Estimation of Genetic Parameters of Grey Brahman Cattle in Thailand Environment

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The objective of this study was to estimate genetic parameters of grey Brahman cattle raised in Thailand environment. Data were collected from livestock research and breeding stations under the Department of Livestock Development. The data analysis was based on 23,318 records collected from 1977 to 2016. Four weight traits used in the genetic analysis were birth weight (BW), weaning weight at 200 days of age (W2), yearling weight at 400 days of age (W4) and final weight at 600 days of age (W6). Multivariate animal mixed model was used to estimate genetic parameters and estimated breeding value. The results showed that estimates of heritabilities of BW, W2, W4 and W6 were 0.22 ± 0.02, 0.20 ± 0.02, 0.36 ± 0.12 and 0.50 ± 0.16, respectively. The genetic correlation estimates between BW and W2, BW and W4, BW and W6 were 0.27 ± 0.017, 0.29 ± 0.05 and 0.07 ± 0.08 and between W2 and W4, W2 and W6, W4 and W6 were 0.54 ± 0.03, 0.56 ± 0.05 and 0.47 ± 0.06, respectively. The genetic analysis showed that the genetic relationships between BW and weight traits measured later in life or post weaning growth were lower than the genetic relationships between W2 and later weight traits. Therefore, W2 is recommended for genetic selection to improve post weaning growth or post weaning weight traits in Grey Brahman cattle raised in Thailand environment.

INTRODUCTION

The Brahman is a tropical cattle breed (Bos indicus) developed from cattle of Indian origin, Guzerat Nellore or Ongole Gir Krishna and Valley. Thailand imported American Brahman cattle in 1954 by Bureau of Animal Husbandry and Genetic Improvement under Department of Livestock Development. Since then the cattle had been bred and selected for growth and fertility in Thailand environment. In 1995 the subsequence Brahman cattle were used for the establishment of Thai Brahman cattle with the ability to adapt to the environment in Thailand. The average birth weight was 28-30 kg, weaning weight at 200 days was 170 kg, adult males weigh 800-1,000 kg and females weigh 500-600 kg. Some characteristics of Thai Brahman cattle include adaptability to tropical environment, resistance to some diseases, ticks and insects. Thai Brahman cattle have been used in beef cattle development to increase growth and fertility efficiency in breeding programs, meat quality improvement in a synthetic breed of Kabinburi (crossing between Simmental and Thai grey Brahman). Two other synthetic breeds were developed from Thai Brahman namely Tak beef cattle (crossing between Charolais and Thai grey Brahman (Suwit, 2558)) and Kamphangsaen beef cattle (three breed crosses between Charolais, Thai Brahman and native cattle). Thai Brahman cattle are importance as a foundation of beef cattle development in Thailand. Therefore, a suitable breeding program is required for their genetic improvement. The genetic parameters specifically estimated from and for the herds are essential for the progress of the genetic selection for breeding improvement. Bourdon (2000) reported that heritability can be low (lower than 0.2), medium (0.2-0.4) and high (higher than 0.4). This study is aimed at estimation of genetic parameters of weight traits birth weight (BW), weaning weight at 200 days of age (W2), yearling weight at 400 days of age (W4) and body weight at 600 days of age (W6) of Thai grey Brahman cattle.

MATERIALS AND METHODS

The data used in this study were Thai grey Brahman beef cattle collected from livestock research and breeding stations under the Department of Livestock Development. The data analysis was based on 23,318 records collected from 1977 to 2016 stored in the database of animal breeding (e-Breeding) of Animal Breeding Information Center of Thailand. Four weight traits used in the genetic analysis were birth weight (BW) weaning weight at 200 days of age (W2) yearling weight at 400 days of age (W4) and body weight at 600 days of age (W6) of both males and females. Records available for analyses of traits are summarized in Table 1.
Table 1. Characteristics of weight traits data Grey Brahman Cattle in Thailand Environment.

<table>
<thead>
<tr>
<th>Traits</th>
<th>N</th>
<th>Average</th>
<th>Std</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal in pedigree</td>
<td>23,318</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Birth weight records (BW) (kg)</td>
<td>16,599</td>
<td>28.49</td>
<td>3.48</td>
</tr>
<tr>
<td>Weaning weight records (W2) (kg)</td>
<td>12,174</td>
<td>163.03</td>
<td>31.11</td>
</tr>
<tr>
<td>400 day records (W4) (kg)</td>
<td>984</td>
<td>262.29</td>
<td>32.18</td>
</tr>
<tr>
<td>600 day records (W6) (kg)</td>
<td>592</td>
<td>375.93</td>
<td>71.06</td>
</tr>
</tbody>
</table>

Variance components were estimated using multivariate animal mixed model with restricted maximum likelihood average information (AI) algorithm (Patterson, and Thompson 1971) and estimation of breeding values method, BLUP (Henderson. 1984) by the computer program ASREML (Gilmour et al, 2002). The genetic parameters included heritability (H2 heritabilities); genetic and phenotypic correlations and breeding value (EBV; Estimated Breeding Value) of the birth weight (BW) the weaning weight at age 200 days (W2) the weight at the age of 400 day (W4) and the weight at the age of 600 day (W6) of beef cattle breed grey Brahman cattle in Thailand environment.

