GENETIC PARAMETERS FOR AGE AT FIRST CALVING AND INTERVAL BEGINNING OF BREEDING SEASON-CALVING IN PUREBRED GUZERAT AND CRIOLLO COWS AND RECIPROCAL CROSSES, AND BIRTH AND WEANING WEIGHT OF THEIR CALVES

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INTRODUCTION

In México there are several groups of Criollo cattle, one of them is located in the mountain region of the state of Nayarit, in the pacific coast. It is estimated that there are around 9,000 heads of this type of Criollo in that state. In 1982, the National Institute for Forestry and Agricultural Research (INIFAP) purchased 50 cows and 10 bulls from small farmers in the mountains of Nayarit; information on ages or any other kind was not available for these cattle. By 1990, the herd with known birth dates and growth data amounted to 70 cows. To evaluate production ability, as well as additive and nonadditive genetic effects, a diallel crossbreeding experiment with Guzerat cattle was then begun.

In the first phase of the experiment, Criollo cows showed higher pregnancy, calving and weaning rates than Guzerat, by 11.2 ± 3.6, 13.0 ± 3.7 and 17.2 ± 3.6 percentage points (P < 0.01). For birth weight, calves out of Guzerat bulls were 1.6 ± 0.54 kg heavier than those out of Criollo bulls (P = 0.0036); calves from Guzerat cows were 3.0 ± .6 kg heavier than those from Criollo cows (P = 0.001). No differences were found between Criollo and Guzerat sires or dams for weaning weight of the calves; however, a direct heterosis for weaning weight of 5.5 ± 2.04 (P = 0.04) was estimated. Overall, Criollo cows produced 22.5 more kg of calf weaning weight per cow exposed than Guzerat cows (Montano-Bermudez, 1998).

The objectives of this study were to estimate heritabilities, heterosis and breed effects for age at first calving and interval between beginning of breeding season and calving of purebred Criollo and Guzerat, as well as F1 (reciprocal crosses) females generated in the first phase of the experiment; birth and weaning weight of the calves of these females were also evaluated.

MATERIAL AND METHODS

Data were collected on 140 females (50 Guzerat, 26 Criollo, 21 Guzerat x Criollo and 43 Criollo x Guzerat) born from 1991 to 1994 at El Verdineño Experiment Station in the state of Nayarit, México; which is 60 m above sea level, with an average daily temperature of 24 C, average rainfall of 1,400 cc and a dry season of 7 to 8 months. Cows were sired by 14 Criollo and 12 Guzerat bulls and mated to 15 Angus bulls. Breeding seasons were 60-days long and began on March 15, in the spring, and September 15, in the fall. Criollo heifers were included in the breeding group when they reached 280 kg, Guzerat and crossbred heifers when they reached 300 kg. Pregnancy was diagnosed by rectal palpation 60 days after the end of the breeding season. Cows were culled if not pregnant after two consecutive breeding seasons, and
Heifers after three. Calves were weighted within the first 24 hours after birth and weaned at 7 months of age, on average. Cows and calves were maintained on pastures of *Andropogon gayanus*.

Trait studied were age at first calving (AFC, n = 140), interval beginning of breeding season-calving (IBBSC, n = 286), and calves birth weight (BW, n = 251) and weaning weight adjusted to 205 days of age (WW, n = 202). Adjustment for weaning weight was made multiplying preweaning average daily gain by 205 and adding the birth weight.

**Statistical Analysis.** Data were analyzed using a single trait animal model. Estimates of the genetic parameters were obtained using a multiple trait derivative-free algorithm to obtain restricted maximum likelihood estimates (MTDFREML, Boldman *et al.*, 1995).

Models used in the analysis were: \( \mathbf{Y} = \mathbf{X}\beta + \mathbf{Z}_0\mathbf{u}_D + \mathbf{g} \), for AFC, and \( \mathbf{Y} = \mathbf{X}\beta + \mathbf{Z}_0\mathbf{u}_D + \mathbf{Wp} + \mathbf{e} \), for IBBSC, BW and WW. Where, \( \mathbf{Y} \) is the vector of observations; \( \beta \) the vector of fixed effects; \( \mathbf{u}_D \) the vector of direct additive genetic effects, and \( \mathbf{p} \) the vector of random permanent environmental effects; \( \mathbf{g} \) is the vector of random residual effects. \( \mathbf{X}, \mathbf{Z}_0 \) and \( \mathbf{W} \) are matrices relating observations to the effects in \( \beta, \mathbf{u}_D \) and \( \mathbf{p} \) respectively. The iterative process was stopped when the variance of function values (-2log L with L = likelihood given the data) of the simplex was less than the convergence criterion (1x10^-8). To check for convergence to a local rather than to a global maximum, the analyses were restarted using the resulting estimates of the parameters as new starting values until the value of -2log L did not change in the first two decimal positions.

Models included the fixed effects of cow genetic group, and year and season of birth for AFC; cow genetic group, year and season of breeding, age of cow and sex of calf, were included as fixed effects for IBBSC, BW and WW.

