Original Research Article

Effect of Non-genetic Factors on Production Traits of Phule Triveni Cattle

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A B S T R A C T

The data on production performance of Phule Triveni cattle maintained at Research cum Development Project on Cattle (RCDP), Mahatma Phule Krishi Vidyapeeth, Rahuri district, Ahmednagar, (M.S) were utilized for present study. The data were analyzed by considering the effects of period of calving, season of calving and lactation order as non-genetic factors. The least squares means recorded for total milk yield (kg), lactation length (days), dry period (days) and peak milk yield (kg) were 2612.88±75.48, 306.43±5.51, 144.12±11.38 and 14.87±0.30, respectively. The effect of period of calving was significant on traits TMY, LL (P<0.05) and PMY (P<0.01) while it was non-significant on DP. The effect of season of calving was non-significant on all the traits viz TMY, LL, DP and PMY. The effect of order of lactation was significant on trait PMY (P<0.01), while it was non-significant on traits TMY, LL, DP.

Keywords
Phule Triveni, TMY, LL, DP, PMY

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Introduction

Increased pressure for intensified milk production and simultaneous rise in environmental temperature due to global warming has increased the thermal load on dairy animals. Elevated environmental temperature combined with high humidity causes discomfort and escalates the stress level in animals which is reflected in terms of reduced physiological and metabolic activities that results in reduced growth, drop in production and reproduction in farm animals. Heat stress is one of the most vital environmental stressor that has negative impact on milk yield, milk composition (fat%, SNF%, protein % etc.). Construction of Temperature Humidity Index (THI) by combining several climatological parameters like dry bulb, wet bulb temperature along with relative humidity to quantify the thermal stress is one of the best methods to assess heat stress on animals. Several research workers have reported that there exists a threshold THI value, above which the negative effects of heat stress is observed on animals. Mitigation strategies to combat heat stress includes selection of heat tolerant animals and their breeding, inclusion of heat tolerance as a trait while constructing selection index, providing...
balanced nutrition to the animals and implementation of good ventilation along with suitable cooling system in the farm (Behera et al., 2020). The temperature and humidity are changes day to day and even seasonal as well as periodical. The literature on Phule Triveni crossbred cattle on this aspect is scanty. Therefore, present investigation was undertaken.

Materials and Methods

The data of Phule Triveni cows maintained at Research Cum-Development Project on Cattle, M.P.K.V., Rahuri for a period from 2009 to 2019 (10 years) were collected for present investigation for various production traits viz., Total lactation milk yield (kg), Lactation length (days), Dry period (days) and Peak milk yield (kg). To examine the production traits, the research data was classified into 3 periods of calving viz. P1 (2009-2011), P2 (2012-2014), P3 (2015 above); 3 seasons of calving, viz. S1 (Rainy) June-September, S2 (Winter) October-January and S3 (Summer) February-May; 5 order of lactation viz. L1 first lactation, L2 second lactation, L3 third lactation, L4 fourth lactation, L5 fifth lactation. The effects of non-genetic factors like period of calving, season of calving and parity were estimated by using least-square analysis as suggested by Harvey (1990). The model was used with the assumption that different components being fitted into the model were as linear, independent and additive. The model used was as follows:

\[ Y_{ijkl} = \mu + A_i + B_j + C_k + e_{ijkl} \]

where \( Y_{ijkl} \) observation of \( i^{th} \) animal, \( k^{th} \) parity, \( j^{th} \) season of calving, \( i^{th} \) period of calving; \( \mu \) overall mean, \( A_i \) fixed effect of \( i^{th} \) period of calving (1 to 3), \( B_j \) fixed effect of \( j^{th} \) season of calving (1 to 3), \( C_k \) fixed effect of \( k^{th} \) parity (1 to 5); \( e_{ijkl} \) random error ~ NID \((0, \sigma^2_e)\).

Whenever the effects were significant Duncan’s Multiple Range Test as modified by Kramer (1957) was used to make pair wise comparison among the least square means with the use of inverse elements and root mean squares for error.

If the values

\[
\begin{align*}
( Y_{i} - Y_{j} ) & \times \sqrt{\frac{2}{C_{ii} + C_{jj} + 2C_{ij}}} \\
& > \sigma^2_e, Z(P, ne)
\end{align*}
\]

Where,

\( Y_{i} - Y_{j} \): Difference between two least squares means

\( C_{ii} \): Corresponding \( i^{th} \) diagonal elements of \( C \) matrix

\( C_{jj} \): Corresponding \( j^{th} \) diagonal elements of \( C \) matrix

\( Z(P, ne) \): Standardized range value in Duncan’s table at the chosen level of probability for the error degrees of freedom

\( P \): Number of means involved in the comparison

\( \sigma^2_e \): Root mean squares for error

Results and Discussion

The least squares means recorded for total milk yield (kg), lactation length (days), dry period (days) and peak milk yield (kg) were presented in Table 1.

