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Evaluation of sires using univariate animal model in Murrah buffaloes

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India is bestowed with vast genetic resources of buffaloes as evidenced by 19 registered breeds of buffaloes. Despite the large cattle population (193.47 million) in the country, the buffaloes (109.85 million) contribute significantly and more than the cattle to the total share of milk production. There has been a constant interest of the farmers in rearing buffaloes from a long time. To achieve the maximum production from any buffalo herd, the sires being used should be of high quality for different economic traits and especially the production traits. The selection of quality sires is very important as more genetic improvement can be obtained through the selection of males rather than females and the higher genetic gain associated with the production performance, mainly comes through sires because of favourable differential and higher selection intensity. Presently, many sire evaluation methods like the least-squares, best linear unbiased prediction, derivative-free restricted maximum likelihood, etc. are prevalent for evaluating the sires. The present study was planned by using the first lactation records on 577 daughters of 68 sires. The methods used were, Least-squares (LS), Best Linear Unbiased Prediction (BLUP), and the Derivative-Free Restricted Maximum Likelihood (DFREML) method. The breeding values were estimated for the traits viz. age at first calving (AFC), first calving interval (FCI), first lactation milk yield (FLMY), first lactation period (FLP), weight at first calving (WFC), and first service period (FSP). The univariate animal model was used for this study and AFC, FCI, FLMY, FLP, WFC, and FSP traits were considered for evaluation of the sires. Data were distributed over seven military dairy farms and one Instructional Dairy farm, viz. Ferozepur, Ambala, Jalandhar, Jhansi, Lucknow, Bareilly, Agra and Pantnagar, and spread over 39 years (1954–1992). The data were divided into five periods of seven years each and three seasons, viz. rainy (July–October), winter (November–February), and summer season (March–June).

The Mixed Model Least-Squares and Maximum Likelihood Programme (LSMLMW) of Harvey (1990), Best linear unbiased prediction (BLUP) and the DFREML method as detailed by Meyer (1998) were used for estimating the least-squares means. The effectiveness of sire evaluation methods was tested by comparing within sire variances or error variances of different methods and by the efficiency of other methods relative to the most efficient method. Following formula was used:

$$\text{Relative efficiency of method} = \frac{\text{Error variance of most efficient method}}{\text{Error variance any other method}} \times 100$$

Spearman's coefficient of rank correlation was applied to data in the form of ranks. The sires were ranked based on breeding values obtained by different methods and according to different traits. The average percentage of sires above-average breeding value and below-average breeding value was different by all the methods. The overall mean value of AFC, FCI, FLMY, FLP, WFC, and FSP traits were 43.48 months, 549.72 days, 1622.58 kg, 297.22 days, 502.98 kg, and 165.64 days, respectively by the LS method as reported by Tewari *et al*. (2020). The corresponding values were 42.12 months, 423.21 days, 1741.82 kg, 325.75 days, 540.23 kg, and 99.23 days by BLUP, and 41.68 months, 468.72 days, 1675.72 kg, 299.13 days, 504.88 kg, and 158.61 days by DFREML methods, respectively. The percentage of sires superior to the population mean was 63.24, 58.82, and 60.29% using LS, BLUP, and DFREML method respectively for AFC trait. The corresponding figure in percentage applying LS, BLUP and DFREML methods were 51.47, 58.82 and 39.71% for FCI; 60.29, 47.06 and 47.06% for FLMY; 54.41, 64.71 and 42.65% for FLP; 51.47, 80.88 and 44.12% for WFC, and 51.47, 29.40 and 44.12% for FSP trait, respectively. The ranking of sires varied according to methods and different traits under consideration. The association among bull's estimated breeding values for different traits was computed in the form of rank correlation. The association between AFC and FLMY was negative in direction, and between FSP and FCI was positive in the case of the LS method. These rank correlations were significant. However, the values for all other combinations were non-significant. In case of BLUP method, the association of the FCI trait was found positively significant with the FLP, WFC, and FSP traits. The association between FLMY and FLP, FLMY and FSP, and

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Table 1. Comparison of various sire evaluation methods

Trait	Sire evaluation method	Error variance	Relative efficiency (%)
AFC	LS	23168.93	94.50
	BLUP	21895.41	100.00
	DFREML	24684.12	88.70
FCI	LS	70125.08	98.92
	BLUP	69367.81	100.00
	DFREML	71457.39	97.07
FLMY	LS	87913.83	96.56
	BLUP	84887.14	100.00
	DFREML	89945.21	94.38
FLP	LS	19140.35	79.17
	BLUP	15153.28	100.00
	DFREML	24930.46	60.78
WFC	LS	13568.13	84.04
	BLUP	11402.72	100.00
	DFREML	13769.55	82.81
FSP	LS	71193.84	97.19
	BLUP	69195.23	100.00
	DFREML	71205.65	97.18

Note: AFC, Age at first calving; FCI, First calving interval; FLMY, First lactation milk yield; FLP, First lactation period; WFC, Weight at first calving; FSP, First service period; LS, Least-squares method; BLUP, Best linear unbiased prediction method, and DFREML, Derivative free restricted maximum likelihood method.

FLP and WFC were also positive and significant. Considering the DFREML method, a positive significant association was found between FLMY and FLP, WFC and FLP, FLMY and FSP, and FLP and FSP traits. However, the correlation between AFC and FLMY traits was found to be negative in direction and significant. The correlations among other combinations were non-significant. The lower genetic association among different traits could be due to the different sets of genes that were responsible for the expression of the trait.

The buffaloes with lower age at first calving produced the higher first lactation milk yield. The animals with a lower first service period indicated a lower first calving interval. Sires selected for a higher lactation period also had a higher first lactation milk yield. The LS and BLUP method gave the same result for evaluating the different sires considering all the traits AFC, FCI, FLMY, FLP, WFC, and FSP (Table 1). This finding is in close agreement with the reports of Dempfle (1977) and Tiwana (1988), Sahana (1996), Deulkar and Kothekar (1999), Singh and Singh (1999), Banik and Gandhi (2006), and Sathwara *et al*. (2019). However, a much higher rank correlation as 0.98 and 0.96 between LS and BLUP was reported by Gandhi and Gurnanai (1991) and Gaur *et al.* (2001), respectively. However, the value of rank correlation between LS and DFREML method, and BLUP and DFREML method were found to be very low and non-significant. As indicated by lower error variance and higher relative efficiency for evaluating the different sires, the BLUP method indicated the best result followed by LS and DFREML method using the trait: age at first calving, first calving interval, first lactation milk yield, first lactation period, weight at first calving and first service period.

SUMMARY

The percentage of sires superior to the population mean was 63.24, 58.82, and 60.29% using LS, BLUP, and DFREML method respectively for AFC trait. The corresponding figure in percentage applying LS, BLUP and DFREML methods were 51.47, 58.82 and 39.71% for FCI; 60.29, 47.06 and 47.06% for FLMY; 54.41, 64.71 and 42.65% for FLP; 51.47, 80.88 and 44.12% for WFC, and 51.47, 29.40 and 44.12% for FSP trait, respectively. The LS and BLUP methods gave almost the same results. This study concluded with the results that LS and BLUP method gave the same result for evaluating the different sires considering all the traits, viz. AFC, FCI, FLMY, FLP, WFC, and FSP. The values of lower error variance and high relative efficiency suggested that the BLUP method was best for evaluating the different sires followed by LS and DFREML methods using different first lactation traits.

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