Genetic parameters of fertility and production traits in Murrah buffaloes

V. Jamuna*, A.K. Chakravarty, Avtar Singh and C.S. Patil

Dairy Cattle Breeding Division, National Dairy Research Institute, Karnal-132 001, India.

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ABSTRACT

Data of 522 Murrah buffaloes sired by 72 bulls scattered over a period of 19 years (1993 to 2011) maintained at National Dairy Research Institute, Karnal were edited to records of 404 buffaloes up to fourth lactation for estimating the genetic parameters of fertility and production traits. Fertility was defined in terms of pregnancy rate (PR), while production traits included Test Day Five Milk Yield (TD 5MY), 305 Days or less Milk Yield (MY) and 305 days or less Wet Average (WA). The heritability of PR, TD 5 MY, MY and WA were estimated as 0.02 ± 0.005, 0.12 ± 0.04, 0.17± 0.04 and 0.15 ± 0.03. The repeatability of PR, TD 5 MY, MY and WA were estimated as 0.09 ± 0.04, 0.18 ± 0.05, 0.27 ± 0.04 and 0.26 ± 0.04. The pregnancy rate had low negative phenotypic correlations with TD 5 MY (-0.09 ± 0.03), MY (-0.08 ± 0.04) and WA (-0.12 ± 0.02). The magnitudes of phenotypic correlation indicated that Murrah buffaloes have good fertility and is not declining sharply with the increasing of milk production in the herd. Better breeding management should be maintained for sustaining reproduction and production efficiency.

Key words: Correlation, Fertility, Heritability, Murrah buffalo, Production, Repeatability.

INTRODUCTION

Buffalo is an integral part of agriculture, contributing 17% in World milk production and 48% in Asia. In India, buffalo contributes 56% of the total milk production, which is about 61.6 million tones (Anonymous, 2012). Long term intense selection of dairy animals for milk production will exacerbate the decline on reproductive traits (Kadarmideen et al., 2007). Many workers reported antagonistic relation between fertility and production traits in dairy cattle. Van Raden et al. (2007) reported the genetic and phenotypic correlation of pregnancy rate with milk yield in cattle as -0.20 and -0.32, respectively. Lawlor et al. (2009) reported genetic correlation of -0.11, while De Vries (2010) reported genetic correlation of -0.10 between pregnancy rate and 305 days or less milk yield in cattle. The genetic parameters of fertility and production traits are used to find out the effectiveness of selection under breeding programme and to assess the reproducing and producing ability of buffaloes in the herd. The literature revealing heritability and repeatability estimates of fertility (pregnancy rate) and pregnancy rate and production traits were not available in Murrah buffaloes. In the present study, attempt has been made to reveal the genetic parameters of performance traits of Murrah buffaloes.

MATERIALS AND METHODS

The present study was conducted on data pertaining to 522 Murrah buffaloes maintained at National Dairy Research Institute Karnal, over a period of 19 years from January 1993 to October 2011. The normal reproduction and production records were considered. The reproduction records of buffaloes showing abortion, dystocia and other reproductive disorders were not included in the study. The buffaloes produced milk for at least 100 days and minimum of 500kg milk, calved and dried under normal physiological conditions were included in the present study. On standardization and normalization of traits, 404, 230, 138 and 81 records of first, second, third and fourth lactations and 340, 204, 126 and 78 pregnancy records of the corresponding lactations were considered (Table 1). The number of lactations was restricted to four, since eighty percent buffaloes produced milk up to fourth lactation constituted 90.27% of the total milk production in the herd. The fertility traits included pregnancy rate (PR), while production traits included test day five (125th day) milk yield (TD 5 MY), 305 days or less milk yield (MY) and the average milk yield per day per buffalo in 305 days of lactation i.e 305 days or less wet average (WA) 305 days or less Wet Average (WA.)