The model in the Matrix notation form

\[
\begin{bmatrix}
  y_1 \\
  y_2 \\
  y_3 \\
  y_4
\end{bmatrix} =
\begin{bmatrix}
  X_1 & 0 & 0 & 0 \\
  0 & X_2 & 0 & 0 \\
  0 & 0 & X_3 & 0 \\
  0 & 0 & 0 & X_4
\end{bmatrix}
\begin{bmatrix}
  b_1 \\
  b_2 \\
  b_3 \\
  b_4
\end{bmatrix} +
\begin{bmatrix}
  Z_1 & 0 & 0 & 0 \\
  0 & Z_2 & 0 & 0 \\
  0 & 0 & Z_3 & 0 \\
  0 & 0 & 0 & Z_4
\end{bmatrix}
\begin{bmatrix}
  a_1 \\
  a_2 \\
  a_3 \\
  a_4
\end{bmatrix} +
\begin{bmatrix}
  S_1 & 0 & 0 & 0 \\
  0 & S_2 & 0 & 0 \\
  0 & 0 & S_3 & 0 \\
  0 & 0 & 0 & S_4
\end{bmatrix}
\begin{bmatrix}
  p_1 \\
  p_2 \\
  p_3 \\
  p_4
\end{bmatrix} +
\begin{bmatrix}
  \varepsilon_1 \\
  \varepsilon_2 \\
  \varepsilon_3 \\
  \varepsilon_4
\end{bmatrix}
\]

Where
\( y_i \) = the vector observations of traits (1 = birth weight (BW); 2 = weaning weight at 200 days of age (W2); 3 = yearling weight at 400 days of age (W4); 4 = final weight at 600 days of age (W6)).
\( b_i \) = the vector of solution for the fixed effects (contemporary group, sex, age of dam and animal).
\( a_i \) = the vector of the direct additive genetic effects.
\( p_e_i \) = the vector of the permanent environmental effects of the dams.
\( \varepsilon_i \) = the vector of the residual effects.
\( X_i, Z_i, S_i \) = incidence matrices of relating fixed effects, random direct additive genetic effects and permanent environmental effects of the dams to the observations.

Results and Discussions

Variance components and genetic parameters
The variance components and the heritabilities of weight traits; BW, W2, W4 and W6 of Thai grey Brahman cattle raising in the environment in Thailand are summarized in Table 2. The genetic variances of BW, W2, W4 and W6 were 2.1, 126.2, 216.7 and 615.3 respectively and phenotypic variances were estimated at 9.7, 628.6, 606.6 and 1238.0. The estimates of heritabilities were 0.22, 0.20, 0.36 and 0.50 respectively indicating that birth and weaning weights are moderately heritable whereas body weights measured at 400 and 600 days are highly heritable.
Table 2 Variance components and genetic parameters for BW, W2, W4 and W6

<table>
<thead>
<tr>
<th>Traits</th>
<th>Variance components</th>
<th>Genetic parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>σ²_a</td>
<td>σ²_pe</td>
</tr>
<tr>
<td>BW</td>
<td>2.1 ± 0.2</td>
<td>0.2 ± 0.1</td>
</tr>
<tr>
<td>W2</td>
<td>126.2 ± 14.2</td>
<td>55.3 ± 6.4</td>
</tr>
<tr>
<td>W4</td>
<td>216.7 ± 81.6</td>
<td>-</td>
</tr>
<tr>
<td>W6</td>
<td>615.3 ± 217.6</td>
<td>-</td>
</tr>
</tbody>
</table>

Traits: BW = Birth weight; W2 = weaning weight at 200 days of age; W4 = yearling weight at 400 days of age; W6 = final weight at 600 days of age.

Variances: σ²_a = direct additive; σ²_pe = permanent environment; σ²_e = error; σ²_p = phenotype; h² = heritability.

