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Estimates of Genetic Parameters of Economic Traits in Murrah Buffaloes

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ABSTRACT

Data from 1991 to 2017, pertaining to early performance traits was collected from 659 Murrah buffaloes, sired by 188 bulls, maintained at Directorate of Livestock Farms, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab. Least squares means and effect on non-genetic factors were evaluated for economic traits. Moderate heritability estimates of 0.217 ± 0.00, 0.231 ± 0.00, 0.260 ± 0.046 were calculated for first calving interval (FCI), First 305 day milk yield (F305MY) and first peak yield (FPY) respectively and low heritability values of 0.015 ± 0.025 and 0.043 ± 0.03 were estimated for age at first calving (AFC) and first lactation length (FLL) respectively. The phenotypic and genetic correlation of AFC was found to be positive with FLL and FCI and negative with F305MY and FPY. Although the production efficiency traits like F305MY, FLL and FPY had high positive genetic and phenotypic correlation among themselves.

KEYWORDS

Least squares means, nongenetic factors, heritability, correlation, Murrah

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INTRODUCTION

Livestock has been an integral segment of rural life and inextricably linked to the rural economy (Soodan *et al*, 2020). Buffaloes, being the most indispensable and important component of livestock sector, form the backbone of Indian dairy industry. With a population of around 109.85 million, buffaloes contribute around 49 per cent to the total milk production and 19.05 per cent to the total meat production of the country, making India the lead producers of carabeef in the world (Anonymous 2020 and Singh 2020). India contributes about 56.7 per cent of the total world buffalo population and has superior genetic resources represented by 17 registered breeds of buffaloes. Of these registered and graded buffalo population adapted to various ecological niches, Murrah is one of the superior breeds being used in upgradation programmes across the country.

The presence of superior germplasm of buffaloes in the country leaves the breeders with a meagre scope of introduction of any superiority form outside, which makes crossbreeding not an option for genetic improvement of the population (Milan *et al*, 2018). Hence the only tool available for bringing genetic improvement in the breed is selection. In order to develop an appropriate selection scheme and adopt a successful breeding plan, an overall knowledge of the genetic parameters affecting the early productive and reproductive traits is important (Kour et al., 2021). Under this background, the present article aims at the evaluation of genetic parameters (heritability and correlation) on early performance traits of Murrah buffaloes. This will help in the formulation of suitable evaluation procedures for appropriate selection of superior animals for improvement in future generation.

MATERIALS AND METHODS

The data pertaining to the early performance traits was collected from 659 Murrah buffaloes, sired by 188 bulls, maintained at the Directorate of Livestock Farms, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana. The history-cum-pedigree sheets, milk production registers, calving registers and reproduction records, maintained at the farm from 1991-2017, were used for collection of data. Traits included were first 305 day milk yield (F305MY), first peak yield (FPY), first lactation length (FLL), age at first calving (AFC) and first calving interval (FCI).

In order to assess the effect of non-genetic factors on different production and reproduction traits, the non-genetic factors viz. season of calving and age at first calving were classified into subclasses. The entire duration of study was divided into four seasons, viz. winter (December to February), summer (March to May), rainy (June to August) and autumn (September to November). Age at first calving was classified into three groups (AFC1, AFC2 and AFC3) using mean and standard deviation after normalizing the data.

The means and standard error were estimated by using standard statistical procedures. The effects of non-genetic factors like season of calving and age at first calving on normalized traits were estimated by using least square analysis for non-orthogonal data (Harvey, 1990), using model:

$$\mathbf{y_{ijk} = S}_i \mathbf{+ A_j + e}_{ijk}$$

where,

y_{ijk} = observation of k^{th} animal of i^{th} season and j^{th} age at first calving

S_i = effect of i^{th} season of calving

A_j = effect of j^{th} age at first calving

e_{ijk} = residual term (NID$\approx$ 0, σ2e)

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The heritability estimates of all production and reproduction traits were obtained by the paternal half-sib correlation method (Becker, 1984) using adjusted data. Genetic and phenotypic correlations were calculated from the analysis of the variance and covariance among sire groups as given by Becker (1984).

RESULTS AND DISCUSSION

Overall least square means for F305MY, FPY, FLL, AFC and FCI were found to be 1893.68 ± 20.69 kg, 10.55 ± 0.07 kg, 343.85 ± 3.47 days, 1331.89 ± 8.76 days and 496.75 ± 4.71 days respectively (Table 1). The results were in confirmation with Thiruvenkadan *et al* (2015), Gupta *et al* (2012) and Dev *et al* (2015). According to the results of present study, the season of calving had significant effect on AFC and FCI, with highest values reported in winter season and lowest in rainy season for both traits. Similar results were reported by T Thiruvenkadan *et al* (2015) and Kour *et al* (2020). Season of calving also had significant effect on F305MY and FLL and both the traits showed desirable results in summer season and were found to be low in values in autumn season. Similar significant effect was reported by Pandey *et al* (2015) and Chitra and Kumar (2016). The season of calving had significant effect on peak yield (FPY). The winter and summer season were found to have significant effect on the trait along with highest production in winter season. Hence, FPY was highest for animals calved during winter, as it is considered to be favourable season for production and reproduction because of high quality leguminous fodder. Literature supporting the present study was reported by Malhotra (2014) and Jakhar *et al* (2016). The effect of age at first calving was non-significant for all early performance traits.

