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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.

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. P_1 (2009-2011), P_2(2012-2014), P_3 (2015above); 3 seasons of calving, 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_3third lactation, L_4 fourth lactation, L_5fifth 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 l^{th} animal, k^{th} parity, j^{th} season of calving, i^{th} period of calving; μ 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

$$(Y_i - Y_j) \times \sqrt{\frac{2}{C_{ii} + C_{jj} + 2C_{ij}}} > \sigma^2 e, Z(P,ne)$$

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

(2003) in Gircrossberd cows. Whereas, higher values were reported by Ambhore *et al.,* (2017) in Phule Triveni (2855 ± 43 kg), Raut *et al.,* (2017) in HF × Girhalfbreds (2556.82 kg), Jadhav *et al.,* (2019) in HF × Girhalfbreds (2701.77 ± 46.04 kg), Gaikwad *et al.,* (2018) in HF × Girhalfbreds (2703.10 ± 97.91 kg Patond (2013) in FJG cattle. However, lower total milk yield was noticed by Hadge *et al*., (2012) in Jersey x Sahiwal, Arya *et al.,* (2013) in crossbred cows and Thombare *et al.,* (2013) in HF × Deoni cows.

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 crossbred cows, 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,FJG, 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, Thombare *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 × Girhalfbreds, Mote *et al.,* (2019) in FG, FIG, R, Gaikwad *et al.,* (2018) in HF × Girhalfbreds, Patond (2009) in Jersey cows, Hadge *et al.,* (2012) in Jersey × Sahiwalhalfbreds. In Phule Triveni, lactation length (days) was highest in cows calved during period P_3 (316.73 ±11.27) followed by P_1 (316.11 ± 8.35) and lowest in P_2 (286.45 ± 8.21). The differences obtained among the cows calved during P_3 and P_2 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, Hadge *et al.,* (2012) in Jersey × Sahiwalhalfbreds, Patond (2013) in Gir triple cross cows and Bhutkar*et al.,* (2014) in Deoni cows. However, present results did not agreed with Jadhav (2019) in HF × Girhalfbreds, Thombare *et al.,* (2013) in HF × Deonihalfbreds and Patond (2014) in Gir triple cross cows, Kamble *et al.,* (2016) in Phule Triveni cows, Mote *et al.,* (2019) in IFJG. InPhule 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 L_2 (320.87 ± 10.45days) lactation followed by L_1(320.75 ± 10.20days), L_3 (308.88 ± 11.38 days) , L_4 (291.25 ± 12.65 days) and lowest in L_5 (290.40 ± 14.89days) lactation. In HF X 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 × Girhalfbreds(88.40 ± 2.58 days), Gaikwad *et al.,* (2018) in HF × Girhalfbreds (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, FJG, 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 × Girhalfbreds, Gaikwad *et al.,* (2018) in HF × Girhalfbreds. In Phule Triveni, the dry period (days) was largest in cows calved during period P_2 (148.1 0±16.95) followed by P_3 (144.65± 23.27) and lowest in P_1 (139.62 ± 17.25). The results revealed that the dry period linearly increased in cows calved during period $P_2$and slightly decreased during P_3 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					
P_1	53	3158.27^{a}±114.36	316.11^{ab}±8.35	139.62±17.25	16.66^{a}±0.45
P_2	55	2334.42^{c}±112.40	286.45^{b}±8.21	148.10±16.95	14.62^{ab}±0.45
P_3	29	2345.95^{b}±154.29	316.73^{a}±11.27	144.65±23.27	13.32^{b}±0.61
Season of calving					
S_1	44	2559.36±129.35	306.74±9.45	147.98±19.51	14.58±0.51
S_2	46	2724.42±123.75	316.49±9.04	126.02±18.66	14.57±0.49
S_3	47	2554.85±124.06	296.07±9.06	158.37±18.71	15.44±0.49
Order of lactation					
L_1	35	2259.24±139.64	320.75±10.20	147.39±21.06	11.60^{c}±0.56
L_2	33	2639.89±143.06	320.87±10.45	126.93±21.57	14.77^{bc}±0.56
L_3	30	2828.24±155.76	308.88±11.38	132.05±23.49	15.85^{b}±0.62
L_4	23	2613.98±173.10	291.25±12.65	163.24±26.11	16.09^{a}±0.68
L_5	16	2723.05±203.83	290.40±14.89	151.01±30.74	16.02^{ab}±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 × Girhalfbreds, 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± 19.51days) and shortest in those calved in winter(126.02± 18.66 days) season.

The difference 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 L_4 (163.24 ± 26.11) followed by L_5 (151.01 ±30.74), L_1(147.39 ± 21.06), L_3 (132.05 ± 23.49) and lowest in L_2 (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 ± 0.13kg) JFG (14.57 ± 0.25kg) 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, Bhutkar*et al.,* (2014) in Deonicattle. The PMY (kg) of cows calved during period P_1 (16.66 ± 0.45) is higher than P_3 (13.32 ± 0.61) and at par with those calved during P_2 (14.62 ± 0.45). The differences in PMY among cows calved during P_1 and P_2 and between P_2 and P_3 were at par with each other. The results revealed that the PMY linearly decreased in cows calved during period P_1 to P_3 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 ± 0.49Kg).

The difference in PMY 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 L_4 (16.09 ± 0.68) is significantly higher than L_3(15.85 ± 0.62), L_2(14.770 ± 0.56) and L_1(11.60 ± 0.56) and at par with those calved during L_5 (16.02 ± 0. 81). The differences in PMY among cows calved during L_4 and L_5, between L_3 and L_5 and L_2 were at par with each other.

In Phule Triveni, the highest PMY (kg) was observed during L_4 (16.09 ± 0.68) followed by, L_5 (16.02 ± 0.81), L_3(15.85 ± 0. 0.62), L_2(14.77 ± 0.56) and lowest in L_1(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 L_4 and L_1, L_5 and L_1, L_3 and L_1as well as $L_2$and $L_1$are at par to each other. The significantly lowest PMY was recorded in cows during L_1 lactation.

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