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GENETIC EVALUATION OF SAHIWAL SIRES USING TEST DAY MILK RECORDS

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ABSTRACT: Genetic improvement of indigenous breeds of cattle is essential for sustainable dairy industry. Sahiwal is best indigenous dairy breeds of cattle. The present study was conducted on performance records of 492 Sahiwal cows maintained at Government Livestock Farm (GLF), Hisar, Haryana and distributed over a period of 20 years from 1994 to 2013. The breeding value of sires estimated by using least square method (LSM) procedure for test day milk records, first lactation milk yield (FLMY) and first lactation peak yield (FLPY) indicated that sires in the top five positions share their ranks in the uppermost positions irrespective of test day milk record used. Model for LSM included year and season of calving as fixed effects and sire as random effect. Results for FLMY revealed that sire number 731 had the highest genetic merit for FLMY (2645.54 kg) and sire number 208 had lowest genetic merit (1161.67 kg). Result for FLPY revealed that sire number 668 had the highest genetic merit (9.07 kg) and sire number 376 had lowest genetic merit (5.46 kg). The rank and product moment correlations between the sires calculated among test days records ranged from 0.19 to 0.98 and 0.19 to 0.97, for first lactation milk yield varies from 0.45 to 0.60 and 0.50 to 0.66 and for first peak yield varies from 0.34 to 0.85 and 0.36 to 0.84, respectively.

***Key words*:** *Test day milk yield, first lactation milk yield, first peak yield, sire value.*

INTRODUCTION

Sahiwal breed is the best milch breed of cattle in the tropics (Khan and Mirza, 2014). It also has tremendous potential for growth, disease resistance and adaptability under Indian condition. Indigenous cow produces 21% milk out of total 132.4 million tonnes produced in India (BAHS 2012) but the average daily milk production of our indigenous cattle is very low (2.14 kg) as compared to cross bred and exotic cows (6.87kg) (Ilatsia *et al.,* 2012).The aim of selection programme is to improve milk production and to reduce cost of production. The complete lactation records essential for systematic evaluation of bulls are not generally available due to selling, death of animals and transfer of animals among herds while, records at some interval may be useful to evaluate the sires (Sangwan *et al*., 2013). An early and accurate appraisal is essential for the maximum annual genetic progress. Use of test day milk records and first lactation milk yield could be helpful in early sire evaluation, reducing generation interval and increasing rate of genetic progress per unit of time (Pander and Hill 1993). The earlier studies conducted in cattle (Saini *et al.* 2005) have revealed fairly large predictability by the use of test-day milk yields because of high association between test-day milk yields and first lactation milk production. Therefore, present investigation was undertaken out with the objective of estimating the breeding value of sires using various test day milk records, first lactation milk yield and first peak yield in Sahiwal cows.

MATERIAL AND METHODS

The twenty year data pertaining to first lactation test day milk records, first lactation milk yield and first peak yield on 492 Sahiwal cows were collected from history cum pedigree sheets maintained at Government Livestock Farm (GLF), Hisar over a period of twenty years from 1994 to 2013. Total duration under study was divided into five periods, each consisting of four consecutive years. Each year was further delineated into four seasons of calving viz. Summer (April - June), Rainy (July - September), Autumn (Oct - Nov) and Winter (Dec - March). Animals having lactation shorter than 150

days, suspected outliers on the basis of histograms, data on daughters of bulls having less than five progenies and abnormal records like abortion, mastitis and chronic illness were excluded from preview of present study. First test day milk record was recorded from 7th day after calving and total of 10 test day milk records (TD_1 to TD_{10}) were taken at every 4 week interval.

Least square method (Harvey 1979) was used for the estimation of breeding value of sires for all test day milk records and first lactation milk yield. Sires were ranked on the basis of their estimated breeding values for various traits. The following statistical model was used:-

$$Y_{ij} = \mu + S_i + e_{ij}$$

Where,

Y_{ij} = is the ith record of individual of the ith sire
μ =overall population mean
S_i = effect of the ith sire
e_{ij} = random effect

Product moment and rank correlations

The product moment and rank correlations among sire's estimated breeding values for first lactation milk yield by different methods were calculated according to Steel and Torrie (1980).

Product moment correlation

Product moment correlations between two methods of sire evaluation was calculated as follows

$$r_{xy} = \frac{\sum XY}{\sqrt{\sum X^2 \sum Y^2}}$$

Where,

r_{xy} = correlation coefficient between X and Y methods.
$\sum XY$ = co-variance between X and Y methods.
$\sum X^2$ = variance of X method.
$\sum Y^2$ = variance of Y method.