*Corresponding author’s e-mail: jamunavalsalan@gmail.com.
TABLE 1: Edited and normalized data structure

<table>
<thead>
<tr>
<th>Lactation</th>
<th>PR</th>
<th>TD 5 MY</th>
<th>MY</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>340</td>
<td>404</td>
<td>404</td>
<td>404</td>
</tr>
<tr>
<td>Second</td>
<td>204</td>
<td>230</td>
<td>230</td>
<td>230</td>
</tr>
<tr>
<td>Third</td>
<td>126</td>
<td>138</td>
<td>138</td>
<td>138</td>
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<tr>
<td>Fourth</td>
<td>78</td>
<td>81</td>
<td>81</td>
<td>81</td>
</tr>
<tr>
<td>Total</td>
<td>748</td>
<td>853</td>
<td>853</td>
<td>853</td>
</tr>
</tbody>
</table>

PR, Pregnancy rate; TD 5 MY, Test day five milk yield; MY, 305 days or less milk yield; WA, 305 days or less wet average

Pregnancy rate measures the per cent of eligible buffaloes that become pregnant during each oestrous cycle was estimated as: PR = 21 / (Service Period – Voluntary Waiting Period + 11), suggested by USDA, (2003). The constant factors 11 centralize the measure of possible conception within each 21 days time period. The Voluntary Waiting Period (VWP) is the period after calving during which no inseminations occur, voluntarily left by the management for better pregnancy rate. The standardized voluntary waiting period of Murrah buffaloes was taken as 63 days (Patil, 2011).

The data were adjusted for significant non-genetic factors for buffaloes calved in different period and season of calving, parities and age group at first calving using fixed linear models. Since the data were not-orthogonal, the least-squares technique suggested by Harvey (1990) was used to estimate the effect of non-genetic factors. The model considered was as follows: $Y_{ijklm} = \mu + S_i + P_j + Pa_k + AG_l + e_{ijklm}$ where, $Y_{ijklm}$ observation of the $m^{th}$ buffalo born in $l^{th}$ age group, calved in $k^{th}$ parity, $j^{th}$ period and $i^{th}$ season; $\mu$, overall mean; $S_i$, Fixed effect of $i^{th}$ season of calving (winter, summer, rainy and autumn); $P_j$, Fixed effect of $j^{th}$ period of calving (1 to 8); $Pa_k$, Fixed effect of $k^{th}$ parity (1 to 4), $AG_l$, Fixed effect of $l^{th}$ age group of calving (1 to 3); and $e_{ijklm}$, Random error ~ NID (0, $\sigma^2$).

In the present study, the effect of non-genetic factors on Test Day 5 milk yield (125 day milk yield) was only studied, as the Association of Monthly Test Day Milk Yield with 305 Days or less Milk Yield have shown that Test Day 5 Milk Yield had the highest phenotypic correlation (0.79 ± 0.31) with 305 Days or less Milk Yield. Paternal half-sib correlation method was used to estimate the heritability of different traits (Becker, 1975) in Murrah buffaloes. The sires with three and more than three progenies were only included for the estimation of heritability of traits. The model for estimation of heritability was as follows: $Y_{ijklm} = m + S_i + e_{ijklm}$ where, $Y_{ijklm}$ observation of the $j^{th}$ progeny of the $i^{th}$ sire; $m$, overall mean; $S_i$, Effect of the $i^{th}$ sire and $e_{ijklm}$ is Random error ~ NID (0, $\sigma^2$). The genetic and phenotypic correlations were estimated from the analysis of variance and covariance among sire groups.

The repeatability of reproduction and production performance traits with maximum four parities were estimated by intraclass correlation method as suggested by Falconer and Mackay (1996). The variability of each trait per lactation was analyzed into a component between buffaloes which measured the permanent differences between buffaloes, which measured the differences between the characteristics of the same buffalo. The ratio between buffalo component to the total phenotypic variance was the correlation between repeated measurements of each trait of the same buffalo. The following model was used for the estimation of repeatability: $Y_{ijklm} = \mu + K_i + B_j + e_{ijklm}$ where, $Y_{ijklm}$ random measurement of each trait of $j^{th}$ buffalo in $i^{th}$ parity; $\mu$, overall mean of a trait; $K_i$, the effect between $i^{th}$ parity within buffalo; $B_j$, is the effect of $j^{th}$ buffalo and $e_{ijklm}$ is random error, NID (0 to $\sigma^2$).

RESULTS AND DISCUSSION

The information of 522 Murrah buffaloes sired by 72 bulls were edited to records of 404 buffaloes up to fourth lactation Fertility trait of Murrah buffaloes was influenced by period and season of calving, parity and age group of calving while production traits were mainly influenced by period of calving. Least-squares means of service period (SP), test day five milk yield (TD 5 MY) and 305 days or less milk yield (MY) were estimated as 146.28 ± 5.58 days, 8.13 ± 0.12 kg and 2078.20 ± 31.21 kg, respectively. The adjusted service periods were used to estimate pregnancy rate in Murrah buffaloes. The average pregnancy rate (PR) was estimated as 0.36 ± 0.01 with coefficient of variation 94.98%. The average wet average (WA) was estimated as 7.29 ± 0.06 kg, with the coefficient of variation 23.45%.

