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Effect of Non-genetic Factors on Monthly Milk Yield for 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.H) were utilized for present study. The least squares means of monthly milk yield (kg) were estimated by considering the effects of period of calving, season of calving and lactation order as non-genetic factors. The effect of period of calving was significant on traits MMY1, MMY9 (P>0.05), from MMY2 to MMY8, MMY10 (P<0.01). The effect of season of calving was significant in MMY9 (P>0.05), MMY7 (P<0.01) while it was non significant on all the traits viz, MMY1 to MMY6, MMY8 and MMY10. The effect of order of lactation was significant on traits MMY4, MMY5, MMY6 (P>0.05), MMY 1 to MMY 3 (P<0.01), while it was non significant on traits from MMY 7 to MMY 10.

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).

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 following Traits:

a)Productive traits:1) Total lactation milk yield (kg),2) Lactation length (days),3) Dry period (days),4) 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 (2015 above); 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_1first 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:

Model I

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

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, $\sigma^2 e$).

Duncan's Multiple Range Test (DMRT)

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

First monthly milk yield

The mean for monthly milk yield (MMY) records of MMY1 observed in Phule Triveni cows under present investigation were 391.69

± 9.34 kg. The present values were closer to those reported in FJG (Jadav, 1993) and JFG (Dange, 1996) cattle. However, higher MMY values were reported in FG cows (Patil, 1989) and lower values in IBFG (Jebale, 1994), JG (Naikare, 1993) and IJFG cows (Dange, 1996).

The variation due to period of calving in monthly milk yield of first was significant in Phule Triveni cows (P<0.01).Similar results were obtained in HF×Girhalfbreds (Deokar *et al.*, 2017), Phule Triveni cows (Kamble, 2014), Kale *et al.,* (2001a) in Triple cross bred, Raut *et al.*, (2017) in HF×Girhalfbreds. In Phule Triveni, monthly milk yield of first (kg) of cows calved during various period of calving was significantly differed from each other. The results revealed that the monthly milk yield of first month linearly decreased in cows calved during succeeding periods over preceding i.e. P_1 to P_3 in Phule Triveni cows.

The variation due to season of calving in first monthly milk yield was non-significant in Phule Triveni cows. This result was in accordance with Deokar *et al.*, (2017) in HF × Girhalfbreds, Kamble (2014) in Phule Triveni cows and Pandey *et al.,* (2018) and Raja (2019) in Sahiwal cattle, Raut *et al.,* (2017) in HF × Girhalfbreds. However contradictory results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the highest MMY1 was observed in cows calved during summer (406.11±15.36) than rainy season (389.02±16.02) and lowest in winter (379.92±15.32).

The difference due to order of lactation in first monthly milk yield was significant (P<0.01) in Phule Triveni cows. Similar results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the highest MMY1 (kg) was observed in cows during L_4 (427.32 ±21.44) followed by L_5(424.99 ± 25.44), L_3(415.83± 19.29), L_2(384.41± 17.32) and lowest in L_1(305.88± 17.29)lactation. In Phule Triveni cows in the present study no specific trend was noticed for MMY1 in various lactations. The difference in MMY1 among total cows calved during L_4 and L_5, L_2 and L_3, L_2 and L_1 were at par to each other.

Second monthly milk yield

The overall least squares mean of second monthly milk yield in Phule Triveni cows was 370.44± 9.29 kg.

The influence of period of calving on second monthly milk yield was significant (P<0.01) in Phule Triveni cows. Similar results were reported in HF × Girhalfbreds (Deokar *et al.*, 2017), Phule Triveni cows (Kamble 2014), Kale *et al.,* (2001a) in Triple cross bred, Raut et al.(2017) in HF×Girhalfbreds. In Phule Triveni cows, monthly milk yield of second month (kg) of cows calved during period P_1 (426.46 ±14.07) was significantly higher than those P_2(358.24 ± 13.83) and P_3 (326.61±18.99) which were at par to each other. The differences in second monthly milk yield among total cows calved during P_1 was significantly higher than P_2 and P_3.The difference in MMY2 among total cows calved during P_3 and P_2 were at par to each other. The results revealed that the monthly milk yield of second month linearly decreased in cows calved during succeeding periods over preceding i.e. P_1 to P_3 in Phule Triveni cows.

