Journal of Veterinary Science & Technology

Singh and Singh, J Veterinar Sci Technol 2016, 7:2
DOI: 10.4172/2157-7579.1000296

Research Article Open Access

Evaluation of Sires Using Different Sire Evaluation Methods on the Basis of First Lactation Traits in Sahiwal Cattle

Jaswant Singh and CV Singh*

Department of Animal Genetics and Breeding, College of Veterinary and Animal Sciences, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (US Nagar), Uttarakhand, India

***Corresponding author:** CV Singh, Department of Animal Genetics and Breeding, College of Veterinary and Animal Sciences, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar-263 145 (US Nagar), Uttarakhand, India, Tel: +915944233377; E-mail: cvsingh2010@gmail.com

Rec date: Nov 10, 2015; **Acc date:** Jan 22, 2016; **Pub date:** Jan 25, 2016

Abstract

The records of 1367 crossbred cattle sired by 112 bulls were analysed to estimate breeding values and to compare various methods of sire evaluation viz. BLUP, LSM and sire evaluation methods on the basis of age at first calving, first service period, first lactation period, first dry period, and first calving interval. The average breeding value for FLMY. FLL, AFC, FCI, and FDP were estimated as 1711.63 kg, 320.38 days, 1299.54 days, 524.25 days and 207.60 days by method, 1941.16 kg, 321.60 days, 1287.12 days, 514.86 days and 195.57 days by LSM method and 1890.06 kg, 313.70 days, 1281.25 days, 508.56 days and 194.46 days by BLUP method.

The accuracy, efficiency and stability of EBV's of sires for the first lactation and lifetime traits were compared by different methods to judge their effectiveness. The estimated breeding values of sires for all the first lactation traits by $\overline{D}$, LSM and BLUP revealed that EBV's of sires estimated by least squares method showed smaller genetic variation in comparison $\overline{D}$ to and BLUP methods. The LSM was adjudged as the most efficient method of sire evaluation. The LSM had minimum error variance for most of the first lactation traits and considered to be more superior over other two methods i.e., $\overline{D}$ and BLUP. The product moment correlations among the estimated breeding value of sires for first lactation traits by $\overline{D}$, LSM and BLUP methods ranged from medium to very high and significant ($P<0.01$) in all the three methods of sire evaluation. The rank correlations among the breeding value of sires estimated based on first lactation traits were medium to high and significant ($P<0.01$). The results indicated that least square method (LSM) had the lower error sum of square for all the first lactation traits and least square method (LSM) is relatively more accurate as compared to best linear unbiased prediction (BLUP) method but not overall. The LSM had higher R^2 value for the first lactation traits as 40.50% (FLMY), 18.17% (FLL), 23.94% (FCI), 24.59% (FDP) and 48.47% (AFC) than the BLUP method. The estimated R^2 values are less which indicates that both methods are less suitable for present data. Therefore as for as stability is concerned among the methods of sire evaluation, the LSM method was most stable being its CV (%) which is closest to the CV (%) of unadjusted data.

The rank correlations obtained were highest and statistically significant ($P<0.01$) and ranged from 0.74 ($\overline{D}$ and BLUP) to 0.88 ($\overline{D}$ and LSM). The highest rank correlations among the breeding values estimated from different methods revealed that rankings of sires were similar to the extent of 74 to 88 per cent from these methods of sire evaluation.

Keywords: Breeding value; First lactation yield; BLUP; Rank correlation; Product moment correlation

Introduction

Indigenous cattle are particularly suited to the climate and environment of their respective breeding tract. They are endowed with qualities of heat tolerance, resistance to diseases and ability to thrive under extreme climatic stress and lesser than optimal nutrition. The performance of Sahiwal cattle is remarkable in hot climate and has been recognized worldwide as one of the best milch breeds [1]. Due to its resistance against various diseases and heat tolerance properties, many countries have imported this breed from Pakistan and India for the production of synthetic breeds of cattle. At present, the selection criteria for young males for future breeding are based on physical appraisal traits of the young bulls and the milk production performance of their dam. These attributes may not adequately represent the real potential of the sire for milk production. Therefore, selection of sire in the future should base on breeding value of the sire.

