RESEARCH ARTICLE Indian Journal of Animal Research, Volume 59 Issue 12: 1988-1991 (December 2025)

Genetic Study to Establish the Relationship between Sire Fertility and Daughter Performance Traits among Murrah Buffaloes

Vikas Diwakar[1], Bharti Deshmukh[2], Simarjeet Kaur[2], Puneet Malhotra[2], Sumeet Singhal[3], Neeraj Kashyap[2]

10.18805/IJAR.B-4818

ABSTRACT

Background: Bull fertility assumes a vital part in bovine reproduction. Since selection intensity of bulls picked for breeding programs in dairy industry is high as they can sire extensively larger counts of offspring as compared to their female counterparts. Therefore the present study was designed to establish the relationship between the sire fertility and performance traits of the Murrah buffaloes.

Methods: A total of 12898 observations were recorded with respect to routine seminal parameters from 130 Murrah breeding bulls spanning between 1995 and 2019 (25 years). Data consisted of 2161 records of 305 days milk yield (305 MY) and lactation length (LL), 2160 records of lactation milk yield (LMY), 2155 records of peak milk yield (PMY), 1905 records of average fat percentage (FP), 1542 records of service period (SP) and 1914 records of conception rate (CR) have been utilized for the current study. Breeding values with respect to 33 Murrah buffalo bulls were taken for the correlation studied and for further ranking of the sires.

Result: Average mean values of seminal parameter *viz*. ejaculated volume (EV), colour (Col), consistency (Con), log sperm concentration (LSC), mass activity (MA), initial motility (IM) and Post-Thaw Motility (PTM) were as 3.25±0.01 (ml), 3.50±0.01 (0-5 scale), 2.52±0.04 (0-5 scale), 3.11±0.01, 2.25±0.01 (0-5 scale), 64.22±0.15 and 38.62±0.19 (%) respectively. The arithmetic means of LMY, 305 MY, PY, LL, FP, CR and SP were calculated to be 2343.33±17.77, 2142.13±13.77, 12.57±0.06, 328.41±2.11, 7.39±0.01, 0.52±0.09 and 166.36±2.75, respectively. The sire rank correlation between the seminal attributes and performance traits was ranged between -0.57±0.15 (ejaculate volume and lactation milk yield) and 0.49±0.16 (semen consistency and lactation milk yield). Association between the fertility using routine semen quality parameters would be helpful to assess the bull fertility which lead to the improvement in the herd fertility.

Key words: Murrah buffaloes, Performance traits, Rank correlation, Seminal attributes, Sire fertility.

INTRODUCTION

India is predominantly relying on agriculture for its income and about 70% of the population are engaged in it. The livestock sector in India is a sub sector of the agriculture of Indian economy. Cattle and buffalo farming is one of the major sources of income for majority of population and play a very important role in the growth of India's economy. Milk production in India, which was around 209.96 million tonnes in 2020-2021 and per capita availability of milk has increased from 406 g in 2019-20 to 427 g in 2020-2021 (Anonymous, 2022). India have 109.85 million buffalo population which contribute more than 50% of the world's buffalo population. India continues to be the world's largest milk producer and buffalo has a remarkable contribution to it. Numerous indigenous buffalo breeds are available in our country, among which Murrah is one such elite buffalo breed with promising genetic potential for milk as well as meat production. It is essentially the cynosure of dairy-type buffalo. The bulls of this breed are extensively used to upgrade the non-descript buffalo stock, evident by the fact that approximately 44.39 percent of buffaloes of the country and more than 79 percent buffaloes of Punjab have at least 50 percent Murrah inheritance (Anonymous, 2013).

The conventional selection methods to improve primarily milk production has made buffaloes more profitable producers in the country and continuous selection for increasing milk yield alone results in reduced fertility and other performances parameters. Therefore in the recent past, the main objective of the breeder was to improve both production and reproduction in dairy animals simultaneously or at least to achieve the point where improvement in both will augment the net gain. For which, bull fertility plays a significant role in improving performance parameters in females. The US Department of Agriculture began measuring

[1]ICAR-National Dairy Research Institute, Karnal-132 001, Haryana, India.

[2]Department of Animal Genetics and Breeding, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana- 141 012, Punjab, India.

[3]Department of Veterinary Gynaecology and Obstetrics, Central Agricultural University, Pusa-848 125, Bihar, India.

