GENETIC RELATIONSHIPS BETWEEN MILK TRAITS, WEIGHT TRAITS AND AGE AT FIRST CALVING IN CROSSBREED DAIRY CATTLE (Bos taurus x Bos indicus).


1APTA Regional do Nordeste Paulista, Cx.P. 58, 13730-970 Mococa, SP, Brazil
2Federal University of Minas Gerais, Belo Horizonte, MG, Brazil
3Department of Animal Science - FCAV-UNESP-Jaboticabal, Brazil
4Federal Research Organization (EMBRAPA) Juiz de Fora-MG
5EPAMIG - Patos de Minas, Brazil
6EPAMIG - Prudente de Morais, Brazil
7Federal University of Mato Grosso do Sul, Campo Grande, Brazil

INTRODUCTION
The formal definition of the breeding objectives is the first step when designing a breeding program. The traits to be selected must be of economic relevance in the production system of interest (Ponzoni & Newman, 1989). In Brazil, the adoption of milk production systems, based on the use of crossbred animals with different grades of specialized dairy breeds and zebu inheritance is a common practice (Madalena et al., 1997). In these systems, in addition to milk production, the sale of male calves and surplus heifers are important sources of revenues, making them a feasible alternative for milk production in the country (Holanda Jr & Gomes, 1998). With the objective of obtaining relevant genetic information on the performance of crossbreed dairy cattle, the Federal Research Organization (EMBRAPA), funded by FAO/PNUD, implemented the project “Development of Brazilian Milking Hybrid (MLB)” (Madalena, 2000). The present study, which is part of that program, aimed to estimate the heritabilities and genetic and phenotypic correlations between milk and weight traits, and with age at first calving.

MATERIAL AND METHODS
Data
The data set consisted of information on growth rate between 12-24 months, first lactation 305-day milk, fat and protein yields, lactation length, cow average live weight and age at first calving of 1407 daughters of 120 MLB sires under progeny testing. The animals were split in seven different farms, in three different states in the southeast region of Brazil.

Statistical analyses
Heritability estimates were obtained by single trait analyses and the genetic and phenotypic correlations by bivariate analyses. Variance components estimates were obtained by REML using MTDFREML package (Boldman et al., 1993). All the analyses were carried out considering an animal model with a complete additive numerator relationship matrix (3,173 animals). The standard errors of the genetic correlations were obtained as Robertson (1959) in Falconer & Mackay (1996).

The mixed model used for the analyses of milk traits included the fixed effects of age at calving, contemporary group, farm-fraction of Bos taurus genes of the animal’s dam and the additive genetic as random effect. Short lactations were not eliminated, in agreement with Madalena (1988). For the age at first calving, the fixed effects were contemporary group, farm-fraction of Bos taurus genes of the animal’s dam and the additive genetic as random effect. The weights were grouped in age classes. The average weights of cows were obtained by
integrating an individual growth curve. A quadratic growth curve was adopted in accordance with Teodoro & Madalena (2002) and Madalena, et al (2003). To estimate the individual growth trajectory regression, a mixed model was considered that included the fixed effects of age of the animal, lactation stage, reproductive stage and contemporary group and the regression coefficients as random effects. The weights were analyzed by PROC MIXED of the SAS package (Littell et al., 1996). The covariance structure that best fitted the data was FA(q). For the analyses of heifers’ the growth rate between 12-24 months, the contemporary group was considered as fixed effect. The procedures and statistical model were the same as those described for the analyses of cow traits, but a linear growth curve was as adopted.

RESULTS AND DISCUSSION
The heritability, genetic and phenotypic correlations obtained are presented in Table 1.

Table 1 - Heritability (diagonal), genetic (upper) and phenotypic correlations (lower) between milk production traits, weight traits and age at first calving (standard errors in parenthesis).

