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Effect of calf birth weight and other non-genetic factors on first lactation test day milk yield in Gir cattle

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Abstract
The present study was carried out using data of first lactation records of 513 Gir cows sired by 75 bulls spread over a period of 34 years (1981 to 2014), maintained at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh. Analysis was carried out by least squares analysis method described by Harvey (1966). The overall least squares means for first lactation monthly test day milk yield (FLMTMY) varied from 3.39 $\pm$ 0.17 kg (FLMTMY10) to 6.40 $\pm$ 0.15 kg (FLMTMY3). Only FLMTMY3 (peak yield phase) was influenced significantly ($P<0.05$) due to variation of season of calving. The period of calving had highly significant ($P<0.01$) effect on all MTDMY. The AFC had significant ($P<0.05$) effect on FLMTMY1, FLMTMY2 and MTMDY5. However, calf birth weight had highly significant ($P<0.01$) effect on FLMTMY1 and FLMTMY2 while its effect was significant ($P<0.05$) on FLMTMY4.

Keywords: FLMTMY, period and season of calving, AFC, calf birth weight and Gir cow

Introduction
The Gir is a famous milch cattle breed of India. The native trait of this breed is Gir hills and forest of Kathiawar including Junagadh, Bhavnagar, Rajkot and Amreli districts of Gujarat. Daily milk recording under field conditions is a costly and time-consuming procedure. Test day milk yield means amount of milk yield (morning & evening) produced by an animal on a particular day of lactation. Test day milk yield recording at regular interval, i.e. weekly, fortnightly or monthly intervals has been recommended by several workers. Test-day milk yield measurements could be used in genetic evaluation of males and females directly without extension of records. A test-day milk yield model is a statistical procedure which considers all genetic and environmental effects directly on a test-day basis (Swalve, 1995) [15].

The main objective of any breed improvement program is to bring about genetic progress by selection of superior sires and dams. The sires are genetically evaluated on the basis of first lactation 300-day milk yield of their daughters at organized farms. The estimation of effects of non-genetic parameters on test-day milk yields are helpful in predicting selection responses and can be used for further refinement of breeding programmes for overall improvement and genetic gains in organized farms. Accordingly, the present study was done to find the effect of non-genetic factors on FLTDMY of Gir cattle.

Materials and Methods
The present investigation was conducted on data comprised of 513 Gir cattle completed first lactation in a span of 34 years from 1981 to 2014 from pedigree cum lactation registers and birth registers of Gir cattle maintained at Cattle Breeding Farm, Junagadh Agricultural University, Junagadh.

The data were classified into 7 periods with first six periods had five consecutive years and last period had four consecutive years. Each year was divided into four seasons viz., summer, rainy, autumn and winter. Data were also classified into five different groups according to the age at first calving and six group according to calf birth weight.

Analysis was carried out by least squares analysis method to study the effect of various non-genetic factors on AFC described by Harvey (1966) [2] using following model.

$$Y_{ijklm} = \mu + a_i + b_j + c_k + d_l + e_{ijklm}$$

Where,

Y_{ijklm}	=	Observation on the mth individual in ith season, jth period, kth age group and lth birth weight of calf
µ	=	Overall population mean
a_i	=	Effect of ith season (i = 1 to 4)
b_j	=	Effect of jth period (j = 1 to 7)
c_k	=	Effect of kth age at first calving group (k = 1 to 5)
d_l	=	Effect of lth birth weight of calf (l = 1 to 6)
e_{ijklm}	=	Random error, NID (0, σ^2_e)

Results and Discussion
Monthly test day milk yield (MTDMY) of first lactation in Gir cows, which completed first lactation for 300 day or less milk yield were analyzed. The first test day was considered 5th day soon after colostrum, the next test day was calculated by adding one month to the preceding test day up to 300 days of lactation.

