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Research Article

PREDICTION OF PHENOTYPIC VALUE AND BREEDING VALUE OF LACTATION PRODUCTION FROM TEST DAY MILK RECORDS IN MURRAH BUFFALOES

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ABSTRACT

The data pertaining to first lactation test day milk records, peak milk yield and first lactation milk yield on Murrah buffalo collected from Buffalo Research Centre, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar was used to determine the accuracy of prediction of phenotypic value and breeding value of lactation milk production from test day milk records and peak yield in their various combinations. The accuracy of direct selection for first lactation milk yield was 0.57. The prediction equations having second, third and fourth test day recording had 61.97 % value for R^2 and after that there was trivial increase in the value of coefficient of determination. The coefficient of determination of breeding value using the sum of 10 test day records was 65.96. Results of odd and even test day bimonthly recording had coefficient of determination of 55.57 and 64.02, respectively. Alternate test day records indicated that prediction of equation using even test day milk records with 64.2 % R^2 value had almost 15 % better prediction equation compared to odd test day records (55.57 % R^2). The accuracy of selection utilizing all test day milk records with and without peak milk yield was estimated as 0.696 and 0.694, respectively. In addition to this, accuracy of selection was obtained as 0.649 and 0.648 when test day second, third and fourth were utilized in combination with and without first lactation peak milk yield. However, accuracy of selection utilizing odd and even test day milk records was similar. Hence, it may be inferred that selection of sires on the basis of test days in mid lactation i.e. second to fourth would be more effective.

Key words: Breeding values, phenotypic values, prediction, Murrah, test day

Among the livestock sector, cattle and buffalo find pre-eminent position in India's economy as it has about 14.34 % of world cattle population and 57.77% of world buffalo population (FAO, 2015). In a country like India, due to small sized herds, maintained by the small and marginal farmers, it is not feasible both economically and physically to have day to day records of milk yield. Recording at intervals rather than daily may be an alternative proposition. Evaluation of sire under field conditions, where regular recording is not possible, could be made from recording at intervals. Generally, the selection of sires is based on the complete lactation yield that is predicted from individual test day milk records taken at monthly intervals. However, Machado *et al*. (2000) reported that test day milk yield records in mid-lactation have high genetic and phenotypic correlations with lactation yield, thereby increase the accuracy of sire evaluation. Use of test day milk records can be helpful in early sire evaluation, reducing generation interval and increasing rate of genetic progress. The earlier studies conducted in cattle and buffaloes (Dass and Sadana, 2003; Saini *et al.,* 2005) have reported fairly large predictability by the use of test day milk yields because of high association between test day milk yields and first lactation milk yield. The present investigation was planned to study the inter-relationship of test day with that of first lactation milk yield in order to develop suitable predictors for the prediction of phenotypic value and breeding value of first lactation milk yield on the basis of different test days, peak milk yield and their various combinations useful for early selection.

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MATERIALS AND METHODS

The data pertaining to first lactation test day milk records and first lactation milk yield on 397 Murrah buffalo was collected from pedigree cum history sheets maintained at Buffalo Research Centre of the University over a period of 20 years from 1992 to 2011. Animals having lactation shorter than 150 d, 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 the study. First test day yield was recorded from 7th day after calving and total of 10 test day milk records TD1 to TD10 were taken at every 4 wk interval. In addition to this, first lactation milk yield (FLY) and first lactation peak milk yield (FPY) were also considered for the present investigation.

Multiple regression analysis was used to predict lactation production from test day records and FPY. The test day records and FPY was utilized for genetic

prediction of lactation yield using selection index procedure:-

$$I = b'X$$

$$b = P^{-1}Cov_g$$

$$r_{IH} = \sigma_I / \sigma_H$$

Where, I= index value to predict H; b=n x l vector of index weights; X=n x l vector of deviations from the mean phenotypic values of test day records; P=n x n phenotypic covariance matrix of test day records; Cov_g= n x l genetic covariance matrix between test day records and first lactation yield; r_{IH}=accuracy of genetic prediction; H=breeding value for first lactation yields; σ_I=phenotypic standard deviation of index; σ_H=genetic standard deviation of lactation records

A total of ten independent variables in terms of test day milk records from TD1 to TD10 were considered for prediction of breeding value of FLY from test day records. In addition to this, bimonthly recording involving odd and even test day records was also utilized for prediction of breeding value of FLY.

