Estimation of Sire,s Breeding Value by Animal Model and Conventional Methods for Milk Production in Crossbred Cattle

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Abstract: The records of 1198 crossbred cattle daughters of 102 sires maintained during 1966-2010 at Instructional Dairy Farm of G. B. Pant University of Agriculture & Technology, Pantnagar were used to evaluate sires for first lactation performance traits. The data were analyzed to estimate the breeding values of sires using Derivative Free Restricted Maximum Likelihood Method (DFREML), Best Linear Unbiased Prediction (Blup), Least Squares Methods (LSM) and WOMBAT. The highest breeding value of sires for first lactation milk yield was obtained by LSM (2779.19kg) and lowest by BLUP(2629.80kg) than average breeding value respectively. The estimated breeding values estimated by BLUP showed small genetic variation in compare toWOMBAT, LSM and REML method.The error variance estimated by BLUP was found lowest than the other methods. Product moment correlation among breeding values of sires estimated by different methods ranged from 0.566 (LSM with BLUP) to 0.997 (WOMBAT with BLUP), where as rank correlations of breeding value of sires ranged from 0.566 (LSM with BLUP) to 0.745 (WOMBAT withLSM).The higher rank correlations(0.566 to 0.745)between different sire evaluation methods revealed that there was higher degree of similarity of ranking sires by different methods ranging from about60 to 75 percent. The BLUP method was found to be more efficient, accurate and stable with lowest genetic variation amongst all four methods of sire evaluation used in the present study.

Keywords: Breeding value; First lactation yield; Wombat; BLUP,DFREML; Rank Correlation.

1. Introduction

For bringing about overall genetic improvement in production, reproduction and growth traits of dairy cattle; the selection in females has limited scope due to insufficient number of replacement stock. On the contrary, intensive selection can be practiced in case of males, as a few males are required for breeding purpose. The selection of the superior sires with maximum accuracy is also of utmost importance for any breed improvement programme. Robertson and Randel [1] opined that as much as 61 per cent of genetic gain in dairy cattle results from selection of sires through bulls to breed cows and bulls to breed bulls' path. Therefore, more emphasize has been given to sire evaluation. Hence, an early and accurate appraisal of sires breeding values is essential for prime importance of long term genetic progress in the population Thus, the knowledge of genetic properties of traits is the pre-requisite in establishing the selection programme or mating system. 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 method would be expected to enhance the accuracy of selection of the sire [2], further [3] developed mixed model programme (BLUP- 90,Dairy Pack) and WOMBAT 1.0 software [4] in animal breeding for genetic evaluation, estimation of breeding value and variance for single and multiple traits.

2. Materials and Methods

Data for the present investigation were collected from history sheet of crossbred cattle at instructional dairy farm of G. B. Pant University of Agriculture and Technology, Pantnagar. The data pertained to 1198 crossbred cattle from 102 sires were distributed over a period of 48 years from 1966 to 2010. Only the sires having records on at least 5 daughters were evaluated on the basis of first lactation milk yield in the present study. The records of only

those animals with known pedigree and normal lactation were considered. The lactation records of less than 150 days were considered as abnormal and were not included in the analysis. The total duration of the present study was divided into 10 equal periods of five years each. 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 genetic group periods and seasons of calving were considered for all the traits. Records on first lactation milk yield of crossbred cattle being in non-orthogonal nature were analyzed by Least Squares Analysis (LSA) technique of fitting constants for the estimation of genetic parameters as well as to examine the simultaneous effects of different genetic and non-genetic factors affecting this trait.

3. 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 [5]. 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. Breeding value of sires for first lactation traits were estimated by WOMBAT 1.0 software as proposed by [4], least square method(LSM) as described by [5], best linear unbiased prediction (BLUP) by Henderson [6] and DFREML version 3.0-β by Meyer [2]. The effectiveness of different sire evaluation methods was judged by the estimated breeding value of sires as taken twice the sire genetic group solution plus sire solution within sire genetic group for that trait. After estimation of breeding value of sires the sires were given ranks as per their genetic merit. Spearman's rank correlations [7] and product moment correlations between breeding values of sires derived by various methods were also used to judge the effectiveness of different methods.

4. Results and Discussion

The average breeding value of sires for first lactation milk yield was ranged from 2779.19Kg. (LSM) and 2629.80kg (BLUP). There were 32 sires whose breeding values observed above the average breeding value and 36 sires with breeding values below the average breeding value. The lowest breeding values observed for first lactation milk yield was 2246.02 for sire no.16 and highest breeding value was 3167.45 kg for sire no.14. The difference between highest and lowest breeding value was 921.43kg. (Table-1).

The estimated overall average breeding value of sires by least squares method (LSM) for first lactation milk yield was found to be 2779.19 kg. There were 27 sires whose breeding value observed above the average breeding value and 41sires with breeding value below the average breeding value. The lowest breeding value observed for first lactation milk yield was 2241.94 kg for sire no.64 and highest breeding value was 3166.45kg for sire no. 97. The difference between highest and lowest breeding values was 2035.60kg. (Table-1).

The average breeding value for first lactation milk yield using best linear unbiased prediction was estimated as 2710.46kg. The breeding value ranged from 3643.90 kg above the average breeding value to 2241.94 kg. below the average breeding value. Thirty two sires out of 68 sires had breeding value above the average breeding value, while 36 were having breeding value below the average breeding value. The difference between highest and lowest breeding values was 755.04 kg. (Table-1).