Corresponding Author: Bharti Deshmukh, Department of Animal Genetics and Breeding, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana-141 012, Punjab, India.
Email: bharti.vet@gmail.com

How to cite this article: Diwakar, V., Deshmukh, B., Kaur, S., Malhotra, P., Singhal, S. and Kashyap, N. (2025). Genetic Study to Establish the Relationship between Sire Fertility and Daughter Performance Traits among Murrah Buffaloes. *Indian Journal of Animal Research*. **59(12):** 1988-1991. doi: 10.18805/IJAR.B-4818.

Submitted: 01-11-2021 **Accepted:** 17-08-2022 **Online:** 01-09-2022

the genetic merit of animals for fertility in 2003, using the pregnancy rate (PR) for cows and the Daughter's pregnancy rate (DPR) for bulls. DPR is a genetic test that determines a bull's daughter's potential to become pregnant throughout each oestrous cycle. For pregnancy rate, it is stated as predicted transmitting ability (PTA) (Van Raden *et al*., 2004). The sires can be ranked based on their fertility and performance traits with respect to their daughters, which could suggest that separate breeding strategies are essentially required for improvement of production and reproduction through bull fertility traits. Whereas, the nil to low correlation between bull conception rate and various performance traits (lactation milk yield, 305 days milk yield, peak yield, lactation length, fat percentage, conception rate and service period) emphasizes that both the traits can simultaneously be improved by distinct selection in bulls and daughters' performance without adversely affecting the response to selection on either of the traits. Association between milk yield and fertility in dairy cattle was reported by many workers. However, no report is available to observe the relationship between the seminal attributes and performance parameters in Murrah buffaloes.

MATERIALS AND METHODS

Data structure

Data spanning from 1995 to 2019 (25 years) were recorded from 130 buffalo bulls maintained at Directorate of Livestock Farms of Guru Angad Dev Veterinary Animal Sciences University, Ludhiana. Total 12898 observations were recorded for estimation of various seminal attributes *viz*. ejaculate volume (ml), colour (0-5 scale), consistency (0-5 scale), log sperm concentration (Log_e), mass activity (0-5 scale), initial motility (%) and post-thaw motility (%). Bulls with more than 10 records of semen collection and AI were included for the present study. Sires having less than 3 daughters were excluded from the correlation analysis based on the performance of their daughters.

Statistical analysis

The mean, standard error, skewness, kurtosis and coefficient of variation were calculated by MS Excel. The breeding values for all the seminal attributes of bulls *viz*. initial motility, volume, colour, consistency, mass activity, total sperms and post-thaw motility and performance parameters (LMY, 305 MY, PY, FP, SP and CR) of daughters were estimated by BLUPF90 software (Misztal *et al*., 2018). Various non-genetic factors *viz*. period and season of semen collection, age of bull at the time of semen collection, ejaculate interval and ejaculation number on seminal attributes were analysed apart from the study of no-genetic factors such as female AI number, parity along with season and period of AI on conception rate.

Sire rank correlation (Spearman's Rank Correlation) between breeding values of 33 sires was performed to find out the relationship between the breeding values of sire's fertility and breeding values of performance parameters among sires based on their daughter's performance using SAS software version 9.3 with the following formula:

where,

$$r_s = 1 - \frac{6 \sum d_1^2}{n (n^2-1)}$$

r_s= Spearman's rank correlation coefficient.
d_i= Difference in ranks of bull for trait 1 and 2.
n= Number of pairs of records.

RESULTS AND DISCUSSION

Descriptive statistics of daughter's performance traits

The size of the progeny groups ranged from 3 to 19 daughters per Murrah sire included in the study. Sires with less than three progenies and less than 10 recorded semen collections were excluded from the correlation study for ranking of the sires based on their daughter's performance. Lactation milk yield, 305 days milk yield, peak milk yield, fat percentage, lactation length, conception rate and service period were all used to evaluate the performance of sires. A total of 2161 records of 305 days milk yield and lactation length, 2160 records for lactation milk yield, 2155 records for peak milk yield, 1905 records for average fat percentage, 1542 records for service period and 1914 records for conception rate of Murrah buffaloes have been utilized for the present study. The arithmetic means of complete lactation milk yield, 305 days milk yield, peak yield, lactation length, fat percentage, conception rate and service period were calculated to be 2343.33±17.77, 2142.13±13.77, 12.57±0.06, 328.41±2.11, 7.39±0.01, 0.52±0.09 and 166.36±2.75, respectively. Similar to present findings, the complete lactation milk yield and average fat percentage was 2229.8±93.7 kg and 7.12±0.11% as reported by Pawar *et al*. (2012) in Murrah buffaloes. Malhotra (2014) found the

Table 1: Descriptive statistics for performance traits.

