

Original Research Article

<https://doi.org/10.20546/ijcmas.2019.802.255>

## Comparison of Sire Evaluation Methods for Milk Production in Tharparkar Cattle

Garima Choudhary\*, U. Pannu, G.C. Gahlot and M. Nehra

Department of Animal Genetics and Breeding, College of Veterinary and Animal Science,  
Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India

\*Corresponding author

### ABSTRACT

#### Keywords

Breeding value,  
Tharparkar cattle,  
First lactation milk  
yield, Rank  
correlation

#### Article Info

Accepted:  
18 January 2019  
Available Online:  
10 February 2019

First lactation records (91) of Tharparkar cows, progeny of 10 sires, were analyzed to estimate the variance components and breeding values of sires for first lactation milk yield using simple daughter's average method ( $\bar{D}$ ), Contemporary comparison method (CC), least-squares method (LSM) and best linear unbiased prediction (BLUP). Using  $\bar{D}$ , CC, LSM and BLUP methods of sire evaluation the average breeding value of sires were 1849.10 kg, 1836.17 kg, 1858.65kg and 1859.03 kg respectively. Although, lowest error variance and highest coefficient of determination in LSM method revealed that this method of sire evaluation was most efficient and accurate followed by BLUP method of sire evaluation but the CC method was the best for discrimination amongst sires as revealed from highest range of breeding values. Higher rank correlation (0.98) between LSM and BLUP methods of sire evaluation indicated that there was higher degree of similarity of ranking of the sires by both the methods of sire evaluation.

### Introduction

Indigenous cattle are particularly suited to the climate and environment of their respective breeding tract. They have qualities of heat tolerance, resistance to diseases and ability to thrive under extreme climatic conditions. Tharparkar breed is adapted to the harsh climatic conditions with extremes of temperature, sand storms, recurrent famines and xeric vegetation which are totally unsuitable for dairy animals. In arid and semi arid zones, Tharparkar cattle play an important role in milk production and reared

in the drought prone region of northwest India. 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 variety viz. simple daughter's average method ( $\bar{D}$ ), Contemporary comparison method (CC), least-squares method (LSM) and best linear

unbiased prediction (BLUP). Therefore, in the present investigation an attempt was made to compare the effectiveness of different sire evaluation methods for milk production in Tharparkar cattle.

**Materials and Methods**

In the present investigation, 91 first lactation records of Tharparkar cows, progeny of 10 bulls (with 3 or more daughters), spread over 11 years (2006 to 2016) at LRS, Beechwal, Bikaner were used to evaluate sires.

The sires were evaluated on the basis of first lactation milk yield using 4 methods of sire evaluation, viz. simple daughter's average method ( $\bar{D}$ ), Contemporary comparison method (CC), least-squares method (LSM) and best linear unbiased prediction (BLUP). The effectiveness of different sire evaluation methods was judged by using the various criteria like error variance, coefficient of determination ( $R^2$ ) and rank correlations. The sire evaluation method with lowest error variance was considered as the most efficient and appropriate.

**Statistical analysis**

The following four methods of sire evolution were used to estimate the breeding values of sires.

**Simple Daughter's average ( $\bar{D}$ )**

Sires were evaluated by Simple daughter's average as proposed by Edward (1932).

$$S = \bar{D}$$

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

**Contemporary Comparison (CC) method**

The following formula was used for the estimation of sire index by CC method:

$$S = A + (\bar{D} - \bar{C}_i) \frac{2nh^2}{4 + (n-1)h^2}$$

Where,

A = herd average,

$\bar{C}_i$  = contemporary daughter's average,

n = no. of daughters of the sire,

$h^2$  = heritability of the trait, and

$\bar{D}$  = daughter's average.

**Least-Squares Method (LSM)**

For estimation of least-squares breeding values the following model was used-

$$Y_{ijk} = \mu + S_i + A_j + e_{ijk}$$

Where  $s_i$  is the fixed effect of  $i^{th}$  sire and  $A_j$  represents all other fixed effects included in the previous models.

$$\text{Least-squares breeding values (LSBV)} = \mu + S_i$$

Where  $\mu$  is the overall least-squares mean  $S_i$  is the least squares constant of  $i^{th}$  sire.

