Sire evaluation (single and multi-trait) in terms of relative efficiency, error variance and spearman's coefficient of rank correlation and product moment correlation in Red Sindhi cattle

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ABSTRACT

The sire evaluation method, which estimated the breeding values of sires with the least error variance, was taken as the best and most efficient method. The records of production and reproduction performances of first lactation traits of 717 Red Sindhi cows, progeny of 58 sires, spread over a period of 40 years (1966-2005) from CCBF, Chiplima, Orissa under the control of Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture, Government of India and CBF, Kalsi, Deheradun, Uttarakhand were analyzed. The present investigation to know the effectiveness and efficiency of different sire evaluation methods was evaluated on the basis of efficiency of a particular method within sire variance or error variance, Spearman's coefficient of rank correlations and simple correlation /product moment correlation. Most efficient methods of sire evaluation D, LSM, DFREML-I, DFREML-II, DFREML-III, BLUP-I, BLUP-II and BLUP-III in terms of relative efficiency for (single and multi-trait) were 9.70, 83.33, 100.00, 80.54, 85.17, 96.88, 96.88 and 96.03 and ranked VII, VI, I, V, IV, II, II and III respectively. Spearman's coefficient of rank correlation among breeding values of sires' for all eight methods ranged from 0.80 (and DFREML-II) to1.00 (LSM with DFREML-III, BLUP-I, BLUP-II) which were positive and highly significant (P≤0.01). The rank correlations of DFREML-I (most efficient method) with , LSM, DFREML-II, DFREML-III, BLUP-I, BLUP-II and BLUP-III were 0.87, 0.99, 0.98, 0.99, 0.99, 0.99 and 0.96, respectively and were highly significant (P≤0.01). The high and significant rank correlations between the breeding values of common sires estimated by different methods indicated that all these methods did not differ significantly in ranking of sires. The high relative efficiency of BLUP-I and BLUP-II (both 96.88 percent) in comparison to most efficient method along with high product moment correlation of BLUPF90-I and BLUPF90-II with DFREML-I indicated that either of these two methods could possibly be used for evaluation and ranking of Red Sindhi sires with equal efficiency and accuracy.

Key words- Relative efficiency, error variance, Spearman's coefficient of rank correlation
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INTRODUCTION

The effectiveness of sire evaluation is the backbone of any breed improvement programme. This investigation was planned to evaluate Red Sindhi sires and ranked on the basis of their estimated breeding values considering FLMY of their progeny considering as single trait under univariate models viz. simple daughter's average (D) method, least squares method (LSM), DFREML-I method and BLUP-I method. However, for evaluation of sires by multi traits, the multi-variate models viz. DFREML-II and DFREML- III and BLUP-II and BLUP-III methods were used. The FLMY was taken as principal trait along with FLP in DFREML-II and BLUP-II methods, while both the traits (FLMY and FLP) along with AFC were taken in DFREML-III and BLUP-III methods. These traits were considered based on higher magnitude of heritability and genetic correlation with the principal trait FLMY. The error variance of breeding values of sires was estimated and used in computing the relative efficiency of different sire evaluation methods. The sire evaluation method, which estimated the breeding values of sires with the least error variance, was taken as the best and most efficient method. In the present study, the DFREML-I with univariate model using single trait i.e. FLMY was having the lowest error variance compared to other seven methods used and accordingly, it was adjudged the most efficient sire evaluation method. Relative efficiency of other seven methods of sire evaluation

were calculated with respect to the most efficient method i.e. DFREML-I. The estimated error variance and relative efficiency of different sire evaluation methods used for estimation of breeding value. Spearman's coefficient of rank correlation commonly called as rank correlation is a measure of correspondence between ranks and applies to data in the form of ranks estimated by different methods. In the present study, the ranks of Red Sindhi sire on the basis of breeding values estimated by different sire evaluation methods were taken into account for measuring rank correlation which is of statistical significance to judge the association among ranks of sires estimated by different sire evaluation methods. The coefficients of rank correlations among breeding values of sire computed by eight different methods and were compare the effectiveness of BLUP with other conventional methods of sire evaluation in Red Sindhi cattle.