Heritabilities of the 4 traits lied in medium - high levels consistent with the Bourdon (2000) who reported that heritability can be divided into 3 levels; a low level is less than 0.2 medium ranged between 0.2-0.4 and higher than 0.4. The results of this study are different from the report of Wuttipong et al (2010) who studied growth characteristics of Thai Brahman cattle and reported that heritability estimates of weights at BW, W2 and W6 were 0.32, 0.25 and 0.34. Thirachai (1996) reported that the estimates of heritability of Thai Brahman cattle weights at BW, W2 and W4 were 0.20, 0.36 and 0.21. Yaowaluck et al (2013) estimated that heritabilities of weights of BW, W2, W4 and W6 of Tak beef cattle at 0.29, 0.34, 0.26 and 0.33. In South African B.A. Pico (2004) reported heritability estimates of Brahman cattle for BW, W2, W4 and W6 at 0.28, 0.14, 0.14 and 0.18 respectively. From several studies of the heritability of animals of the same species, it can be seen that the results are different. This is due to the differences of the genetic structures of the populations, the managements, environment and the evaluation methods of variances. Genetic selection of the four studied weight traits in the Thai Brahman cattle can be obtained since the heritability estimates from this study were at the medium to high levels. The progress and efficiency of the genetic improvement for the Thai Brahman cattle is achievable through genetic selection. However, in breeding program attention should be paid to the environmental improvement as well.

Genetic and phenotypic correlations

Genetic and phenotypic correlations between BW, W2, W4 and W6 of Thai grey Brahman cattle raised in the environment of Thailand are shown in the Table 3.

Table 3 Genetic (below diagonal) and phenotypic (above diagonal) correlations estimates

<table>
<thead>
<tr>
<th>Traits</th>
<th>BW</th>
<th>W2</th>
<th>W4</th>
<th>W6</th>
</tr>
</thead>
<tbody>
<tr>
<td>BW</td>
<td>0</td>
<td>0.69 ± 0.05</td>
<td>0.62 ± 0.17</td>
<td>0.32 ± 0.20</td>
</tr>
<tr>
<td>W2</td>
<td>0.27 ± 0.01</td>
<td>0</td>
<td>0.54 ± 0.03</td>
<td>0.56 ± 0.05</td>
</tr>
<tr>
<td>W4</td>
<td>0.29 ± 0.05</td>
<td>0.74 ± 0.15</td>
<td>0</td>
<td>0.47 ± 0.06</td>
</tr>
<tr>
<td>W6</td>
<td>0.07 ± 0.08</td>
<td>0.80 ± 0.17</td>
<td>0.78 ± 0.25</td>
<td>0</td>
</tr>
</tbody>
</table>

In this study it was found that the correlation estimates of BW with W2, W4 and W6 were 0.27, 0.29 and 0.07; W2 with W4 and W6 were 0.74 and 0.80; and W4 with W6 was 0.78, respectively. The resulting correlation estimates conform to a report by Teerachai (1996) who also estimated genetic correlations in Thai Brahman cattle of BW with W2 and W4 of 0.44 and 0.18 and W2 with W4 of 0.43. Yaowaluck et al (2013) reported that the genetic correlations between BW with W2, W4 and W6 were 0.30 0.25 0.15; W2 with W4, and W6 were 0.62 and 0.31. W4 with W6 was 0.51, respectively. It can be seen that the correlation estimates between the four weight traits are all positive therefore improving by selecting weights at any ages; BW, W2, W4 and W6 would result in some progress of other weight traits in the same direction depending on the magnitude of the genetic correlations. Selection of calves with high BW and W2 would result in the increase in yearling weight W4 and W6 weight as the correlation coefficients are moderately positive. The longer the periods between body weight measurements tend to have the lower genetic and phenotypic correlations which is consistent with the Wuttipong et al (2010) who suggested selection for replacements of Thai Brahman in Thailand should be carried out at weaning (W2) approximately 20-25 % for sales to farmers and Thai Brahman cattle should be selected again at
W6.

**Conclusion**

Estimation of Genetic Parameters of Grey Brahman Cattle in Thailand Environment revealed that the genetic variances of BW, W2, W4 and W6 were 2.1, 126.2, 216.7 and 615.3 respectively and phenotypic variances were estimated at 9.7, 628.6, 606.6 and 1238.0 respectively. The estimates of heritabilities were 0.22, 0.20, 0.36 and 0.50 respectively and Correlation of BW with W2, W4 and W6 were 0.27, 0.29 and 0.07; W2 with W4 and W6 were 0.74 and 0.80 and W4 with W6 was 0.78 respectively. The genetic analysis showed that the genetic relationships between BW and weight traits measured later in live or post weaning growth were lower than the genetic relationships between W2 and later weight traits. Therefore, W2 is recommended for genetic selection to improve post weaning growth or post weaning weight traits in grey Brahman cattle raised in Thailand Environment. Genetic improvement of market weight of Thai Brahma cattle should include all the weight traits studied to form a suitable selection index using the appropriate genetic parameters specifically for the herds in Thailand.

**Key words:** Genetic parameter, Grey Brahman cattle, estimated breeding value of cattle, Beef cattle

**Reference**


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