RESULTS AND DISCUSSION

The prediction equations for the prediction of phenotypic value of first lactation milk yield from the first lactation test day records indicated that the coefficient of determination (R^2) was minimum for TD1 (9.80%) and maximum for TD3 (34%) among all the ten prediction equations having only one variable (Table 1). The contents of Tables 1 & 2 further revealed that index involving stepwise procedure for first lactation test day recording second, third and fourth had 61.97% value for R^2 and after that there was a slight increase in the value of coefficient of determination. Prediction equation for FLY using only first lactation peak milk yield had R^2 value as 32.01%. Furthermore, prediction equation for FLY using all test day milk records and all test day milk records with peak milk yield involving stepwise procedure had R^2 value 65.96% and 65.97%, respectively. In addition to this, prediction equations for the prediction of phenotypic value of lactation milk

Table 1
Prediction equations for the prediction of phenotypic value of first lactation milk yield from the test day milk records

	Predicted equations	R^2 %
Equations using individual test days records	$\hat{\gamma}$ = 1576.44+101.41TD1	9.80
	$\hat{\gamma}$ = 1188.11+116.18TD2	32.04
	$\hat{\gamma}$ = 960.51+149.49TD3	34.00
	$\hat{\gamma}$ = 849.64+146.70TD4	32.16
	$\hat{\gamma}$ = 821.97+154.67TD5	28.37
	$\hat{\gamma}$ = 694.18+178.14TD6	26.67
	$\hat{\gamma}$ = 1194.49+118.02TD7	25.86
	$\hat{\gamma}$ = 929.80+165.88TD8	24.58
	$\hat{\gamma}$ = 1240.72+145.63TD9	23.39
	$\hat{\gamma}$ = 1325.52+59.29 TD10	22.94
Equation using peak milk yield	$\hat{\gamma}$ = 870+125.671FPMY	32.01
Equations using stepwise procedure	$\hat{\gamma}$ = 960.51+149.49TD3	34.00
	$\hat{\gamma}$ = 570.32+105.02TD2+102.26TD3	57.21
	$\hat{\gamma}$ = 349.61+82.72 TD2+74.78TD3+112.10TD4	61.97
	$\hat{\gamma}$ = 263.72+37.83TD2 + 61.86TD3 + 72.72TD4 +60.80TD5	63.42
	$\hat{\gamma}$ = 224.58+45.34TD2 +55.78TD3 + 45.15TD4 + 44.95TD5 +41.36TD6	64.40
	$\hat{\gamma}$ = 203.22+35.45TD2 + 49.03TD3 +38.53TD4 +37.52TD5 + 36.17TD6 +24.24TD7	65.01
	$\hat{\gamma}$ = 180.95+33.56TD2 +40.61TD3 + 37.89TD4 + 34.88TD5 + 33.27TD6 +32.12TD7 +25.75TD8	65.48
Equations using test day milk records with and without peak milk yield	$\hat{\gamma}$ = 167.80 + 10.17TDl+ 32.11TD2 + 34.23TD3 + 32.18TD4 + 33.32TD5 + 27.21TD6 + 27.09TD7 + 22.17TD8 + 11.44TD9 + 9.78TD10 + 5.07FPMY *(Prediction of equation using all test days milk record with peak milk yield)*	65.97
	$\hat{\gamma}$ = 167.83 + 10.29TDl+ 32.28TD2 + 34.47TD3 + 32.30TD4 + 33.58TD5 + 27.63TD6 + 29.21TD7 + 22.39TD8 + 11.63TD9 + 9.09TD10 *(Prediction of equation using all test days milk record)*	65.96
Equations using alternate test day milk records	$\hat{\gamma}$ = 219.31 +23.23TDl+ 85.35TD3 + 71.09TD5 + 44.44TD7 + 18.79TD9 *(Prediction of equation using odd test days milk records)*	55.57
	$\hat{\gamma}$ = 275.14 + 45.32TD2+ 96.25TD4 + 50.80TD6 + 40.34TD8 + 18.26TD10 *(Prediction of equation using even test days milk records)*	64.02