**RESULTS AND DISCUSSION**

Effects of breed of sire and breed of dam of the cow, as well as the interaction between them were significant (P <0.05) for AFC. Individual heterosis for this trait was 140 days (Table 1). Heifers out of Guzerat bulls or cows were older at first calving; with purebred Guzerat heifers being the oldest (1661 days, on average). Sacco *et al.* (1987) and Ríos-Utrera *et al.* (1996) also found *Bos indicus* heifers to be older at first calving than either *Bos taurus* or F1 *Bos taurus x Bos indicus*. The resulting heterosis is much higher than that of 13 days reported by McElhenney *et al.* (1985).

No significant effect of breed of sire, breed of dam of the cow, nor the interaction between them were found for IBBSC and BW. General means for these traits were 317.4 ± 19.0 days and 30.6 ± 3.8 kg, respectively. Boston *et al.* (1976) found a non-significant difference of 5 days in calving date between crossbred and purebred cows. In contrast, Williams *et al.* (1990) found that crossbred cows calved earlier than purebreds. In birth weight and in contrast to our results, Riley *et al.* (2001) reported that Angus x Hereford cows had heavier calves at birth than *Bos indicus x Hereford* cows. Olson *et al.* (1993) found a maternal heterosis Angus-Brahman of 2.9 kg (P < 0.0001)) for birth weight.
For WW, no significant effect of breed of sire nor breed of dam of the cow were found but a significant interaction between breed of sire and breed of dam of the cow was observed (Table 1). In contrast, Riley et al. (2001) found that Bos indicus x Hereford cows weaned heavier calves than Angus x Hereford. The estimated maternal heterosis of 12 kg is smaller than those, between 16 and 29 kg, estimated by Crockett et al. (1978), Peacock et al. (1981) and Olson et al. (1993).

The estimate of heritability for AFC obtained in the present study (Table 2) was higher (0.11) than estimates published by Baco et al. (1998) and De Alba and Kennedy (1994) for Japanese cattle (0.04) and Criollo cattle (0.07), respectively. Several authors, however, have reported higher estimates for the same trait (Duarte, 1987; Toth and Gere, 1998).

Estimates of heritability for BW (0.38) and WW (0.28) are presented in Table 2. Estimates from 0.11 to 0.34 for BW have been reported in nine pure breeds and three composite populations (Dodenhoff et al., 1999). In contrast, higher estimates of heritability for BW were found by Meyer et al. (1990) in Hereford (0.43) and Wokalups (0.52) cattle. For WW, Bennett and Gregory (1996) reported a similar estimate of heritability (0.28) obtained from data of several Bos taurus breeds. Smaller estimates (from 0.10 to 0.18) were published by Dodenhoff et al. (1998) for weaning weight of four composite populations.

Table 1. Breed of sire and breed of dam of the cow effects (Guzerat – Criollo), and interaction between them for Age at First Calving (AFC), and Weaning Weight (WW) in purebred Criollo and Guzerat cows and reciprocal crosses

<table>
<thead>
<tr>
<th>Effect</th>
<th>AFC (d)</th>
<th>WW (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed of sire</td>
<td>152 ± 39 *</td>
<td>6.1 ± 3.6 NS</td>
</tr>
<tr>
<td>Breed of dam</td>
<td>101 ± 37 *</td>
<td>5.8 ± 3.5 NS</td>
</tr>
<tr>
<td>Breed of sire x Breed of dam</td>
<td>-135 ± 37 *</td>
<td>12.0 ± 3.4 *</td>
</tr>
</tbody>
</table>

*P < 0.05     NSP > 0.05.

Table 2. Estimates of heritability (h²), and additive genetic (g²) and phenotypic (p²) variances for Age at First Calving (AFC), beginning of breeding season-calving interval (IBBSC), and calves birth weight (BW) and weaning weight adjusted to 205 days of age (WW)

<table>
<thead>
<tr>
<th>Trait</th>
<th>(h²)</th>
<th>(g²)</th>
<th>(p²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFC</td>
<td>0.11</td>
<td>4082.53</td>
<td>37113.91</td>
</tr>
<tr>
<td>IBBSC</td>
<td>0.00</td>
<td>0.00002</td>
<td>360.67</td>
</tr>
<tr>
<td>BW</td>
<td>0.38</td>
<td>5.78</td>
<td>15.17</td>
</tr>
<tr>
<td>WW</td>
<td>0.28</td>
<td>135.13</td>
<td>490.21</td>
</tr>
</tbody>
</table>
CONCLUSIONS
Daughters of Guzerat bulls or Guzerat cows were older at first calving than those of Criollo bulls or Criollo cows. Heterosis for AFC was -135 days. No significant effects of breed of sire and breed of dam of the cow were found for IBBSC, BW and WW. No heterosis for IBBSC and BW was found. A maternal heterosis of 12 kg was calculated for WW. Estimates of heritability found for AFC and IBBSC suggest that, for these traits, little variation is due to additive genetic effects.

REFERENCES