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Comparison of Crossbred Cows Mated Naturally to Produce Calves At 3-7 Years of Age to Simmental Sires for Production and Growth Traits

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Abstract: Crossbred dams when mated at different ages and in different years by natural service to Simmental bulls were compared for calf birth weight, weaning weight, calving difficulty, measured categorically and calving ease measured, binomially and calf survival. 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 by Bos taurus, Bos taurus × Bos indicus, Bos indicus × Bos indicus crosses instead of breed combination of dam. Differences among crossbred dam groups were observed for birth and weaning weight and calving difficulty. Birth and weaning weights were less in female calves than bull calves. Crosses involving Brhaman and Sahiwal cows had least calving difficulty.

Key words: Breed differences, growth traits, calving difficulty, survival

INTRODUCTION

The contribution of heterosis for economical important traits has been well documented (Cundiff, 1970; Peacock *et al*., 1978; Franke, 1980; Turner, 1980). Crossbreeding programs should involve crossbred cows because more than half of advantage of cross breeding is dependent on their use (Cundiff and Goegorg, 1977).

MATERIALS AND METHODS

This study used data as part of a program to characterize a broad range of biological types of cattle as represented by breeds that differs widely in traits such as milk yield, growth rate, mature size and carcass composition (Gregory *et al*., 1993).

Mating plans: The cows used to initiate this phase of the experiment (Cycle III, phase 3) were originally produced by mating Hereford (H) and Angus (A) cows to produce F1 crosses from Hereford (HA), Angus (AH), Pinzgauer (PH and PA), Brahman (BH and BA), Sahiwal (SH and SA) and Tarentaise (TH and TA) cows. These females were mated naturally to unidentified Simmental sires to produce calves at 3, 4, 5, 6 and 7 years of age.

Analyzed traits: The traits analyzed in this study were BW, WW (adjusted to 200 d of age), CD 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 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).

Statistical analyses: 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) 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 by Bos taurus, Bos taurus × Bos indicus, Bos indicus × 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.

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Table 1: Solutions for analyses of records of calves of crossbred cows mated naturally to produce calves at 3,4,5,6 and 7 years of age to unidentified Simmental sires

	Trait[a]						
Item	BW	WW	CD-C	CE	S-Wn	S-3d	S-Bth
Mean	82.8	502	1.11	1.97	1.93	1.98	1.96
Breed of dam							
H×A	1.7	-21	0.01	0.00	-0.01	-0.00	0.00
A×H	3.5	-3	-0.06	0.02	0.00	0.02	-0.00
B×H	-0.1	45	-0.16	0.06	-0.02	0.02	0.00
B×A	-3.3	40	-0.17	0.07	0.00	-0.02	0.00
S×H	-6.1	13	-0.11	0.05	0.01	0.03	0.01
S×A	-9.4	6	-0.16	0.07	-0.000	0.01	0.02
P×H	10.7	27	0.05	-0.00	-0.00	0.01	0.00
P×A	7.2	21	0.02	0.01	0.01	0.03	-0.00
T×H	7.5	42	0.01	0.02	0.01	0.02	0.01
T×A	-0.2	24	0.12	0.05	0.02	-0.01	0.00
SE[b]	±1.3	±7	±0.03	±0.02	±0.04	±0.03	±0.01
SexBull	5.1	34	0.10	-0.03	0.00	0.00-	0.01
Heifer	0.0	-35	0.00	0.00	0.08	0.08	0.00
Steer		20			0.00		
SE[c]B-H	±0.4	±4	±0.03	±0.01	±0.04	±0.04	0.01
SE[c]B-S		±4	0.14		±0.06		
SE[c]H-S		±3	0.13		±0.01		
Age of dam							
3	0.1	-24	0.10	-0.07	-0.05	-0.07	-0.02
4	-3.2	-8	-.04	-0.02	-0.05	-0.03	-0.02
5	-0.9	-5	-0.03	-0.02	0.00	-0.01	-0.01
6	0.1	2	0.00	-0.02	0.00	0.00	0.00
7	0.0	0	0.00	0.00	0.00	0.01	0.01
SE[d]	±1.9	±10	±0.10	±0.03	±0.04	±0.03	±0.02
JBD	0.1000	-.1300	-0.0004	0.0003	0.0005	0.0001	0.0001
SE[e]	0.0160	±.0700	±0.0009	±0.0002	±0.0004	±0.0002	±0.0003

[a]BW = Birth weight (lb), WW = Weaning Weight (lb), CD-C = Calving difficulty measured ategorically,CE = Calving ease measured binomially, SWn = Survival at weaning, S-3d = Survival at 3-d, S-Bth = Survival at birth; [b]H = Hereford, A = Angus, B = Brahman, S = Sahiwal, P = Pinzgauer, T = Tarentaise; average standard error of difference between crossbred dam groups; [c]B-S = Bulls minus steers; standard error of the difference between steer and bull calves. [c]H-S = Heifers minus steers; standard error of the difference between steer and heifer calves; Age of dam; average standard error of the difference for age of dam effect. Julian birth day; standard error of regression coefficient

RESULTS AND DISCUSSION

F1 crossbred cows mated to Simmental bulls (n= 1879): Analyses of progeny records of the same F1 cross cows mated in multiple pastures by natural service to Simmental bulls to produce calves at 3-7 year of age are presented in Table 1. Birth weights from crosses involving Brahman and Sahiwal cows were the smallest while Pinzgauer × Hereford, Tarentaise × Hereford and Pinzgauer × Angus dams had the largest calves at birth. Birth weights were smaller for female than bull calves. Smith (1976) found for Hereford and Angus cows mated artificially to Hereford, Angus, Jersey South Devon, Limousin, Charolais and Simmental bulls that Charolais and Simmental crossbred calves were heaviest at birth.