Total milk yield (kg)

The overall least squares mean of total milk yield in Phule Triveni cow was 2612.88 ± 75.48 kg. This was in accordance with Deokar
The influence of period of calving on total milk yield was highly significant (P<0.01) in Phule Triveni cow. This was in accordance with Pandey et al., (2018) in Sahiwal cattle and Baranwal et al., (2018) in Vrindavani cows. In Phule Triveni cow, total milk yield (kg) of cows calved during period P_1 (3158.27 ± 114.36 kg) was significantly highest followed by cows calved in P_3 (2345.95 ± 154.29 kg) and P_2 (2740.98 ± 98.50 kg) which were at par with each other.

The influence of season of calving on total milk yield was non-significant in Phule Triveni cow. The present results were in agreement with Hadge et al., (2012) in Sahiwal and Jersey x Sahiwal crossbreds, Patond (2013) in Gir triple crossbreds, Bhutkar et al., (2014) in Deoni cows, Radhika et al., (2012) in crossbred cows and Pandey et al., (2018) in Sahiwal cattle. In present study Phule Triveni cows calved during winter season yielded highest TMY (2724.42 ± 123.75 kg) followed by rainy season (2559.36 ± 129.35 kg) and lowest TMY in summer season (2554.85 ± 124.06kg).

The variation due to order of lactation in total milk yield (kg) of Phule Triveni cow was non-significant. Similar results were obtained by Radhika et al., (2012) in crossbred cows. However contradictory results were obtained by Deokar et al., (2003) in FG, JG,FIG, JFG, BFG, Kale et al., (2001a) in FJG, JFG, BFG, Pol et al., (2015) and Garudkar et al., (2015) in Phule Triveni, Jadhav et al., (2010) in HF × Girhalfbreds. In Phule Triveni cow, the differences in total milk yield of cows L_3 (2828.24 ± 155.76 kg), L_5 (2723.65 ± 203.83 kg), L_2(2639.39± 143.06kg) and L_4(2613.98 ± 173.10 kg) were at par with each other and significantly higher than and L_1 (2259.24 ± 139.64 kg). The L_3 and L_5, L_2 and L_4 which was at par with each other and L_3 was significantly higher than those L_1. The difference in TMY among total cows calved during L_3 and L_5, L_2 and L_4 were at par to each other.

**Lactation length**

The overall least squares mean of lactation length in Phule Triveni cow was 306.43 ± 5.51 days which was in close agreement with Pol et al.,(2013) in Phule Triveni cows. Whereas, higher lactation length were reported by Usman et al., (2012) in HF cows, Patond (2013) in Gir triple cross cows, Ambhore et al., (2017) in Phule Triveni cows (331.3 ± 3 days), Jadhav et al., (2019) in HF × Girhalfbreds (320.43 ± 3.04 days), Mote et al., (2019) in IFG (352.21 ± 5.14 days) FG (327.22 ± 4.15 days), FIG (331.71 ± 3.97 days), IFJG (358.33 ± 3.81 days), R (343.37 ± 7.52 days), Gaikwad et al., (2018) in HF × Girhalfbreds (332.80 ± 8.72 days). However, lower lactation length was observed by Hadge et al., (2012) in Jersey × Sahiwal, Thombre et al., (2013) in HF × Deonicows.

The variation due to period of calving in lactation length was significant (P<0.05) in Phule Triveni cows. The significant effect of period of calving on lactation length was reported by Ambhore et al., (2017) in Phule Triveni cows, Mote et al., (2019) in IFG, IFJG and Patond (2013) in Gir triple cross cows. However, non significant effect of period of calving on lactation length was also
noticed by Jadhav et al., (2019) in HF × Gir halfbreds, Mote et al., (2019) in FG, FIG, R, Gaikwad et al., (2018) in HF × Gir halfbreds, Patond (2009) in Jersey cows, Hadge et al., (2012) in Jersey × Sahiwal halfbreds. In Phule Triveni, lactation length (days) was highest in cows calved during period P₁ (316.11 ± 8.35) followed by P₃ (316.73 ± 11.27) and lowest in P₂ (286.45 ± 8.21). The differences obtained among the cows calved during P₁ and P₃ were at par to each other.

The influence of season of calving on lactation length was non-significant in Phule Triveni cows. These results were in accordance with Ambhore et al., (2017) in Phule Triveni cows, Mote et al., (2019) in IFG, FG, FIG, R, Jadhav (2011) in HG halfbreds, Patond (2013) in Gir triple cross and Bhutkaret al., (2014) in Deoni cows. However, present results did not agree with Jadhav (2019) in HF × Gir halfbreds, Thombare et al., (2013) in HF × Deoni halfbreds and Patond (2013) in Gir triple cross cows. In Phule Triveni cows, the highest lactation length was observed in cows calved during winter (316.49 ± 9.04days) season followed by rainy (306.74 ± 9.45days) and lowest in summer (296.07 ± 9.06days) season.