MATERIALS AND METHODS

The records of production and reproduction performances of first lactation traits of 717 Red Sindhi cows, progeny of 58 sires, spread over a period of 40 years (1966-2005) were analyzed.The effectiveness and efficiency of different sire evaluation methods were evaluated on the basis of within sire variance or error variance, spearman's coefficient of rank correlations (Steel and Torrie, 1960) and product moment correlation. Higher rank correlation amongst the sires from different sire evaluation methods revealed higher degree of similarity of ranking from different methods.

RESULTS AND DISCUSSION

The error variance of breeding values of sires was estimated and used in computing the relative efficiency of different sire evaluation methods. The sire evaluation method, which gives least error variance, was taken as the best.. In the present study, the DFREML-I using single trait i.e. FLMY had the lowest error variance and highest relative efficiencies compared to the other seven methods used. Relative efficiency of other seven methods of sire evaluation were calculated with respect to the most efficient method i.e. DFREML-I. The estimated error variance and relative efficiency of different sire evaluation methods in the present study are presented in Table 1. The BLUP-I with univariate model using single trait as FLMY and BLUP-II with multivariate model using two traits as FLMY and FLP had similar relative efficiency of 96.88% to that of DFREML-1 (100%) and were placed as second best methods followed by BLUP-III with multivariate model using three traits as FLMY, FLP and AFC with a relative efficiency of 96.02 %, which ranked third with respect to the relative efficiency among the methods used. The DFREML-III, DFREML-II, LSM and were found with a relative efficiency of 85.17%, 80.54%, 83.33% and 9.70%, respectively and ranked as IVth, Vth, VIth and VIIth best method for evaluation of Red Sindhi sires in the present study. Further, it was found that among the multivariate sire evaluation methods BLUP-II using two traits (FLMY and FLP) was found to be most efficient sire evaluation methods followed by BLUP-III, DFREML-III and DFREML-II, respectively (Table 1). Arora (1981), Jain (1996) and Jain and Sadana (2000) reported the BLUP method under multi-trait animal model incorporating FLMY with other trait to be more efficient and accurate for sire evaluation in different breeds of cattle and buffalo. In the present investigation, simple daughter average method () was having highest error variance among all methods of sire evaluation used. This could be because non-genetic variations were not estimated and removed from data prior to the estimation of breeding values of sires, which might have resulted into the highest error variance and lowest relative efficiency of this method. This finding was in agreement with the reports of Jain and Malhotra (1971), Gill and Parmar (1988), Sahana (1996), Sahana and Gurnani (2000) and Aswathanarayana et al. (2003) as they have reported highest error variance and least relative efficiency for simple daughter average () than any other method. BLUP-I and BLUP-II were similar and were placed second best as they have shown lower error variance than BLUP-III, DFREML-III DFREMEL-II, LSM and . Henderson (1973), Danell (1982), Harvey (1987), Singh et al. (1992), Raheja (1992), Tailor et al. (2000) and Dahiya et al. (2005) have also reported BLUP as one of the best and most efficient sire evaluation

Table 1. Efficiency of different sire evaluation methods

Sire evaluation method	Traits considered	Error variance	Relative efficiency	Rank
FLMY	3335015.00	9.70	VII	
LSM	FLMY	388293.79	83.33	VI
DFREML-I	FLMY	323576.65	100.00	I
DFREML-II	FLMY and FLP	401780.00	80.54	V
DFREML-III	FLMY, FLP and AFC	379920.00	85.17	IV
BLUP-I	FLMY	334000.00	96.88	II
BLUP-II	FLMY and FLP	334000.00	96.88	II
BLUP-III	FLMY, FLP and AFC	337000.00	96.02	III

method in different breeds of cattle. However, Taneja and Rai (1990), Deb et al. (1998) and Kishore (1993) in different breeds of cattle reported in field condition that LSM was the most efficient method of sire evaluation compared to BLUP method. Banik and Gandhi (2006) in Sahiwal and Mukherjee (2005) in Frieswal also reported that DFREML method was the most efficient method for sire evaluation as it was having lowest error variance compared to LSM and BLUP with univariate model.