The variation due to season of calving in second month milk yield was non-significant in Phule Triveni cows. This result was in accordance with Deokar *et al.*, (2017) in HF × Girhalfbreds, Kamble (2014) in Phule Triveni cows and Pandey *et al.,* (2018) and Raja (2019) in Sahiwal cattle, Raut *et al.*, (2017) in HF × Girhalfbreds. However contradictory results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the

highest MMY2 was observed in cows calved during winter (381.93±15.23) followed by summer (379.95±15.27) and lowest in rainy (349.43±15.92).

The difference due to order of lactation in second month milk yield (kg) was significant (P<0.01) in Phule Triveni cows. Similar results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the highest MMY2 (kg) was observed in cows during L_4(410.78 ±21.30) followed by, L_5 (395.22± 25.08), L_3(382.37± 19.17), L_2(366.16± 17.60) and lowest in L_1(297.66± 17.18) lactation. The difference in MMY2 among total cows calved during L_4 and L_5, L_2 and L_3 and L_5, L_2 and L_1 at par to each other. In Phule Triveni cows in the present study no specific trend of lactation order was noticed for MMY2.

Monthly milk yield 3

The overall least squares mean for monthly milk yield of third month in Phule Triveni cows was 333.59± 8.78kg.The influence of period of calving on monthly milk yield of third month in Phule Triveni cows was significant (P<0.01). Similar results were reported in HF × Girhalfbreds (Deokar *et al.,* 2017) and Phule Triveni cows (Kamble 2014), Kale *et al.,* (2001a) in Triple cross bred, Raut *et al.,* (2017) in HF×Girhalfbreds. In Phule Triveni, monthly milk yield of third month (kg) in cows calved during P_1(383.08 ±13.30), P_2(316.45 ± 13.08) and P_3 (301.23±17.95) was significantly differed from each other. The results revealed that the monthly milk yield of third month linearly decreased in cows calved during succeeding periods over preceding i.e. P_1 to P_3 in Phule Triveni cows.

The variation due to season of calving in MMY3 was non-significant in Phule Triveni cows. This result was in accordance with Varshney and Tomar (1982) in Hariana and different crossbred cattle, D. K. Deokar*et al.,* (2017) in HF × Girhalfbreds, Kamble (2014) in Phule Triveni cows, Pandey *et al.,* (2018) and Raja (2019) in Sahiwal cattle, Raut *et al.*(2017) in HF × Girhalfbreds. However contradictory results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the highest MMY3 (kg) was observed in cows calved during winter season (348.37 ± 14.40) followed by summer (338.46 ± 14.43) and lowest in rainy (313.93 ± 15.05).

The difference due to order of lactation in third monthly milk yield (kg) was significant (P<0.01) in Phule Triveni cows. Similar results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the highest MMY3 (kg) was observed in cows during L_4 (363.94±20.14) followed by, L_5 (360.60± 23.71), L_3 (337.64± 18.12), L_2(331.09± 16.64) and lowest in L_1(274.67± 16.25) lactation. The difference in MMY3 among total cows calved during L_4 and L_5, L_3 and L_2, L_2 and L_1 were at par to each other. In Phule Triveni cows in the present study no specific trend of lactation order was noticed for MMY3.

Fourth Monthly milk yield

The overall least squares mean for monthly milk yield of fourth month in Phule Triveni cows under was 299.73 ± 8.37kg.The influence of period of calving on monthly milk yield of fourth month was significant (P<0.01) in Phule Triveni cows. Similar results were reported in HF×Girhalfbreds (Deokar *et al.,* 2017), Phule Triveni cows (Kamble 2014), Kale *et al.,* (2001a) in Triple cross bred, Raut *et al.,* (2017) in HF×Girhalfbreds. In Phule Triveni, monthly milk yield of fourth month (kg) of cows calved during different period viz., P_1(349.78 ±12.69), P_2(278.29 ± 12.47) and P_3 (271.12±17.42) was significantly different

from each other. The results revealed that the monthly milk yield of forth month linearly decreased in cows calved during succeeding periods over preceding i.e. P_1 to P_3 in Phule Triveni cows. The variation due to season of calving in fourth monthly milk yield was non-significant in Phule Triveni. This result was in accordance with Deokar *et al.,* (2017) in HF × Girhalfbreds, Kamble (2014) in Phule Triveni cows, Manjari Pandey *et al.,* (2018) and Raja(2019) in Sahiwal cattle, Raut *et al.,* (2017) in HF × Girhalfbreds. However contradictory results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the highest MMY4 (kg) was observed in cows calved during winter (312.61±13.73) followed by summer (295.80±13.77) and lowest in rainy season (290.78±14.35).