The effect of order of lactation on lactation length was non-significant in Phule Triveni cows. These results were in accordance with Garudkar et al., (2015) in Phule Triveni cows, Patond (2013) in Gir triple cross and Thombare et al., (2013) in HF × Deoni crossbred cows. However, significant effect of order of lactation on lactation length was observed by Kamble (2003) in Gir crossbred cows and Mhasade (2010) and Jadhav (2011) in FG halfbreds. In Phule Triveni cows, the highest lactation length was observed in L₂ (320.87 ± 10.45days) lactation followed by L₁(320.75 ± 10.20days), L₃ (308.88 ± 11.38 days), L₄ (291.25 ± 12.65 days) and lowest in L₅ (290.40 ± 14.89days) lactation. In HF × Gir no specific trend of lactation length was noticed during different lactations.

**Dry Period**

The overall mean dry period recorded in Phule Triveni was 144.12 ± 11.38 days. These results were in close agreement with Roy et al., (1993) in FT cows. Whereas, higher values were observed by Pandey et al., (2009) in FJH, Usman et al., (2012) in HF cows, Hadge et al., (2012) in Jersey × Sahiwal cows and Hassan et al., (2013) in crossbred cows. However, lower values were noticed by Kamble (2003) in HG cows, Deokar et al., (2008) in Phule Triveni cows(93.57 ± 4.94 days), Zol et al., (2009) in Phule Triveni cows(79.06 ± 1.89 days), Kamble et al., (2016) in Phule Triveni cows(114.74 ± 7.54 days), Ambhore et al., (2017) in Phule Triveni cows (93 ± 3 days), Jadhav et al., (2019) in HF × Gir halfbreds(88.40 ± 2.58 days), Gaikwad et al., (2018) in HF × Gir halfbreds (85.59 ± 7.45 days).

The variation due to period of calving in dry period was non-significant in Phule Triveni. Similar results were observed by Kamble (2003) in FG, FIG, JFG and BFG crossbreds, Deokar et al., (2008) in Phule Triveni cows, Pandey et al., (2009) in FJH crossbreds and Usman et al., (2012) in HF cows, Jadhav et al., (2019) in HF × Gir halfbreds, Gaikwad et al., (2018) in HF × Gir halfbreds. In Phule Triveni, the dry period (days) was largest in cows calved during period P₂ (148.1 0±16.95) followed by P₃ (144.65± 23.27) and lowest in P₁ (139.62 ± 17.25). The results revealed that the dry period linearly increased in cows calved during period P₂ and slightly decreased during P₃ in Phule Triveni cows.
Table 1: Least squares means for total milk yield (kg), lactation length, dry period, peak milk yield as affected by non-genetic factors

| Effect           | N   | LEAST SQUARE MEANS                      |
|------------------|-----|----------------------------------------|
|                  |     | Total Milk Yield | Lactation Length | Dry period | Peak milk yield |
|                  |     | µ                         |                  |            |                |
|                  | 137 | 2612.88±75.48          | 306.43±5.51      | 144.12±11.38 | 14.87±0.30     |
| Period of calving|     |                          |                  |            |                |
| P₁               | 53  | 3158.27a±114.36         | 316.11ab±8.35    | 139.62±17.25 | 16.66a±0.45    |
| P₂               | 55  | 2334.42c±112.40         | 286.45b±8.21     | 148.10±16.95 | 14.62abc±0.45  |
| P₃               | 29  | 2345.95b±154.29         | 316.73a±11.27    | 144.65±23.27 | 13.32b±0.61    |
| Season of calving|     |                          |                  |            |                |
| S₁               | 44  | 2559.36±129.35          | 306.74±9.45      | 147.98±19.51 | 14.58±0.51     |
| S₂               | 46  | 2724.42±123.75          | 316.49±9.04      | 126.02±18.66 | 14.57±0.49     |
| S₃               | 47  | 2554.85±124.06          | 296.07±9.06      | 158.37±18.71 | 15.44±0.49     |
| Order of lactation|     |                          |                  |            |                |
| L₁               | 35  | 2259.24±139.64          | 320.75±10.20     | 147.39±21.06 | 11.60bc±0.56   |
| L₂               | 33  | 2639.89±143.06          | 320.87±10.45     | 126.93±21.57 | 14.77bc±0.56   |
| L₃               | 30  | 2828.24±155.76          | 308.88±11.38     | 132.05±23.49 | 15.85bc±0.62   |
| L₄               | 23  | 2613.98±173.10          | 291.25±12.65     | 163.24±26.11 | 16.09bc±0.68   |
| L₅               | 16  | 2723.05±203.83          | 290.40±14.89     | 151.01±30.74 | 16.02abc±0.81  |
The variation due to season of calving in dry period was non-significant in Phule Triveni. These results were in agreement with Deokar et al., (2008), Zol et al., (2009), Kamble et al., (2016) and Ambhore et al., (2017) in Phule Triveni cows; Jadhav et al., (2019) in HF × Gir halfbreds, Kamble (2003) in HG halfbreds, Zol (2007) in Phule Triveni, Pandey et al., (2009) in FJH crossbreds, Shinde (2010) in HF and Hadge et al., (2012) in Jersey × Sahiwal crossbred cows and Bhutkar et al., (2014) in Deoni cows. In Phule Triveni, the longest dry period was observed in cows calved during summer (158.37± 18.71 days) season followed by rainy (147.98± 19.51 days) and shortest in those calved in winter (126.02± 18.66 days) season.

