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Research Article

GENETIC EVALUATION OF MURRAH SIRES USING TEST DAY MILK RECORDS

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ABSTRACT

The present study was conducted on performance records of 397 Murrah buffaloes; progeny of 49 sires maintained at the Buffalo Research Centre of the University. The records were distributed over a period of 20 years from 1992 to 2011. The breeding value of sires estimated by using best linear unbiased prediction (BLUP) procedure for monthly test day milk records and first lactation milk yield (FLMY) indicated that five top sires share their ranks in the uppermost positions, irrespective of test day milk record used. Model for BLUP included year and season of calving as fixed effect and sire as random effect. Result for FLMY revealed that sire number 49 had the highest genetic merit (353.54) and sire number 21 had the lowest genetic merit (-332.5). The rank and product moment correlations between the sires calculated among test days ranged from 0.2151(TD_1 and TD_7) to 0.7941 (TD_2 and TD_3) and 0.2560 (TD_7 and TD_{10}) to 0.8299 (TD_5 and TD_6), respectively and for first lactation milk yield varied from 0.4007 (FLMY and TD_7) to 0.8039 (FLMY and TD_6) and 0.4362 (FLMY and TD_7) to 0.7871 (FLMY and TD_9), respectively. Rank and product-moment correlations had higher values between adjacent test days. The high values of product moment and rank correlations were found between the estimated breeding values of sires for test day milk records of mid lactation i.e. second to fourth test day milk records. Selection of sires could be based on mid lactation test days milk records to enhance genetic improvement in milk production per unit of time in this breed.

Key words: Breeding value, correlation, test day milk yield, sire

Murrah breed is one of the renowned breed of buffaloes in India by virtue of its milk producing capacity combined with tremendous potential for growth and adaptability. The aim of selection programme is to improve milk production and to reduce cost of milk production. The complete lactation records essential for systematic evaluation of bulls are not generally available due to their selling, deaths and transfer of animals among herds while, records at some interval may be useful to evaluate the sires. An early and accurate appraisal is essential for the maximum annual genetic progress. Use of test day milk records and first lactation milk yield (FLMY) could be helpful in early sire evaluation, reducing generation interval and increasing rate of genetic progress per unit of time. The earlier studies conducted in cattle and buffaloes (Dass and Sadana, 2003; Saini *et al.*, 2005) have revealed fairly large predictability by the use of test-day milk yields. Therefore, this study was carried out with the objective to estimate the breeding value of sires using test day milk records and FLMY in Murrah buffaloes.

MATERIALS AND METHODS

The data pertaining to first lactation test day milk records and FLMY of Murrah buffaloes was collected from history cum pedigree sheets maintained at the Buffalo Research Centre, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar for over a period of 20 years from 1992 to 2011. Twenty years were divided into five periods, each consisting of four consecutive years. Each year was further delineated into three seasons of calving viz. Summer (March-June), Monsoon (July-October) and Winter (November-February). 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 a total of 10 test day milk records (TD_1 to TD_{10}) were taken at every 4 week interval.

Best Linear Unbiased Prediction (BLUP) described by Henderson (1973) was used for the estimation of breeding value of sires for all test day milk records and FLMY. Sires were ranked on the basis of their estimated breeding values for various traits.

$$Y = Xb + Zu + e$$

Where, Y=vector of observations on progeny of sire in u; X=known design matrices that relate records (Y) to fixed effects; b=vector of fixed effect; Z=known design matrices that relate records (Y) to random sires; u=vector of random sire effects; e=vector of residual effects

$$Var\ (u) = I\sigma_s^2$$

$$Var\ (e) = I\sigma_e^2$$

$$Var\ (Y) = Z'Z + R$$

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The solution to b and u were obtained from mixed model equations given below:

Where, k=ratio of residual to sire variance components

The ratio of residual and sire variance (k) components required for BLUP was obtained from estimates of heritability from the same data as given below:

$$k = (4 - h^2)/ h^2$$

Where, h^2=heritability

Product Moment Correlation*:* Product moment correlation between two sire ranks was calculated as:

Where, r_{XY}=correlation coefficient (product moment) between X and Y traits; $ó_{XY}$=covariance between X and Y traits; $ó_x$=variance of X traits; $ó_Y$=variance of Y traits

Spearman's Rank Correlation: Sires were ranked on the basis of their estimated breeding values for various traits. Spearman's rank correlations between ranks of estimated breeding values for various traits were calculated by the formula:

$$r_s = 1 - [6 \Sigma d^2 / N (N^2 - 1)]$$

Where, r_s=rank correlation between ranks of sires breeding values for two traits; Hd^2=summation of square difference between ranks of the same sire for different traits; N=number of sires

