Studies on Persistency of Milk Yield in Phule Triveni

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ABSTRACT

The records pertaining to 1049 lactations of 382, Phule Triveni cows maintained at Research Cum Development Project on Cattle, MPKV, Rahuri over a period of 40 years from 1977-2016, were used for research work. The least squares means of milk production traits and persistency of milk yield were estimated by considering the effect of period of calving, season of calving, order of lactation, age at first calving and peak milk yield. The data were first adjusted for the significant effect of non-genetic factors considered in this study and then stepwise regression analysis was carried out. Persistency of milk yield was significantly affected by period of calving, season of calving, order of lactation and peak milk yield. The lactation milk yield can be (R²=96.8 %) predicted by using persistency index P6 including lactation length and peak milk yield by using Y= -2967.97+14.74 PI+ 0.18 LL+ 195.76 PMY equation in Phule Triveni cattle.

Keywords
Phule Triveni, Persistency, Peak milk yield, Cattle

Introduction

The persistency of milk production is of economical interest to dairy farmers as it is closely associated with the total milk production in cows.Persistency is generally expressed as the rate of decline in milk yield from maximum production after parturition until milk secretion ceases. Milk yield is the result of interaction between genetic constitution of animal and its environment in which they thrive. Milk yield is complex character observed at later age and thus direct selection for it, may not be very efficient at an early age hence selection for milk yield may be based on highly heritable but easily associated with milk yield. Milk production is the major trait around which the economy of dairy animal revolves. The milk production criteria includes various trait viz. peak yield, days to attain peak yield, total milk yield and lactation length.

Persistency of milk yield is important factor which determines the shape of lactation curve. There is also consideration that highly persistent animal have more milk yield and thus provide regular source of income to the farmer throughout the year. Persistent animals are more beneficial to farmers to maintain it’s economic development. Therefore, present investigation was carried out to study persistency of milk yield in Phule Triveni.
Materials and Methods

The records pertaining to 1049 lactations of 382, Phule Triveni cows maintained at Research Cum Development Project on Cattle, MPKV, Rahuri Dist. Ahmednagar (Maharashtra) over a period of 40 years from 1977-2016, were used for research work. All complete lactations with lactation length not less than 200 days and lactation yield not less than 1000 kg were analyzed.

To examine the persistency of milk yield, the research data was classified into 7 periods of calving viz. P_1 (1977-1982), P_2 (1983-1988), P_3 (1989-1994), P_4 (1995-2000), P_5 (2001-2006), P_6 (2007-2013), and P_7 (2013-2016); 3 seasons of birth, viz. S_1 (Rainy) June-September, S_2 (Winter) October-January and S_3 (Summer) February-May; 5 order of lactation viz. L_1 first lactation, L_2 second lactation, L_3 third lactation, L_4 fourth lactation, L_5 fifth lactation; 3 different age at first calving groups as A_1 (<860 days), A_2(861-1000 days), A_3($\geq$1001 days); and 3 peak milk yield groups viz. Y_1 (12 kg), Y_2 (12-14 kg), Y_3($>$14 kg). Persistency index was calculated by following methods:

**Method I (Johanson and Hanson, 1940)**

$$PI_1 = \frac{2^{nd} \text{ 14 week yield}}{1^{st} \text{ 14 week yield}} \times 100$$

$$PI_2 = \frac{3^{rd} \text{ 14 week yield}}{1^{st} \text{ 14 week yield}} \times 100$$

**Method -2 (Ludwick and Peterson, 1943)**

$$PI_3 = \frac{\sum x_2 \cdot x_1 \cdot x_4 \cdot x_1}{9}$$

$$PI_4 = \frac{\sum x_2 \cdot x_1 \cdot x_4}{7}$$

**Method -3 (Mahadevan, 1951)**

$$PI_5 = \frac{(A-B)}{B}$$

where,

A = Total lactation milk yield in first 26 week of lactation; and,

B = Lactation yield in first 10 week of lactation.

**Method -4 (Rao and Sundaresan, 1982)**

$$PI_6 = \frac{\text{Lactation milk yield}}{\text{Peak yield}}$$

**Method -5 (Weller et al., 1987)**

$$PI_7 = \frac{5^{th} \text{ month postpartum production}}{\text{Peak postpartum production}}$$

The following model was used for step-wise regression of milk yield on lactation length, peak yield and a measure of persistency taken one by one:

$$\gamma = a + b_1(X_1 - X_1) + b_2(X_2 - X_2) + b_3(X_3 - X_3) + e$$

Where, b’ s are the partial regression coefficients and X_1, X_2, X_3 and Y are the persistency index, peak yield, lactation length and lactation yield respectively. The residual error (e) is NID (0,$\delta^2e$).

