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Comparison of the Performance of the Progeny of Crossbred Cows Mated Naturally to Calve at 2 and 3 Years of Age to Red Poll and Longhorn Sires

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Abstract: Crossbred dams when mated at different at different ages and in different years by natural service to sires Longhorn and Red Poll (n = 81 and 86, respectively) were compared for calf birth weight BW, weaning weight WW, calving difficulty CD measured categorically and calving ease CE measured binomially, and calf survival CS. Crossbred cows were from Angus, Hereford, Pinzgauer, Brahman, Sahiwal and Tarentaise crosses. The analytical model included: dam line (breed combination of dam) age of dam, sex and year as fixed effects, whereas julian birth day was a covariate. For analyses with back cross dams, covariates were included in the model for fractions of inheritance from each breed and fraction of complete heterosis of dams due to Bos taurus×Bos taurus, Bos indicus Bos indicus and Bos taurus×Bos indicus crosses instead of breed combination of dam. Red Poll sired calves had more calving difficulty than bull calves, but were heavier at birth and weaning than Longhorn sired calves. Variance due to dam within dam breed effects was important for growth traits and as a fraction of phenotypic variance ranged from 0.47 to 0.48 for birth weight, and weaning weight, respectively. Phenotypic variances due to individual effects of dams whithin crossbred groups mated to Red Poll and Longhorn bulls were 109 and 3528 for birth weight and weaning weight, respectively.

Key words: Breed differences, birth weight, weaning weight, calving difficulty

INTRODUCTION

Differences in performance for most bioeconomic traits are the result of different selection goals in different breeds. These differences represents an important genetic resource for improving efficiency of beef production (Gregory *et al*., 1993). Crossbreeding programs should involve crossbred cows because more than half of advantage of crossbreeding depend on their use (Cundiff and Gregory, 1977). Best linear unbiased prediction (BLUP) of genetic values with mixed model methodology with animals models is the method of choice of animal breeders (Henderson, 1988). Modifications introduced by Boldman *et al*. (1991) to use a sparse matrix solver (George *et al*., 1993) increased the order of mixed model equations that can be used with REML. The objective of this study was to compare the progeny of crossbred cows mated to calve at 2 and 3 years of age by natural service to unidentified sires Longhorn and Red Poll.

MATERIALS AND METHODS

This research made use of a group of cows (Cycle III, phase 3) were originally produced by mating Hereford (H) and Angus (A) cows to produce F_1 crosses from Hereford (HA), Angus (AH), Pinzgauer (PH and PA), Brahman (BH and BA), Sahiwal (SH and SA) and Tarentaise (TH and TA) sires. These crossbred females (Cycle III, phase 5) were mated to produce calves at 2 and 3 years of age when mated by natural service to unidentified bulls Longhorn and Red Poll (n = 81 and 86, respectively).

Data Collection: The traits analyzed in this study were birth weight, weaning weight (adjusted to 200 day of age), calving ease measured categorically, calving ease measured binomially, and survival at weaning, at 3 day and at birth, respectively. Calving difficulty was subjectively evaluated categorically using descriptive scores (i.e., 1 = no difficulty, 2 = little difficulty by hand, 3 = little difficulty with jack, 4 = slight difficulty with a

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calf jack, 5 = moderate difficulty with calf jack, major difficulty with calf jack and 7 = Caesarean birth presentation. Calving ease was also analyzed binomially with score 1 = ease (categorical, 1 and 2) and 0 = not so ease (categorical, 3-6). Survival was not analyzed to cows mated for calves Red Poll and Longhorn bulls because nearly all calves survived to weaning.

Separate analyses for each trait used Multiple Trait Derivative Free Restricted Maximum Likelihood (MTDFREML) program (Boldman *et al.*, 1993). The analytical model included: dam line (breed combination of dam), sex, age of dam and year as fixed effects, whereas julian birth day was a covariate. For analyses with back cross dams, covariates were included in the model for breed fractions and heterosis of dams due to Bos taurus×Bos taurus, Bos indicus×Bos indicus and Bos taurus×Bos indicus crosses instead of breed combination of dam. Variance components due to dam and residual effects were jointly estimated. Standard errors were used to test significance of differences among crossbred dam groups and other effects.

RESULTS AND DISCUSSION

Heterosis and epistasis are caused by the comple × interrelationships among primary and higher-order interactions gene products in the network of biochemical pathways. They may be considered as universal phenomena in the inheritance of quantitative traits (Geiger, 1987). Results of analyses of progeny of crossbred cows mated to calve at 2 and 3 years of age by natural service to Red Poll and Longhorn sires are presented in Table 1. Red Poll sires produced heavier calves at birth and at weaning that had much more calving difficulty than calves of Longhorn sires. Cows with Pinzgauer inheritance had heavier birth weights. Calving difficulty has been shown to be correlated with birth and postnatal weights (Bennett and Gergory, 2001). Birth weight is an effective correlated trait that can be used to reduce calving difficulty (Bennett and Gorgory, 2001). Nevertheless, selection only for reduced calving difficulty or birth weight will to lighter postnatal weight. Schemes for simultaneously changing or limiting change in calving difficulty, birth weight and postnatal weight have been proposed (Dickerson *et al.*, 1974; MacNeil *et al.*, 1998).