RESULTS AND DISCUSSION

Top five and bottom five sires for TD_1 to TD_{10} and FLMY are presented in Tables 1 and 2, respectively. The critical review of Tables 1 and 2 revealed that sire no. 48 had the highest merit for all the test day milk records included in the study except TD_4, TD_7 and TD_8 where sire nos. 16, 14 and 49 excelled in performance. Results for FLMY revealed that sire number 49 had the highest genetic merit (353.54) and sire number 21 had the lowest genetic merit (-332.5). In addition, ranking of sires changes considerably when comparisons were made considering FLMY and all test day milk records all together. Tables 1 and 2 further indicated that when ranking of top five sires was done on the basis of FLMY and test day milk records, atleast three sires were able to manage their position among top five slots. However, when comparisons were made for bottom five sires for FLMY and test day milk records, ranking of sires changed frequently with the change of trait(s) included in the study. Breeding value obtained for FLMY in the present study was higher than that obtained by Chakraborty and Dhaka (2014).

Critical analysis of results pertaining to breeding value estimation of FLMY and test day indicated that for FLMY 22 sires (44.9%) had breeding value more than average breeding value, while 27 sires (55.1%) were below the average breeding value. The modules average breeding value for all sires TD_1, TD_2, TD_3, TD_4, TD_5, TD_6, TD_7, TD_8, TD_9, TD_{10} (kg/day) and FLMY (kg) were 4.56, 7.32, 8.05, 8.04, 7.72, 7.40, 7.05, 6.35, 5.74, 4.96 and 2007.79, respectively. In various test day milk records like TD_1, TD_2, TD_3, TD_4, TD_5, TD_6, TD_7, TD_8, TD_9 and TD_{10} sum of sires 23 (46.9%), 25 (51.0%), 23 (49.6%), 22 (44.9%), 25 (51.0%), 25 (51.0%), 24 (49.0%), 22 (44.9%), 23 (46.9%) and 23 (46.9%), respectively, had breeding value more than average breeding value while the remaining sires had below average breeding value. It indicated that sires which were having higher breeding value in one test day also had higher breeding value in other test day milk records.

$$r_{XY} = ó_{XY} / \sqrt{ó_x^2 ó_Y^2}$$

$$\Sigma X' X \Sigma' \Sigma + k \quad u = \Sigma' Y$$

Rank and product-moment correlations among estimated sire merits for FLMY and test day milk records have been presented in Table 3. The rank correlations between the ranking of the sires calculated among test days varied from 0.2151 (TD_1 and TD_7) to 0.7941 (TD_2 and TD_3) whereas product-moment correlations varied from 0.2560 (TD_7 and TD_{10}) to 0.8299 (TD_5 and TD_6). Rank correlation between FLMY and test days varied

Table 1
Ranking of top five sires for test day milk records (kg/day) and first lactation milk yield (kg)

Rank	Test day milk records										FLMY
	TD_1	TD_2	TD_3	TD_4	TD_5	TD_6	TD_7	TD_8	TD_9	TD_{10}	
1	1.1435(48)	1.0017(48)	1.3566(48)	1.2340(16)	1.5220(48)	1.4113(48)	1.2784(14)	1.0187(49)	1.4049(48)	1.0638(48)	353.54(49)
2	0.7892(14)	0.6018(35)	0.9132(10)	1.1321(48)	0.9704(9)	0.9886(49)	1.0634(48)	0.9674(48)	1.3186(20)	0.9726(49)	345.03(9)
3	0.4911(35)	0.5931(10)	0.7263(11)	0.8774(9)	0.8861(20)	0.9025(20)	0.8463(20)	0.9032(9)	1.0273(27)	0.9092(20)	272.48(27)
4	0.4455(27)	0.5888(33)	0.6959(19)	0.8415(10)	0.6366(49)	0.8865(9)	0.8237(44)	0.8741(20)	0.7768(11)	0.5778(9)	258.15(48)
5	0.4056(3)	0.5663(6)	0.6779(35)	0.7352(27)	0.5767(34)	0.6097(27)	0.784(33)	0.8075(11)	0.5461(14)	0.5274(41)	227.78(11)

Figures within parenthesis are sire code, FLMY=First lactation milk yield

Table 2

Ranking of bottom five sires for test day milk records (kg/day) and first lactation milk yield (kg)