Overall least squares means of different individual monthly test day milk yield varied from 3.39 ± 0.17 kg (MTDMY10) to 6.40 ± 0.15 kg (MTDMY3). Here in table no 1 showed that the least square mean of first lactation test day milk yield. MTDMY was consistently increasing up to peak yield (MTDMY3) and after that gradually decreasing in phase which showed the typical pattern of lactation curve (Figure 1)

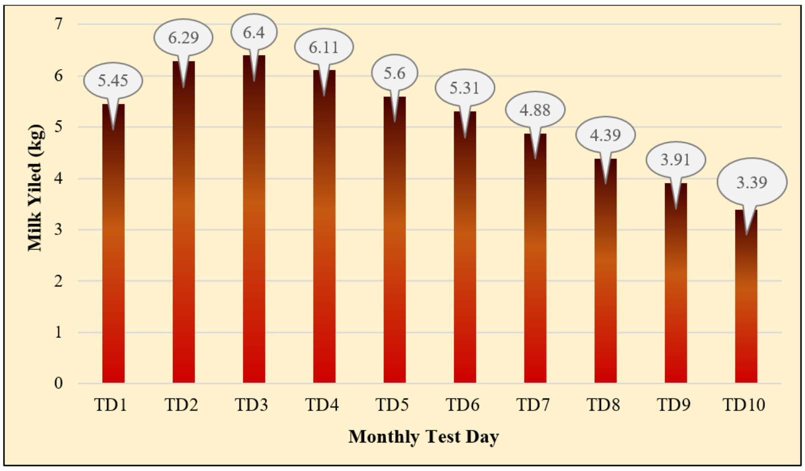

Fig 1: Over all least squares means of monthly test-day milk yield (kg)

Table 1: Analysis of variance (mean square only) for monthly test-day milk yield in Gir cows

Source of variance	d.f.	Mean squares									
		TD1	TD2	TD3	TD4	TD5	TD6	TD7	TD8	TD9	TD10
Season of calving	3	5.52	4.15	12.89*	10.92	4.19	2.74	0.45	0.89	4.34	6.48
Period of calving	6	15.32**	25.92**	41.99**	34.03**	24.88**	18.96**	17.61**	18.22**	20.35**	16.81**
AFC	4	13.47*	11.59*	6.79	8.80	12.76*	8.08	4.56	7.11	3.64	8.28
Birth weight of calf	5	16.57**	14.81**	9.15	12.23*	9.23	5.66	4.68	6.66	7.58	4.32
Error	494	4.64	4.67	5.00	4.93	5.15	4.83	5.82	6.29	6.61	6.49

[* P<0.05(significant); ** P<0.01(highly significant)]

Table 2: Least squares means for first lactation monthly test-day milk yield (kg) in Gir cows