Rank correlations

$$r_S = 1 - \frac{6\Sigma d_i^2}{N\ (N^2 - 1)}$$

Where,

r = Rank correlation coefficient
N = Number of sires under evaluation
$\sum d^2$ = summation of the square of difference between ranks of same sire.

RESULTS & DISCUSSION

Overall least square mean of test day ranged from 6.07 to 2.39, for FLMY 2105 kg and FLPY was 8.04 kg. Top five and bottom five sires for TD_1 to TD_{10}, FLMY and FLPY are presented in table 1 and 2, respectively. The appraisal of results in table 1 and 2 revealed that sire no. 731 had the highest merit for TD_1 (8.27 kg) to TD_4 (7.49 kg), TD_8 (5.30 kg) and TD_9 (5.80 kg) milk records included in the study except TD_5 (6.86 kg), TD_6 (6.19 kg) and TD_{10} (5.58 kg) where sire no. 1274 and 668, respectively excelled in performance. Result for FLMY revealed that sire number 731 had highest genetic merit (2645.54 kg) and sire number 208 had lowest genetic merit (1161.67 kg) and result for FLPY revealed that sire number 668 had highest genetic merit (9.07 kg) and sire number 376 had lowest genetic merit (5.46 kg). When ranking of top five sires was done on the basis of test day milk records, FLMY and FLPY at-least three sires would able to manage their position among top five slots. However, when comparisons were made for bottom five sires for test day milk records, FLMY and FLPY ranking of sires changed frequently with the change of trait(s) included in the study. Breeding value obtained for FLMY in the present studies were higher than obtained by Dalal *et al*. (1999), Deulkar and Kothekar (1999), Rameshchander *et al*. (2004) Khan *et al*. (2008) and Munde *et al*., (2015), however breeding values obtained for FLPY were higher than obtained by Deulkar and Kothekar (1999) and Banik and Gndhi (2010). When ranking of top five sires was done on the basis

of test day milk records FLMY and FLPY at-least three sires would able to manage their position among top five slots.

Investigation of results pertaining to breeding value estimation of test day, FLMY and FLPY indicated that sires no 731 having higher breeding value in one test day are also having higher breeding value in other test day milk records.

Rank and product-moment correlations among estimated sire merits for test day milk records, FLMY and FLPY have been presented in table 3. The rank correlations between the ranking of the sires calculated among test days varied from 0.19 (TD_1 and TD_{10}) to 0.98 (TD_2 and TD_3) whereas product moment correlations varies from 0.19 (TD_3 and TD_{10}) to 0.97 (TD_2 and TD_3). Rank correlation between FLMY and test days varies from 0.45 (FLMY and TD_{10}) to 0.60 (FLMY and TD_1) while product moment correlation between traits ranged from 0.50 (FLMY and TD_7) to 0.66 (FLMY and TD_9). Rank correlation between FLPY and test days varies from 0.34 (FLPY and TD_{10}) to 0.85 (FLPY and TD_1) while product moment correlation between traits ranged from 0.36 (FLPY and TD_{10}) to 0.84 (FLPY and TD_1). Rank and Product-moment correlations had higher values between adjacent test day records. In general, product-moment correlation among various test day milk records, FLMY and FLPY were comparatively higher than corresponding rank correlations barring few exception especially correlation of TD_9 with other traits included in the study. The rank correlation between test day milk records, FLMY and FLPY were found less than one as in the close confirmation of these reported by Tailor and Singh (2011). Kaygisiz (2013) however, reported higher correlations between ranks of breeding values of different test days of sires than the present studies. The present results indicative of the fact that ranking of the sires are changing slightly among different test day records, hence for bringing genetic improvement, sire should be evaluated on the basis of early test day milk records to bring more genetic gains per unit of time.

Conclusion

Overall appraisal of the results indicated that selection of sires could be based on test days milk records in mid lactation i.e. second to fifth test days milk records to improve genetic gain in milk production per unit of time in Sahiwal cattle. Expression of mid lactation test day milk records earlier in life would also reduce the generation interval and increase the selection intensity and thereby improve in genetic gain