The difference due to order of lactation in fourth monthly milk yield (kg) was significant ($P<0.05$) in Phule Triveni cows. Similar results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni cows, the MMY4 was observed in cows calved during order of lactation L_4(326.28±19.21) followed by L_3 (319.82 ± 17.28),L_2(289.30± 15.87) and L_1(251.32 ± 15.49) and lowest in L_5 (311.95± 22.62) lactation. In Phule Triveni cows in the present study no specific trend of lactation order was noticed for MMY4 in various lactations.

Monthly milk yield 5

The overall least squares mean for monthly milk yield of fifth month in Phule Triveni cows was 270.54± 8.43kg.The influence of period of calving on monthly milk yield of fifth month was significant($P<0.01$) in Phule Triveni cows. Similar results were reported in HF×Girhalfbreds (Deokar *et al.,* 2017), Phule Triveni cows (Kamble 2014), Kale *et al.,* (2001a) in Triple cross bred, Raut *et al.,* (2017) in HF×Girhalfbreds. In Phule Triveni, monthly milk yield of fifth month (kg) of cows calved during period P_1 (324.27 ±12.77), P_2(247.37 ± 17.23) and P_3 (239.99±12.55) was significantly different from each other. The difference in monthly milk yield of fifth month among total cows calved during period P_1 was significantly higher than P_2 and P_3. The results revealed that the monthly milk yield of third month linearly decreased in cows calved during succeeding periods over preceding i.e. P_1 to P_3 in Phule Triveni cows.

The variation due to season of calving in monthly milk yield of fifth was non-significant in Phule Triveni cows. This result was in accordance with Deokar *et al.,* (2017) in HF × Girhalfbreds, Kamble (2014) in Phule Triveni cows, ManjariPandey *et al.,* (2018) and Raja (2019) in Sahiwal cattle, Raut *et al.,* (2017) in HF × Girhalfbreds. However contradictory results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni cows, the highest MMY5 (kg) was observed in cows calved during season winter (293.55±13.82 kg) followed by summer (264.83±13.86 kg) and lowest in rainy season (253.26±14.45 kg). The difference due to order of lactation in monthly milk yield of fifth (kg) was significant ($P<0.05$) in Phule Triveni cows. Similar results were obtained by Kale *et al.*(2001a) in Triple cross bred (207.63 ± 4.42). The MMY5 (kg) of cows calved during order of lactation L_3(298.66±17.40 kg) is significantly higher thanL_5(275.36± 22.77 kg), L_2(262.36 ± 15.98 kg) and L_1(227.84± 15.60 kg) and at par with those calved during L_4 (288.49 ± 19.33 kg). In Phule Triveni, the highest MMY5 (kg) was observed in cows calved during L_3(298.66±17.40) followed by, L_4 (288.49± 19.33), L_5(275.36 ± 22.77), L_2 (262.36± 15.98) and lowest in L_1(227.84 ± 15.60) lactation. In Phule Triveni cows in the present study no specific trend was noticed for MMY5 in various lactations (Table 1 and 2).

