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Research Article

Prediction of First Lactation Milk Yield on The Basis of Test Day Yield Using Multiple Linear Regression in Gir Cows

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ABSTRACT

The test-day model is a method of choice for the study of milk yield traits, and this method is very important in countries like India, where herd size is generally smaller and lacks a well-established milk recording system. The present investigation was carried out on 365 records of Gir cows maintained at a cattle breeding farm from 1986 to 2014 with the objective of predicting the first lactation milk yield using monthly test day milk records. MLR was used with the backward elimination method. The optimum equation had total five variables (test days) viz. TD1, TD2, TD3, TD4 and TD5. This equation gave an accuracy of prediction of 77.71%. Therefore, it is concluded that first lactation 305 day milk yield could be predicted as early as 5th month of lactation with higher degree of accuracy.

Keywords: *First lactation 305 day milk yield, MTDMY, MLR, Gir cow.*

INTRODUCTION

Livestock biodiversity is integral to our rural livelihood, culture, history, environment, economy and, most importantly, our future. The diversity of livestock genetic resources is very wide in variety and variability in species, breeds, populations and unique genotypes. India is a mega-biodiversity in the world and maintains more than its proportionate share of livestock breeds (Sadana & Pandey, 2004). As per the 20th Livestock Census 2019, India has a total livestock population of 535.78 million, showing an increase of 4.6 per cent over the livestock census of 2012, and is a home of about 11.54 per cent of the total livestock population in the world. India has 53 registered pure indigenous cattle breeds, including Shahiwal, Gir, Red Sindhi, Tharparkar and Rathi. All these five are known as milch breeds.

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Gir cattle is a well-known milch breed of the country, having its origin in Gir forest and abundantly found in districts like Junagadh, Amreli, Bhavnagar, Gir- Somanth and Rajkot, Porbandar and some parts of Jamnagar, Morbi and Surendranagar Districts of Gujarat. This breed is also known as Bhodali, Desan, Guajarati, Kathiawar and Sorthi.. Gir animals have been acknowledged for their tolerance to stress condition and resistance to various tropical diseases. The ability to predict the complete lactation yield of a cow from its test day milk yields would determine the success of dairy herd culling programmes. In dairy cattle, high rate of genetic improvement is only possible through early culling of low producing cows. This can be achieved by selecting cows and bulls on the basis of their test-day records, provided that full lactation yield can be accurately predicted from test-day milk yields. Therefore, the present work was undertaken to study the pattern of test day milk yield in different lactation phases and to study the predictability of standard lactation milk yield using the test day milk records.

MATERIALS AND METHODS

The present investigation was carried out in Gir cattle maintained at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh. Data for the present study were collected from pedigree & history sheets/registers for various production traits pertaining to the first lactation records of 358 daughters born to 40 sires of Gir cattle, spread over a period of 29 years (1986– 2014).

Only those animals whose lactation was normal and has completed at least 100 lactation days were selected in the study. Animals are fed with ad lib quality green fodder feed throughout the year. Animals are maintained on uniform feed and managemental conditions and offered concentrate and fodder as per ICAR standards. Monthly test day records with an interval of 30 days (i.e.4thday, 34th day, 64th day……and 304th day of lactation) were recorded from the daily milk yield register. Standard lactation milk yield was calculated by adding daily milk yield till 30th days of lactation. The data were subjected to standardization, applying mean ± 2SD. Multiple linear regression model was used to predict the 305D MY as described by Draper and Smith (1998). The different combinations of all these test day yields were utilized to predict the lactation yield to find the optimum equation with all possible combinations of independent variables using the following model

$\hat{Y}_i = a + b_i \Sigma X_i$

Where,

$\hat{Y}_i$: Estimated first lactation 305-day milk yield of the ith animal

$X_{i:}$ Test day record of the animal

a: Intercept

$b_{i:}$ Regression coefficient of first lactation 305 day or less milk yield on test day records

The per cent coefficient of determination (R^2) or the accuracy of fitting the regression model was calculated by using the following formula:

R^2 = (Sum of squares due to regression /Total sum of squares) X 100

RESULTS AND DISCUSSION

The monthly test day milk yields were used to predict the first lactation 305-day milk yield (FL305DMY) by using the multiple linear regression method. The backward elimination method was used to find the optimum equation (Table 1).

When all of the test day records (TD1 to TD11) were incorporated in an equation, the R^2-value was 87.97%. These results are higher than Pander and Hill (1993) reported, where the accuracy of an index of all 10 test-day records for milk yield was 71%. Garcha and Dev (1994) also reported a higher estimate of 99% R^2-value for the prediction of lactation milk yield from all the ten monthly test day records in crossbred cattle.