Table 1 Top five estimated sire value of different production traits

Rank	TD_1	TD_2	TD_3	TD_4	TD_5	TD_6	TD_7	TD_8	TD_9	TD_{10}	FLMY	FPY
1	8.27 (731)	8.31 (731)	8.21 (731)	7.49 (731)	6.86 (1274)	6.74 (1274)	6.19 (668)	5.30 (731)	5.80 (731)	5.58 (668)	2645.54 (731)	9.07 (111)
2	8.06 (1337)	8.15 (111)	7.99 (111)	7.41 (160)	8.81 (160)	6.35 (668)	5.08 (111)	4.72 (187)	4.33 (614)	4.15 (614)	2302.22 (668)	8.91 (731)
3	7.47 (160)	7.92 (160)	7.92 (160)	7.30 (668)	6.67 (668)	5.65 (730)	5.02 (614)	4.35 (871)	3.58 (187)	3.58 (187)	2208.17 (618)	8.88 (730)
4	7.38 (111)	7.89 (1274)	7.89 (1274)	7.21 (1337)	6.36 (1357)	5.49 (731)	4.94 (730)	4.23 (614)	4.04 (624)	3.57 (624)	2134.69 (624)	8.75 (160)
5	7.29 (730)	7.83 (668)	7.82 (1337)	7.14 (111)	6.14 (111)	5.43 (618)	4.87 (624)	4.11 (730)	3.74 (668)	3.34 (188)	2056.92 (730)	8.67 (668)

Table 2 Bottom five estimated sire value of different production traits

Rank	TD_1	TD_2	TD_3	TD_4	TD_5	TD_6	TD_7	TD_8	TD_9	TD_{10}	FLMY	FPY
45	3.75 (208)	3.90 (208)	3.71 (1479)	3.47 (1223)	3.49 (208)	2.93 (1479)	2.29 (208)	2.20 (208)	1.80 (208)	1.30 (208)	1161.67 (208)	5.46 (376)
44	3.94 (1056)	3.94 (1479)	3.84 (1223)	3.67 (1479)	3.59 (1479)	3.02 (208)	2.39 (376)	2.39 (376)	2.10 (376)	1.33 (376)	1242.64 (376)	5.82 (208)
43	3.95 (1223)	4.16 (1056)	4.27 (1056)	3.89 (1056)	3.66 (1223)	3.11 (376)	2.44 (1479)	2.23 (260)	2.23 (260)	1.60 (1056)	1259.75 (1056)	6.22 (1056)
42	4.22 (1033)	4.56 (376)	4.65 (1033)	4.05 (208)	3.67 (1056)	3.32 (1056)	2.59 (558)	2.33 (558)	2.33 (558)	1.67 (1357)	1354.45 (252)	6.49 (689)
41	4.34 (376)	4.72 (1033)	4.80 (376)	4.09 (376)	3.90 (3.76)	3.45 (260)	2.74 (260)	2.43 (278)	2.43 (278)	1.69 (1356)	1362.96 (1223)	6.55 (558)

Table 8. Rank(above diagonal) and product moment (below diagonal) correlation among various test day milk records, first lactation yield and first peak yield

	TD_1	TD_2	TD_3	TD_4	TD_5	TD_6	TD_7	TD_8	TD_9	TD_{10}	FLY	FPY
TD_1	-	0.96	0.91	0.86	0.79	0.69	0.52	0.46	0.35	0.19	0.48	0.85
TD_2	0.96**	-	0.98	0.93	0.86	0.75	0.60	0.52	0.39	0.22	0.51	0.83
TD_3	0.92**	0.97**	-	0.96	0.88	0.77	0.64	0.55	0.41	0.21	0.52	0.79
TD_4	0.88**	0.94**	0.96**	-	0.95	0.86	0.72	0.62	0.50	0.25	0.58	0.82
TD_5	0.80**	0.87**	0.89**	0.96**	-	0.91	0.73	0.61	0.49	0.28	0.57	0.81
TD_6	0.71**	0.77**	0.78**	0.86**	0.90**	-	0.85	0.73	0.63	0.39	0.56	0.77
TD_7	0.60**	0.65**	0.66**	0.74**	0.75**	0.88**	-	0.92	0.87	0.61	0.57	0.60
TD_8	0.48**	0.51**	0.50**	0.57**	0.57**	0.73**	0.92**	-	0.87	0.66	0.55	0.52
TD_9	0.33*	0.36*	0.35*	0.44**	0.46**	0.62**	0.84**	0.90**	-	0.80	0.60	0.48
TD_{10}	0.22	0.23	0.19	0.24	0.27	0.42**	0.67**	0.77**	0.88**	-	0.45	0.34
FLY	0.50**	0.56**	0.54**	0.62**	0.63**	0.65**	0.65**	0.60**	0.66**	0.54**	-	0.58
FPY	0.84**	0.82**	0.77**	0.80**	0.80**	0.76**	0.65**	0.53**	0.47**	0.36**	0.64**	-

Figures below the diagonal are estimates of product moment correlations;
*P<0.05, **P<0.01

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