Table 2
Accuracy of selection and genetic gain from selection using indexes

Traits in index	Accuracy of selection (rIH)	Increase in accuracy in comparison of direct selection	Genetic gain (ΔG)
All test days			
TD1 + TD2 + TD3 + TD4 +TD5 + TD6 + TD7 + TD8 + TD9 + TD10	0.694	21.97	266.63
All test days + peak milk yield			
TD1 + TD2 + TD3 + TD4 +TD5 + TD6 + TD7 + TD8 + TD9 + TD10 + FPMY	0.696	22.31	266.66
TD2 + TD3 + TD4	0.648	13.88	228.91
TD2 + TD3 + TD4 +FPMY	0.649	14.05	233.47
All odd test days			
TD1 + TD3 + TD5 + TD7 + TD9	0.649	14.06	233.50
All even test days			
TD2 + TD4 + TD6 + TD8 + TD10	0.650	14.24	233.86

yield from alternate test day records indicated that prediction of equation using even test day milk records with 64.2% R^2 value had almost 15 % better prediction equation compared to odd test day that have 55.57% R^2.

All the individual test day using single simple regression led to prediction equation having R^2 value less than 50% suggesting for multiple test day selection as single test day milk record cannot be used to predict FLY. Comparative higher R^2 value for 2nd, 3rd, 4th and 5th test day milk records are supported by Saini *et al*. (2005). Little contribution of TD1 in index formation was supported by Garcha and Dev (1994). Very little increase in accuracy due to addition of TD9 and TD10 in index was supported by Pander and Hill (1993). R^2 values for prediction of FLY was the highest for TD3 followed by TD2. Mid lactation equations having higher accuracy of prediction of FLMY revealed that two phases of lactation ascending and persistent were more important than descending phase for prediction. Alternate test days could also be used to predict the first lactation milk yield.

Monthly test day milk yields were used to predict FLY by using multiple regression method. A total of ten independent variables in terms of test day milk records from TD1 to TD10 were taken for this purpose. Table 2 presents the accuracy of selection for the prediction of breeding value of FLY from test day records. The accuracy of direct selection for first lactation yield was 0.569. Accuracy of selection utilizing all test day milk records with and without peak milk yield was estimated as 0.696 and 0.694, respectively (Table 2). In addition, accuracy of selection was 0.649 and 0.648 when first lactation test day second, third and fourth were utilized alone or in combination with first lactation peak milk yield, respectively. However, accuracy of selection utilizing odd and even test day milk records was 0.649 and 0.650, respectively. Alternate recording will save human resource and recurring charges and will be less time consuming and more convenient. Pander *et al.* (1992) also suggested the use of alternate test day milk yield for selection of sires. Park and Lee (2006) supported the recommendation of use of three test day and also reported nearly same accuracy of prediction of first lactation milk yield. Based on relative efficiency of selection TD2 to TD4 were more appropriate criteria to assess production potential of the buffaloes in early stage of lactation.

From this study, it may be concluded that selection of sires on the basis of test days in mid lactation i.e. second to fourth would be more effective as these parameters are expressed earlier in life and have better prediction equations for prediction of phenotypic value of lactation milk yield and high accuracy of selection. Thus, selection on the basis of these traits would utilize available human resource and reduce generation interval and would also be cost effective.

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