
SA	32	X			X	X	X	X

[a]This mating system was used to estimate maternal heterosis in Phase II.
[b]These matings produced the first generation of Phase III.
[c]H = Hereford, A = Angus, S = Shorthorn, R = Red Poll, HA = Hereford sire and Angus dam . . ., SA = Shorthorn sire and Angus dam.

Table 2.—Breed group means and effects of heterosis for longevity (yr) under two culling policies

	Culling policy	
Item	Actual	Imposed
Breed group		
Hereford	8.5	6.9
Angus	9.4	7.6
Shorthorn	7.3	5.6
Hereford-Angus	11.0	8.8
Angus-Hereford	10.6	9.4
Hereford-Shorthorn	8.0	5.3
Shorthorn-Hereford	9.6	7.6
Angus-Shorthorn	9.3	6.8
Shorthorn-Angus	9.9	8.3
Crossbred average	9.7	7.7
Purebred average	8.4	6.7
Differences (heterosis)	1.3	1.0

[a]*Actual culling policy.* Heifers and cows 10 years old or older diagnosed as not pregnant were culled the first time they were open. After the first breeding season through 9 years of age, cows failing to conceive in two successive breeding seasons were culled. Cows were also culled for severe unsoundness.
Imposed culling policy. Females were culled the first time they were open, regardless of age, and for severe unsoundness.

Table 3.—Reasons for disposal and average age (yr) at removal from cow herd

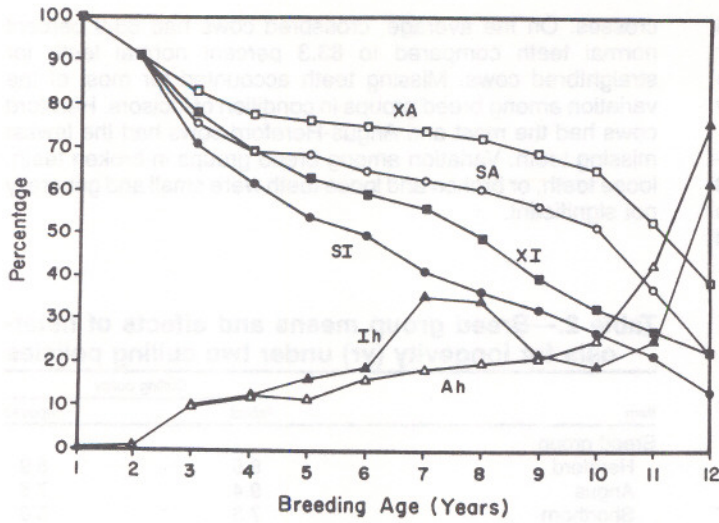|	Straightbreds			Crossbreds		
Reason	No.	pct	Age	No.	pct	Age
Open	85	54.5	6.5	91	52.9	7.9
Death	31	19.9	10.1	18	10.5	9.0
Emaciation	11	7.1	12.0	7	4.1	13.1
Crippled	5	3.2	10.5	7	4.1	11.4
Unsound udder	0	0.0	- - -	9	5.2	12.8
Cancer eye	4	2.6	11.1	0	0.0	- - -
Prolapse	3	1.9	3.9	0	0.0	- - -
Lump jaw	1	.6	8.6	0	0.0	- - -
Unknown	6	3.8	5.4	7	4.1	4.6
End of experiment	10	6.4	13.1	33	19.2	13.2
Total	156	100	9.0	172	100.0	10.3

Figure 1—Cumulative survival of straighbred (S) and crossbred (X) cows and percent of heterosis (h) under both actual (A) and imposed (i) culling policies.

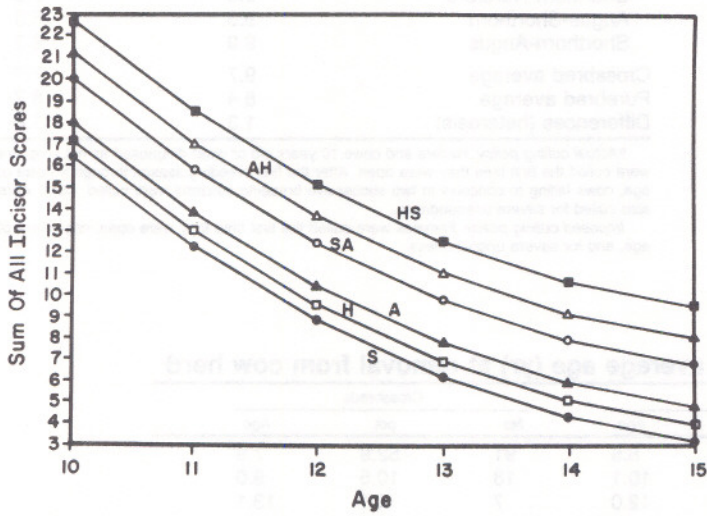Figure 2—Effect of age on teeth length of straightbred Hereford (H), Angus (A), Shorthorn(s) and reciprocal cross cows.
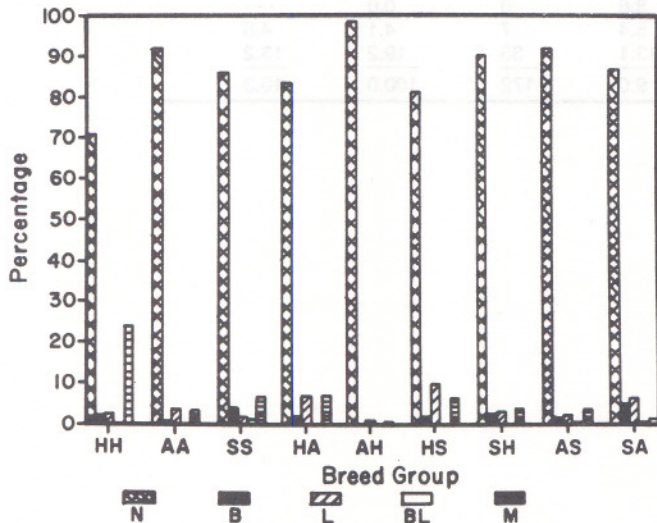

Figure 3—Relative frequency of normal (N), broken (B), loose (L), broken and loose (BL), and missing (M) teeth in aged (10 to 15 yr) cows.