Smallest calves had dams with Sahiwal inheritance. Calves intermediate at birth weight involved Angus and Brahman cows. Crosses involving Brahman and Pinzgauer cows produced the heaviest calves at weaning. Smallest weaning weights involved Sahiwal and Angus inheritance. Hereford and Angus inheritance in dams associated with the most calving difficulty and Sahiwal with the least. Key genetic parameters needed for developing Schemes for simultaneously changing or limiting change in calving difficulty, birth weight and postnatal weight.

Table 1: Solutions from analyses of records of calves of crossbred cows mated naturally to calve at 2 and 3 years of age to unidentified Red Poll and Longhorn sires

	Trait[a]			
Item	BW	WW	CD-C	CE
Mean	69.8	398	1.38	1.90
Regresion on fraction of breed of dam				
H	23.9	24	1.32	-0.41
A	20.4	4	0.88	-0.32
P	28.1	42	-0.19	-0.12
B	12.5	52	0.36	-0.09
S0.0	0	0.00	0.00	0.00
se[b]	±6.3	±39	±0.57	±0.16
Heterosis	-4.4	10	0.28	-0.07
se [c]	±7.7	±45	± 0.69	±0.20
Sire Breed				
Red Poll	0.4	50	-0.41	0.12
Longhorn	-4.4	22	-1.05	0.25
Se[d]	±1.9	±11	±0.17	±0.05
Sex				
Bull	4.0	78	0.59	-0.14
Heifer	0.0	-80.00	0.00	
Steer	0			
se[e] (B-H)	±1.7	±24	±0.16	±0.05
se[e] (B-S)		±26		
se[e] (H-S)		±11		
Age of dam (year)				
2	-2.2	-46	0.67	-0.16
3	0.0	0	0.00	0.00
se[f]	±1.9	±11	±0.18±0.05	
JBD	0.2557	-0.1879	0.0253	-
0.0071				
se[g]	± 0.0923	± 0.5456	±0.0087	
±0.0025				

[a] BW= Birth weight weight, (lb), WW= Weaning weight (lb), CD-C= Calving difficulty measured categorically, CE= Calving ease measured binomially, SW= Survival at weaning, S-3d= Survival at 3-d, S-Bth= Survival at birth; [b] H= Hereford, A=Angus, P= Pinzgauer, B= Brahman, S= Sahiwal, [c] Heterosis; average standard error for difference in heterotic effects between Bos taurus x Bos taurus and Bos taurus x Bos indicus crosse; [d] B-H= Standard error of difference between heifer and bull calves; B-S: between steer and bull calves. H-S: between steer and heifer calves; [e] Age of dam; average standard error of difference between age of dam effects; [f] Julian birth day; standard error of regression coefficient

Variance due to dams within dam breed: Table 2 lists phenotypic variances and fractions due to individual effects of dams within breed of dam groups. As shown, variance due to dam within dam breed effects was important for growth traits and as a fraction of phenotypic variance ranged from 0.47 to 0.48 for birth weight and weaning weight, respectively. Phenotypic variances due to individual effects of dams whithin crossbred groups mated to Red Poll and Longhorn bulls were 109 and 3528 for birth weight and weaning weight, respectively.

Table 2 also shows the variance values (109 and 3528) due to effects of dams for both birth weight and weaning weight, respectively; corresponded to analyses of calves of crossbred cows mated to Red Poll and

Table 2: Phenotypic variances and fractions of variance due to individual effects of dams within crossbred groups mated naturally to Red Poll and Longhorn bulls

Sire of breed	Age of Dam yr	BW	WW	CD-C	CE	S-Wn	S-3d	S-Bth
Fraction of Variance due to dam effects								
Red Poll and Long Horn	2-3	.47	.48	.26	.10	c	C	C
Phenotypic Variances								
Red Poll and Long Horn	2-3	109	3528	.88	.07	c	C	C

[a]BW =Birth weight (lb), WW = Weaning weight (lb), CD-C= Calving difficulty categorical, CE= Calving ease binomial, S-Wn= Survival at weaning, S-3-d= Survival at 3d, S-Bth= Survival at birth; [c]Estimates were not obtained because mean survival was nearly 100%

Longhorn sires to calve at 2 and 3 years old age. Because nearly, all animals survived, survival was not analyzed for the Red Poll or for the Red Poll and Longhorn analyses.

IMPLICATIONS

Red Poll sires produced heavier calves at birth and at weaning weight that had more calving difficulty than Longhorn sires. Cows with Pinzgauer inheritance had heavier birth weights. Smallest calves had dams with Sahiwal inheritance. Calves intermediate at birth weight involved Angus and Brahman cows. Crosses involving Brahman and Pinzgauer cows produced the heaviest calves at weaning. Smallest weaning weights involved Sahiwal and Angus inheritance. Hereford and Angus inheritance dams was associated with the most calving difficulty and Sahiwal with the least. Variance due to dam within dam breed effects was important for growth traits and as a fraction of phenotypic variance ranged from .47 to .48 for birth weight, and weaning weight, respectively. Phenotypic variances due to individual effects of dams whithin crossbred groups mated to Red Poll and Longhorn bulls were (109 and 3528) for birth weight and weaning weight, respectively.

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