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Sire Evaluation Considering First Lactation and Milk Constituent Traits in Crossbred Cattle

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Abstract

The performance records of 579 crossbred daughters of 36 sires maintained at Directorate of Livestock Farms of GADVASU, Ludhiana were used to evaluate the sires for first lactation and milk constituent traits. The first lactation traits viz. age at first calving (AFC), weight at first calving (WFC), first dry period (FDP), first service period (FSP), first lactation 305 days milk yield (FL305MY), first calving interval (FCI), peak yield (PY), days to attain peak yield (DPY) and milk constituent traits *viz.,* fat percent, SNF percent, fat yield (FY), SNF yield (SNFY), were considered for the study. The Least squares and Best linear unbiased prediction (BLUP) procedure were used to obtain the estimates of breeding values. By LSM the estimated breeding values for AFC, WFC, FDP. FSP, FL305MY, FCI, PY, DPY, FP, SNF, fat yield, and SNF yield were ranged from 807.46 to 1161.75 days; 307.28 to 433.21 kg; 54.91 to 113.5 days; 103.56 to 273.63 days; 2076.61 to 4606.26 kg; 371.84 to 569.17 days; 11.85 to 21.76 kg; 34.29 to 74.85 days; 3.511 to 4.150 %; SNF percent 7.605 to 8.754 %; 77.46 to 187.84 kg and 178.85 to 283.20 kg respectively. By BLUP method the estimated breeding values for AFC, WFC, FDP. FSP, FL305MY, FCI, PY, DPY, FP, SNF, fat yield, and SNF yield were ranged from 827.01 to 1116.29 days; 356.11 to 400.29 kg; 68.35 to 101.52 days; 124.24 to 241.76 days; 2709.97 to 3635.22 kg; 393.22 to 520.84 days; 14.74 to 19.24 kg; 46.95 to 65.81 days; 3.767 to 4.090 %; 7.932 to 8.311 %; 115.23 to 135.30 kg and 210.50 to 243.59 kg respectively. The estimated breeding values (EBV's) by both methods showed large genetic variation between sires for first lactation and milk constituent traits. While, product moment correlations among EBVs of sires for milk constituent traits were medium to very high. Rank correlation estimates indicated that top 4 to 5% sires had similar rank for first lactation performance traits and milk constituent traits. The results suggested that to improve milk productivity and quality selection of bulls should be done on the basis of daughter's FL305MY performance along with WFC and milk constituent traits.

Key words : *Breeding value, first lactation yield, milk constituent traits, rank correlations, sire evaluation.*

Introduction

Considering the need for the large and the rapid increase in milk production, crossbreeding of local cattle with exotic dairy breeds is therefore thought to be the only option. Selecting the animals on the basis of overall breeding worth instead for selection for individual traits is desirable. The milk yield and milk constituent are complex biological process influenced by genetic as well as non-genetic factors including breed, level of exotic inheritance in crossbreds, season, parity and level of milk production (1). The crossbreeding among dairy cattle has increased in recent years which showed 22.8% increase over last census (1997) where the crossbred cattle population was 20 million. Crossbreeding requires more accurate mating decisions than a traditional breeding program where herd breed composition continually changes.

Sire selection continues to be the most important genetic decision for a producer considering production and quality traits. A great success from crossbreeding is achieved by intense selection of outstanding bulls followed by inter se mating. The milk production and milk constituents both reflect the real economic worth of the cow and are considered as a selection criterion for the improvement of genetic potential of dairy animals. The genetic evaluation of milk production traits in crossbred cattle has been established and very few reports (2, 3) are available to incorporate the milk constituent traits in the genetic evaluation of the crossbred cattle.

The evaluation of sire has been of prime importance from long past. The predictions of breeding values constitute an integral part of most breeding programmes for genetic improvement of sire for different productive and reproductive traits. Traditionally, the breeding value was estimated as the individual or progeny deviation from contemporary performance within an environment (4). The sire evaluation based on milk yield was most widely used criteria. The other auxiliary traits like age at first calving, first lactation period, first calving interval, etc. had also been considered for evaluating a sire. With advancement in computing power, many procedures have been proposed for evaluating sires based on the record of their progeny. Henderson's (5) mixed model or the Best Linear Unbiased Prediction (BLUP) procedure

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Table-1: Sires of top five ranks by both methods.

