Indian Journal of Animal Sciences **81** (1): 77–79, January 2011

Sire evaluation using animal model and conventional methods for milk production in crossbred cattle

V K SINGH[1] and C V SINGH[2]

Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand 263 145 India

Received: 20 December 2009; Accepted: 18 October 2010

Key words: Animal model, BLUP, Breeding value, DFREML, Sire evaluation

In recent past the best linear unbiased prediction (BLUP) procedure have been widely used as standard method of sire evaluation. However, Henderson (1984) opined that analysis of variance and covariance may give biased components of variance from selected population by BLUP method, whereas restricted maximum likelihood (REML) can give bias-free estimate. Hence, the sire evaluation using advanced statistical techniques based on derivative free restricted maximum likelihood (DFREML) as described by Meyer (1998), would be expected to enhance the accuracy of selection of bulls. However, animal models in Indian breeds have been used preciousness (Mukharjee *et al.* 2007, Kumar *et al*. 2008. Hence an attempt was made to compare effectiveness of different methods of sire evaluation for milk production in crossbred cattle.

The data for the present study were obtained from the performance records of 1 085 crossbred daughters of 57 sires maintained at Instructional Dairy Farm of the university during 1974–2004. These were used to estimate breeding value of sires for first lactation milk yield. The exotic breeds used were Holstein Friseian (HF), Jersey (J) and Red Dane (RD) and the indigenous breeds were Sahiwal (S) and Rathi (R). The crossbreds were HF × S, J × S, RD × S, HF × S × RD, RD × S × J, HF × R × J and HF × S × RD × J. Cows with abnormal and in complete records were excluded from the study. The data on sires having at least 3 daughters per sire were included for evaluation of sires. Each year was divided into 3 seasons, viz. summer (March to June), rainy (July to October) and winter (November to February) based on climatic conditions. Daughters were grouped into 7 genetic groups on the basis of their breeding history. Period of study was divided into 7 periods, each period of 5 years in which their daughters were born.

Breeding value of sires for first lactation traits were estimated by least squares method (LSM) as described by Harvey (1990), best linear unbiased prediction by Henderson (1975) and DFREML version 3.0 – ß by Meyer (1998). The effectiveness of different sire evaluation methods was judged by the estimated breeding value of sires taken as twice the sire genetic group solution plus sire solution within sire genetic group for that trait. After estimation of breeding value of sire, the sires were given ranks as per their genetic merit. Spearmans rank correlation (Steel and Torrie 1960) and product moment correlation between breeding values of sires derived by various methods were also used to judge the effectiveness of different methods.

In the present study, the breeding values of sires were estimated, evaluated and ranked on the basis of breeding value of their progeny by 3 different sire evaluation methods and presented in Table 1. The estimated overall average breeding value of sires by LSM for first lactation milk yield was 3 050.85 kg. There were 33 (57.89%) sires whose breeding values were above the average and 24 (42.11%) sires with below the average values.

The estimated average breeding value of sires by DFREML for first lactation milk yield was 3 050.84 kg. Out of 57 sires, 30 (52.63%) sires had breeding value above the overall average (Table 2), and 24 (47.32%) sires had the below the average breeding value.

The average breeding value for first lactation milk yield using BLUP was 3 054.84 kg. Of the 57 sires, 30 (52.63%) had breeding values above the average, while 27 (47.37%) were having values below the average breeding value.

The estimated breeding values of sire estimate for first lactation milk yield by LSM showed less genetic variation than DFREML and BLUP methods and therefore LSM was considered as the most efficient method out of all 3 methods of sire evaluation used in the present study. Gaur *et al.* (2001), Dajetha (2006) and Dubey *et al.* (2006) reported BLUP as

Present address: [1]Subject Matter Specialist, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad, Uttar Pradesh.

[2]Professor and Head/Joint Director (e mail cvsing2422 @rediffmail.com), Department of Genetics and Animal Breeding, College of Veterinary and Animal Sciences.

Table 1. Average breeding value estimates for first lactation milk yield by different methods of estimation

Trait	Sire evaluation method	Average breeding value	Minimum breeding value (% below average)	Maximum breeding value (% below average)	Number of sires over average (% of sires)	Number of sires below average breeding value (% of sires)
First lactation milk yield	LSM	3 050.84	2 829.20 (7.26)	3 291.70 (7.89)	33.00 (57.89)	24.00 (42.11)
	DFREML	3 050.84	2 464.70 (19.21)	3 784.60 (24.05)	30.00 (52.63)	27.00 (47.37)
	BLUP	3 050.84	2 484.30 (18.57)	3 643.90 (19.44)	30.00 (52.63)	27.00 (47.37)

LSM, Least squares method; DFREML, derivative free restricted maximum likelihood; BLUP, best linear unbiased prediction.

best sire evaluation method when compared with other procedures of sire evaluation. While Kumar *et al.* (2008) reported DFREML method as the most efficient method out of all the 3 methods of sire evaluation.

In general estimated breeding values for sires did not show 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 estimated breeding values of sires which revealed more genetic variation in the herd. Large genetic variation was also observed between the estimated breeding values of sires by Dalal *et al.* (1999) and Dubey *et al.* (2006) in crossbred cattle; Banik and Gandhi (2006) and Mukherjee *et al.* (2007) in Sahiwal cattle, Kumar *et al.* (2008) in Karanfries cattle and Moges *et al.* (2009) in crossbred cattle.