There are several methods of sire evaluation with a wide range of complexity starting from very simple (simple daughter average) to highly complicated (REML) method. Different methodologies like contemporary comparison, contemporary daughter average index, least squares (LSM) technique and simple regressed least squares technique (SRLS) could be used to evaluate sires for a single trait i.e., milk yield. Henderson opined that analysis of variance and covariance may give biased components of variance from selected population; whereas restricted maximum likelihood (REML) estimate can give bias free estimators [2]. Simultaneous attention to reproductive traits in addition to milk production is expected to bring about overall improvement in the index value of a sire. So, multi trait criteria of sire evaluation using advance statistical technique like derivative free restricted maximum likelihood (DFREML) and best linear unbiased prediction (BLUP) would be expected to enhance the accuracy of selection of the bulls.

One has to look in the efficiency of these methods with practical applicability to the local conditions. This paper reports breeding value of Sahiwal sires using 3 sire evaluation methods and compares the methods in terms of efficiency, accuracy and stability of the different sire evaluation methods by within sire variance (error variance), Relative efficiency (RE), the coefficients of determination and coefficient of variation of different methods.

Materials and Methods

The data for the present investigation were collected over a period of 71 years (1944-2014) from pedigree sheets of 1367 Sahiwal cows born to 112 sires maintained at Government Livestock Farm, Chakganjaria, Lucknow (UP). Only the sires having records on at least 3 daughters were included in the present study. The total duration of the present study was divided into 8 periods. Out of 8 periods 7 are of nine years each and 8th period of 8 years only. Each year was divided into three seasons namely winter (November-February), summer (March-June) and Rainy (July-October). In order to classify the data for different periods and seasons, year and season of calving was considered for all the traits. The traits considered in the present study were age at first calving, first lactation length, first dry period, first calving interval, and first service period.

Statistical analysis

As the data in the present study were non-orthogonal in nature with unequal subclass numbers, they were subjected to least squares analysis of variance without interactions using different models to examine the effect of genetic as well as non-genetic factors on various first lactation traits as per standard procedures of Harvey [3]. The model was based on the assumption that different components fitting in the model were linear, independent and additive. While sire was treated as random effect, the other genetic and non-genetic factors (genetic group, season and period) were taken as fixed effects in the model. The main objective of sire evaluation is to obtain an accurate and unbiased estimate of breeding value of bulls and ranking them on the basis of performance of their daughters so as to enable the breeders to choose the best bull for subsequent improvement of the herd. Many sire evaluation methods based on performance of adequate number of progeny recorded have been proposed. The following three methods of sire evolution were used to estimate the breeding values of sires.

Simple Daughters Average

Sires were evaluated by Simple Daughter's Average as proposed by Edward [4]. The breeding values of sires were computed as follows

$I = \bar{D}$

Where, $\bar{D}$ is the average milk yield of all daughters of a sire.

Least Squares Method (LSM)

The Least Squares Method was used to estimate the breeding value of sires, using the following statistical model [3].

$Yij=\mu+Si+eij$

Where,

Yij=jth dependent single trait of the daughter of ith sire

μ=population mean

Si=effect of ith sire

eij=random error assumed to be normally and independently distributed with mean zero and variance σ^2 i.e., NID $(0,\sigma e^2)$.

Best Linear Unbiased Prediction: BLUP F90 and related programs were developed in the lab of Misztal et al. with the purpose of providing comprehensive computing capabilities to problems related to mixed models in animal breeding [5]. Best Linear Unbiased Prediction (BLUP) method Under BLUP method, the sire effects were obtained by using single trait model. For this purpose the LS estimates of variance components from the corresponding model were used. The BLUP evaluations were based on an animal model which utilized information from all the known relationships. The BLUP evaluations were obtained under single trait animal model.