Variable	N	Mean	Skewness	Kurtosis	CV
Lactation length	2161	328.412±2.113	0.826	2.42423	29.921
Lactation milk yield	2160	2343.330±17.774	0.456	1.240	35.253
305Days milk yield	2161	2142.130±13.769	-0.018	0.797	29.881
Service period	1542	166.363±2.750	0.932	-0.0551	64.894
Conception rate	1914	0.524±0.009	-0.012	-1.634	80.007
Average fat percentage	1905	7.385±0.014	0.258	0.538	8.781
Peak yield	2155	12.567±0.061	0.744	1.244	22.712

average first lactation milk yield as 2118.9±26.67 kg and average fat percentage as 7.13±0.03% for the first lactation yield in Murrah buffaloes which is in accordance with the present findings. Jakhar *et al*. (2016) and Jamuna *et al*. (2015) observed an average 305-day milk yield as 2060.93±20.22 kg and 2078.20±31.21 kg, respectively, which is in close agreement with the present findings. Das and Sadana (2000) found the peak yield in Murrah buffaloes as 12.04±0.14 kg that supports the present findings. The service period reported by Jakhar *et al*. (2016) was 187.10±5.91 days, which is comparable to the present findings. The other descriptive statistical estimates *viz*. median, skewness, kurtosis, coefficient of variation (CV) and 95% confidence limit of the mean (CLM) for all these traits are represented in Table 1.

Sire rank correlation between bull fertility and performance traits

A positive rank correlation of initial motility with female conception rate *i.e*. 0.37±0.17 and negative correlation with the lactation length as -0.38±0.17 was found at 5% level of significance. The semen volume was revealed to have positive and moderate significant rank correlations with fat percentage, female conception rate and service period (0.34±0.17, 0.44±0.16 and 0.39±0.17) at 5% level of significance. While, a negative and moderate to high correlation with 305 days milk yield (P<0.01), lactation milk yield (P<0.01) and lactation length (P<0.05) as -0.46±0.16, -0.57±0.15 and -0.41±0.16 were revealed. The colour was found to have a negative correlation with the lactation milk yield (0.44±0.16) at 5% level of significance. Consistency of the semen was found to be positively and moderately correlated with 305 days milk yield (P<0.05), lactation milk yield (P<0.01) and lactation length (P<0.05) as 0.39±0.17, 0.49±0.16 and 0.38±0.17 respectively; while the negative correlation with female conception rate (P<0.05) as -0.38± 0.167. The mass activity was found to have a positive and moderate correlation with female conception rate as 0.40±0.16 and had a negative correlation with 305 days milk yield, lactation milk yield and lactation length as -0.36±0.17, -0.24±0.17 and -0.42±0.16 respectively at 5% level of significance. There was no significant correlation for the log sperm concentration. Post-thaw motility had a positive and moderate correlation with female conception rate as 0.34±0.17 and negative correlation with lactation length as -0.38±0.17 at a 5% level of significance. The sire rank correlation of the bull conception rate with their ranks for breeding values estimated by BLUP for fat percentage only as 0.41±0.16; which was found significant at 5% level of significance. However, the rank correlation of bull CR with 305 days milk yield, lactation milk yield, peak yield, lactation length, female conception rate and service period were found to be non-significant. The findings indicate that the sire rankings based on breeding values for bull CR have either no or low sire rank correlation with important economic traits, highlighting that an indirect selection is least expected and a separate selection strategy may be required for

Table 2: Sire rank correlation between seminal attributes and performance traits.

