ABSTRACT: The objective of the study was to estimate the heritability of Calving Date (CDate) in Nellore cattle and the possibility of its use as a reproductive trait in a breeding program. A dataset of 148,897 births of Nellore females calved between 1992 and 2011 were used. The data was provided by the Nellore Breeding Program Qualitas. The CDate trait was calculated as the day number in which the cow calved within the calving season. The variance components were estimated through the restricted maximum likelihood using the software AIREMLF90. The heritability estimates found for CDate without penalty was 0.26 while estimates for CDate with penalty (21 days added highest day number if the female was open) was 0.09. Our findings suggest the inclusion of CDate trait additive genetic value as a selection criteria in beef cattle breeding programs.

Keywords: beef cattle; genetics parameters; reproduction trait

Introduction

Reproductive traits are highly important in all livestock farming activities. Reproduction performance is one of the main factors in the efficiency and productivity of a beef cattle production system. In beef cattle, cow fertility has great influence on economic efficiency as the production of calves reflects the productivity of the system, mainly those that aim to sell weaned calves (Mwansa et al., 2002). Thus, sexual precocity and reproductive traits are crucial for beef cattle production systems leading several studies to highlight the importance of these traits in selection programs.

The low reproductive efficiency is a limiting factor in beef cattle, affecting the selection intensity and generation interval and consequently decreasing the genetic gain. Newman et al. (1992) reported that the removal of reproductive traits from the aggregate selection index for cattle selection in New Zealand considerably decreased the efficiency of selection in economic terms. According to Notter and Johnson (1988), reproductive traits are difficult to measure and have low heritability.

Thus, knowledge of reproductive traits to be considered in selection programs is required. Several traits have been studied as an alternative for evaluating fertility in females. Among these traits, it has been suggested the use of the record of the calving date (CDate) which indicates the calving ability of a cow early in the calving season. CDate is conceptually the same than days to calving, however, CDate date is more appropriate to analyses field data because do not need to record the first joining date. (Gutiérrez et al., 2002). The CDate aims to produce bulls that originate females with greater activity during early estrus of the breeding season, which requires fewer services for obtaining pregnancy and likely shorter period of gestation. The aim of the study was to estimate the heritability of reproductive trait calving date (CDate) in Nellore females and the possibility of its use in breeding programs.

Material and Methods

In the present study, a total of 148,897 births of female Nellore calves produced between 1992 and 2011 were used. The data were provided by the Nellore Breeding Program Qualitas with collaboration of beef farms from the states of São Paulo, Goiás, MatoGrosso, Rondônia and Tocantins.

The CDate trait was calculated as the day number in which the cow calved within the calving season. Only females that have calved within the program were considered in this study. Data were analyzed by using the SAS (SAS, 2010) statistical program. Records of females lacking a registration in at least one of the pre-and post-weaning traits evaluated by the program over the age of 21 months, less than 10 contemporary within the group and, below or above three standard deviations from the mean within contemporary group were not considered. After quality control, a total of 132,543 records remained for the CDate trait.

The contemporary group (CG) consisted of a herd and year of calving season. The variables contained in the CG had significant effects in previous analyzes (P<0.001) on the GLM procedure (SAS, 2010) in addition to the effect of previous reproductive status (1, no parity and 2, parity) and female age on the entry of calving season.

To include the female companions who had no birth in the analysis, a record was created by adding another 21 days to the highest value for CDate within CG. As a result of this procedure the data file included 10,843 records.
The pedigree file was built to the sixth generation from females with record CDate totaling 75,031 animals. A description of the database analyzed is presented in Table 1.

<table>
<thead>
<tr>
<th>Trait²</th>
<th>No Obs</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDate</td>
<td>132,543</td>
<td>76</td>
<td>43</td>
<td>1</td>
<td>274</td>
</tr>
<tr>
<td>CDate_P</td>
<td>143,386</td>
<td>85</td>
<td>55</td>
<td>1</td>
<td>295</td>
</tr>
</tbody>
</table>

²CDate, calving date; CDate_P, calving date with penalty

Table 2. Estimates of variances, heritability and repeatability for Calving Date (CDate) in Nellore animals Breeding Program Qualitas

<table>
<thead>
<tr>
<th>Estimate⁶</th>
<th>CDate</th>
<th>CDate_P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Va</td>
<td>210.3</td>
<td>95.6</td>
</tr>
<tr>
<td>Vap</td>
<td>69.2</td>
<td>142.8</td>
</tr>
<tr>
<td>Ve</td>
<td>536.4</td>
<td>778.0</td>
</tr>
<tr>
<td>h²</td>
<td>0.26</td>
<td>0.09</td>
</tr>
<tr>
<td>r</td>
<td>0.34</td>
<td>0.23</td>
</tr>
</tbody>
</table>

⁶Va = additive variance; Vap = permanent environmental variance; Ve = residual variance; h² = heritability estimate; r = repeatability estimate.

An animal repeatability model was used including the effect due to the animal, other than additive genetic, as an additional random effect for each animal. Fixed effects fitted were CG and previous reproductive status, while the linear effect of age at entry in the breeding season was considered as a covariate. The variance components were estimated using restricted maximum likelihood with AIREML program (Misztal et al, 1999).

Results and Discussion

The observed CDate was superior to the averages reported by Mercadante et al., (2005) and Gutiérrez et al. (2002) in Nellore and Asturiana cattle, who found values of 0.16 ± 0.02 and 0.21 ± 0.02, respectively.

Table 2 shows the values of the heritability estimates of CDate for analysis with and without penalty. A difference of 0.17 between the values of heritability analyzes with and without penalty was observed, which respectively had values of 0.09 and 0.26. These results suggest that the use of the inclusion of open female biases the heritability estimates as the values obtained in the analysis were lower than those without penalty. Meyer et al. (1990) reported similar results to those obtained in the present study, suggesting that the low heritability estimates for days to calving feature may be caused by the analysis model and the method of allocation of penalty values.

In the present study, penalties for females not calved within herd and year of entry into the calving season were assigned and no increase was observed in the estimated heritability. Pereira et al. (2000) obtained similar results to those reported by Meyer et al. (1990) who report that assignment of penalties has little effect on the estimates of heritability and repeatability of the trait days to calving similarly to the observation of the current study for CDate.

The estimated values of heritability (without penalty) were higher than the estimates found in the literature described by Mercadante et al. (2005) which ranged from 0.07 to 0.16 and by Gutiérrez et al. (2002). Moreover, the values of repeatability estimate (0.23) was also higher than those reported by Mercadante et al. (2005).

The value of permanent environmental variance was higher in the analysis with the use of penalty also showing a higher environmental variance, suggesting that the model applied is affecting the results or adjustment, leading to a loss of additive genetic variability.

Conclusion

The CDate have additive genetic variability that may be included as selection criteria in beef cattle breeding programs.

Literature Cited