Table 1: Least square means and effect of non-genetic factors on economic traits

Traits	F305MY	FLL	FPY	AFC	FCI
Overall mean	1893.7±20.9 (659)	343.8±3.5 (659)	10.5±0.1 (659)	1331.9±8.8 (659)	496.7±4.7 (460)
Season	**S***	**S***	**S***	**S***	**S****
Winter	1922.2^{ab}±36.7	355.9^{a}±6.6	10.9^{a}±0.1	1371.3^{a}±16.2	550.5^{a}±9.1
Summer	1981.2^{a}± 42.5	358.7^{a}±7.7	10.7^{a}±0.1	1349.7^{ab}±18.5	504.1^{b}±9.7
Rainy	1877.9^{ab}±3561	336.2^{ab}±6.4	10.2^{b}±0.1	1310.4^{b}±15.6	462.9^{c}± 7.8
Autumn	1816.2^{b}±38.3	325.0^{b}±6.9	10.4^{ab}±0.1	1305.7^{b}± 16.7	485.3^{bc}±9.04
AFC	**NS**	**NS**	**NS**	**-**	**NS**
AFC1	1888.9±34.3	343.4 ± 6.2	10.47± 0.1	-	497.0 ± 7.7
AFC2	1887.6±31.3	344.5± 5.6	10.45± 0.1	-	497.5 ± 7.2
AFC3	1921.8 ±35.6	345.1 ± 6.4	10.7 ± 0.1	-	507.5 ± 8.6

** - Highly significant (P≤ 0.01); * - Significant (P≤0.05); NS – Non significant

The heritability estimates for early performance traits were moderate to the tune of 0.217 ± 0.00, 0.231 ± 0.00, 0.260 ± 0.046 for FCI, F305MY and FPY respectively (Table 2). Whereas, for traits like AFC and FLL, lower estimates of heritability were found to be 0.015± 0.025 and 0.043 ± 0.03 respectively (Table 2). Similar estimates for moderate range of heritability for calving interval were reported by Pander *et al* (2017) and Jakhar *et al* (2017) . Higher estimates of 305 day milk yield were reported by Gupta *et al* (2012) and Chitra and Kumar (2016) and lower estimates by Kumar *et al* (2003), but the heritability estimates for the said trait was moderate as compared to estimates reported by other researchers. The similar heritability estimates of AFC were found in concurrence with Saha and Sadana (2000) and T Thevamanoharan *et al* (2000). The low heritability estimates are partially in concurrence with those of Nath (1998) and Aziz *et al* (2003). The low heritability estimates of AFC and FLL along with high standard error indicates that the traits seem to be more influenced by the non-genetic factors and hence need to be improved with better managemental practices.

The phenotypic and genetic correlation of AFC was found to be positive with FLL and FCI and negative correlation was found with F305MY and FPY (Table 2). Similar results were reported by Malhotra (2014) and T Thiruvenkadan *et al* (2015). Positive genetic and phenotypic correlations were found for FCI and FLL with all other traits, which were in accordance with Jakhar *et al* (2016). Positive genetic correlation was found between F305MY and FCI, FLL and FPY whereas negative correlation was found with AFC. The results are in line with those reported by Malhotra (2014), Jakhar *et al* (2016) and Jakhar *et al* (2017). Positive phenotypic and genetic relationship of FPY was found for all the traits especially with F305MY and negative for the traits like AFC. The results of the study were in concurrence with those reported by Malhotra (2014) and T Thiruvenkadan *et al* (2015). The high genetic and phenotypic correlation among the early production traits indicate that there are some common genes which govern the expression of these traits. Therefore, selection for any one trait may improve the other production efficiency traits through correlated response.

Table 2: Estimates of heritability (diagonal), genetic (above diagonal) and phenotypic (below diagonal) correlation among early performance traits

	F305MY	FLL	FPY	AFC	FCI
F305MY	**0.231 ± 0.00**	0.694 ± 0.202	0.923 ± 0.037	-0.143 ± 0.375	0.240 ± 0.416
FLL	0.541 ± 0.023	**0.043 ± 0.03**	0.325 ± 0.249	0.641 ± 0.795	0.570 ± 0.525
FPY	0.725 ± 0.016	0.207 ± 0.034	**0.260 ± 0.046**	-0.478 ± 0.362	0.108 ± 0.361
AFC	-0.083 ± 0.03	0.006 ± 0.04	-0.057 ± 0.14	**0.015 ± 0.025**	0.526 ± 0.729
FCI	0.299 ± 0.037	0.326 ± 0.038	0.019 ± 0.67	0.110 ± 0.017	**0.217 ± 0.00**

CONCLUSION

In a breeding program, the genetic improvement through selection depends on the identification of genetically superior animals. This depends on the evaluation of performance records of the animals, while estimating the effect of non-genetic factors and genetic parameters like heritability and correlation. The low heritability of the traits like AFC and FLL can be improved by removing the variance affecting these trait and employing better selection protocols. In general, the low to moderate magnitude of heritability for production and reproduction traits indicated that these traits could be improved by efficient management, proper care and feeding during pregnancy and lactation. The high genetic and phenotypic relation among the production traits paved way for selection through correlated response. The negative correlation among AFC and other production traits demand a balanced selection methodology for overall improvement of the herd.

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