Traits	305 days milk yield	Lactation milk yield	Peak yield	Fat percentage	Lactation length	Female conception rate	Service period
Initial motility	-0.225±0.175	-0.123±0.178	0.222±0.175	0.286±0.172	-0.384±0.166*	0.371±0.167*	0.305±0.171
Volume	-0.464±0.159**	-0.573±0.147**	0.193±0.176	0.339±0.169*	-0.412±0.164*	0.442±0.161*	0.389±0.165*
Colour	-0.291±0.172	-0.436±0.162*	0.049±0.179	0.268±0.173	-0.266±0.173	0.304±0.171	0.212±0.176
Consistency	0.392±0.165*	0.494±0.156**	-0.037±0.179	-0.24±0.174	0.377±0.166*	-0.379±0.166*	-0.328±0.17
Mass activity	-0.364±0.167*	-0.241±0.174*	0.15±0.178	0.414±0.164*	-0.418±0.163*	0.402±0.164*	0.329±0.17
Log sperm concentration	0.138±0.178	0.332±0.169	0.057±0.179	0.025±0.18	0.038±0.179	-0.085±0.179	-0.051±0.179
Post-thaw motility	-0.193±0.176	-0.019±0.18	0.215±0.175	0.299±0.171	-0.375±0.167*	0.343±0.169*	0.286±0.172
Bull conception rate	-0.213±0.175	0.033±0.18	0.257±0.174	0.406±0.164*	-0.302±0.171	0.279±0.172	0.294±0.172

*Sign indicates the level of significance at 5%.
**Sign indicates the level of significance at 1%.

improvement in bull conception rates in the herd (Table 2). The present correlation values were comparable to the findings of Chakraborty and Dhaka (2020) as they have reported that the range of rank correlations among first lactation milk yield, first peak yield, milk yield per day of first calving interval and milk yield per day of age at second calving traits was from 0.026 to 0.835 in Murrah buffaloes. Whereas, High genetic correlation for first lactation total milk yield was reported with first lactation length, total lifetime milk yield, per day of productive life, milk yield per day of productive days by Tamboli *et al*. (2021).

CONCLUSION

The sires were ranked based on semen attributes and performance traits revealed that separate breeding strategies would be required for production and bull fertility traits while nil to low correlation of bull conception rate with female production trait emphasizes that both the traits can simultaneously be improved by distinct selection in bulls and daughters' performance without adversely affecting the response to selection on either of the traits.

Conflict of interest

All authors declare that they have no conflict of interest.

REFERENCES

Anonymous (2013). Estimated Livestock Population Breed Wise Based on Breed Survey. Animal Husbandry Statistics Division, DAHD. Ministry of Agriculture, Government of India.

Anonymous (2022). DAHD (Department of Animal Husbandry, Dairying and Fisheries). Annual Report. 2020-21. Ministry of Agriculture, Government of India.

Chakraborty, D. and Dhaka, S.S. (2020). Sire evaluation based on first lactation production efficiency traits in murrah buffaloes. *Journal of Buffalo Science*. **9:** 71-75.

Das, G. and Sadana, D.K. (2000). Factors affecting some economic traits in Murrah buffaloes. *Indian Journal Animal Research.* **34:** 43-45.

Jakhar, V., Vinayak, A.K. and Singh, K.P. (2016). Genetic evaluation of performance attributes in Murrah buffaloes. *Haryana Veterinarian.* **55(1):** 66-69.

Jamuna, V., Chakravarty, A.K., Singh, A. and Patil, C.S. (2015). Genetic parameters of fertility and production traits in Murrah buffaloes. *Indian Journal of Animal Research*. **49(3):** 288-291. doi: 10.5958/0976-0555.2015.00034.5.

Malhotra, P. (2014). Genetic evaluation of Murrah buffaloes at organized herds (Doctoral dissertation, GADVASU, Ludhiana).

Misztal, I., Tsuruta, S., Lourenco, D.A.L., Masuda, Y., Aguilar, I., Legarra, A. and Vitezica, Z. (2018). Manual for BLUPF90 family programs. University of Georgia.

Pawar, H.N., Kumar, G.R. and Narang, R. (2012). Effect of year, season and parity on milk production traits in Murrah buffaloes. *Journal of Buffalo Science.* **1(1):** 122-125.

Tamboli, P., Bharadwaj, A., Chaurasiya, A., Bangar, Y.C. and Jerome, A. (2021). Genetic parameters for first lactation and lifetime traits of nili-ravi buffaloes. *Frontiers in Veterinary Science*. **8:** 563.

Van Raden, P.M., Sandres, A.H., Tooker, M.E., Miller, R.H. and Norman, H.D. (2004). Development of national genetic evaluation for cow fertility. *Journal of Dairy Science.* **87 (7):** 2285-2292.