The effectiveness of different sire evaluation methods was judged by within sire variance (error variance). The method giving lowest error variance had higher efficiency and was most appropriate. The efficiency was measured by the following equation.

$$\text{Efficiency} = \frac{1}{\text{Error variance}}$$

Relative efficiency (RE) of method II with respect to method I (most efficient method) was calculated by the following equation.

$$\text{RE}\ (\%) = \frac{\text{Error variance of method I}}{\text{Error variance of method II}} \times 100$$

The coefficients of determination (R^2-Value) of different methods were estimated for judging the accuracy of sire evaluation method.

The coefficient of variation (CV%) of traits under study from different models of sire evaluation were estimated for judging the stability of sire evaluation methods. The Spearman's rank correlation between breeding values of sires derived by various methods was used to judge the effectiveness of different methods. The rank correlation was estimated as per Steel and Torrie [6].

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

Where, r=Rank correlation coefficient

n=number of sires under evaluation

di=difference of rank between paired items under two methods

The significance of rank correlation was tested by t-test as given below:

$$t = r\sqrt{\frac{(n-2)}{(1-r^2)}}$$

It was compared with t-table value with (n-2) degree of freedom.

Results and Discussion

The different descriptive statistics such as mean, minimum and maximum breeding value and range are presented in Table 1. The average breeding values of 112 sires evaluated by $\overline{D}$, LSM and BLUP sire evaluation methods on the basis of first lactation milk yield, first lactation period, age at first calving, first calving interval and first dry period. The average breeding value for FLMY. FLL, AFC, FCI and FDP were estimated as 1711.63 kg, 320.38 days, 1299.54 days, 524.25 days and 207.60 days by $\overline{D}$ method, 1941.16 kg, 321.60 days, 1287.12 days,

514.86 days and 195.57 days by LSM method and 1890.06 kg, 313.70 days, 12891.25 days, 508.56 days and 194.46 days by BLUP method (Table 1).

Traits	Method	Average BV	Minimum BV (% below average BV)	Maximum BV (% above average BV)	Number of sires over the average BV (% of sires)	Number of sires below the average BV (% of sires)
FLMY		320.38	243.00(24.15)	419.00(30.78)	56(50)	56(50.00)
	LSM	321.6	217.90(32.25)	397.77(23.68)	44(39.29)	68(60.71)
	BLUP	313.7	265.67(15.31)	390.89(24.61)	54(48.21)	58(51.79)
FLL		1299.54	904(30.44)	1950(50.05)	56(50.0)	56(50.0)
	LSM	1287.12	813.96(36.76)	1722.39(33.82)	54(48.21)	58(51.79)
	BLUP	1281.25	1007.41(21.37)	1546.38(20.69)	55(49.11)	57(50.89)
AFC		524.25	380(27.52)	870(65.95)	52(46.43)	60(53.57)
	LSM	514.86	265.11(48.51)	741.57(44.03)	42(37.50)	70(62.50)
	BLUP	508.56	365.31(28.17)	658.35(29.45)	52(46.43)	60(53.57)
FCI		524.25	380(27.52)	870(65.95)	52(46.43)	60(53.57)
	LSM	514.86	265.11(48.51)	741.57(44.03)	42(37.50)	70(62.50)
	BLUP	508.56	365.31(28.17)	658.35(29.45)	52(46.43)	60(53.57)
FDP		207.6	92(55.68)	510(145.66)	52(46.43)	60(53.57)
	LSM	195.57	24.24(87.61)	360.63(84.40)	49(43.75)	63(56.25)
	BLUP	194.46	89.96(53.74)	303.40(56.02)	47(41.96)	65(58.04)

Table 1: Average Breeding Value of Sahiwal Sires for First Lactation Traits by Different Methods.