Effect	TD1	TD2	TD3	TD4	TD5	TD6	TD7	TD8	TD9	TD10
Over all	5.45 ± 0.25	6.29 ± 0.14	6.40 ± 0.15	6.11 ± 0.15	5.60 ± 0.15	5.31 ± 0.15	4.88 ± 0.16	4.39 ± 0.17	3.91 ± 0.17	3.39 ± 0.17
Season of calving										
S1	5.13 ± 0.25	6.12 ± 0.25	6.29 ± 0.26	5.75 ± 0.26	5.34 ± 0.26	5.10 ± 0.26	4.79 ± 0.28	4.31 ± 0.29	3.62 ± 0.30	2.99 ± 0.30
S2	5.68 ±0.23	6.12 ± 0.23	5.96 ± 0.24	5.89 ± 0.24	5.55 ± 0.25	5.29 ± 0.24	4.92 ± 0.26	4.34 ± 0.27	3.91 ± 0.28	3.51 ± 0.18
S3	5.61 ± 0.26	6.53 ± 0.26	6.69 ± 0.27	6.53 ± 0.27	5.90 ± 0.28	5.55 ± 0.27	4.96 ± 0.29	4.41 ± 0.31	4.19 ± 0.31	3.63 ± 0.31
S4	5.40 ± 0.17	6.41 ± 0.17	6.65 ± 0.18	6.25 ± 0.18	5.61 ± 0.18	5.32 ± 0.17	4.86 ± 0.19	4.49 ± 0.20	3.93 ± 0.20	3.42 ± 0.20
Period of calving										
P1	6.02 ± 0.39	6.17 ± 0.39	7.08 ± 0.40	6.92 ± 0.40	6.49 ± 0.41	6.26 ± 0.39	6.03 ± 0.43	5.76 ± 0.45	5.30 ± 0.46	4.62 ± 0.46
P2	5.95 ± 0.26	7.07 ± 0.26	7.37 ± 0.27	6.86 ± 0.27	6.22 ± 0.28	5.75 ± 0.27	5.17 ± 0.29	6.63 ± 0.31	4.19 ± 0.31	3.58 ± 0.31
P3	5.58 ± 0.30	6.40 ± 0.30	6.55 ± 0.31	6.12 ± 0.31	5.70 ± 0.32	5.11 ± 0.31	4.70 ± 0.34	3.87 ± 0.35	3.41 ± 0.36	2.92 ± 0.36
P4	4.91 ± 0.33	6.40 ± 0.33	6.94 ± 0.35	6.71 ± 0.34	5.87 ± 0.35	5.64 ± 0.34	5.04 ± 0.37	4.19 ± 0.39	3.52 ± 0.40	2.81 ± 0.39
P5	4.80 ± 0.24	5.38 ± 0.24	5.53 ± 0.25	5.40 ± 0.25	5.23 ± 0.25	5.10 ± 0.24	4.69 ± 0.27	4.34 ± 0.28	4.02 ± 0.29	3.59 ± 0.28
P6	5.35 ± 0.24	5.87 ± 0.24	5.76 ± 0.25	5.56 ± 0.24	5.07 ± 0.25	4.84 ± 0.24	4.40 ± 0.27	4.08 ± 0.28	3.62 ± 0.28	3.00 ± 0.28
P7	5.58 ± 0.27	6.22 ± 0.27	5.54 ± 0.28	5.17 ± 0.27	4.63 ± 0.28	4.49 ± 0.27	4.13 ± 0.30	3.84 ± 0.31	3.34 ± 0.32	3.20 ± 0.31
Age at first calving										
A1	5.29 ± 0.38	6.28 ± 0.38	6.29 ± 0.39	6.12 ± 0.39	5.40 ± 0.40	5.01 ± 0.38	4.62 ± 0.42	3.92 ± 0.44	3.44 ± 0.45	2.71 ± 0.45
A2	4.99 ± 0.21	5.83 ± 0.21	6.08 ± 0.22	5.66 ± 0.22	5.09 ± 0.23	4.97 ± 0.22	4.64 ± 0.24	4.22 ± 0.25	3.93 ± 0.26	3.38 ± 0.25
A3	5.31 ± 0.20	6.33 ± 0.20	6.27 ± 0.21	6.16 ± 0.21	5.67 ± 0.21	5.43 ± 0.20	4.97 ± 0.22	4.37 ± 0.23	3.96 ± 0.24	3.42 ± 0.24
A4	5.83 ± 0.23	6.77 ± 0.23	6.72 ± 0.24	6.46 ± 0.23	6.00 ± 0.24	5.66 ± 0.23	5.16 ± 0.25	4.74 ± 0.26	4.09 ± 0.27	3.63 ± 0.27
A5	5.85 ± 0.25	6.25 ± 0.25	6.62 ± 0.26	6.12 ± 0.25	5.84 ± 0.26	5.50 ± 0.25	5.02 ± 0.28	4.68 ± 0.29	4.16 ± 0.29	3.820 ± 0.29
Birth weight of calf										

B1	4.74 ± 0.30	5.68± 0.30	5.87 ± 0.31	5.54 ± 0.31	5.42 ± 0.32	4.87 ± 0.31	4.61 ± 0.34	4.28 ± 0.35	3.84 ± 0.36	3.71± 0.36
B2	5.13 ± 0.19	5.85 ± 0.19	5.98 ± 0.20	5.67 ± 0.20	5.21 ± 0.20	5.04 ± 0.20	4.55 ± 0.22	4.00 ± 0.22	3.47 ± 0.23	3.13 ± 0.23
B3	5.33 ± 0.18	6.12 ± 0.18	6.26 ± 0.19	5.82 ± 0.19	5.56 ± 0.19	5.19 ± 0.19	4.84 ± 0.21	4.19 ± 0.22	3.82 ± 0.22	3.24 ± 0.22
B4	6.00 ± 0.23	6.69 ± 0.23	6.66 ± 0.24	6.42 ± 0.24	6.11 ± 0.24	5.54 ± 0.23	5.14 ± 0.26	4.74 ± 0.27	4.26 ± 0.28	3.61 ± 0.27
B5	6.12 ± 0.36	7.03 ± 0.37	6.77 ± 0.38	6.60 ± 0.38	5.81 ± 0.38	5.67 ± 0.38	5.02 ± 0.41	4.67 ± 0.43	4.18 ± 0.44	3.38 ± 0.43
B6	5.41 ± 0.48	6.39 ± 0.48	6.83 ± 0.25	6.59 ± 0.50	5.49 ± 0.51	5.57 ± 0.49	5.13 ± 0.54	4.64 ± 0.56	3.91 ± 0.58	3.25 ± 0.57

