

*Original Research***Effect of Non-Genetic Factors on Milk Yield and Composition Traits of Sahiwal Cattle at Organized Dairy Farm****Manvendra Singh^{1*}, M. A. Mir², I. D. Gupta³ and A. K. Gupta³**¹Krishi Vigyan Kendra, Banda – 210001, Uttar Pradesh, INDIA²Krishi Vigyan Kendra, Nyoma, Leh ladakh – 194101, INDIA³DCB Division, ICAR-NDRI, Karnal - 132001 Haryana, INDIA***Corresponding author:** manav31vet@gmail.com

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Abstract

A study was carried out to evaluate the effect of non-genetic factors on first lactation 305-day milk yield and milk composition traits of 328 Sahiwal cows calved between 1989 to 2015 at ICAR-National Dairy Research Institute, Karnal. A mixed model analysis was carried out by least-squares maximum likelihood programme to study the effects of non-genetic factors. Overall least squares means for first lactation 305 day milk yield, average test day milk yield, average test day fat percentage and lactational fat yield were 1874.05 ± 61.25 kg, 6.72 ± 0.17 kg, 4.81 ± 0.02 % and 88.75 ± 2.99 kg, respectively. The effect of season of calving and age at first calving group was found to be non-significant on all the first lactation milk yield and milk composition traits. In the present study the period of calving had highly significant ($p < 0.01$) effect on all the traits under study. It is thus important to preadjust data for these environmental factors when carrying out genetic evaluations of production traits in dairy cattle.

Key words: Milk Yield, Non-Genetic Factors, Sahiwal, Period of Calving**How to cite:** Singh, M., Mir, M., Gupta, A., & Gupta, I. (2019). Effect of Non-Genetic Factors on Milk Yield and Composition Traits of Sahiwal Cattle at Organized Dairy Farm. International Journal of Livestock Research, 9(12), 135-141. doi: 10.5455/ijlr.20191102092223**Introduction**

India has a rich and diverse germplasm of cattle with 43 recognized cattle breeds. These breeds are classified into milch, dual purpose and draught type according to their utility. The total number of cattle populations is 192.49 million (35.92% of total livestock population) out of which indigenous cattle population comprised of 142.11 million (20th Livestock Census, 2019). India ranks first in world in milk production with 176.3 million tonnes of total milk production during 2017-18 (BAHS, 2018). The share of indigenous cattle is around 20% of the total milk produce in the country. Sahiwal breed is known for higher milk production, disease resistance ability, remarkable power of endurance for hot climate of tropics, higher feed

conversion efficiency and low cost of maintenance (Nivsarkar *et al.*, 2000). In India, many breed improvement programmes were started for increasing the productivity of animals with major emphasis on increasing lactational milk yield however; milk composition traits have received little importance. Milk yield and fat percentage are the major factors that determine the profitability of dairy farmers. Production potential of any animal primarily depends on its genetic makeup and is also affected by many factors which are not the part of genetic constituent and are not transmitted from parents to offspring and are known as non-genetic factors (Nyamushamba *et al.*, 2013). The variation in milk production and milk composition traits can be attributed to several non-genetic factors. These non-genetic factors mainly include effect of period of calving, season of calving and age at first calving. The information on environmental factors affecting milk yield and milk constituent traits is helpful in devising the breeding and management practices in accordance with season, period, and age of the animals which gives higher yield with less input cost. The objective of the present investigation was to determine the effect of non-genetic factors on milk yield and milk composition traits in Sahiwal cattle.

Materials and Methods

Location and Climatic Conditions of the Study Area

The present study was conducted at Dairy Cattle Breeding Division and Livestock Research Centre, ICAR-NDRI, Karnal, situated at an altitude of 235 to 252 meters above the mean sea level at 29.68°N latitude and 76.98°E longitude in eastern zone of Haryana which comes under the Trans-Gangetic plain agro-climatic zone of India.