The variation due to order of lactation in dry period was non-significant in Phule Triveni cows. These results were similar to Zol et al., (2009) in Phule Triveni cows, Kamble (2003) in Gir crossbreds, Zol (2007) in Phule Triveni, Shelar (2012) in Gir crossbreds. In Phule Triveni cows, the longest dry period (days) was observed in cows during L₄ (163.24 ± 26.11) followed by L₅ (151.01 ± 30.74), L₁ (147.39 ± 21.06), L₃ (132.05 ± 23.49) and lowest in L₂ (126.93±21.57) lactation. In Phule Triveni cows in the present study no specific trend of dry period was noticed for different lactations.

**Peak Milk Yield**

The overall least squares mean observed for PMY was 14.87± 0.30 kg in Phule Triveni cattle which was in close agreement with Patond (2009) reported in Jersey cows, Shelke (2012) in Phule Triveni, whereas, higher values were observed by Patond (2013) in Gir triple cross cows. However, lower values were noticed by Kale et al., (2001) in FJG (14.87 ± 0.13 kg) JFG (14.57 ± 0.25 kg) and BFG (14.91 ± 0.19 kg), Kamble (2003) in HG cows.

The variation due to period of calving in PMY was significant (P<0.01) in Phule Triveni which was also noticed by Kale et al., (2001) in FJG (14.87 ± 0.13 kg) JFG (14.57 ± 0.25 kg) and BFG (14.91 ± 0.19 kg), Patond et al., (2009) in Jersey cows, Bhutkaret al., (2014) in Deoni cattle. The PMY (kg) of cows calved during period P₁ (16.66 ± 0.45) is higher than P₃ (13.32 ± 0.61) and at par with those calved during P₂ (14.62 ± 0.45). The differences in PMY among cows calved during P₁ and P₂ and between P₂ and P₃ were at par with each other. The results revealed that the PMY linearly decreased in cows calved during period P₁ to P₃ in Phule Triveni.

The variation due to season of calving in PMY was non-significant in Phule Triveni. These results were in agreement with Nanavati and Singh et al., (2004) reported in Gir cattle, Patond et al., (2009) in Jersey cows, Shelke et al., (2012) in Phule Triveni cows Bhutkar et al., (2014) in Deoni cattle and Radhika et al., (2012) in crossbred cows. However significant results were obtained by Kale et al., (2001) in FJG, JFG and BFG. In Phule Triveni, the highest PMY was observed in cows calved during summer (15.44 ± 0.49 Kg) season and lowest in winter (14.57 ± 0.49 Kg).

The variation due to order of lactation was significant in Phule Triveni (P<0.01). Similar results were noticed by Kale et al., (2001) in FJG (14.87 ± 0.13 kg) JFG (14.57 ± 0.25 kg) and BFG (14.91 ± 0.19 kg) and Patond (2013) in Gir triple cross cows. The PMY (kg) of cows calved during order of lactation L₄ (16.09 ± 0.68) is significantly higher than L₃ (15.85 ± 0.62), L₂ (14.770 ± 0.56) and L₁ (11.60 ± 0.56) and at par with those calved during L₅ (16.02 ± 0.81). The differences in PMY among cows calved during L₄ and L₅, between L₃ and L₅ and L₂ were at par with each other.
In Phule Triveni, the highest PMY (kg) was observed during L₄ (16.09 ± 0.68) followed by, L₅ (16.02 ± 0.81), L₃(15.85 ± 0.62), L₂(14.77 ± 0.56) and lowest in L₁(11.60 ± 0.56) lactation. In the present investigation no specific trend of PMY was noticed for different lactations. The differences among the cows calved during L₄ and L₁, L₅ and L₁, L₃ and L₁ as well as L₂ and L₁ are at par to each other. The significantly lowest PMY was recorded in cows during L₁ lactation.

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