Trait Ranks	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}
						Least Squares						
1.	23	18	22	16	13	16	24	31	7	2	13	26
3.	15	13	11	21	22	35	14	26	2	3	22	29
3.	19	23	18	35	4	21	6	24	3	11	4	30
4.	11	4	17	36	18	36	5	25	27	35	18	25
5.	4	35	5	17	23	3	19	9	11	36	23	31
						Blup						
1.	19	18	21	16	13	16	22	9	15	2	13	30
2.	15	35	5	21	22	32	5	28	27	36	27	26
3.	23	3	17	32	18	21	23	25	3	35	6	33
4.	11	14	31	36	5	35	7	17	7	3	5	13
5.	4	26	8	35	4	36	27	30	11	17	18	35

T_1 = Age at first calving, T_2 = Weight at first calving, T_3 = First dry period, T_4 = First service period, T_5 = Milk yield, T_6 = Calving interval, T_7 = Peak yield. T_8 = Days to peak yield, T_9 = Fat %age, T_{10} = SNF %age, T_{11} = Fat yield and T_{12} = SNF Yield.

have become standard method in animal breeding and are widely used in many developed countries for evaluating the genetic merit of sires (5). Recently, there is a constant thrust to get BLUP evaluating single and multiple traits animal model, depending upon the goal of breeding programme.

Materials and Methods

The performance records of 579 crossbred daughters of 36 sires maintained at Directorate of Livestock Farms of GADVASU, Ludhiana were used to evaluate the sires for first lactation and milk constituent traits. The first lactation traits *viz.,* age at first calving (AFC), weight at first calving (WFC), first dry period (FDP), first service period (FSP), first lactation 305 days milk yield (FL305MY), first calving interval (FCI), peak yield (PY), days to attain peak yield (DPY) and milk constituent traits viz. fat percent, SNF percent, fat yield (FY), SNF yield (SNFY), were considered for the study. The Least squares and Best linear unbiased prediction (BLUP) procedure were used to obtain the estimates of breeding values. Abnormal and incomplete data were removed from the study.

Estimation of sire's breeding value for first lactation performance and milk constituent traits : Breeding values of sires for different economic traits was estimated by least square and BLUP methods.

Best linear unbiased prediction (BLUP) procedure : (5) used the BLUP procedure to estimate the breeding values of sires for different performance traits. The model for BLUP was same as given above. In matrix notation the model can be written as :

$$Y = Xb + Za + c$$

Where,

Y = n 1 vector of observations; n = number of records

b = p 1 fixed effects of model; p = number of levels for fixed effects

a = q 1 vector of random sire effects; q = number of levels for random effects

e = n 1 vector of random residual effects

x = design matrix of order n q, which relates records to fixed

Z = design matrix of order n q, which relates records to random animal effects

$$\text{Var}(\ ) = I\hat{}^2_s,\ \text{Var}(\ ) = I\hat{}^2_e,\ \text{Var}(Y) = ZZ' + R$$

The solution to b and U were obtained from mixed model equation given below :

$$\begin{matrix} X\,X & X\,Z \\ X\,Z & Z\,Z + K \end{matrix} \begin{matrix} b \\ U \end{matrix} = \begin{matrix} X\,Y \\ Z\,Y \end{matrix}$$

Where,

K = ratio of residual to sire components; sire and residual variance components needed for BLUP were obtained from the same data using Henderson method 3. The estimated breeding value of the sire was calculated by the following formula :

$$\text{Estimated breeding value} = 2\,\hat{G} \quad \hat{S}_i K$$

$\hat{G}$ = the sire group solution and $\hat{S}_i K$ = the sire solution within sire group

Relationship between sire's breeding values for different economic traits : The product moment and rank correlations among sire's estimated breeding values of different traits were calculated according to (6).

