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# Comparison of Crossbred Cows Mated by Natural Service to Unidentified Charolais Sires to Calve at 4-9 Years of Age

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**Abstract:** Crossbred dams when mated at different ages and in different years by natural service to Charolais (n = 415) bulls 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 x Bos taurus, Bos indicus x Bos indicus and Bos taurus x Bos indicus crosses instead of breed combination of dam. Differences among crossbred dam groups were observed for birth and weaning weights 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. Heifer calves had less calving difficulty than bull calves. There were few differences among dam breeds for survival at weaning, at 3 d or at birth.

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

## INTRODUCTION

Performance attributes of traits of greatest economic value for different breeds or breed crosses are important in determining the potential value of alternative germplasm resources for profitable beef production. To help define the most efficient system, theoretical considerations of crossbreeding and heterosis effects were presented by Dickerson (1969, 1973) and Hill (1971). Experiments have been conducted on crossbreeding (Gregory *et al*., 1991) to provide relevant information.

Best Linear Unbiased Prediction (BLUP) of genetic values using mixed model methodology with animal models is the method of choice of animal breeders (Henderson, 1988). Modifications introduced by Boldman *et al*. (1993) to use a sparse matrix solver Sparspak, (George and Liu, 1980) increased the order of mixed model equations that can be used with REML.

The objective of this study was to compare the performance of the progeny of crossbred dams when mated by natural service to Charolais sires to calve at 4, 5, 6, 7 and 9 years of age.

## 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). 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 $F_1$ 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 4-9 years of age when mated by natural service to Charolais bulls.

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 calf jack, 5 = moderate

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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 at birth, 3 day and weaning was recorded for all calves born.

**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 x Bos taurus, Bos taurus x Bos indicus, Bos taurus x 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

**Crossbred cows mated to charolais bulls (n = 398):** Analyses of records of calves of crossbred cows mated to Charolais sires by natural service to produce calves at 4, 5, 6, 7, 8 and 9 years of age are presented in Table 1. The largest effect on birth weight involved fraction of Pinzgauer inheritance. Smallest calves were associated with Sahiwal inheritance. On the binomial scale cows with Pinzgauer inheritance had the least calving difficulty and the most calving difficulty corresponded to calves from cows with Brahman inheritance.

Gregory *et al*. (1991) reported that effects of heterosis on calving difficulty were not consistent and generally were not significant, i.e., effects of heterosis on birth weight are not reflected in increased calving difficulty as trait of the dam.

Brinks *et al*. (1961) in a study in Herefords, indirect selection resulted in bulls that weighed 36.5 kg at birth while those not selected for breeding weighed 35.8 kg (Brinks *et al*., 1961). Birth weight is positively correlated with weaning, yearling and mature weights. Therefore, selection for any of these traits would cause some increase in birth weight (Brinks *et al*., 1973). A major challenge to the beef industry is to find a way to minimize this correlated response in birth weight. Strhoben *et al*. (1993) reported that a program of selection for low birth weight could lead to declines in weaning and yearling weights, which does not seem desirable. However, the author indicate that in the 1981 Angus sire evaluation

Table 1: Solutions from analyses of records of calves born to crossbred cows mated by natural service to unidentified Charolais sires to calve at 4,5,6,7 and 9 years of age