**Best linear unbiased prediction (BLUP)**

Sires were evaluated by the BLUP procedure as used by Henderson (1973).

The following methods were used for judging the effectiveness of various sire evaluation methods:

Relative efficiency as percent error variances of a method relative to the variance of most efficient method having least error variance.

$$\text{Relative efficiency (\%)} =$$

$$\frac{\text{Error variance of most efficient method}}{\text{Error variance of other method}} \times 100$$

Coefficient of determination: The coefficients of determination ( $R^2$  - Value) of different methods were estimated for judging the accuracy of sire evaluation method. The model, which shows the highest  $R^2$ -value, was most accurate.

### **Association among different methods of sire evaluation**

Spearman's rank correlation was also used as criteria to judge the relative efficiency of different methods.

Spearman's rank correlation:

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

Where,

$r_s$  = Spearman's rank correlation

$n$  = Number of sires under observation

$d_i$  = Difference between the ranking of a sire by the two methods.

### **Results and Discussion**

The average breeding value of sires estimated by different models is summarized in Table 1. Five sires out of 10 sires had breeding value above average breeding value, while 5 sires were having breeding values below the average in first two methods of sire evaluation whereas seven sires had breeding value above average and 3 sires were having breeding values below the average in LSM and 6 sires had breeding value above average and 4 sires were having breeding values below the average in BLUP method (Table 2).

The lowest breeding value observed for FLMY was 1463 Kg that was 20.89% below the average. The highest breeding value was 2158 Kg, which was 16.71% above the average. The range of breeding value (695 Kg) was 37.59% of the average breeding value for first lactation milk yield by simple daughter's average method. The lowest and

highest breeding values observed by CC method were 1227.20 Kg and 2077.60 Kg respectively and the range of breeding value was highest (850.4 Kg) by contemporary comparison method. Thus, it can be concluded that as per discrimination of Tharparkar sires is concerned the contemporary comparison method of sire evaluation was best for discrimination amongst sire as revealed from highest range of breeding values. The lowest and highest breeding values observed by LSM were 1651.06 Kg and 1993.66 Kg respectively and the range of breeding value (342.6 Kg) was 18.43% of the average breeding value by least-squares method. The breeding value ranged from 1673.45 Kg to 1992.97 Kg with a difference of 319.52 Kg by best linear unbiased prediction method. The lowest range of breeding value using BLUP method of sire evaluation indicated that this method was least capable in discrimination among Tharparkar sires.

The LSM had minimum error variance (8952.17kg) and therefore, it was considered to be the most efficient followed by BLUP (9729.79kg) (Table 3). Various workers such as, Sahana and Gurnani (1999), Mukherjee (2005), Banik and Gandhi (2006), Singh and Singh (2011), Kishore (2012) and Singh (2015) also advocated LSM method as the most efficient method of sire evaluation compared to BLUP. The relative efficiencies (%) of different methods were estimated in comparison most efficient method and the relative efficiencies of BLUP, CC and  $\bar{D}$  were 92.01%, 15.04% and 14.59%, respectively (Table 3). Thus it can be concluded that as far as efficiency is concerned LSM and BLUP methods were almost equally efficient in partitioning of variance.

Accuracy of different methods of sire evaluation was compared using coefficient of determination of methods.

**Table.1** Estimates of breeding values of sires and their ranks for first lactation milk yield in different methods of sire evaluation

Sire ID	ESBV (D̄)		ESBV (CC)		ESBV (LSM)		ESBV (BLUP)	
	Estimates	Rank	Estimates	Rank	Estimates	Rank	Estimates	Rank
1997	2158	1	1963.07	4	1914.84	3	1936.62	2
2081	1463	10	1690.44	9	1763.56	9	1725.21	9
2087	2040	3	1969.24	3	1924.65	2	1928.58	3
2164	1794	7	1827.20	7	1833.53	8	1807.15	8
2249	2122	2	1948.99	5	1898.94	4	1914.41	4
2355	2008	4	2029.77	2	1993.66	1	1992.97	1
2385	1921	5	2077.60	1	1875.50	5	1870.34	6
Tb-01	1470	9	1227.20	10	1651.06	10	1673.45	10
Tb-02	1720	8	1800.83	8	1859.62	7	1859.36	7
Tb-03	1795	6	1827.43	6	1871.12	6	1882.17	5