The coefficients of rank correlations among breeding values of sire computed by eight different methods were presented in Table 4. The coefficient of rank correlation among breeding values of sires' for all eight methods ranged from 0.80 (D and DFREML-II) to1.00 (LSM with DFREML-III, BLUP-I, BLUP-II) which were positive and significant (P≤0.01). The rank correlations of DFREML-I (most efficient method) with , LSM, DFREML-II, DFREML-III, BLUP-I, BLUP-II and BLUP-III were 0.87, 0.99, 0.98, 0.99, 0.99, 0.99 and 0.96, respectively and were highly significant (P≤0.01). The high and significant rank correlations between the breeding values of sires indicated that all these methods did not differ significantly in ranking of sires. However, the second highest relative efficiencies of BLUP-I and BLUP-II (96.88% of both) in comparison to most efficient method DFREML-I and high rank correlations with DFREML-I indicated that either of these two methods could possibly be used for evaluation of Red Sindhi sires with equal efficiency and reasonable accuracy. These findings agreed with Mukherjee (2005) in Frieswal cattle, Banik and Gandhi (2006) in Sahiwal and Tailor and Kothari (2006) in Surti buffaloes as they have reported significant rank correlations between single trait (DFREML for univariate model) and multi-trait methods (DFREML for multi trait model) of sire evaluation and observed that the breeding values and the ranks of the sires did not differ significantly from both the models. Similarly, for single trait sire evaluation methods various workers have reported highly significant rank correlations among breeding values estimated by different methods of sire evaluation. Vij and Tiwana (1988), Gandhi and Gurnani (1991), Murdia and Tripathi (1992), Raheja (1992), Sahana (1996), Delkur and Kothekar (1999), Tailor et al. (2000), Sahana and Gurnani (2000), Gaur et al. (2001), Vinoo et al. (2005), and Baink and Gandhi (2006) reported high rank correlation between LSM, SRLS and BLUP suggesting that these methods were similar in ranking of dairy sires and any of the methods could be used to obtain unbiased estimate of breeding values of sires. Product moment correlation among sires merit calculated by eight different methods of sire evaluation ranged from 0.66 to 1.00 and all the values were positive and significant. Atil and Khattab (2000) reported that product moment correlations were also higher and almost similar to those of rank correlations. The estimates of product moment correlations confirm the fact that sire evaluation by were highly correlated with LSM; LSM with DFREML-I, DFREML-III, BLUP-I and BLUP-II; DFREML-I with BLUP-I and BLUP-II; DFREML-III with BLUP-I and BLUP-II and BLUP-I with BLUP-II. The product moment correlation of DFREML-I (most efficient method) with , LSM, DFREML-II, DFREML-III, BLUP-I, BLUP-II and BLUP-III were 0.82, 1.00, 0.95, 0.99, 1.00, 1.00 and 0.98, respectively. The high relative efficiency of BLUP-I and BLUP-II (both 96.88%) in comparison to most efficient method along with high product moment correlation of BLUP-I and BLUP-II

Table 2. Spearman's Rank and Product moment correlation among different sire evaluation methods

Methods	D	LSM	DFREML-I	DFREML-II	DFREML-III	BLUP-I	BLUP-II	BLUP-III
D	0.85**	0.87**	0.80**	0.84**	0.84**	0.84**	0.83**	
LSM	1.00**		0.99**	0.99**	1.00**	1.00**	1.00**	0.96**
DFREML-I	0.82**	1.00**		0.98**	0.99**	0.99**	0.99**	0.96**
DFREML-II	0.66**	0.96**	0.95**		0.99**	0.99**	0.99**	0.96**
DFREML-III	0.76**	1.00**	0.99**	0.98**		1.00**	1.00**	0.97**
BLUP-I	0.78**	1.00**	1.00**	0.97**	1.00**		1.00**	0.97**
BLUP-II	0.78**	1.00**	1.00**	0.97**	1.00**	1.00**		0.97**
BLUP-III	0.76**	0.98**	0.98**	0.96**	0.98**	0.98**	0.98**	

with DFREML-I indicated that either of these two methods could possibly be used for evaluation and ranking of Red Sindhi sires with equal efficiency and accuracy. Similar product moment correlation was also reported by Singh and Singh (1999) as they have observed BLUP to be more efficient sire evaluation method than any other method in Murrah sire evaluation.

The high and significant rank correlations between the breeding values of sires estimated by different methods indicated that all these methods did not differ significantly in ranking of sires. The high relative efficiency of BLUP-I and BLUP-II (both 96.88 percent) in comparison to most efficient method along with high product moment correlation of BLUP-I and BLUP-II with DFREML-I indicated that either of these two methods could possibly be used for evaluation and ranking of Red Sindhi sires with equal efficiency and accuracy.

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