<table>
<thead>
<tr>
<th></th>
<th>MY</th>
<th>FY</th>
<th>PY</th>
<th>LL</th>
<th>AFC</th>
<th>ACW</th>
<th>HGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>MY</td>
<td>0.28</td>
<td>0.15</td>
<td>0.85</td>
<td>0.07</td>
<td>0.03</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>(0.08)</td>
<td>(0.14)</td>
<td>(0.09)</td>
<td>(0.02)</td>
<td>(0.12)</td>
<td>(0.06)</td>
<td>(0.06)</td>
<td></td>
</tr>
<tr>
<td>FY</td>
<td>0.90</td>
<td>0.90</td>
<td>0.83</td>
<td>0.07</td>
<td>0.03</td>
<td>0.08</td>
<td>0.07</td>
</tr>
<tr>
<td>(0.00)</td>
<td>(0.02)</td>
<td>(0.01)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.07)</td>
<td>(0.07)</td>
<td></td>
</tr>
<tr>
<td>PY</td>
<td>0.92</td>
<td>0.92</td>
<td>0.12</td>
<td>-0.08</td>
<td>-0.03</td>
<td>0.00</td>
<td>0.06</td>
</tr>
<tr>
<td>(0.02)</td>
<td>(0.03)</td>
<td>(0.01)</td>
<td>(0.12)</td>
<td>(0.06)</td>
<td>(0.00)</td>
<td>(0.06)</td>
<td></td>
</tr>
<tr>
<td>LL</td>
<td>0.28</td>
<td>0.19</td>
<td>0.48</td>
<td>-0.05</td>
<td>-0.13</td>
<td>-0.21</td>
<td>0.18</td>
</tr>
<tr>
<td>(0.11)</td>
<td>(0.09)</td>
<td>(0.07)</td>
<td>(0.12)</td>
<td>(0.07)</td>
<td>(0.00)</td>
<td>(0.06)</td>
<td></td>
</tr>
<tr>
<td>AFC</td>
<td>-0.02</td>
<td>0.00</td>
<td>-0.13</td>
<td>-0.22</td>
<td>-0.12</td>
<td>-0.22</td>
<td>0.02</td>
</tr>
<tr>
<td>(0.18)</td>
<td>(0.00)</td>
<td>(0.00)</td>
<td>(0.23)</td>
<td>(0.18)</td>
<td>(0.23)</td>
<td>(0.23)</td>
<td></td>
</tr>
<tr>
<td>ACW</td>
<td>-0.03</td>
<td>0.03</td>
<td>-0.13</td>
<td>-0.54</td>
<td>-0.49</td>
<td>-0.12</td>
<td>-0.55</td>
</tr>
<tr>
<td>(0.18)</td>
<td>(0.14)</td>
<td>(0.18)</td>
<td>(0.18)</td>
<td>(0.31)</td>
<td>(0.18)</td>
<td>(0.31)</td>
<td></td>
</tr>
<tr>
<td>HGR</td>
<td>-0.59</td>
<td>-0.73</td>
<td>-0.62</td>
<td>-0.22</td>
<td>-0.44</td>
<td>-0.67</td>
<td>0.68</td>
</tr>
<tr>
<td>(0.35)</td>
<td>(0.44)</td>
<td>(0.37)</td>
<td>(0.37)</td>
<td>(0.42)</td>
<td>(0.42)</td>
<td>(0.42)</td>
<td></td>
</tr>
</tbody>
</table>

MY – Milk yield, FY - fat yield, PY - protein yield, LL - lactation length, AFC - age at first calving, ACW - cow average live weight and HGR - heifer growth rate between 12-24 mo

The heritabilities obtained in this study are in accordance with that obtained for tropical dairy cattle (Lôbo et al, 2000a). The high heritability of AFC shows considerable genetic variation for this trait of high economic importance in a system were the reposition heifers are raised in the herd (Vercesi Filho et al, 2000, Cardoso et al, 2004).

The genetic correlation between milk production traits presented values of difficult interpretation, probably because of the reduced number of records and of daughter/sires in the data set. The high genetic correlation between MY and LL indicates that in studies involving tropical dairy cattle, the removal of short lactations of normal causes eliminates genetic variation and biases results of genetic evaluation (Madalena, 1988). The genetic correlations between milk and weight traits were all negative with moderate to high values, what indicates genetic antagonism between them, although the accuracies were low. In Brazil, Cardoso et al. (1995) and Queiroz et al. (2005) obtained negative genetic correlations values between milk and weight traits for different genetic groups, what reinforces the results obtained in this study. This means that it would not be possible to select both milk and meat production traits in the same animal. Also in Brazil, Vercesi Filho et al (2000), Martins et al. (2003) and Cardoso et al (2004) presented negative economic values for cow mature weight in milk production systems with crossbred cattle. Lôbo et al (2000, b,c) evaluated selection schemes of dual purpose zebu
cattle and showed that the genetic profit for decreasing cow mature weight was higher than the profit obtained by increasing milk production. As the genetic correlations between milk and meat traits obtained in different studies in Brazil are negative, and the economic value for cow mature weight is negative too, the utilization of dual purpose animals do not find economic and genetic backboard in the literature that justifies its utilization.

CONCLUSION
These results suggest that there is a genetic antagonism between milk production and weight traits in the studied population, although the accuracy of the estimates where low. The high heritability of age at first calving suggests that this trait, of high economic importance, should be considered when designing breeding goals for tropical dairy cattle. The high genetic correlation between 305-day milk yield and lactation length indicates that elimination of short lactations should be avoided in genetic evaluation and studies involving crossbred dairy cattle in the tropics.

AKNOLEDGEMENTS
The authors are thankful to Lenira el Faro and Vera L. Cardoso, for reading this paper and valuable suggestions.

REFERENCES
Falconer D.S; Mackay, T. Introduction to quantitative genetics. London: Longman Group, 1996.