Simple daughters average

The minimum and maximum breeding values of first lactation milk yield were 974.00 kg and 4061.00 kg respectively. Forty one out of 112 sires (36.61%) had breeding value above the average, while 71 sires (63.39%) had their breeding value below the average breeding value. The top ranking sires had very high genetic superiority over the overall average, whereas bottom ranking sires had 43.10% low breeding value than overall average breeding value (Table 1).

The minimum and maximum breeding values of first lactation period were 243.00 and 419.00 days respectively. 56 out of 112 sires (50%) had breeding value above the average, while 56 sires (50%) had breeding value below the average breeding value. The top ranking sires had 24.14% higher genetic superiority over the overall average, whereas bottom ranking sires had 30.78% low breeding value than overall average breeding value (Table 1).

The minimum and maximum breeding values of age at first calving were 904.00 and 1950.00 days respectively. 56 out of 112 sires (50%) had breeding value above the average, while 56 sires (50%) had breeding value below the average breeding value. The top ranking sires had 30.44% higher genetic superiority over the overall average, whereas below average ranking sires had 50.05% low breeding value than overall average breeding value.

The minimum and maximum breeding values for first calving interval were 380.00 and 870.00 days respectively. 52 out of 112 sires (46.43%) had breeding value above the average, while 60 sires (53.57%) had breeding value below the average breeding value. The top ranking sires had 27.52% higher genetic superiority over the overall average, whereas below average ranking sires had 65.95% low breeding value than overall average breeding value.

The minimum and maximum breeding values for first dry period were 92.00 and 510.00 days respectively. 52 out of 112 sires (46.43%) had breeding value above the average, while 60 sires (53.57%) had breeding value below the average breeding value (Table 1). The top ranking sires had 55.68% higher genetic superiority over the overall average, whereas below average ranking sires had lower genetic worth than overall average breeding value.

Least Squares Method (LSM)

The minimum and maximum breeding values of first lactation milk yield were 906.92 kg and 3377.00 kg respectively. 20 out of 112 sires (17.86%) had breeding value above the average, while 92 sires (82.14%) had breeding value below the average breeding value. The top ranking sires had very high genetic superiority (73.96%) over the overall average, whereas below average ranking sires had 68.73% low breeding value than overall average breeding value (Table 1).

The minimum and maximum breeding values for first lactation length were 219.00 and 397.77 days respectively. 44 out of 112 sires (39.29%) had breeding value above the average, while 68 sires (60.71%) had breeding value below the average breeding value. The top ranking

sires had 23.68% higher genetic superiority over the overall average, whereas below average ranking sires had 32.25% low breeding value than overall average breeding value.

The minimum and maximum breeding values of age at first calving were 813.96 and 1722.39 days respectively. 54 out of 112 sires (48.21%) had breeding value above the average, while 58 sires (51.79%) had breeding value below the average breeding value. The top ranking sires had 36.76% higher genetic superiority over the overall average, whereas below average ranking sires had 33.82% low breeding value than overall average breeding value (Table 1).

The minimum and maximum breeding values for first calving interval were 265.11 and 741.57 days respectively. 42 out of 112 sires (37.50%) had breeding value above the average, while 70 sires (62.50%) had breeding value below the average breeding value. The top ranking sires had 48.51% higher genetic superiority over the overall average, whereas below average ranking sires had 44.03% low breeding value than overall average breeding value.

The minimum and maximum breeding values for first dry period were 24.24 and 360.63 days respectively. 49 out of 112 sires (43.75%) had breeding value above the average, while 63 sires (56.25%) had breeding value below the average breeding value (Table 1). The top ranking sires had 87.61% higher genetic superiority over the overall average, whereas below average ranking sires had 84.80% low breeding value than overall average breeding value. Deulkar and Kothekar reported estimated breeding value of Sahiwal sires for FLMY ranged from 517.46 to 1859.64 kg using least square method of sire evaluation [7]. Banik and Gandhi reported average breeding value of Sahiwal sires for first lactation milk yield (FLMY) as 1502.27 kg and it ranged from 830.41 kg to 2247.90 kg [8]. Dongre and Gandhi reported overall breeding value of 1880.85 kg using least square method [9]. Gandhi and Gurnani [10] Singh [11] observed higher estimate of breeding value for this trait using least squares method of sire evaluation.