Effect of season of calving on FLMTMY

The effect of season of calving on MTDMY3 was significant ($P<0.05$), while effect of season of calving on all other TDs (from TD1, TD2 and TD4 to TD10) were found to be non-significant in Gir cows (Table-1). The highest least square means of MTDMY for summer (6.29 ± 0.26 kg), autumn (6.69 ± 0.27 kg) and winter (6.65 ± 0.18 kg) season in 3rd month of lactation while for rainy (6.12 ± 0.23 kg) season in 2nd month of lactation, indicating MTDMY3 was significantly different from other monthly test days. That means most of seasons of calving in Gir cow had significant effect on peak yield phase (MTDMY3) of first lactation.

Many other worker like Rose (2008) [6], Singh *et al.* (2016) [8] and Tripathy *et al.* (2017) [16] in Karan-Fries cows, Monalisa *et al.* (2010) [4] in Sahiwal cows and Mundhe *et al.* (2018) in Jersey crossbred cattle. Ramani (2016) [5] reported highly significant ($P<0.01$) effect of season of calving on MTDMY1, while on rest of all other MTDMY found to be non-significant in Gir cattle.

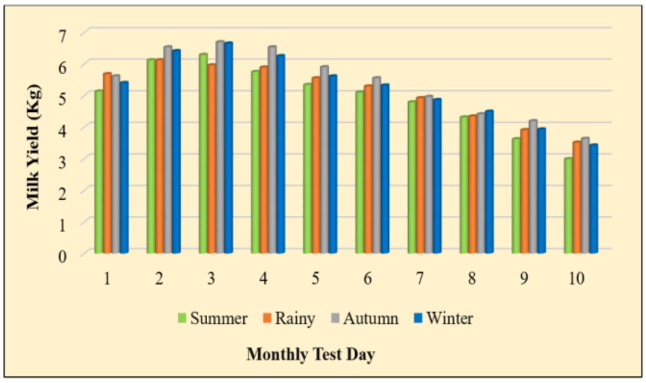

Fig 2: Season of calving- wise least squares means of FLMTMY in Gir cows

Effect of period of calving on FLMTMY

In the present study, effect of period of calving on all monthly test-day milk yield were found to be highly significant ($P<0.01$) in Gir cows (Table-1). Variation was found in all FLMTMY from period to period. Generally highest individual MTDMY was found during the period 1991-95 for MTDMY3 (7.37 ± 0.27 lit) (Table-2). The differences in different test day milk yield over the periods may be due differential culling levels as well as difference in feeding and managemental practices during the periods.

Similar results were observed by Rose (2008) [6], Japheth *et al.* (2016) [17] and Tripathy *et al.* (2017) [16] who reported that the period of calving significantly influenced all the monthly test day milk yields of first lactation in Karan-Fries cows. Monalisa *et al.* (2010) [4] and Dongre *et al.* (2012) [1] reported highly-significant ($P<0.001$) effect of period of calving on all weekly test-day milk yield in Sahiwal cow. While, Ramani (2016) [5] reported non-significant effect of period of calving on all MTDMY in Gir cattle. Singh *et al.* (2016) [8] reported non-significant effect of period of calving on test-day milk yield in Karan-Fries cows.