Table.1 Least Square means of MMY 1 TO MMY 5 in Phule Triveni Cattle

Effect	N	LEAST SQUARE MEANS				
		MMY 1	MMY 2	MMY 3	MMY 4	MMY 5
μ	137	391.69± 9.34	370.44±9.29	333.59± 8.78	299.73±8.37	270.54±8.43
Period of Calving						
P_1	53	434.26^{a}±14.16	426.46^{a}±14.07	383.08^{a}±13.30	349.78^{a}±12.69	324.27^{a}±12.77
P_2	55	387.39^{b}±13.92	358.24^{b}±13.83	316.45^{b}±13.08	278.29^{b}±12.47	239.99^{c}±12.55
P_3	29	353.41^{c}±19.11	326.61^{c}±18.99	301.23^{c}±17.95	271.12^{c}±17.12	247.37^{b}±17.23
Season of Calving						
S_1	44	389.02±16.02	349.43±15.92	313.93±15.05	290.78±14.35	253.26±14.45
S_2	46	379.92±15.32	381.93±15.23	348.37±14.40	312.61±13.73	293.55±13.82
S_3	47	406.11± 15.36	379.95±15.27	338.46±14.43	295.80±13.77	264.83±13.86
Lactation Order						
L_1	35	305.88^{c}±17.29	297.66^{c}±17.18	274.67^{c}±16.25	251.32^{c}±15.49	227.84^{c}±15.60
L_2	33	384.41^{b}±17.72	366.16^{b}±17.60	331.09^{b}±16.64	289.30^{b}±15.87	262.36^{b}±15.98
L_3	30	415.83^{ab}±19.29	382.37^{ab}±19.17	337.64^{b}±18.12	319.82^{ab}±17.28	298.66^{a}±17.40
L_4	23	427.32^{a}±21.44	410.78^{a}±21.30	363.94^{a}±20.14	326.28^{a}±19.21	288.49^{ab}±19.33
L_5	16	424.99^{ab}±25.24	395.22^{ab}±25.08	360.60^{ab}±23.71	311.95^{ab}±22.62	275.36^{ab}±22.77

Table.2 Least Square means of MMY 6 TO MMY 10 in Phule Triveni Cattle

Effect	N	MMY6	N	MMY7	N	MMY8	N	MMY9	N	MMY10
μ	137	234.97±7.90	136	165.13±8.48	131	168.05±7.49	113	162.12±8.14	98	146.12±7.95
Period of Calving										
P_1	53	294.23^{a}±11.93	53	220.13^{a}±12.79	53	215.19^{a}±11.14	53	188.27^{a}±10.60	42	179.71^{a}±10.90
P_2	54	211.48^{b}±11.83	54	138.25^{b}±12.69	49	141.28^{c}±11.59	55	141.76^{c}±12.68	33	118.99^{c}±12.49
P_3	29	199.19^{c}±16.10	29	137.00^{c}±17.27	29	147.67^{b}±15.06	29	156.33^{b}±16.47	23	139.65^{b}±15.17
Season of Calving										
S_1	43	227.23±13.62	43	170.84^{b}±14.61	41	172.28±13.04	44	189.86^{a}±13.59	32	153.70±12.91
S_2	46	265.46±12.91	46	191.77^{a}±13.85	45	184.49±12.15	46	155.03^{b}±11.70	39	132.35±11.36
S_3	47	212.22±12.94	47	132.77^{c}±13.88	45	147.37±12.29	47	141.47^{c}±13.94	27	152.29±14.15
Lactation Order										
L_1	35	203.66^{c}±14.57	35	149.72±15.62	35	150.38±13.61	35	152.40±13.39	28	135.45±12.99
L_2	33	225.29^{b}±14.92	33	164.53±16.01	31	170.50±14.40	33	164.04±14.35	26	152.47±13.49
L_3	30	252.54^{a}±16.25	30	179.05±17.43	29	193.97±15.33	30	180.03±15.48	22	148.80±15.22
L_4	22	241.63^{ab}±18.42	22	172.31±19.76	20	158.58±18.03	23	158.78± 19.86	13	123.90±19.38
L_5	16	251.72^{ab}±21.26	16	160.02±22.81	16	166.81±19.86	16	155.36±21.93	9	169.96±22.81

Monthly milk yield 6

The overall least squares mean of monthly milk yield of sixth month in Phule Triveni cows was 234.97± 7.90kg.

The influence of period of calving on monthly milk yield of sixth month was significant (P<0.01) in Phule Triveni cows. Similar results were reported in HF×Girhalfbreds (Deokar *et al.,* 2017), Phule Triveni cows (Kamble 2014), Kale *et al.,* (2001a) in Triple cross bred, Raut *et al.,* (2017) in HF×Girhalfbreds. In Phule Triveni, monthly milk yield of sixth month (kg) of cows calved during period P_1(294.23 ±11.93) was significantly higher than those in P_2(211.48± 11.83) and P_3 (199.19+±16.10) which were significantly different from each other. The results revealed that the monthly milk yield of sixth month linearly decreased in cows calved during succeeding periods over preceding i.e. P_1 to P_3 in Phule Triveni cows.