Best Linear Unbiased Prediction (BLUP)

The minimum and maximum breeding values of first lactation milk yield were 1153.95 and 2560.29 kg respectively. 38 out of 112 sires (33.93%) had breeding value above the average, while 74 sires (66.07%) had breeding value below the average breeding value. The top ranking sires had 35.46% genetic superiority over the overall average, whereas below average ranking sires had 38.95% low breeding value than overall average breeding value (Table 1).

The minimum and maximum breeding values of first lactation period were 217.90 and 390.89 days respectively. 54 out of 112 sires (48.21%) had breeding value above the average, while 58 sires (51.79%) had breeding value below the average breeding value. The top ranking sires had 24.61% genetic superiority over the overall average, whereas below average ranking sires had 15.31% low breeding value than overall average breeding value.

The minimum and maximum breeding values of age at first calving were 1007.41 and 1546.38 days respectively. 55 out of 112 sires (49.11%) had breeding value above the average, while 57 sires (50.89%) had breeding value below the average breeding value. The top ranking sires had 21.37% genetic superiority over the overall average, whereas below average ranking sires had 20.69% low breeding value than overall average breeding value (Table 1).

The minimum and maximum breeding values for first calving interval were 365.31 and 658.35 days respectively. 52 out of 112 sires (46.43%) had breeding value above the average, while 60 sires (53.57%) had breeding value below the average breeding value. The top ranking sires had 28.17% genetic superiority over the overall average, whereas bottom ranking sires had 29.45% low breeding value than overall average breeding value (Table 1).

The minimum and maximum breeding values for first dry period were 89.96 and 303.40 days respectively. Out of 112 sires 47 (41.96%) had breeding value above the average, while 65 sires (58.04%) had breeding value below the average breeding value. The top ranking sires had 53.74% genetic superiority over the overall average, whereas below average ranking sires had 56.02% low breeding value than overall average breeding value (Table 1). Deulkar and Kothekar reported estimated breeding value of Sahiwal sires for FLMY ranged from 1262.90 to 1543.65 kg using BLUP method of sire evaluation [7]. Banik and Gandhi [8] Kumar and Gandhi [11] using LSM reported lower estimate (1463.33, 1520.72 and 1522.53 kg, respectively) than the present estimate of breeding value in Sahiwal sires. Kumar and Gandhi [11] using BLUP method reported 1581.80 kg breeding value for FLMY. Dongre and Gandhi [9] using LSM reported average estimated breeding value of 1869.91 kg which range from 928.33-2641.06 kg and 28 out of 51 sires (54.90%) had breeding value above the average, while 23 sires (45.10%) had breeding value below the average breeding value.

Comparison of sire evaluation methods by error sum of square

The error sums of square from both of the above methods of sire evaluation studied along with their relative efficiencies were summarized in Table 2. The results indicated that least square method (LSM) had the lower error sum of square for all the first lactation traits as 743822164.00 for FLMY, 7920813.03 for FLL, 22643510.79 for FCI, 16766860.45 for FDP and 51109094.30 for AFC. Whereas, in best linear unbiased prediction (BLUP) method the error sum of squares for these traits were 771433516.00 (FLMY), 8143844.23 (FLL), 23664944.85 (FCI), 17432184.07 (FDP) and 56228513.62 (AFC). The finding revealed that the least square method (LSM) was adjudged most efficient method over best linear unbiased prediction (BLUP) method. The relative efficiency of BLUP over LSM was 96.42% for FLMY, 97.26% for FLL, 95.68% for FCI, 96.18% for FDP and 90.90% for AFC. These results depicted that both the methods have estimated breeding value with fairly high accuracy as relative efficiencies of BLUP for all the first lactation traits with respect of LSM was higher than 90%. Various workers had compared different methods of sire evaluation on the basis of relative efficiency and differed in their conclusion and advocated [12-14] that BLUP was one of the most efficient methods of sire evaluation compared to LSM. However, similar to present findings, Sahana and Gurnani [15], Mukherjee [16] and Banik and Gandhi [8] reported that LSM is most efficient over the BLUP method of sire evaluation. While Dubey et al. [12] and Bajeetha and Singh [13] also reported BLUP as best procedure in comparison to other procedures of sire evaluation.

