

Study of relative effectiveness of different sire evaluation methods in sahiwal cattle

Abstract

The performance records of 927 Sahiwal Cattle daughters of 72 sires maintained during 1978 to 2007 at State Livestock Farm Chak Ganjaria, Lucknow were used to evaluate sire for first lactation and life time traits. The traits included were first lactation milk yield, first dry period, first calving interval, first service period and life time milk yield. The breeding value of sire estimated by two methods viz. least squares and best linear unbiased prediction methods. BLUP and least squares method have variation in the estimated value of coefficient of variation (C.V.%). It indicated that the BLUP method is the best over the least squares method (LSM) because estimated value of coefficient of variation (C.V.%) by BLUP method had smaller values (C.V.%) than that of least squares method. the BLUP using single trait viz. FSP, FDP, FCI, FLMY, PL and HL were having lowest error variances as compared to the least squares method (LSM). So, BLUP was the most efficient sire evaluation method. The estimated R² values in the present study indicated that variability in the herd and genetic potentiality of the animals at this farm merely can improve through the introduction of the new germ plasm of Sahiwal cattle from outside of the herd.

Keywords: breeding value, first lactation yield, lifetime milk yield, breeding value, genetic variation

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Abbreviations: AFC, age at first calving; FCI, first calving interval; FLMY, first lactation milk yield; FLP, first lactation period; WFC, weight at first calving; FSP, first service period; LS, least squares

Introduction

The main aim of sire evaluation is to obtain an accurate, efficient and ranking them according to their merit so as to enable the breeder to choose the best bulls. Today, the need for sire evaluation for their additive genetic ability (breeding values) or transmitting ability to its progeny has been recognized. For assessing the breeding values of bulls for the traits viz. age at first calving (AFC), first calving interval (FCI), first lactation milk yield (FLMY), first lactation period (FLP), weight at first calving (WFC) and first service period (FSP), there are several methods of sire evaluation with a wide range of complexity starting from very simple (Simple daughter's average index),¹ to highly complicated (REML) method. Different methodologies like contemporary comparison, corrected daughter average index² equivalent parent, least squares (LS) technique, dairy search index,³ and simple regressed least squares technique (SRLS) could be used. Henderson⁴ 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. The multi traits criteria of sire evaluation using advanced 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 bull.

Materials and methods

The performance records of 927 Sahiwal cattle daughters of 72 sires, maintained at State Livestock Farm Chak Ganjaria, Lucknow, during 1978 to 2007 were used to estimate sire breeding value for first lactation traits. Cows with abnormal and in complete records were

excluded from the study. Each year was divided into four seasons viz. summer (April–June), rainy (July–September), autumn (October–December) and winter (January–March) based on climatologically conditions. The period of calving was divided into 7 periods on the basis of period in which their first daughter was born. First lactation and life time traits included in this study were FSP, FDP, FCI, FLMY and LTM.

Breeding values of sires for first lactation traits were estimated by least squares method as described by Harvey⁵ and Best linear unbiased prediction (BLUP) method as proposed by Henderson.⁶ The effectiveness of different sire evaluation methods shall be judged by within sire variance (error variance). The method giving lowest error variance had higher efficiency and would be most appropriate. The efficiency of other methods relative to the most efficient method under the present study were calculated as.

$$\text{Relative efficiency of a method (\%)} = \frac{\text{Error variance of most efficient method}}{\text{Error variance of any other method}} \times 100$$

Results & discussion

Coefficient of Variation (C.V.%)

The coefficient of variation (C.V.%) for different traits were measured under BLUP and least squares method, and presented in Table 1. The coefficient of variation (C.V.%) for first calving interval (FCI) under BLUP and least squares method was reported as 24.36 and 25.32 percent, respectively. Longer calving interval could be controlled by reducing dry period and service period and this can be achieved by better management practices. The coefficient of variation (C.V.%) for first service period (FSP) in the present study by BLUP and least squares method was found to be 53.8 and 55.92percent, respectively (Table 1). The higher value of coefficient of variation showing, there was very large variation in the herd for first service

period. The increased service period can only be controlled through proper management and feeding practices.

Table 1 Coefficient of multiple determinant (R^2) and coefficient of variation (C.V.%) under BLUP and LS Method

S.No	Traits	R^2		C.V.%	
		BLUP	LSM	BLUP	LSM
1	FSP	0.004	0.078	53.8	55.92
2	FDP	0.011	0.168	53.9	54.88
3	FCI	0.005	0.087	24.36	25.32
4	FLMY	0.003	0.127	34.77	35.63
5	LTMY	0.012	0.166	23.55	23.98
6	PL	0.152	0.404	9.61	9.64
7	HL	0.124	0.27	9.88	9.94

The coefficient of variation (C.V.%) for first dry period (FDP) in present investigation by BLUP and least squares method to be as 53.90 and 54.88 percent, respectively. Dry period needs to be reduced which can only be possible by reducing the service period by providing the efficient management practices at this farm. The coefficient of variation (C.V.%) for first lactation milk yield (FLMY) has been found under BLUP and least squares method in the present study to be as 34.77 and 35.63 percent, respectively. This result revealed that this trait could be improved through selection, better management and feeding practices at this farm.