Results and Discussion

The persistency of milk yield was calculated by five different methods viz., Method I (Johanson and Hanson, 1940), Method II (Ludwick and Peterson, 1943), Method III (Mahadevan, 1951), Method IV (Rao and Sundarsean, 1982) and Method V (Weller et al., 1987) in Phule Triveni and presented.
Table 1 Least squares means of persistency of milk yield in Phule Triveni

| N   | Method-I          | Method-II         | Method-III        | Method-IV         | Method-V         |
|-----|-------------------|-------------------|-------------------|-------------------|------------------|
|     | $P_1$             | $P_2$             | $P_3$             | $P_4$             | $P_5$            |
| $\mu$ | 1049 | 81.80 ± 0.86 | 53.16 ± 1.50 | 0.84 ± 0.006 | 0.88 ± 0.006 | 1.38 ± 0.15 | 195.53 ± 2.21 | 18.89 ± 0.20 |
| $P_1$ |      | 199  | 82.32 $^{b}$ ± 1.49 | 56.08 $^{bc}$ ± 2.60 | 0.85 $^{b}$ ± 0.11 | 0.88 $^{b}$ ± 0.011 | 1.38 ± 0.026 | 194.03 $^{b}$ ± 3.82 | 19.05 $^{bc}$ ± 0.35 |
| $P_2$ |      | 362  | 85.84 $^{b}$ ± 1.11 | 58.53 $^{b}$ ± 1.93 | 0.87 $^{b}$ ± 0.008 | 0.90 $^{b}$ ± 0.008 | 1.40 ± 0.019 | 216.55 $^{c}$ ± 2.84 | 19.91 $^{bc}$ ± 0.26 |
| $P_3$ |      | 257  | 84.39 $^{b}$ ± 1.10 | 53.32 $^{b}$ ± 1.91 | 0.86 $^{b}$ ± 0.008 | 0.89 $^{b}$ ± 0.008 | 1.40 ± 0.019 | 198.81 $^{b}$ ± 2.82 | 18.96 $^{bc}$ ± 0.25 |
| $P_4$ |      | 79   | 80.41 $^{b}$ ± 1.92 | 51.88 $^{b}$ ± 3.34 | 0.84 $^{b}$ ± 0.014 | 0.87 $^{b}$ ± 0.014 | 1.38 ± 0.033 | 189.51 $^{b}$ ± 4.92 | 18.47 $^{bc}$ ± 0.45 |
| $P_5$ |      | 80   | 82.58 $^{b}$ ± 1.98 | 64.67 $^{c}$ ± 3.45 | 0.87 $^{b}$ ± 0.014 | 0.89 $^{b}$ ± 0.014 | 1.39 ± 0.034 | 192.41 $^{b}$ ± 5.08 | 18.15 $^{b}$ ± 0.46 |
| $P_6$ |      | 48   | 83.44 $^{b}$ ± 2.48 | 50.07 $^{b}$ ± 4.31 | 0.85 $^{b}$ ± 0.018 | 0.90 $^{b}$ ± 0.018 | 1.43 ± 0.042 | 213.70 $^{c}$ ± 6.34 | 20.32 $^{c}$ ± 0.58 |
| $P_7$ |      | 24   | 73.65 $^{a}$ ± 3.43 | 37.57 $^{a}$ ± 5.97 | 0.74 $^{a}$ ± 0.024 | 0.82 $^{a}$ ± 0.025 | 1.28 ± 0.059 | 163.71 $^{a}$ ± 8.78 | 17.38 $^{a}$ ± 0.80 |

Period of Calving

| S   | Season of Calving | Order of Lactation | Age at First Calving | Peak Milk Yield |
|-----|-------------------|-------------------|----------------------|------------------|
|     | $S_1$            | $S_2$            | $S_3$                | $S_4$            |
|     | 333              | 394              | 322                  | 384              |
|     | 86.25 $^{a}$ ± 1.12 | 81.51 $^{b}$ ± 1.10 | 77.65 $^{a}$ ± 1.17 | 83.03 ± 1.06 |
|     | 58.89 $^{b}$ ± 1.95 | 50.83 $^{a}$ ± 1.92 | 49.76 $^{b}$ ± 2.03 | 58.52 $^{b}$ ± 1.84 |
|     | 0.86 $^{a}$ ± 0.008 | 0.84 $^{a}$ ± 0.008 | 0.82 $^{a}$ ± 0.008 | 0.86 $^{a}$ ± 0.008 |
|     | 0.90 $^{b}$ ± 0.008 | 0.88 $^{b}$ ± 0.008 | 0.85 $^{b}$ ± 0.008 | 0.88 $^{b}$ ± 0.008 |
|     | 1.41 $^{b}$ ± 0.019 | 1.41 $^{b}$ ± 0.019 | 1.31 $^{b}$ ± 0.020 | 1.40 ± 0.018 |
|     | 200.46 $^{b}$ ± 2.88 | 193.55 $^{b}$ ± 2.83 | 192.58 $^{b}$ ± 3.00 | 200.82 $^{b}$ ± 2.71 |
|     | 19.33 $^{b}$ ± 0.26 | 19.30 $^{b}$ ± 0.26 | 19.35 $^{b}$ ± 0.27 | 18.88 ± 0.24 |
|     | 188.23 $^{c}$ ± 3.50 | 188.23 $^{c}$ ± 3.50 | 189.75 $^{b}$ ± 5.29 | 19.33 ± 0.48 |
|     | 18.35 ± 0.32      | 18.76 ± 0.27     | 19.15 ± 0.38         | 18.86 ± 0.28     |
|     | 18.82 ± 0.27      | 19.84 ± 0.29     | 18.82 ± 0.27         | 18.88 ± 0.28     |
|     | 195.63 ± 3.01     | 195.12 ± 3.08    | 18.99 ± 0.27         | 18.99 ± 0.27     |
|     | 200.14 $^{b}$ ± 3.75 | 199.85 $^{b}$ ± 3.08 | 17.55 $^{a}$ ± 0.22  | 19.93 $^{c}$ ± 0.34 |