Smith (1976) found reported that for Hereford and Angus cows mated by artificial insemination with Hereford, Angus, Jersey, South Devon, Limousin, Charolais and Simmental bulls that Charolais Simmental crosses were heaviest at birth and Jersey crosses were lightest. Limousin and South Devon crosses were similar in birth weights and intermediate between the Charolais and Simmental crosses. Straightbred Herefrord calves were 8.4 lb heavier than straightbred Angus calves; a comparable 4.4 lb heavier weight was found for all crossbred calves from Hereford dams than for calves from Angus dams. Males were 5.9 lb heavier than females (80 vs 74.1 lb).

Ferrel (1993) reported that birth weights lower than optimum are associated with reduced energy reserves, lowered thermoregulatory capability and increased calf deaths at or near birth. Low birth weights are also related to low rates of growth after birth and decreased mature size. Conversely, birth weights greater than optimum are associated with greater calving difficulty, calf losses at birth and increased difficulties with rebreeding the cow.

The fetal genotype determines the maximum potential for fetal growth. Nevertheless may be argued that fetus rarely expresses its full genetic potential for growth (Ferrel, 1993). The maternal nutrition, number of fetuses and environmental temperature may cause further limitation of fetal growth, because those factors are most apparent during the later stages of gestation when fetal growing rate and nutrients needs are the greatest (Ferrel, 1993).

Table 2: Phenotypic variances and fractions of variance due to individual effects of dams within crossbred groups mated naturally to Simmental 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								
Simmental	3-7	0.17	0.35	0.07	0.07	0.02	0.03	0.08
Phenotypic Variances								
Simmental	3-7	102	2163	0.32	0.03	0.06	0.04	0.01

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

Calves from Brahman × Hereford, Brahman × Angus, Tarentaise × Hereford and Pinzgauer × Hereford dams were significantly heavier at weaning than calves from Herefordb by Angus cross dams. Calves from Pinzgauer × Angus and Tarentaise × Angus dams were intermediate for weaning weight. Differences among crossbred cows for calving difficulty are shown in Table 2. Calves from Pinzgauer × Hereford, Pinzgauer × Angus and Tarentaise× Hereford dams had the most calving difficulty. The least calving difficulty involved Brahman and Sahiwal cross cows. Laster *et al.* (1973) and Notter (1978) indicated that when birth weight was examined as a source of variation in level of calving difficulty, it appeared to be highly significant, both in heifers and in cows. Calving difficulty was significantly less for female calves than bull calves. Survival rates at weaning, at 3rd day and at birth were not much different among breed groups. Effects of sex were not significant for survival. The sex of the calf is major source of variation in levels of calving difficulty and stillbirths; frequencies for male calves being about twice as high as for female calves.

Pollak analyzed a subset of data of Simmental for weaning weights for female progeny (n = 50,616) out of sires (n = 3,067) and dams (n = 37,865) of three herds. Preliminary estimates using records on females were as follows. The estimate of variance permanent environmental effect of the dam was 4% of the total phenotypic variance and the correlation between direct and maternal genetic effects was -0.36. Estimated heritability for direct genetic effects was much larger than the reported by Garrick *et al.* (1989) for female calves with records (0.58 vs 0.34). The estimate of heritability of the maternal effect for weaning weight was comparable (0.15 vs 0.18) as was the genetic correlation between direct and maternal (-0.36 vs -0.34). They also found that genetic additive variation was larger for direct and maternal genetic effects than reported by Garrick *et al.* (1989) as was the covariance between them. The kind and relative amount of genetic variation attributable to maternal effects of traits especially the sign and magnitude of the genetic correlation between direct and maternal effects of traits with high economic importance, is critical in the design of optimal breeding plans.

Strhoben (1993) using a total of 170 Simmental reference sires with 300 or more progeny ratios for both calving ease and yearling weight, which suggests that their daughters will calve more easily than daughters of hard calving sires. However, calving ease for first calving is moderately heritable (about 25%) so that selection is possible (Strhoben, 1993).

IMPLICATIONS

Breeders can expect a reasonable response to selection for birth and weaning weight. They need to monitor birth weight when selecting for higher weaning weights. A low to moderate response to selection can also be expected if calving difficulty is selected for. Breeders must consider involve inheritance of Continental beef breeds in the design of their crossbreeding programs because the advantage to improve economically important traits. Both direct and maternal effects should be considered to achieve optimum genetic gain in a selection program.

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