The coefficient of variation (C.V.%) in life-time milk yield (LTMY) was found by BLUP and least squares method to be as 23.55 and 23.98 per cent, respectively. This value of coefficient of variation for LTMY indicate that this trait could be improved through better animal husbandry practices for obtaining the higher milk production. The coefficient of variation (C.V.%) for productive life (PL) under BLUP and least squares method was found to be as 9.61 and 9.64 percent, respectively, in the present investigation. These values of coefficient of variation could be improved through better managerial practices and sire selection at this farm.

The coefficient of variation (C.V.%) for herd life (HL) under BLUP and least squares method was estimated as 9.88 and 9.94 per cent, respectively, herd life may be improved by an efficient managerial practices of the animal at an early growth phase. BLUP and least squares method have variation in the estimated value of coefficient of variation (C.V.%). It indicated that the BLUP method is the best over the least squares method (LSM) because estimated value of coefficient of variation (C.V.%) by BLUP method had smaller values (C.V.%) than that of least squares method. There was no literature available for the comparison of the above mentioned results.

Coefficient of multiple determinants (R^2)

The coefficient of multiple determinant estimated under BLUP and least squares (LS) method were 0.004 and 0.078 for FSP, 0.011 and 0.168 for FDP, 0.005 and 0.087 for FCI, 0.003 and 0.127 for FLMY, 0.012 and 0.166 for LTMY, 0.152 and 0.404 for PL and 0.124 and 0.270 for HL, respectively (Table 1). These estimated R^2 values in the present study indicated that variability in the herd and genetic potentiality of the animals at this farm merely can improve through the introduction the new germ plasm of Sahiwal cattle from outside of the herd.

Relative effectiveness of different sire evaluation method

The error variances of breeding values of sires were calculated and used in the computing the relative efficiency by BLUP and least squares method (LSM). 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 investigation, the BLUP using single trait viz. FSP, FDP, FCI, FLMY, PL and HL were having lowest error variances as compared to the least squares method (LSM). So, BLUP was the most efficient sire evaluation method.

Relative efficiency of above mentioned traits was calculated with respect to the most efficient method i.e. BLUP. The estimated error variance and relative efficiency of BLUP and LSM used for estimation of breeding value of 72 sires in the present study are presented in Table 2. The productive life has relative efficiency of 99.45% and it was placed 1st traits. The FSP, FDP, FCI, FLMY and LTMY were found with a relative efficiency of 92.64%, 96.53%, 92.60%, 95.20% and 96.37%, respectively (Table 2) and were ranked VI, III, VII, V, and IV.

Table 2 Comparison of sire evaluation method in term of error variance and relative efficiency

S.No	Traits	BLUP(Error variance)	LSM(Error variance)	Relative efficiency	Rank
1	FSP	18041	19474	92.64	VI
2	FDP	10212	10579	96.53	III
3	FCI	16601	17927	92.6	VII
4	FLMY	246568	258996	95.2	V
5	LTMY	3502922	3634732	96.37	IV
6	PL	99035	99575	99.45	I
7	HL	142667	144498	98.73	II

Relative efficiency, Error variance of method in which found less error variance (BLUP)/error variance of other method (LSM)

Taneja and Rai (1990), Raheja,⁷ Singh and Singh,⁸ Tailor et al.,⁹ Dahiya et al.,¹⁰ Bajetha,¹¹ Dubey et al.,¹² Moges et al.,¹³ Singh & Singh,¹⁴ Bajetha & Singh,¹⁵ Bajetha et al.,¹⁶ Bajetha et al.,¹⁷ Lodhi et al.,¹⁸ Lodhi et al.,¹⁹ Singh & Singh²⁰ also reported BLUP method as most efficient than the other methods.

Conclusion

The coefficient of variation (C.V.%) for different traits were measured under BLUP and least squares method. The higher value of coefficient of variation showing, there was very large variation in the herd for first service period. BLUP and least squares method have variation in the estimated value of coefficient of variation (C.V.%). It indicated that the BLUP method is the best over the least squares method (LSM) because estimated value of coefficient of variation (C.V.%) by BLUP method had smaller values (C.V.%) than that of least squares method. The coefficient of multiple determinants estimated under BLUP and least squares (LS) methods and indicated variability in the herd. On the basis of the error variances of breeding values of sires the BLUP method was found most efficient sire evaluation method.

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Conflict of interest

Author declares that there is no conflict of interest.

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