Means with different superscripts differ significantly from each other.
Table 2: Step-wise regression of lactation yield on lactation length (LL), peak milk yield (PMY), persistency index (PI)

| Step | Variable | Partial 'b' | SE of 'b' | Partial 't' | Intercept | $R^2$(%) |
|------|----------|-------------|-----------|-------------|-----------|----------|
| I    | PI$_1$   | 14.95       | 0.83      | 17.81       | -3435.63  | 76.2     |
|      | LL       | 7.11        | 0.24      | 28.76       |           |          |
|      | PMY      | 186.97      | 3.99      | 46.79       |           |          |
| II   | PI$_2$   | 6.57        | 0.605     | 10.86       | -1971.91  | 72.1     |
|      | LL       | 5.83        | 0.312     | 18.69       |           |          |
|      | PMY      | 175.32      | 4.22      | 41.54       |           |          |
| III  | PI$_3$   | 2209.10     | 127.28    | 17.35       | -3676.53  | 75.9     |
|      | LL       | 5.89        | 0.266     | 22.13       |           |          |
|      | PMY      | 186.73      | 4.02      | 46.42       |           |          |
| IV   | PI$_4$   | 2070.36     | 118.10    | 17.53       | -4015.53  | 76       |
|      | LL       | 7.03        | 0.24      | 28.25       |           |          |
|      | PMY      | 188.35      | 4.03      | 46.63       |           |          |
| V    | PI$_5$   | 757.92      | 51.47     | 14.72       | -3306.411 | 74.3     |
|      | LL       | 7.39        | 0.25      | 28.89       |           |          |
|      | PMY      | 184.81      | 4.16      | 44.33       |           |          |
| VI   | PI$_6$   | 14.74       | 0.154     | 95.89       | -2967.97  | 96.8     |
|      | LL       | 0.18        | 0.118     | 1.55        |           |          |
|      | PMY      | 195.76      | 1.427     | 137.20      |           |          |
| VII  | PI$_7$   | 85.43       | 3.08      | 27.70       | -3799.94  | 82.1     |
|      | LL       | 7.07        | 0.21      | 33.07       |           |          |
|      | PMY      | 187.13      | 3.39      | 55.08       |           |          |

Note: All requested variable entered

The least squares means for persistency index PI$_1$, PI$_2$, PI$_3$, PI$_4$, PI$_5$, PI$_6$ and PI$_7$ in Phule Triveni indicated that the overall least squares means for corresponding persistency were 81.80 ± 0.86, 53.16 ± 1.50, 0.84 ± 0.006, 0.88 ± 0.006, 1.38±0.15, 195.53 ± 2.21 and 18.89 ± 0.20, respectively shown in Table 1. The period of calving had significant (P<0.01) effect on persistency of milk yield estimated by PI$_1$, PI$_2$, PI$_3$, PI$_4$, PI$_6$ and PI$_7$ in Phule Triveni. The effect of season of calving on persistency of milk yield was significant in PI$_1$, PI$_2$, PI$_3$, PI$_4$, PI$_5$, PI$_6$ and PI$_7$. The Lactation order had significant effect on persistency of milk yield in PI$_2$, PI$_3$, PI$_6$. The effect of age at first calving had non significant effect on persistency of milk yield estimated by all five methods.. The peak milk yield had significant effect on persistency of milk yield in PI$_1$, PI$_2$, PI$_3$, PI$_4$, PI$_5$, PI$_6$, and PI$_7$ (Table 1).

For prediction of LMY step down regression analysis was carried out. For step down regression analysis LL, PMY and various persistency indexes were considered. Out of them LL and PMY was kept constant and only persistency index was changed for regression analysis. From results depicted in Table 2 indicated that prediction of LMY by using LL, PMY and various persistency indexes all were having $R^2$. However, prediction of LMY by using LL, PMY and persistency index PI$_6$ had maximum $R^2$ (96.8%). From these results it can be
recommended that for prediction of LMY in Phule Triveni following equation can be used.

\[
Y = -2967.97 + 14.74 PI + 0.18 LL + 195.76 \text{ PMY.}
\]

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