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Mean | 89.4 | 498 | 1.22 | 0.94 | 0.94 | 0.97 | 0.98 |
| **Regression on fraction of breed of dam.** | | | | | | | |
| H | 32.3 | -27 | -0.07 | 0.28 | 0.04 | 0.04 | -0.02 |
| A | 23.8 | -19 | -0.12 | 0.38 | 0.01 | 0.01 | -0.01 |
| P | 47.0 | 90 | - 0.28 | 0.72 | 0.06 | 0.06 | -0.00 |
| B | 15.9 | 29 | -0.24 | -0.00 | 0.03 | 0.03 | -0.01 |
| S | 0.0 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| se[b] | ±4.6 | ±25 | ±0.41 | ±0.12 | ±0.09 | ±0.06 | ±0.05 |
| Heterosis | 32.1 | 72 | -0.31 | 0.64 | -0.09 | -0.12 | -0.18 |
| se [c] | ±16.8 | ±93 | ±1.18 | ±0.35 | ±0.35 | ±0.22 | ±0.17 |
| **Sex** | | | | | | | |
| Bull | 0.8 | 64 | 0.03 | -0.06 | -0.03 | -0.02 | -0.00 |
| Heifer | -4.6 | 18 | 0.10 | -0.33 | 0.06 | -0.01 | -0.00 |
| Steer | -21.6 | 34 | 0.12 | -0.27 | 0.08 | | |
| se [d](B-H) | | ±15 | ±0.08 | ±0.02 | ±0.03 | ±0.02 | ±0.01 |
| se [d] (B-S) | | ±12 | | | ±0.05 | | |
| se [d] (H-S) | | ±7 | | | ±0.03 | | |
| **Age of dam[e]** | | | | | | | |
| 3 | -6.1 | 0 | -0.02 | 0.14 | 0.00 | 0.04 | 0.03 |
| 4 | 11.8 | -75 | - 0.16 | 0.50 | -0.03 | 0.06 | 0.04 |
| 5 | 6.0 | 17 | - 0.12 | 0.40 | -0.03 | 0.05 | 0.02 |
| 6 | 2.8 | 16 | -0.02 | 0.18 | -0.01 | -0.02 | -0.01 |
| 7 | -0.4 | 14 | -0.04 | 0.17 | -0.05 | 0.01 | 0.00 |
| 8 | 0.0 | 7 | 0.00 | 0.00 | -0.06 | 0.00 | 0.00 |
| 9 | 0.1 | -5 | 0.01 | 0.01 | -0.06 | 0.01 | -0.00 |
| Se | ±8.7 | ±23 | ±0.32 | ±0.09 | ±0.09 | ±0.04 | ±0.04 |
| JBD | 0.3200 | -0.2400 | -0.0041 | 0.0002 | 0.0050 | 0.0013 | 0.0002 |
| Se [f] | 0.0050 | ±0.3000 | ±.0040 | ±0.0011 | ±0.0010 | ±0.0006 | ±0.0007 |

[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 crosses, [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

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

| Sire of breed | Age of Dam year | BW | WW | CD-C | CE | S-Wn | S-3d | S-Bth |
|---|---|---|---|---|---|---|---|---|
| **Fraction of variance due to dam effects** | | | | | | | | |
| Charolais | 4-9 | 0.23 | 0.38 | 0.31 | 0.06 | 0.16 | 0.05 | 0.10 |
| **Phenotypic variances** | | | | | | | | |
| Charolais | 4-9 | 126 | 3300 | 0.05 | 0.05 | 0.06 | 0.02 | 0.01 |

[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, [b]Estimates were not obtained because mean survival was nearly 100%

report of 673 sires listed, 59 had below average birth weight but were above average on weaning weights, yearling weight and maternal breeding value.

Cundiff *et al.* (1986) reported that selection of bulls and replacement heifers with heavier weaning weights relative to the herd average will lead to genetic decline in nursing ability. Nevertheless selection of heifers on the basis of heavy weaning weights is less effective than selection of bulls with oustanding weaning weights. When selection for increased weaning weight, the breeder often selects for mothering ability, as well as for the calf's own ability to grow. However, selection among cows for mothering ability should be reasonably effective (Cundiff *et al.*, 1986). This can be accomplished by selecting cows on the basis of weaning weights of their calves; cows that wean calves heavier than the herd average in one year are more apt to produce calves heavier than average in succeeding years. They also indicated that differences in mother ability can be evaluated about as accurately on the basis of 112-day calf weights as the conventional weaning age (205 days). The adjustments for differences in age of dam, sex of the calf are necessary because these factors influence weaning weight (Cundiff and Gregory, 1977). Table 1 also shows that crossbred calves from Pinzgauer inheritance were heavier at weaning. The smallest weaning weights involved cows with Sahiwal and Hereford inheritance.

Table 2 lists phenotypic variances and fractions due to individual effects of dams within breed of dam groups mated naturally to Charolais bulls, to calve at 4, 5, 6, 7, 8 and 9 years old age. As shown, variation due to dam effects (0.23 and 0.38) was important for growth traits as birth and weaning weights, respectively and moderate low important (0.10 and 0.16) for survival at birth and weaning, in that order. The phenotypic variance values (126 and 3300) corresponded to birth weight and weaning weight, in that order. Table 2 also shows the phenotypic variances values (0.06, 0.02 and 0.01) which corresponded to survival at weaning, 3-days and survival at birth of the progeny of crossbred cows.

## IMPLICATIONS

Breeders must consider that crossbred calves from 4-9 years with Pinzgauer inheritance mated to Charolais bulls not only had less calving difficulty but their calves can be expected to be heavier at weaning. Dams with increased fractions of inheritance of Brahman and Sahiwal breeds, can be expected to produce the smallest calves at birth similarly dams with Hereford and Angus inheritance can be expected to produce the lowest weaning weights. Analyses for survival at weaning, 3 d and at birth indicate little or no significant variation among dam breed groups.

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