Table-2 : The estimates of product moment correlations among estimated breeding values of sires for first lactation performance traits and milk constituent traits by LS (above diagonal) and BLUP (Below diagonal) procedure.

S. No.	Traits	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}
1.	T_1-Age at first calving	-	-0.584**	0.627**	0.247	-0.540**	0.372*	0.097	-0.162	-0.249	-0.258	-0.138	0.371*
2.	T_2-Weight at first calving	-0.337*	-	-0.533**	0.073	0.806**	-0.092	-0.013	0.358*	0.263	0.161	-0.038	-0.271
3.	T_3-First dry period	0.265	-0.210	-	0.327	-0.477**	0.505**	-0.018	0.148	-0.081	-0.240	-0.195	0.491**
4.	T_4-First service period	0.191	0.221	0.494**	-	0.146	0.802**	0.294	0.046	0.110	-0.046	-0.232	0.057
5.	T_5-Milk yield	-0.325	0.552**	-0.116	0.476**	-	0.103	-0.034	0.552**	0.181	0.252	0.054	-0.311
6.	T_6-Calving interval	0.161	0.170	0.511**	0.974**	0.446**	-	0.233	0.058	0.022	-0.040	-0.209	0.293
7.	T_7-Peak yield	-0.314	0.507**	-0.061	0.379*	0.785**	0.328	-	0.031	0.084	0.171	-0.022	-0.306
8.	T_8-Days to peak yield	-0.203	0.200	-0.025	0.80	0.348*	0.094	0.301	-	0.280	0.208	-0.018	-0.287
9.	T_9-Fat percent (%)	-0.393*	0.095	-0.044	-0.137	0.012	-0.144	-0.076	-0.046	-	0.199	-0.094	-0.109
10.	T_{10}-SNF percent (%)	-0.194	0.275	-0.195	-0.13	0.229	-0.004	0.206	0.084	0.308	-	0.039	-0.196
11.	T_{11}-Fat yield	-0.234	0.603**	-0.066	0.446**	0.900**	0.404*	0.725**	0.265	0.203	0.294	-	-0.229
12.	T_{12}-SNF yield	0.194	-0.097	0.244	0.215	0.002	0.275	0.174**	0.160	-0.242	-0.307	-0.134	-

**P < 0.01, *P < 0.05

Table-3 : Rank correlations among sires ranks on the basis of estimated breeding values of sires for first lactation performance traits and milk constituent traits by LS (above diagonal) and BLUP (below diagonal) procedure.

S. No.	Traits	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9	T_{10}	T_{11}	T_{12}
1.	T_1-Age at first calving	-	0.543**	0.507**	0.345*	0.516**	0.419*	-0.098	-0.194	0.204	0.409*	0.535**	-0.378*
2.	T_2-Weight at first calving	0.193	-	0.491**	-0.066	0.830	0.73	0.068	-0.395*	0.183	0.326	0.808**	-0.397*
3.	T_3-First dry period	-0.256	0.372*	-	0.296	0.461**	0.474**	-0.082	-0.241	-0.057	0.375*	0.440**	-0.273
4.	T_4-First service period	0.547**	0.070	-0.366**	-	-0.079	0.816**	-0.324	0.046	-0.126	0.180	-0.095	0.063
5.	T_5-Milk yield	-0.223	0.429**	0.946**	0.407*	-	-0.096	0.025	-0.537**	0.122	0.294	0.979**	-0.395*
6.	T_6-Calving interval	0.503**	0.023	-0.387	0.785**	-0.400*	-	-0.259	0.046	-0.022	0.246	-0.096	-0.138
7.	T_7-Peak yield	-.156	-0.009	0.043	-0.286	0.096	-0.316	-	0.133	0.135	0.115	0.014	-0.423*
8.	T_8-Days to peak yield	0.163	-0.044	0.309	-0.007	0.245	-0.118	0.060	-	-0.146	-0.176	-0.532**	0.299
9.	T_9-Fat percent (%)	0.295	0.088	0.118	0.245	0.127	0.191	-0.065	0.349*	—	0.312	0.204	-0.212
10.	T_{10}-SNF percent (%)	0.579**	0.011	-0.350*	0.885**	-0.373*	0.750**	-0.235	0.127	0.277	-	0.296	-0.253
11.	T_{11}-Fat yield	-0.057	-0.216	-0.206	0.147	-0.281	-0.123	0.158	-0.169	-0.246	-0.039	-	-0.455
12.	T_{12}-SNF yield	-0.179	-0.133	-0.039	-0.080	-0.077	-0.336*	0.397*	-0.185	-0.235	-0.232	0.855**	—