**Table.2** Average breeding value estimates of sires for first lactation milk yield by different methods

Traits	Methods	Average breeding value (Kg)	No. of sires above average	No. of sires below average	Maximum breeding value	Minimum breeding value	Range of breeding value	Range of % of average breeding value
First Lactation Milk Yield	D̄	1849.1	5	5	2158 (16.71)	1463 (20.89)	695	37.59%
	CC	1836.17	5	5	2077.60 (13.15)	1227.20 (33.16)	850.4	46.31%
	LSM	1858.65	7	3	1993.66 (7.26)	1651.06 (11.17)	342.6	18.43%
	BLUP	1860.03	6	4	1992.97 (7.20)	1673.45 (9.98)	319.52	17.19%

Figures in the parenthesis represent the percent higher/ lower than the average breeding value.

**Table.3** Error variances, relative efficiency and coefficient of determination (%) of different sire evaluation methods

Method of sire evaluation	Error variances	relative efficiency	Coefficient of determination (%)
D̄	61352.77	14.59	10.96
CC	59532.53	15.04	12.70
LSM	8952.17	100.00	27.49
BLUP	9729.79	92.01	15.74

**Table.4** Rank correlations among sire breeding value for first lactation milk yield by different methods

Method	CC	LSM	BLUP
D̄	0.76	0.87	0.88
CC		0.87	0.79
LSM			0.98

The LSM was adjudged as the most accurate (27.49% R<sup>2</sup> value) followed by BLUP (15.74% R<sup>2</sup> value).

The rank correlations among breeding values of sires estimated from LSM and BLUP methods of sire evaluation were very high (0.98) (Table 4). Higher correlation indicated that evaluation by these two methods was highly correlated. Parekh and Singh (1989) also reported similar results.

The estimated breeding values of sires by different methods of sire evaluation revealed that least-squares method is more accurate and efficient as it showed smaller error variance and higher R<sup>2</sup> in comparison to all other methods. Rank correlation between LSM and BLUP method of sire evaluation was found to be high (0.98). It indicated that ranking of sires by LSM and BLUP maintains a high consistency with each other. Thus BLUP method was equally good in terms of their efficiency and accuracy for ranking of Tharparkar sires.

## References

Banik, S. and Gandhi, R.S. (2006). Animal model versus conventional models of sire evaluation in Sahiwal cattle. *Asian Aust. J. Anim. Sci.*, 19(9): 1225-1228.

Edward, J. (1932). The progeny test as a

method of evaluating the dairy sire. *J. Agric. Sci.*, 22: 811-837.

Henderson, C.R. (1973). Sire evaluation and genetic trends. *Proc. Anim. Breed. Genet.Symp.* in honour of J.L. Lush. USDA, Illinois, USA, pp. 10-41.

Kishore, K. (2012). Genetic evaluation of sires in Tharparkar cattle. M.V.Sc. Thesis, *RAJUVAS, Bikaner*.

Mukherjee, S. (2005). Genetic evaluation of Frieswal cattle. Ph.D. Thesis, *NDRI, Karnal, India*.

Parekh, H.K.B. and Singh, M. (1989). Efficiency of different procedures in dairy sire evaluation using crossbred progeny. *Indian J. Dairy Sci.*, 42: 482-488.

Sahana, G. and Gurnani, M. (1999). Efficacy of Auxiliary traits in estimation of breeding value of sires for milk production. *Asian-Avs. J. Anim. Sci.* 12(4): 511-514.

Singh, J. (2015). Genetic studies on first lactation and life time traits and sire evaluation using animal models in Sahiwal cattle, Ph.D. Thesis, *GBPUA&T, Pantnagar*.

Singh, V.K. and Singh, C.V. (2011). Sire evaluation using animal model and conventional methods for milk production in crossbred cattle. *Indian J. Anim. Sci.*, 81(1): 77-79.

## How to cite this article:

Garima Choudhary, U. Pannu, G.C. Gahlot and Nehra, M. 2019. Comparison of Sire Evaluation Methods for Milk Production in Tharparkar Cattle. *Int.J.Curr.Microbiol.App.Sci.* 8(02): 2205-2209. doi: <https://doi.org/10.20546/ijemas.2019.802.255>