This might be due to fact that this herd had number of genetic groups and maintained as closed herd and animals with low production might have not been culled from the herd. Accuracy of the methods of sire evaluation was determined by comparing the simple (Product moment correlations and spearman's rank correlations) correlation of breeding values of sires estimated by various sire evaluation methods for first lactation milk yield. Product moment correlations between breeding values of sires and rank correlations by various methods are presented in Table 2. The simple correlations and rank correlations among all the 3 methods of sire evaluation were high and highly statistically significant ($P<0.01$) indicating, 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 correlations among breeding values of sires estimated by different methods ranged from 0.997 (LSM with DFREML) to 0.998 (DFREML with BLUP), whereas rank correlations of breeding value of sires ranged from 0.987 (LSM with DFREML) to 0.994 (DFREML with BLUP). Their findings agreed with the reports of Dalal *et al.* (1999), Gaur *et al.* (2001), Dubey *et al.* (2006), Banikand Gandhi (2006), Bajetha (2006), Mukherjee *et al.* (2007), Kumar *et al.* (2008) and Moges *et al.* (2009).

Table 2. Spearman's rank (below diagonal) and product moment correlations (above diagonal) for first lactation traits among different sire evaluation methods

Trait method	FLMY		
	Methods		
	LSM	DFREML	BLUP
LSM	-	0.997	0.998
DFREML	0.987	-	0.998
BLUP	0.992	0.994	-

Table 3. Sires of top 10 rank on the basis of estimated breeding values of sires for first lactation milk yield (FLMY) by different methods

Rank	FLMY		
	LSM	DFREL	BLUP
1.	64	64	64
2.	29	29	29
3.	34	51	54
4.	54	15	15
5.	31	54	31
6.	22	31	20
7.	15	34	51
8.	20	20	22
9.	51	22	34
10.	23	46	46

Top 10 sires ranked on the basis of estimated breeding values of sires for first lactation traits by all 3 methods are presented in Table 3. The top 10 sires ranked on the basis of first lactation milk yield revealed 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% top sires almost had similar rank for all the methods. Similar results were also reported by Dalal *et al.* (1999), Bajetha (2006), Dubey *et al.* (2006) and Moges *et al.* (2009).

In comparison of their methods of sire evaluation LSM method was found to be more efficient, accurate and stable with lowest genetic variation. The rank correlation coefficients amongst breeding value of sires by different methods of sire evaluation showed a reasonably high degree of agreement (790%) in the ranking of sires.

SUMMARY

The present study was made to compare effectiveness of

different methods of sire evaluation for milk production in crossbred cattle. Breeding values of sires for first lactation traits were estimated by least square method (LSM), best linear unbiased prediction (BLUP) and DFREML version 3.0- . The estimated breeding value of sires estimated for the first lactation milk yield by LSM was adjudged as the most efficient and accurate. The results indicated that there was high degree of similarity in ranking of sires by these 3 methods.

REFERENCES

Bajetha G. 2006. 'Selection of sires by using different sires evaluation methods in crossbred cattle'. Ph D Thesis, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, Uttarakhand, India.

Banik S and Gandhi R S. 2006. Animal model versus conventional models of sire evaluation in Sahiwal cattle. *Asian Australasian Journal Animal Science* **19** (90): 125–28.

Dalal D S, Rathi S S and Raheja K L. 1999. Relationship between sires estimated breeding values for first lactation and lifetime traits in Hariana cattle. *Indian Journal of Animal Sciences* **72** (5): 398–401.

Dubey P P, Singh C V and Prasad R B. 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** (10): 824–28.

Edward J. 1932. the progeny test as a method of evaluating the dairy sire. *Journal of Agricultural Science* **22**: 810–37.

Gaur G K, Tripathi V N, Mukherjee S and Choudhary V K. 2001. Efficiency of sire procedures in Frieswal cattle. *Indian Journal of Veterinary Research* **10** (2): 1–6.

Harvey W R. 1990. User guide for LSMLMW and MIXMDL package. Mix model least squares and maximum likelihood computer programme. PC–2 Version Mimeograph, Columbia, Chio. U S A.

Henderson C R. 1975. Use of relationship among sires to increase accuracy of sire evaluation. *Journal Dairy Science* **58**: 1731–38.

Henderson C R. 1984. Application of linear model in breeding. University of Guelph Press, Guelph, Canada.

Kumar A, Gandhi R S, Singh A and 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** (12): 1393–96.

Meyer K. 1998. DFREML (Derivative free Restricted Maximum Likelihood) Programme Version 3.0 ß users note. University of New England, Armidale. NSW 2351, Australia.

Moges T G, Singh C V, Barwal R S, Kumar D, and Singh C B. 2009. Evaluation of sires using different multitrait sire evaluation methods in crossbred cattle. *Indian Journal of Dairy Sciences* **62** (3): 1–4.

Mukherjee S, Joshi B K and Gaur G K. 2007. Sire evaluation methods in Frieswal cattle. *Indian Journal of Animal Sciences* **77** (8): 123–26.

Steel R G D and Torrie J H. 1960. *Principles and Procedures of Statistics*. 2nd edn. Mcgraw-hill Book Co, New York.