On the contrary, the reported estimate was lower than the estimates reported on monthly test day milk yield by Debbarma, 2010 (93.74 %) in Sahiwal cattle.

When TD1 to TD10 and TD1 to TD9 were involved as an independent variables to predict the lactation yield (Equations 2 and 3), R^2-values of 87.89 % and 87.76 % were observed, respectively. Subsequently, different prediction equations were formulated by step-wise backward elimination and all combinations were analyzed. It was observed that as the number of independent variables was decreased, there was a fall in the accuracy of standard lactation milk yield prediction. In the seventh equation, when TD1 to TD6 was involved in an equation, it gave a 77.71 % R^2-value. This resulted in a significant decrease in the accuracy of the prediction. When TD6 was removed in equation eighth, it decreased accuracy below the optimum level (74.39).

The optimum equation had five variables (test days): TD1, TD2, TD3, TD4, and TD5. This equation predicted milk yield with an accuracy of 77.71%. Therefore, it is concluded that the first lactation 305-day milk yield could be predicted with a higher degree of accuracy as early as the fifth month of lactation.

Table 1: Prediction equations for first lactation 305-day or less milk yield on the basis of Monthly test day milk yields by backward elimination method:

Sr. No.	Prediction equations	R^2 Value (%)	Actual Error	Percentage Error
1	$\hat{Y}$ = 93.11 + 3.19 TD1 + 37.72 TD2 + 40.59 TD3 + 14.29 TD4 + 38.88 TD5 + 17.19 TD6 + 24.76 TD7 30.94 TD8 + 55.83 TD9 + 9.35 TD10 + 13.42 TD11	87.97	236.08	15.21 %
2.	$\hat{Y}$ = 87.66 + 3.41 TD1 + 38.15 TD2 + 40.34TD3 + 14.47 TD4 + 38.61 TD5 + 16.25 TD6 + 26.24TD7 + 30.55 TD8 + 58.69TD 9 + 18.17TD10	87.89	236.79	15.26%
3.	$\hat{Y}$ =85.50 + 4.18 TD1 + 38.76 TD2 +37.66 TD3 + 15.65 TD4 + 37.91 TD5 + 18.51 TD6 + 26.21 TD7 + 31.97 TD8 + 71.99 TD9	87.76	238.05	15.34 %
4	$\hat{Y}$ =88.41 + 2.24 TD1 + 33.51 TD2 + 39.73 TD3 + 17.63 TD4 + 29.81 TD5 + 31.36 TD6 + 39.92 TD7 + 78.32 TD8	85.88	255.70	16.48 %
5	$\hat{Y}$ =66.76 + 6.62 TD1 + 30.77 TD2 + 43.31 TD3 + 17.86 TD4 + 38.41 TD5 + 35.56 TD6 + 96.91 TD7	83.62	275.44	17.75 %
6	$\hat{Y}$ =88.08 + 9.28 TD1 + 26.70 TD2 + 50.55 TD3 + 25.29 TD4 + 57.38 TD5 + 86.23 TD6	79.87	305.38	19.68 %
7	$\hat{Y}$ =99.88 + 11.76 TD1 + 30.19 TD2 + 53.87 TD3 + 49.29 TD4 + 100.60 TD5	77.71	321.35	20.71 %
8	$\hat{Y}$ =146.37 + 13.15 TD1 + 31.51 TD2 + 84.83 TD3 + 100.28 TD4	74.39	344.42	22.19 %
9	$\hat{Y}$ =202.99 + 15.15 TD1 + 49.77 TD2 + 152.04 TD3	70.24	371.30	23.93 %
10	$\hat{Y}$ =327.70 + 28.45 TD1 + 171.49 TD2	54.78	457.72	29.50 %
11	$\hat{Y}$ =1048.01 + 109.45 TD1	13.39	632.56	40.76

CONCLUSIONS

First, lactation 305-day milk yield is considered an important trait for selecting cows. The test-day model is a method of choice for the study of milk yield traits in order to maximize the use of all available information. This method is very important in countries like India, where herd size is generally smaller and lacks well-established milk recording. The monthly test day milk yields were used to predict the first lactation 305-day milk yield (FL305DMY) by using the multiple linear regression method. The backward elimination method was used to find the optimum equation

When all of the test day records (TD1 to TD43) were incorporated in an equation, the R 2—value was 87.97%. The optimum equation had five variables (test days): TD1, TD2, TD3, TD4, and TD5. This equation gave a prediction accuracy of 77.71%. Therefore, it is concluded that the first lactation 305-day milk yield could be predicted with a higher degree of accuracy as early as the 5th month of lactation.

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Author Contribution: This work is my post-graduation work, and all the authors are on my advisory committee. One coauthor helped me prepare the manuscript.

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