

Sire evaluation using single and multiple trait animal models in Sahiwal cattle

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The effectiveness of sire evaluation is the backbone of any breed improvement programme as the contribution of sire path is higher than the dam path for the overall genetic improvement for a trait (Robertson and Randel, 1954). In addition, very intense selection can be practised in case of males, as few males are required for breeding purpose. Hence, one of the main criteria for enhancing the genetic potential of progenies in a herd is to use proven sires to transmit superior genetic potential for higher milk production. The derivative free restricted maximum likelihood (DFREML) method as described by Meyer (1989) has become a useful method for single/multi trait sire evaluation with the advancement of computational facilities. Therefore, the present investigation was undertaken to estimate breeding value of Sahiwal sires by this latest method of sire evaluation using single and multiple traits.

Data on 1367 first lactation records of Sahiwal cows, progenies of 81 sires, spread over a period of 37 years (1966–2002), maintained at the National Dairy Research Institute, Karnal and Government Livestock Farm, Chak Ganjaria, Lucknow were analyzed. Sires having five or more progenies were evaluated on the basis of first lactation 305 days or less milk yield by single and multiple trait derivative free maximum likelihood (DFREML) and their effectiveness were compared. DFREML version 3.0-β computer package as suggested by Meyer (1998) was used. For both the models of DFREML, season and period of calving were used as fixed effects, age at first calving was used as covariable and sires were considered as random effect. For multi trait evaluation of breeding value of sires, a combination of four traits namely, 305 days or less milk yield (305 MY), age at first calving (AFC), first service period (FSP) and first calving interval (FCI) were incorporated in the model. The effectiveness of different sire evaluation methods was judged using the following criteria viz. within sire variance or error variance and rank correlations. The most efficient method had the

lowest error variance from fitting a model.

Derivative free restricted maximum likelihood (DFREML) method gave the average breeding value (BV) as 1503.99 kg for the evaluation of sires. Forty (49.38%) out of 81 sires showed higher values than the average for BV. The highest and the lowest breeding values were estimated as 1911.74 kg and 856.12 kg, respectively. In this method, three sires showed BV over and above 20% as compared to overall average BV. Out of 81 sires, 7, 17 and 28 sires were having breeding values 15, 10 and 5% higher than the overall average value. In multi trait DFREML method, the average breeding value of sires for 305 MY, AFC, FSP and FCI were 1503.99 kg, 1216.92 days, 175.63 days and 413.24 days, respectively. Out of 81 sires, 39 and 42 sires were having breeding value below and above the average for 305 MY. The corresponding figures for AFC, FSP and FCI were 46 and 35, 43 and 38 and 43 and 38, respectively.

The breeding value of sires for 305 MY ranged from 1912.64 to 846.89 kg from multi trait model. These estimates were 27.17% higher and 43.69% lower than the average breeding value. The difference between these two extremes was 1065.75 kg. There were three sires whose breeding value was 20% and higher than the average value. Eight, 17 and 28 sires showed 15, 10 and 5%, respectively, higher values than the average breeding value. The lowest estimate for AFC was 1066.84 days, which was 12.33% lower than the average breeding value. Whereas, the highest estimate was 1594.87 days, which was 31.06% higher than the average breeding value. The difference in these values was 528.03 days. FSP showed a lowest value of 121.15 days, which was 31.02% lower than average breeding value. While the highest value was observed as 228.13 days, which was 29.89% higher than the average breeding value for the trait. The difference in the range of breeding value for first service period was 106.98 days. The lowest breeding value of sires (386.12 days) estimated for FCI was 6.56% lower than average breeding value. However, the highest breeding value was observed as 440.55 days, which was 6.61% higher than the average breeding value of sires for this trait. The difference in the range of breeding value for FSP was 54.43 days.

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Table 1. Rank correlations among breeding values of sires estimated from single/multiple traits by DFREML method

	305	AFC	FSP	FCI
305 DMY	1.000	0.634	0.0050	0.1024
AFC		1.000	0.1239	0.0555
FSP			1.000	0.8846**
FCU				1.000

**singnificant at 1% level

Within sire variance or error variance for first lactation 305 days or less milk yield by multi trait DFREML was smaller (190580 kg²) than the single trait DFREML (191111 kg²); therefore, it was concluded that efficiency of multi trait DFREML was slightly higher than the single trait model. The relative efficiency (%) of single trait DFREML in comparison to multi trait DFREML was 99.72%. These findings revealed that single trait DFREML method was almost equally effective as compared to multi trait model for this set of data.

Comparing the breeding value of 305 days or less milk yield from a single trait model with the multi trait model, it was observed that, the breeding value and the ranks of sires do not differ significantly for both the models. Rank correlation between the breeding value of 305 days or less milk yield of single trait REML and multi trait REML was very high approaching unity as ranking of sires by both these methods was similar for all most all the sires. On the other hand, the rank correlations among the estimates of breeding value of sires from multi trait DFREML method for different traits were non-significant (Table 1). This indicated that ranking of sires on the basis of age at first calving, first service period and first calving interval was almost entirely different than that from first lactation 305 days or less milk yield. However, the rank correlation of first service period with first calving interval was very high (0.8846) and significant ($P < 0.01$). These results indicated that ranking of sires for first service period and first calving interval was similar to the extent of 88%.

The results of the present study were comparable fairly well with those reported by Raheja *et al.* (2000), Jain and Sadana (2000), Gaur *et al.* (2001), Pundir *et al.* (2004), Mukherjee *et al.* (2005) and Kumar (2007).

It can be concluded that both the single and multi trait models were almost equally effective in estimating breeding value of sires for milk yield in Sahiwal cattle. However, multi trait model seems to have an edge over the single trait model in terms of accuracy of evaluation of Sahiwal sires for this set of data.

SUMMARY

Sire evaluation was carried by derivative free restricted maximum likelihood (DFREML) method for single (305 days milk yield) and multiple traits (305 day milk yield, age at first calving, first service period and first calving interval) using 1367 first lactation records on daughters of 81 sires, having 5 or more progenies of Sahiwal cattle. The highest and lowest overall average breeding value of sires for first lactation 305 days or less milk yield was obtained by single trait model ranged from 1911.74 to 856.12 kg with an average of 1503.99 kg. The corresponding figures from multi trait model were 1912.64 to 846.89 kg with an average of 1503.91 kg. The average breeding values of sires from multi trait model for age at first calving, first service period and first calving interval were 1216.92 days, 175.63 days and 413.24 days, respectively. On comparing the breeding value of 305 days or less milk yield from a single trait model with the multi trait model, it was observed that the breeding value and the ranks of sires do not differ significantly from both the models. The rank correlations amongst breeding value of sires for various traits from multi trait model were low and non-significant except for first calving interval with first service period.

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