Data Structure

Data for the present investigation comprised of milk yield and composition records of 328 Sahiwal cows sired by 64 bulls spread over a period of 27 years (1989-2015) collected from history cum-pedigree sheets, daily milk yield recording registers and milk constituent registers. Only those records of Sahiwal cows were considered that had produced milk for at least 100 days and minimum of 500 kg. The outliers beyond two-standard deviation on both the tail of the distribution were removed from the data. The following traits were generated i.e. age at first calving (AFC), average test day milk yield (ATDMY), average test day fat percentage (ATDFP) and lactation fat yield (LFY). Lactation fat yield was calculated using the formulae; $LFY = ATDFY \times Lactation\ Length$. Each year was divided into 4 seasons, viz. winter, December – March; summer, April – June; rainy, July – September; and autumn, October – November. The data spread over 27 years (1989-2015) were classified into 4 age at first calving groups and into 9 period of calving groups (P1 to P9) of three consecutive years.

Statistical Analysis

In order to examine the effect of various non-genetic factors on milk yield and milk composition traits least-squares analysis of variance for unequal and non-orthogonal data was used as described by Harvey (1990). The model was used with the assumptions that different components being fitted into the model were linear, independent and additive. The following model was used for first lactation yield and composition traits;

$$Y_{ijkl} = \mu + P_i + S_j + (AG)_k + e_{ijkl}$$

where, Y_{ijkl} , observation on i^{th} cow in k^{th} age group of first calving in j^{th} season and i^{th} period of calving ; μ , overall population mean ; P_i , fixed effect of i^{th} period of calving (1 to 9) ; S_j , fixed effect of j^{th} season of calving (1 to 4) ; $(AG)_k$, fixed effect of k^{th} age group of animals at first calving (1 to 4) ; e_{ijkl} , random error $\sim \text{NID}(0, \sigma_e^2)$. The statistical significance of various fixed effects in the least squares model was determined by 'F' test. For significant effects, the differences between pairs of levels of effects were tested by Duncan's Multiple Range Test as modified by Kramer (1957).

Results and Discussion

The simple means along with their standard errors (S.E.) and coefficient of variation (C.V.) for first lactation milk yield and milk composition traits are presented in Table 1. The overall mean in the present study for the first lactation 305-day or less milk yield (FL305DMY), average test day milk yield (ATDMY), average test day fat percentage (ATDFP) and lactation fat yield were found to be 1816.56 ± 40.79 kg, 6.61 ± 0.11 kg, 4.76 ± 0.02 % and 84.68 ± 2.00 kg, respectively.

Table 1: Mean, standard error and coefficients of variation of first lactation milk yield and milk composition traits of Sahiwal cattle

Trait	N	Mean± SE	CV (%)
FL305MY (kg)	328	1816.56 ± 40.79	29.5
ATDMY (kg)	328	6.61 ± 0.11	37.98
ATDFP (%)	328	4.76 ± 0.02	4.99
LFY (kg)	328	84.68 ± 2.00	39.81

Effect of Non-Genetic Factors

Analysis of variance (ANOVA) and overall least-squares means of first lactation milk yield and milk composition traits are presented in Table 2 and Table 3.

First Lactation 305-day or Less Milk Yield (FL305DMY)

The overall least-squares mean for first lactation 305-day or less milk yield in the present study was found to be 1874.05 ± 61.25 kg (Table 3). The highest milk yield was recorded for animals which calved in period-2 (2457.48 kg) while the least yield was recorded in period-5 (1421.76 kg). Effect of period of calving was

highly significant ($p < 0.01$) on this trait (Table 2). In accordance to the present finding significant effect of period of calving on FL305DMY was reported by many workers (Kumar, 2007; Sentitula, 2007; Raja, 2010; Manoj *et al.*, 2013; Dongre and Gandhi, 2014 and Prakash *et al.*, 2015). Effect of season of calving and age at first calving group was non-significant on first lactation 305-day or less milk yield in Sahiwal cattle (Table 2). Similar to the present study non-significant effect of season of calving on FL305DMY was reported by Kumar (2007); Raja (2010); Manoj *et al.* (2013); Dongre and Gandhi (2014); Prakash *et al.* (2015) and Yadav *et al.* (2018). Non-significant effect of age at first calving group on FL305DMY was also reported by many workers (Gupta, 2013; Dongre and Gandhi, 2014; Prakash *et al.*, 2015 and Yadav *et al.*, 2018) in Sahiwal cattle.