First Lactation Milk Yield (FLMY)				
Method	**Error sum of square**	**Relative efficiency**	**R^2**	**C.V%**
LSM	7.4E+08	--	40.5	44.16
BLUP	7.7E+08	96.42	38.3	42.93
First Lactation Length (FLL)				

LSM	7920813	--	18.17	25.8
BLUP	8143844	97.26	15.9	24.98
First Calving Interval (FCI)				
LSM	2.3E+07	--	23.94	27.11
BLUP	2.4E+07	95.68	20.5	26.46
First Dry Period (FDP)				
LSM	1.7E+07	--	24.59	660.92
BLUP	1.7E+07	96.18	21.6	59.3
Age at First Calving (AFC)				
LSM	5.1E+07	--	48.47	16.45
BLUP	5.6E+07	90.9	43.3	16.47

Table 2: Effectiveness of different sire evaluation methods for first lactation traits.

Coefficient of determination (R^2)

The coefficient of determination (R^2) is of fitting the different models to judge the accuracy of sire evaluation methods for the first lactation traits (Table 2). The higher the R^2 value, the higher was the accuracy of fitting the model. It was found that LSM had higher R^2 value for the first lactation traits as 40.50% (FLMY), 18.17% (FLL), 23.94% (FCI), 24.59% (FDP) and 48.47% (AFC) followed by BLUP where R^2 values for these traits were 38.30% (FLMY), 15.90% (FLL), 20.50% (FCI), 21.60% (FDP) and 43.30% (AFC). These finding clearly indicated that when R^2-value was used as criterion to judge the effectiveness of sire evaluation method LSM was found to be fittest over the BLUP method of sire evaluation, but the accuracy of BLUP was much close to LSM.

Similar to these findings, Gandhi and Gurnani [10] compared accuracy of LSM and BLUP method using R^2-value and revealed that LSM was most accurate. On the other hand, Banik (2004) reported highest R^2- value of BLUP (24.54%) and by LSM (11.07%) for FLMY.

Coefficient of variation (CV%)

Estimates of coefficient of variation were used as criterion to compare the stability of sire evaluation methods for first lactation traits. The CV (%) of unadjusted data for FLMY was 55.03%. The CV (%) values of population by different methods ranged from 42.93% in BLUP to 44.16% in LSM (Table 2). The CV (%) of unadjusted data for FLL was 27.24%. The CV (%) values of population by different methods ranged from 24.98% in BLUP to 25.80% in LSM (Table 2). The CV (%) of unadjusted data for AFC was 21.98%. The CV (%) values of population by different methods ranged from 16.47% in BLUP to 16.45% in LSM. The CV (%) of unadjusted data for FCI was 29.73%. The CV (%) values of population by different methods ranged from 26.46% in BLUP to 27.11% in LSM (Table 2). The CV (%) of unadjusted data for FDP was 67.02%. The CV (%) values of population by different methods ranged from 59.30% in BLUP to 60.92% in LSM (Table 2). Therefore as for as stability is concerned among the both the methods of sire evaluation the LSM method was most stable being its CV (%) which is closest to the CV (%) of unadjusted data.