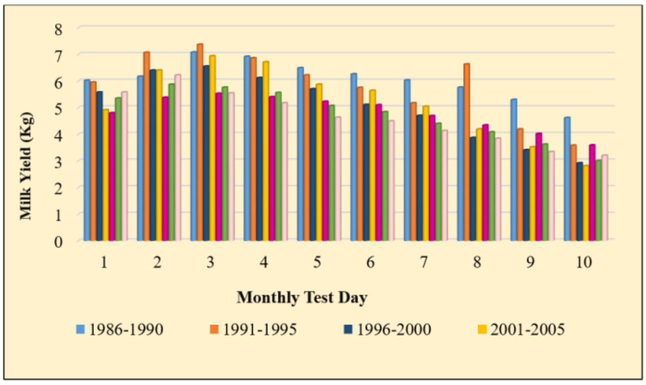

Fig 3: Period of calving- wise least squares means of FLMTMY in Gir cows

Effect of age at first calving on FLMTMY

Effect of age at first calving on test-day milk yield was found to be significant ($P<0.05$) on MTMDY1, MTMDY2 and MTMDY5 in present the study (Table 1). Which indicates the variation in AFC had an influence on early part of lactation in Gir cow. Figure 4 showed that, specific increasing trend for MTMDY was found between age group A2 to A4 might be depend upon optimum physiological body condition/weight, well developed reproductive system and mammary gland. Generally most of individual MTDMY were highest in the heifers calving at an age of 1601-1800 days (A4) days while 1st, 9th and 10th MTDMY were highest at an age of >1800 days and highest MTDMY was 6.77 ± 0.23 kg has been observed in MTDMY2 in same age group (Table-2).

Similar results were also found by Singh *et al.* (2016) [8] in Karan-Fries cattle. But contrary results were also reported by Rose (2008) [6] and Tripathy *et al.* (2017) [16] observed that the AFC had no significant effect on any of the MTDMY in the first lactation of Karan-Fries cows. Ramani (2016) [5] reported non-significant effect of AFC on all MTDMY in Gir cattle.

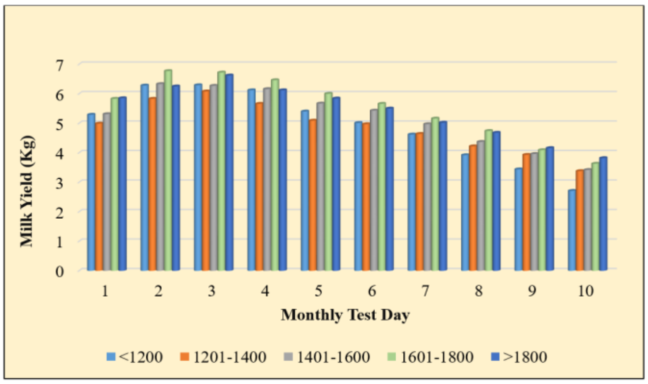

Fig 4: Age at first calving- wise least squares means of FLMTMY in Gir cows

Effect of calf birth weight on FLMTMY

The effect of calf birth weight was found to be highly significant ($P<0.01$) on MTDMY1 and MTDMY2 and significant ($P<0.05$) on MTDMY4 in Gir cows (Table 1). This indicated that calf birth weight had effect on initial phase of lactation in Gir cow. Figure 5 showed that MTDMY increased with increase in calf birth weight might be due provided better nutritious diet, better health and reproductive management in last trimester of pregnancy in Gir cows. Generally an all MTDMY were highest in 22.1-24 (B4) and 24.1-26 (B5) calf birth weight group and highest an individual MTDMY was 7.03 ± 0.37 kg has been observed in MTDMY2 in B5 group (Table-2).

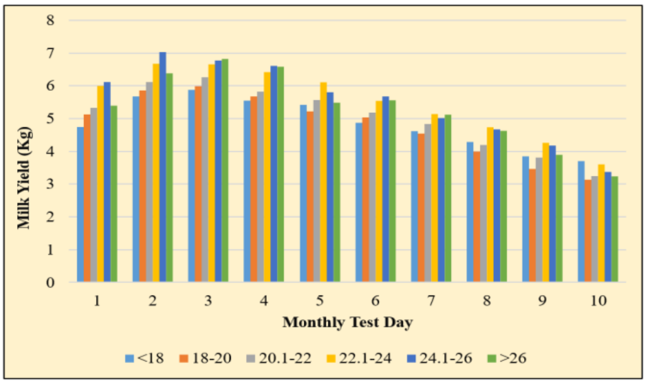

Fig 5: Calf birth weight wise least squares means of FLMTMY in Gir cows

Conclusions

Only FLMTDMY3 was significantly ($P<0.05$) affected by season of calving while all other FLMTDMY (from TD1, TD2 and TD4 to TD10) were not affected significantly. The effect of period of calving on all FLMTDMY were found to be highly significant ($P<0.01$). The significant ($P<0.05$) effect of age at first calving on FLMTMDY1, FLMTMDY2 and FLMTMDY5, while the calf birth weight was found to be highly significant ($P<0.01$) effect on FLMTDMY1 and FLMTDMY2 and significant ($P<0.05$) effect on FLMTDMY4 in Gir cows.

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