The heritability for fertility (pregnancy rate) in Murrah buffaloes was estimated as 0.02 ± 0.005 (Table 2 and Fig 1). The literature revealing heritability estimates of pregnancy rate in Murrah buffaloes was not available. Van Raden et al. (2004) and Kuhn et al. (2004) reported the heritability estimates of pregnancy rate as 0.04 and 0.05 in

<table>
<thead>
<tr>
<th>Traits</th>
<th>PR</th>
<th>TD 5 MY</th>
<th>MY</th>
<th>WA</th>
</tr>
</thead>
<tbody>
<tr>
<td>PR</td>
<td>0.02 ± 0.005</td>
<td>-0.09 ± 0.03</td>
<td>-0.08 ± 0.04</td>
<td>-0.12 ± 0.02</td>
</tr>
<tr>
<td>TD 5 MY</td>
<td>-0.17±0.45</td>
<td>0.12 ± 0.04</td>
<td>0.73 ± 0.21</td>
<td>0.73 ± 0.32</td>
</tr>
<tr>
<td>MY</td>
<td>-0.58±0.63</td>
<td>0.73 ± 0.09</td>
<td>0.15±0.03</td>
<td>0.93 ± 0.04</td>
</tr>
<tr>
<td>WA</td>
<td>-0.43±0.21</td>
<td>0.70 ± 0.23</td>
<td>0.99±0.04</td>
<td>0.17 ± 0.4</td>
</tr>
</tbody>
</table>

Heritability on diagonal, genetic correlations below diagonal and phenotypic correlations above diagonal.
Holstein Friesian cattle. The low heritability estimates suggest that pregnancy rate is strongly influenced by environmental factors in Murrah buffaloes.

The heritability estimates of production traits were found low to medium (Table 2 and Fig 1). The heritability of Test Day 5 Milk Yield was estimated as 0.21 ± 0.04. Geetha et al. (2006) reported higher estimates of Monthly Test Day Milk Yield as 0.33-0.59. The heritability of 305 Days or less Milk Yield and wet average were estimated as 0.15 ± 0.03 and 0.17 ± 0.04. The results were in almost conformity with results obtained by Kumar et al. (2002).

In the present study, phenotypic correlations of fertility (pregnancy rate) with test day 5 milk yield, 305 days or less milk yield and 305 days or less wet average in Murrah buffaloes were estimated as -0.09 ± 0.03, -0.08 ± 0.04 and -0.12 ± 0.02, respectively (Table 2). The genetic correlations of pregnancy rate with 305 Days or less Milk Yield, 305 Days or less Wet Average, Test Day 5 Milk Yield were estimated as -0.17 ± 0.45, -0.58 ± 0.63 and 0.43 ± 0.21, respectively. The estimated standard errors of genetic correlation between pregnancy rate and production/productivity traits were found high in the present study which may be due to small size of buffalo population for genetic correlation estimation. The low and negative phenotypic correlation between fertility and production/productivity traits indicated that the fertility is not declining sharply with the increasing milk production in the herd.

Repeatability estimate of pregnancy rate was found low (0.09 ± 0.04), while repeatability estimates of production traits varying from low to medium in Murrah buffaloes as depicted in (Fig 2). The literature revealing repeatability estimates of pregnancy rate in buffalo was not available. However, Van Raden et al. (2004) and Kuhn et al (2004) reported the repeatability estimates of pregnancy rate as 0.11 and 0.13 in Holstein Friesian cattle. The low repeatability estimates suggest that additive variability of the fertility traits are low which shows a strong influence of temporary environmental effects on the traits.

The repeatability of Test Day 5 Milk Yield, 305 Days or less Milk Yield and Wet Average of Murrah buffaloes were estimated as 0.18 ± 0.05, 0.27 ± 0.04 and 0.26 ± 0.04, respectively (Fig 2). Similar estimates were reported by Tohanti et al. (2004) in Murrah buffaloes. The low to medium repeatability estimates of production traits suggests that buffaloes could be selected based on early lactation records. Thus, the findings of the present study indicated that to overcome the deterioration in reproductive traits, more emphasis should be given on reproductive traits in addition to production traits in the selection strategy of Murrah buffaloes.

REFERENCES