**P < 0.01, * P < 0.05

Results and Discussion

The breeding values of sires for first lactation performance and milk constituent traits were estimated by two methods (i) Best Linear Unbiased Prediction (BLUP) procedure described by (5) and (ii) Least Squares method described by (7). The estimated breeding values top 10 sires (EBV's) for lactation performance and milk constituent traits are presented in Table-1.

The estimated breeding values of sires by BLUP and least squares method showed large genetic variation between sires for first lactation performance and milk constituent traits. By Least Squares method the estimated breeding values (EBV's) for age at first calving ranged from 807 to 1161 days; for weight at first calving 307.28 to 433.21 kg, for first dry period 54.91 to 115.62 days, for first service period 103 to 273 days, for first lactation milk yield (305 days) 2076.61 to 4606.26 kg, for first calving intervals 371 to 569 days, for peak yield 11.85 to 21.76 kg and for days to attend peak yield 74 to 34 days. By BLUP method the estimated breeding values for sires (EBV's) for age at first calving ranged from 827 to 1116 days; for weight at first calving 356.11 to 400.29 kg, for first dry period 68 to 101 days, for first service period 124 to 241 days, for first lactation milk yield (305 days) 2709.97 to 3635.22 kg, for first calving intervals 393 to 520 days, for peak yield 14.74 to 19.24 kg and for days to attend peak yield 46 to 65 days. The result showed large genetic variation for first lactation performance traits by least squares than BLUP which is close agreement with the report of (8,9). However, it is reported that large genetic differences between the breeding values of sires for first lactation traits using by BLUP method (10).

Both the methods also showed large variation between the estimated breeding values of sires for milk constituent traits. By least squares method the estimated breeding values ranged from 3.51 to 4.15% for fat percent, 7.60 to 8.75 % for SNF, 77.46 to 187.84kg for fat yield and 178.85 to 283.20kg SNF yield. By BLUP method the estimated breeding values ranged from 3.76 to 4.09% for fat percent, 7.93 to 8.31 % for SNF, 115.23 to 135.30kg for fat yield and 210.50 to 243.59kg SNF yield which also reported large genetic variation between sires for milk constituent traits. In general, EBV's of sires did not showed any systematic trend for first lactation performance traits as well as for milk constituent traits with both methods.

In the present investigation the estimated breeding values for sires estimated by Least Squares and BLUP method showed large difference between the EBV's for first lactation performance and milk constituent traits revealed more variation in this herd. This might be due to the fact that this herd has been maintained as close herd and animals with low production might have not culled from the herd.

The EBV's of sires estimated for first lactation performance and milk constituent traits BLUP and Least Squares method revealed that EBV's estimated by BLUP method showed small genetic variation in comparison to least squares method. Because of its desirable properties, the BLUP method was considered to be more appropriate than that of least squares method. (8,9,11) ranked Sahiwal and Holstein-Friesian sires using LS and BLUP method and reported that BLUP method was the best method. (12) also evaluated Sahiwal sires using D, LS and BLUP methods and reported that the LS and BLUP methods were the most accurate methods, but LS to be more accurate than BLUP when variance is not known. (12) evaluated sires using LS and BLUP methods and reported that LS was more accurate. (13) also evaluated Sahiwal sires using D, LS and BLUP methods and reported that D method was equally good when compared with LS and BLUP methods.