Rank	Test day milk records										FLMY
	TD_1	TD_2	TD_3	TD_4	TD_5	TD_6	TD_7	TD_8	TD_9	TD_{10}	
49	-0.6587(5)	-0.996(12)	-0.8702(12)	-0.8247(23)	-0.8981(30)	-0.9305(21)	-1.1018(40)	-0.7792(36)	-1.3674(40)	-0.7781(43)	-332.5(21)
48	-0.557(31)	-0.6388(46)	-0.7212(40)	-0.7783(46)	-0.8872(21)	-0.9079(43)	-1.032(25)	-0.682(46)	-1.1329(21)	-0.5411(25)	-302.2(43)
47	-0.4707(38)	-0.5722(18)	-0.6519(38)	-0.6284(1)	-0.8605(4)	-0.7746(40)	-0.8083(1)	-0.6272(15)	-0.7745(1)	-0.5319(40)	-256(40)
46	-0.4502(41)	-0.5662(36)	-0.5894(21)	-0.591(15)	-0.7837(12)	-0.7627(36)	-0.7848(5)	-0.6219(4)	-0.7508(17)	-0.5183(47)	-209.4(15)
45	-0.3728(12)	-0.5433(15)	-0.5802(18)	-0.5887(17)	-0.7037(45)	-0.6605(18)	-0.7685(43)	-0.5163(40)	-0.6527(25)	-0.515(13)	-207.3(38)

Figures within parenthesis are sire code

Table 3

Rank and product-moment correlation among various test day milk records and first lactation milk yield

	Test day milk records										FLMY
	TD_1	TD_2	TD_3	TD_4	TD_5	TD_6	TD_7	TD_8	TD_9	TD_{10}	
TD1	---------	0.2851	0.419	0.367	0.3642	0.3648	0.2151	0.367	0.3523	0.4364	0.4893
TD2	0.3929	---------	0.7941	0.7105	0.5302	0.6912	0.4241	0.6308	0.3706	0.1568	0.6197
TD3	0.4833	0.8279	----------	0.734	0.6249	0.7058	0.4238	0.6476	0.4037	0.2348	0.7093
TD4	0.4444	0.6854	0.7513	---------	0.6953	0.6635	0.4611	0.6977	0.5839	0.337	0.7608
TD5	0.4222	0.5834	0.678	0.7384	----------	0.7817	0.4674	0.6909	0.4317	0.4562	0.6982
TD6	0.4349	0.6991	0.7413	0.6881	0.8299	----------	0.551	0.6797	0.5183	0.4312	0.8039
TD7	0.2748	0.3701	0.3841	0.4132	0.4577	0.4944	----------	0.4419	0.3886	0.2727	0.4007
TD8	0.3616	0.6213	0.6722	0.7199	0.7254	0.7408	0.404	----------	0.6064	0.4584	0.8029
TD9	0.4392	0.4409	0.5228	0.6231	0.5468	0.6175	0.4312	0.6303	---------	0.6697	0.7736
TD10	0.4727	0.2693	0.3889	0.4756	0.5471	0.5768	0.256	0.5698	0.6984	----------	0.7075
FLMY	0.4787	0.6306	0.6681	0.7567	0.6571	0.7747	0.4362	0.7619	0.7871	0.6573	---------

Figures above diagonal are estimates of rank correlation; figures below the diagonal are estimates of product moment correlation; All the above estimates were found to be highly significant ($P<0.01$) except rank correlation of TD1 with TD7 which was found significant at 5% level

from 0.4007 (FLMY and TD_7) to 0.8039 (FLMY and TD_6) while product-moment correlation between traits ranged from 0.4362 (FLMY and TD_7) to 0.7871 (FLMY and TD_9). Rank and product-moment correlations had higher values between adjacent test days. In general, product-moment correlation among various test day milk records and FLMY were comparatively higher than corresponding rank correlations barring few exception especially correlation of TD_7 with other traits included in the study. The rank correlations between FLMY and test day milk records were found less than one as in the close approximation of Tailor and Singh (2011) in Surti buffaloes. Kaygisiz (2013) while analysing data on Holstein cattle reported higher correlation between ranks of breeding values of different test days of sires then the present studies. The present results were indicative of the fact that ranking of the sires are changing slightly. Hence for bringing genetic improvement, sire should be evaluated on the basis of test day milk records because as they are expressed earlier in life.

Therefore, it may be concluded that selection of sires could be based on test days milk records in mid lactation i.e. second to fourth test days milk records to improve genetic gain in milk production per unit of time in this breed. Expression of mid lactation test day milk records earlier in life would also reduce the generation interval and increase the selection intensity and thereby genetic gain in Murrah buffaloes.

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