The variation due to season of calving in monthly milk yield of sixth month was non-significant in Phule Triveni cows. This result was in accordance with Deokar *et al.,* (2017) in HF × Girhalfbreds, Kamble (2014) in Phule Triveni cows, Pandey *et al.,* (2018) and Raja (2019) in Sahiwal cattle, Raut *et al.,* (2017) in HF × Girhalfbreds. However contradictory results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the highest MMY6 (kg) was observed in cows calved during season winter (265.46±12.91 kg) followed by rainy (227.23±13.62 kg) and lowest in summer (212.22±12.94 kg). The MMY6(kg) of cows calved during season S_2 is significantly higher thanS_3, and at par with those calved during S_1.

The difference due to order of lactation in monthly milk yield of sith month (kg) was significant (P<0.05) in Phule Triveni. Similar result was reported in Triple cross bred by Kale *et al.*(2001a). In Phule Triveni, the highest MMY6 (kg) was observed in cows calved during L_3(252.54±16.25) followed by, L_5 (251.52± 21.26), L_4 (241.63± 18.42), L_2 (225.29± 14.92) and lowest in L_1(203.66± 14.57) lactation. In Phule Triveni cows in the present study no specific trend was noticed for MMY6 in different lactations.

Monthly milk yield 7

The overall least squres mean of monthly milk yield of seventh month in Phule Triveni cows was 165.13± 8.48kg.The period of calving on monthly milk yield of sevent month was significant (P<0.01) in Phule Triveni cows. Similar results were reported in HF×Girhalfbreds (Deokar *et al.,* 2017) and Phule Triveni cows (Kamble 2014), Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni cows, monthly milk yield of seventh month (kg) of cows calved during period P_1(220.13 ±12.79) was significantly higher than those in P_2(138.25 ± 12.69) and P_3 (137.00±17.27) which were significantly different from each other. The results revealed that the monthly milk yield of seventh month linearly decreased in cows calved during succeeding periods over preceding i.e. P_1 to P_3 in Phule Triveni cows.

The variation due to season of calving in monthly milk yield of seventh month was significant (P<0.01) in Phule Triveni cows. This result was in accordance with Kale *et al.,* (2001a) in Triple cross bred. However contradictory results were obtained by Deokar *et al.,* (2017) in HF × Girhalfbreds, Kamble (2014) in Phule Triveni cows, Pandey *et al.,* (2018) and Raja (2019) in Sahiwal cattle.

In Phule Triveni cows, the highest MMY7 (kg) was observed in cows calved during winter (191.70±13.85 kg) followed by rainy (170.84±14.61 kg) and lowest in summer (132.±14.45 kg).In Phule Triveni cows in the

present study no specific trend of season of calving was noticed for MMY7.

The difference due to order of lactation monthly milk yield of seventh month was non-significant in Phule Triveni cows. In Phule Triveni, the highest MMY7 (kg) was observed during L_3(179.05±17.43) followed by, L_4 (172.31± 19.76),L_2 (164.53± 16.01), L_5(160.02± 22.81) and lowest in L_1(149.72± 15.62)lactation. In Phule Triveni cows in the present study no specific trend was noticed for MMY7 in various lactations.

Eighth monthly milk yield

The overall least squares mean of monthly milk yield of eighth month in Phule Triveni cows was 168.05± 7.49kg.

The influence of period of calving on monthly milk yield of eighth month was significant (P<0.01) in Phule Triveni cows. Similar results were reported in HF×Girhalfbreds (Deokar*et al.,* 2017), Phule Triveni cows (Kamble 2014), Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni cows, monthly milk yield of eighth month (kg) of cows calved during period P_1(215.19±11.14) was significantly higher than those in P_3(147.67 ± 12.29) and P_2 (141.28±11.59) which were at par to each other. The MMY8 (kg) among total cows calved during period P_2 and P_3 were at par with each other. The results revealed that the monthly milk yield of eighth month there was no specific trend observed in Phule Triveni cows.