Relationship between sires breeding values for different first lactation performance and milk constituent traits : The product moment correlations among the EBV's of sires for first lactation performance traits by BLUP and Least Squares methods were ranged from very low to moderate (Table-2). While, product moment correlations among estimated breeding values of sires for milk constituent traits were found to be medium to very high (Table-3). The moderate product moment correlation between first lactation milk yield and milk constituent traits suggested that first lactation milk yield can be taken as a selection criterion for genetic improvement of milk constituent traits. The rank correlation between estimates of breeding values of sires (by both BLUP and LS methods) based on first lactation traits and milk constituent traits performance traits were less than one. This indicated that sire ranking would change from first lactation performance traits to milk constituent traits. However same trend was depicted by (8) for first lactation and life time traits in crossbred cattle.

The product moment correlations between the sire's EBV's and rank correlations between sire's ranks obtained on the basis of different traits were positive and significant for all the major traits except few. On the basis of this study, it can be concluded that all the sires would not rank same for first lactation performance and milk constituent traits. However, the ranks of sires for different traits revealed that 4-5% of top sires (Table-1) had comparatively less variability with respect to their ranks for first lactation performance traits and milk constituent traits. These suggested that to improve milk productivity

and milk quality major culling of bulls should be done on the basis of their daughter's first lactation milk yield, weight at first calving and milk constituent traits.

References

1. Singh D., Yadav A.S. and Dhaka S.S. (2003). Genetic and phenotypic evaluation of milk and fat production traits and their interrelationship in (Zebu × European) crossbred cattle using parent group mixed model. *Asian-Australias. J. Anim. Sci.,* 16(9): 1242-46.
2. Haile A., Joshi B.K., Ayalew W., Tegegne A., Singh A. and Yilma Z. (2008). Genetic evaluation of Ethiopian Boran cattle and their crosses with Holstein Friesian for milk constituent traits in central Ethiopia. *J. Cell Ani. Biol.,* 2(10): 171-176.
3. Ghorbani A., Miraiiashtiani S.A., Salamatdoust N., Agdamshahriar H. and Nikzad S. (2011). Estimation of genetic parameter in Iranian Holstein crossbred dairy cattle. *African J. Microbio. Res.,* 5(12): 1568-1570.
4. Nicholas, F.W. (1993). Veterinary genetics. *Clarendon Press, Oxford*, U.K., 580 p.
5. Henderson C.R. (1973). Sire evaluation and genetic trends. *Proceedings of Animal Breeding and Genetics. Symposium held in honour of Dr. J.L. Lush, ASAS,* ADS Champaign I.L., pp. 10-11.
6. Steel R.G.D. and Torrie J.H. (1980). Principles and procedures of statistics : A biometrical approach. *2nd edn. Mc Graw Hill International Book Co., London.*
7. 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, USA.*
8. Dubey P.P., Singh C.V. and Prasad R.B. (2006) Relationship between sire's estimated breeding values for first lactation and life time traits and ranking of sires in Sahiwal and its cross. *Ind. J. Anim. Sci.,* 76(10): 824-828.
9. Bajetha G. and Singh C.V. (2008). Estimates of genetic and phenotypic parameters of first lactation and lifetime performance traits in crossbred cattle. *Indian J. Dairy. Sci.,* 64(6): 494-500.
10. Dalal D.S., Rathi S.S. and Raheja K.L. (1999). Relationship between sire's estimated breeding value for first lactation and life-time traits in Hariana cattle. *Indian J. Anim. Sci.,* 69(8): 592-595.
11. Tajane K.R. and Rai A.V. (1990). Efficiency of sire evaluation methods to improve milk yield of Sahiwal x Holstein Frisian cattle. *Indian J. Anim. Sci.,* 60: 182-191.
12. Gaur G.K. and Raheja K.L. (1996). Variation of genetic and phenotypic relationship in three parities of Sahiwal cows for some economical traits. *Ind. J. Ani. Res.,* 30(2): 137-138.
13. Deulkar P.B. and Kothekar M.D. (1999). Sire evaluation considering first lactation for improvement of lifetime production in sahiwal cows. *Ind. J. ani. Sci.*, 69(4): 240-242.