HERITABILITY OF GROWTH AND REPRODUCTIVE TRAITS IN NELORE CATTLE[3]

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INTRODUCTION

According to the Animal Model method it is possible to obtain estimates of populational genetic parameters and the genetic value of individuals under selection corrected by fixed effects included in the model (Iemma, 2003) and presently its use is common in animal breeding programs. Growth traits, such as, body weight are of upmost importance to the efficiency of any bovine production system and, as a consequence, these characteristics are largely applied as a selection criterion. In Brazil, reproductive traits are one of the limiting factors of cattle herd productive efficiency (Pereira et al, 2000a) and should be incorporated to other traits evaluated in selection programs (De Oliveira, 2003; Boligon et al, 2007).
The aim of this paper was the estimation of the heritability of weaning weight, weight gain, muscle development, scrotum perimeter and age at first parturition, applying the mixed model classic method.

MATERIAL AND METHODS

Data was obtained from three herds from Agro-Pecuária CFM Ltda, located in São Paulo and Mato Grosso do Sul (Brazil). Statistical analyses were conducted at the Departamento de Zootecnia da Universidade Federal de Lavras (UFLA) at Lavras/MG. The growth traits studied were: weaning weight (WW), weight gain at 345 days (WG345), muscle development at 18 moths (MUSC18) and the reproductive traits were: age at first parturition (AFP) and scrotal perimeter at 18 months (SP18). The data set had 8,746 observations for WW, SC and MUSC18; 8,741 observations for WG345 and 8,600 observations for AFP. Distinct models were used for the estimations of variance and heritability components. For AFP the model included the fixed effects of the contemporary yearling group and the random effect of animal. For SP, the fixed effect of contemporary yearling group and animal, maternal and permanent environment random effects were included, as well as, animal age at measurement (linear) and dam age at parturition (linear and quadratic) as covariates. For WW, the fixed effect of the contemporary group at weaning and the random effects of permanent environment were included and animal age at weaning (linear) and dam age at parturition (linear and quadratic) were used as covariates. For WG345, the fixed effect of the contemporary group at 345 days and the animal and dam random effects were included and, as covariates, age at weaning (linear) and age of the dam at parturition (linear and quadratic). For MUSC18, the fixed effect of the contemporary group muscling at 18 months and the animal random effects were included and, as covariates, yearling animal age (linear). For the estimations of variance components and heritability made from the animal model univariate analyses were used, by the maximum likelihood estimation through the MTDFREML (*Multiple Trait Derivative Free Restricted Maximum Likelihood*) application described by BOLDMAN et al., 1993. The convergence criterion was considered met when the likelihood variance function reached a value smaller than 10^{-15}. The program was reinitiated using the values obtained at the previous round until these values equalized after two consecutive rounds.

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RESULTS AND DISCUSSION

The estimation components of variance and heritability are presented on table 1.

Table 1 – Heritability and (co)variance estimations for age at first parturition (AFP), muscling at 18 months of age (MUSC18), scrotal perimeter at 18 months (SP18), weight gain at 345 days WG345 and weaning weight (WW) of Nelore cattle

Traits	σ^2_P	σ^2_a	σ^2_m	σ^2_{pm}	σ^2_e	σ_{am}	h^2_a	h^2_m
AFP	0.80	0.06	(-)	(-)	0.74	(-)	0.08	(-)
MUSC18	0.67	0.12	(-)	(-)	0.55	(-)	0.18	(-)
SP18	105.49	32.05	81.21	42.99	0.25	-51.0	0.30	0.77
WG345	419.75	73.44	46.29	(-)	294.73	5.29	0.17	0.11
WW	295.50	48.89	45.06	45.47	202.67	-46.6	0.17	0.15

σ^2_P = Phenotypic variance; σ^2_a = Additive genetic effect variance; σ^2_m = Maternal genetic effect variance; σ^2_{pm} = Dam permanent environment effects variance; σ^2_e = residual effects variance; σ_{am} = Covariance between the direct and maternal genetic effects; h^2_a = Direct heritability; h^2_m = Maternal heritability; (-) = Effect not included in the trait model.

For AFP the heritability found in this paper was lower than values found in Brazilian literature (0.14 and 0.28) for zebu cattle (Mercadante et al.. 2000; Azevêdo et al.. 2006; Boligon et al.. 2009). This heritability value indicates that the AFP expression is strongly linked to non-genetic effects which are not identified in the model, therefore increasing the residual variance. In the herds used, heifers are firstly exposed to bulls at 12 months of age, differently from what occurs in Brazilian commercial herds, where the pre-determined first breeding age (around 27 months) is greater. This shows that environmental factors may alter the heritability values found. For MUSC18, the estimated heritability was lower than that found in most Brazilian research (0.22 to 0.27) for Nelore cattle (Koury Filho, 2005; Pedrosa et al., 2008). This difference may be explained by the fact that the visual evaluation method used in the selection of this trait type is subjective and that the scoring systems are different among the studies reviewed. This may have influenced the scoring values obtained overestimating its importance in the analysis of the variance components. For SP18, the direct heritability value is lower than that found in the Brazilian literature (0.31 to 0.52) for Nelore cattle (Dias et al. 2003; Boligon et al. 2006).This may be related to the use of the age of the animal as a covariate and the inclusion of the maternal effect in the model, causing a reduction on the additive genetic variance. The estimation of the direct heritability of GP345 was considerate as average and that of the maternal effect as low. These values are similar to those estimated for the Nelore in Brazil (0.16 to 0.42) by Marcondes et al. (2000), Mascioli et al. (2000), Boligon et al. (2006) and Boligon et al. (2009). This estimation values may have been influenced by the environment conditions in which animals were weaned. For this reason, the inclusion of maternal effect in the GP345 analysis model may add accuracy to the heritability values estimated. For WW, the direct heritability effect was of average magnitude and bellow values found in the literature (0.29 to 0.34) for Nelore cattle. The estimation of maternal heritability was also of average magnitude, indicating that it is possible to increase pre-weaning growth in Nelore, by selecting animals with greater maternal ability, because the contribution of the maternal effect is relatively high. The inclusion of the maternal effect in the WW model may have resulted in lower heritability values, for, according to Oliveira et al. (2002), models that did not include the maternal effect tend to have greater direct heritability, because this effect is added to the additive effect. The inclusion of covariates, as correction factors for calf age and dam age at parturition, may also have influenced the WW direct heritability in the present work, since the phenotypic variance is composed of various effects that, when not considered in the model, become part of the additive genetic variance.

CONCLUSION

All the traits studied may have a favorable response to selection. However, for AFP, this response will be slower compared to the other traits studied.

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