Rank correlations

The correlation coefficients between the ranks of Sahiwal sires evaluated by various sire evaluation methods were very high and ranged from 0.74 ($\overline{D}$ and BLUP), 0.88 ($\overline{D}$ and LSM) to 0.92 (LSM and BLUP) for FLMY, 0.61 (LSM and $\overline{D}$), 0.80 ($\overline{D}$ and BLUP) to 0.83 (LSM and BLUP) for FLL and 0.63 ($\overline{D}$ and LSM), 0.67 ($\overline{D}$ and BLUP) to 0.98 (LSM and BLUP) for AFC; all these values were highly significant ($P<0.01$) (Table 3). These results revealed that ranking of sires using any one of these method could result in similar ranking ranging from 72 to 93 per cent for FLMY and 59 to 88 per cent for FLL and 63 to 98 per cent for AFC.

First Lactation Milk Yield (FLMY)			
Methods		**LSM**	**BLUP**
	1	0.88**	0.74**
LSM	0.93**	1	0.92**
BLUP	0.72**	0.88**	1
First Lactation Length (FLL)			
	1	0.61**	0.80**
LSM	0.59**	1	0.83**
BLUP	0.88**	0.79**	1
First Calving Interval (FCI)			
	1	0.07	0.56**
LSM	0.24	1	0.79**
BLUP	0.67**	0.82**	1
First Dry Period (FDP)			
	1	0.08	0.40**
LSM	-0.09	1	0.92**
BLUP	0.61**	-0.27	1
Age at First Calving (AFC)			
	1	0.63**	0.67**
LSM	0.68**	1	0.98**
BLUP	0.73**	0.98**	1

Table 3: Rank correlations (above diagonal) and product moment correlations (below diagonal) among different methods sire evaluation for first lactation traits.

The correlation coefficients between other first lactation traits evaluated by different methods were ranged from very low 0.07 ($\overline{D}$ and LSM), 0.56 ($\overline{D}$ and BLUP) to highly significant 0.79 (BLUP and LSM) for FCI and 0.08 (LSM and $\overline{D}$), 0.40 ($\overline{D}$ and BLUP) to 0.92 (LSM and BLUP) for FDP (Table 3). Similar to the present findings, Dubey [17] Mukherjee [18] and Banik and Gandhi [8] reported high rank correlations between LSM and BLUP method and suggested that these methods were more or less similar in ranking of dairy sires for first lactation milk yield. Dongre and Gandhi [9] reported highly

significant rank correlation (P<0.01) ranged from 0.67 to 1.0 (LSM and SRLS) for FLMY. In the present investigation least square method could be a better option for estimation of breeding value of sires than BLUP. The rank of sires obtained by daughter's average was exactly similar to those obtained by LSM.

Product moment correlation

The simple correlations among the estimates of breeding value of sires for first lactation traits by based on different sire evaluation methods were estimated (Table 3). The estimates of correlation were ranged from 0.72 ($\overline{D}$ and BLUP), 0.93 (LSM and $\overline{D}$) and 0.88 (LSM and BLUP) for FLMY, 0.59 (LSM and $\overline{D}$), 0.88 ($\overline{D}$ and BLUP) and 0.79 (LSM and BLUP) for FLL, 0.68 ($\overline{D}$ and LSM), 0.73 ($\overline{D}$ and LSM) and 0.98 (LSM and BLUP) for AFC all these values were significant (P<0.01) (Table 3). The correlation coefficients between other first lactation traits evaluated by different methods were ranged from very low 0.24 ($\overline{D}$ and LSM), 0.67 ($\overline{D}$ and BLUP) to highly significant 0.82 (BLUP and LSM) for FCI and -0.09 (LSM and $\overline{D}$), -0.27 (LSM and BLUP) to 0.61 ($\overline{D}$ and BLUP) for FDP. These finding indicated that in almost all the first lactation traits ranking of sires by ($\overline{D}$ and LSM) have similarity and having significant correlation which was moderately over and above the BLUP method.

Banik and Gandhi [8] reported higher simple correlation coefficients of least squares with BLUP with their values being 0.967 and 0.850 respectively, while Deulkar and Koothekar [7] found comparatively smaller value (0.64) of simple correlation between LSM and BLUP method [19,20].