The estimated average breeding value of sires by DFREML for first lactation milk yield was found to be 2680.29 kg. Out of 68 sires 32 sires had breeding value above the overall average breeding value (Table-1) and 36 sires had the breeding value below the average breeding value. The lowest breeding value observed for first lactation milk yield was 2309.49 kg. and highest breeding value was 3064.53. The difference between highest and lowest breeding values was 924.51kg. (Table-1).

The estimated average breeding value of sires by WOMBAT for first lactation milk yield was found to be 2713.86 kg. Out of 68 sires 32 sires had breeding value above the overall average breeding value (Table-1) and 36 sires had the breeding value below the average breeding value. The lowest breeding value observed for first lactation milk yield was 2246.02 kg. and highest breeding value was 3167.45kg. The difference between highest and lowest breeding values was 921.43 kg. (Table-1).

The estimated breeding values of sire's estimates for first lactation milk yield by BLUP showed small genetic variation in compare to WOMBAT, LSM and REML method. However, the BLUP method seemed to be the most efficient method out of all four methods of sire evaluation used in the present study.

The similar results were also reported by Gaur, *et al.* [8], Dahia, *et al.* [9], Bajetha [10] and Dubey, *et al.* [11]. While Banik and Gandhi [12] found DFREML method most effective sire evaluation method as compare to other methods in Sahiwal Cattle.

While Dalal, *et al.* [13], in crossbred cattle, Banik and Gandhi [12] in Sahiwal Cattle; Kumar, *et al.* [14] on Karan fries cattle and Moges, *et al.* [15], Singh and Singh [16], Singh, *et al.* [17] and Dubey, *et al.* [18] reported large genetic variation between the estimated breeding values of sires estimated by different sire evaluation methods.

In general, EBV's for sires did not showed any systematic trend of first lactation yield. In the present investigation the estimated breeding values of sires for first lactation yield showed large variation between EBV'S of sires which revealed more genetic variation in the herd.

The simple correlations and rank correlations among all the four methods of sire evaluation were statistically significant (P<0.01) suggesting that all the methods of sire evaluation were equally effective to discriminate amongst sires on the basis of first lactation milk yield (Table-2). Product moment correlation among breeding values of sires estimated by different methods ranged from 0.566 (LSM with BLUP) to 0.997 (WOMBAT with BLUP), where as rank correlations of breeding value of sires ranged from 0.566 (LSM with BLUP) to 0.745 (WOMBAT with LSM) (Table-2). These findings agreed with the reports of Dalal, *et al.* [13], Gaur, *et al.* [8], Dubey, *et al.* [11], Banik and Gandhi [12], [10], , Kumar, *et al.* [14], Moges, *et al.* [15] and Bajetha, *et al.* [19].

The top10 sires ranked on the basis of first lactation milk yield revealed that sire no.14 ranked Ist by WOMBAT, sire no.97 by LSM,sire no. 17 by REML and sire no. 14 by BLUP methods. Sire no.97 ranked IInd by WOMBAT, sire no.14 by LSM, sire no.27 DFREML and sire no. 97 by BLUP methods, respectively. These results indicated that all sires would not rank same for all the methods.

However, the rank of sires for different sire evaluation methods revealed that 4-5% of top sires almost had similar rank for all the methods. Similar results were also reported by

Dalal, *et al.* [13], Dubey, *et al.* [11] and Moges, *et al.* [15], Singh and Singh [16], Singh, *et al.* [17] Dubey, *et al.* [18] and Bajetha, *et al.* [19] in crossbred cattle.

5. Conclusions

The comparison of different methods of sire evaluation based on single trait (first lactation trait) showed that the BLUP was most accurate and efficient method to estimate the breeding values of sires with lowest. The rank correlation coefficients among breeding values by different sire evaluation methods do exhibit a notable degree of similarity of ranking sires by different methods ranging from about60 to 75 percent. It was concluded that BLUP method was most efficient and accurate method of sire evaluation as compared to the other methods.

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Table-1. Average breeding value estimates for first lactation milk yield by different sire evaluation methods.

Traits	Sire evaluation method	Average breeding value	Minimum breeding value	Maximum breeding value	Number of sires over average	Number of sires below average breeding value	Range of Breeding Value
First Lactation Milk Yield	Wombat	2713.86	2246.02	3167.45	32	36	921.43
	LSM	2779.19	1872.09	3907.69	27	41	2035.60
	DFREML	2710.46	2241.94	3166.45	32	36	924.51
	BLUP	2680.29	2309.49	3064.53	32	36	755.04

Table-2. Spearman's rank (above diagonal) and product moment correlation (belowdiagonal) for first lactation milk yield among different sire evaluation methods.

Traits	FLMY			
Methods	Methods			
	wombat	LSM	BLUP	DFREML
wombat	-	0.745**	0.664**	o.631**
LSM	0.636**	-	0.566**	0.575**
BLUP	0.997**	0.566**	-	0.956**
DFREML	0.959**	0.575**	0.956**	-

**Correlation is significant at the 0.01 level

Table-3. Sires of top 10 ranks on the basis of estimated breeding values of sires for first lactation milk yield by different methods.

Rank No.	Wombat FLMY	LSM FLMY	DFREML FLMY	BLUP FLMY
1	14	97	17	14
2.	97	14	27	97
3.	22	102	103	22
4.	65	22	35	65
5.	40	40	49	40
6.	21	38	65	21
7.	78	100	25	78
8.	66	18	26	66
9.	102	31	45	102
10.	08	35	10	8