The variation due to season of calving in monthly milk yield of eighth was non-significant in Phule Triveni cows. This result was in accordance with Deokar *et al.,* (2017) in HF X Girhalfbreds, Kamble (2014) in Phule Triveni cows, Pandey *et al.,* (2018) and Raja (2019) in Sahiwal cattle. However contradictory results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni, the highest MMY8 (kg) was observed in cows calved during season winter (184.49±12.15) than rainy season (172.28±13.04) and lower in summer season of calving (147.37±12.29).

The difference due to order of lactation in monthly milk yield of eighth month (kg) was non-significant in Phule Triveni. Contradictory results were obtained by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni cows, the highest MMY8 (kg) was observed in cows calved during L_3 (193.97±15.33) followed by L_2 (170.50 ± 14.40), L_5 (166.81± 19.86),L_4 (158.58± 18.03) and lowest in L_1 (150.38± 13.61) lactation. In Phule Triveni cows in the present study no specific trend was noticed for MMY8 in various lactations.

Nineth monthly milk yield

The overall least square mean of monthly milk yield of ninth month in Phule Triveni cows was 162.12 ± 8.14kg.The influence of period of calving on monthly milk yield of ninth month (kg) was significant (P<0.05) in Phule Triveni cows. Similar results were reported by Kale *et al.,* (2001a) in Triple cross bred. In Phule Triveni cows, monthly milk yield of ninth month (kg) of cows calved during period P_1(188.27±10.60) was significantly higher than those in P_3(156.33±16.47) and P_2 (141.76±12.68) which were significantly different from each other. The differences obtained among the cows calved during period P_1 and P_3, P_3 and P_2 were at par to each other. The results revealed that the monthly milk yield of ninth month there was no specific trend of period of calving noticed in Phule Triveni cows.

The variation due to season of calving in monthly milk yield of ninth month was significant (P<0.05) in Phule Triveni cows. In

Phule Triveni, the highest MMY9 (kg) was observed in cows calved during season rainy (189.86±13.59 kg) followed by winter (155.03±11.70 kg) and lowest in summer (141.47±13.94 kg).The differences obtained among the cows calved during season S_1 and S_2 and S_2 andS_3 were at par to each other.

The difference due to order of lactation in total milk yield (kg) was non-significant in Phule Triveni. In Phule Triveni cows, the highest MMY9 (kg) was observed in cows calved during L_3 (180.03±15.48) followed by L_2 (164.04± 14.35), L_4 (158.78± 19.86), L_5 (155.36± 21.93) and lowest in L_1(152.40± 13.39) lactations.

Tenth monthly milk yield

The overall least square mean of monthly milk yield ofttenth month in Phule Triveni cows was 146.12 ±7.95 kg.

The influence of period of calving on monthly milk yield of tenth month was significant ($P<0.01$) in Phule Triveni cows. Similar results were reported by Kale *et al.*(2001a) in Triple cross bred (185.15 ± 4.97). In Phule Triveni, monthly milk yield of tenth month (kg) was highest in cows calved during period P_1(179.71 ±10.90) followed by P_3(139.65± 15.17) and lowest in P_2 (118.99±12.49). The differences obtained among the cows calved during period P_1 and P_3 and between P_3 and P_2 were at par to each other. The results revealed that the monthly milk yield of tenth month had not specific trend in various period of calving.

The variation due to season of calving in monthly milk yield of tenth month was non-significant in Phule Triveni cows. This result was in accordance with Deokar *et al.*, (2017) in HF × Girhalfbreds, Kamble (2014) in Phule Triveni cows, Pandey *et al.*, (2018) and Raja (2019) in Sahiwal cattle, Kale *et al.*, (2001a) in Triple cross bred. In Phule Triveni, the highest MMY10 was observed in cows calved during rainy (153.70±12.91 kg) followed by summer (152.29±14.15 kg) and lowest in winter (132.35±11.36 kg).

The difference due to order of lactation in monthly milk yield of tenth month (kg) was non-significant in Phule Triveni cows. Similar results were obtained by Kale *et al.*(2001a) in Triple cross bred. In Phule Triveni cows, the MMY10 (kg) was observed in cows calved during L_5 (169.96±22.81) followed by L_2 (152.47± 13.49), L_3(148.80± 15.22), L_1 (135.45± 12.99) and lowest in L_4 (123.90± 19.38) lactation. In Phule Triveni cows, in the present study no specific trend was noticed for MMY10 in various lactations.

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