References

1. Ilatsia ED, Roessler R, Kahi AK, Piepho HP, Zárate V (2012) Production objectives and breeding goals of Sahiwal cattle keepers in Kenya and implications for a breeding programme. Trop Anim Health Prod 44: 519-530.
2. Henderson CR (1986) Recent development invariance and covariance estimation. Journal of Animal Science 63: 208-216.
3. Harvey WR (1990) User guide for LSMLMW and MIXMDL package. Mix model least squares and maximum likelihood computer programme. PC-2 Version Mimeograph, Columbia, Chio, USA.
4. Edward J (1932) The progeny test as a method of evaluating the dairy sire. Journal of Agricultural Science 22: 810-837.
5. Misztal I, Duangjinda M, Tsuruta S (2004) BLUPF 90, Dairy Pack Version 2; enetic Evaluation Program for Dairy Cattle, Department of Animal and Dairy Science, The University of Georgia.
6. Steel RGD, Torrie JH (1960) Principles and procedures of statistics. 2nd edn. Mc Graw hill book Co. New York, USA.
7. Duelkar PB, Kothekar MD (1999) Sire evaluation considering FLY for improvement of lifetime production in Sahiwal. Indian Journal of Animal Sciences 69: 240-242.
8. Banik S, Gandhi RS (2006) Animal model versus conventional models of sire evaluation in Sahiwal cattle. Asian Australasian Journal of Animal Sciences 19: 1225-1228.
9. Dongre VB, Gandhi RS (2014) Study on sire evaluation methods in Sahiwal cattle. Indian Journal of Veterinary & Animal Science Research 43: 174-179.
10. Gandhi RS, Gurnani M (1991) Accuracy of different methods of sire evaluation in Sahiwal cattle. Indian Veterinary Journal 68: 659-662.
11. Kumar Amit, Gandhi RS, Singh Avtar, Aynalemhaile (2008) Comparison of animal model with other conventional methods of sire evaluation for milk production in Karan Fries cattle. Indian Journal of Animal Sciences 78: 1393-1396.
12. Dubey PP, Singh CV, Prasad RB (2006) Relationship between sire's estimated breeding values for first lactation and lifetime traits and ranking of sires in Sahiwal and its cross. Indian Journal of Animal Sciences 76: 824-828.
13. Bajetha G (2006) Selection of sires by using different sires evaluation methods in crossbred cattle. PhD Thesis, GB Pant University of Agriculture & Technology, Pantnagar, US Nagar.
14. Moges TG, Singh CV, Barwal RS, Kumar D, Singh CB (2009) Evaluation of sires using different multitrait sire evaluation methods in crossbred cattle. Indian Journal of Dairy Science 62: 1-4.
15. Sahana G, Gurnani M (1996) Effectiveness of sire evaluation methods for milk production along with auxiliary traits via vis other methods in crossbred cattle. Indian Journal of Dairy Science 51: 439-442.
16. Mukharjee S, Joshi BK, Gaur GK (2007) Sire evaluation methods in frieswal cattle. Indian Journal of Animal Sciences 77: 123-126.
17. Dubey PP, Singh CV, Barwal RS (2014) Sire evaluation considering first lactation yield for improvement of life time production in Sahiwal and crossbred Cattle. Advances in Animal and Veterinary Sciences 2: 56-62.
18. Mukharjee S (2005) Genetic evaluation of frieswal cattle. PhD Thesis, NDRI, Deemed University, Karnal, India.
19. Singh VK, Singh CV (2011) Sire evaluation using animal model and conventional methods for milk production in crossbred cattle. Indian Journal of Dairy Science 81: 71-79.
20. Singh VK, Singh CV, Barwal RS, Shahi BN (2014) Estimation of Breeding Values by Different Animal Models for Selection of Sires in Crossbred Cattle. Proceedings, 10th World Congress on Genetics Applied to Livestock Production held from 17-22 August 2014 at the gorgeous city of Vancouver, British Columbia, Canada.