Table 2: Least-squares analysis of variance (M.S values) of first lactation milk yield and milk composition traits of Sahiwal Cattle

Sources of Variation	d.f.	FL305DMY	ATDMY	ATDFP	LFY
Period	8	3000460.98**	23.52**	1.03**	8091.11**
Season	3	422319.73 ^{NS}	4.07 ^{NS}	0.02 ^{NS}	1493.17 ^{NS}
Age group	3	879474.73 ^{NS}	7.25 ^{NS}	0.02 ^{NS}	1021.09 ^{NS}
Residual	313	476118.9	3.81	0.06	1136.6

** ($p < 0.01$); NS, nonsignificant

Table 3: Least-squares means along with their standard errors for first lactation milk yield and milk composition traits of Sahiwal cattle

TRAITS	N	FL305DMY	ATDMY	ATDFP	LFY
Overall(μ)	328	1874.05 \pm 61.25	6.72 \pm 0.17	4.81 \pm 0.02	88.75 \pm 2.99
P1 (1989-1991)	15	2041.00 ^{cd} \pm 190.24	7.19 ^{bc} \pm 0.54	5.11 ^e \pm 0.07	100.45 ^d \pm 9.29
P2 (1992-1994)	26	2457.48 ^e \pm 142.74	8.53 ^d \pm 0.40	5.03 ^e \pm 0.05	122.36 ^e \pm 6.97
P3 (1995-1997)	34	1936.83 ^{bcd} \pm 125.18	6.85 ^{bc} \pm 0.35	5.01 ^e \pm 0.04	94.86 ^{bcd} \pm 6.12
P4 (1998-2000)	30	1593.07 ^{ab} \pm 137.61	5.81 ^a \pm 0.39	4.77 ^{cd} \pm 0.05	72.48 ^a \pm 6.72
P5 (2001-2003)	30	1421.76 ^a \pm 137.82	5.70 ^a \pm 0.39	4.71 ^{bc} \pm 0.05	70.56 ^a \pm 6.73
P6 (2004-2006)	55	1705.77 ^{abc} \pm 105.17	6.28 ^{ab} \pm 0.30	4.83 ^d \pm 0.04	76.57 ^a \pm 5.14
P7 (2007-2009)	63	1782.82 ^{bc} \pm 96.69	6.36 ^{ab} \pm 0.27	4.64 ^{ab} \pm 0.03	82.61 ^{abc} \pm 4.72
P8 (2010-2012)	40	1728.09 ^{abc} \pm 119.47	6.29 ^{ab} \pm 0.34	4.59 ^a \pm 0.04	80.26 ^{ab} \pm 5.84
P9 (2013-2015)	35	2199.62 ^{de} \pm 128.47	7.51 ^{cd} \pm 0.36	4.60 ^{ab} \pm 0.04	98.60 ^{cd} \pm 6.28
S1 (Winter)	159	1879.87 \pm 58.10	6.92 \pm 0.16	4.81 \pm 0.02	89.61 \pm 2.84
S2 (Summer)	111	1762.29 \pm 68.74	6.49 \pm 0.19	4.78 \pm 0.02	82.01 \pm 3.36
S3 (Rainy)	44	1932.96 \pm 109.27	6.65 \pm 0.31	4.80 \pm 0.04	89.03 \pm 5.34
S4 (Autumn)	14	1921.07 \pm 191.08	6.83 \pm 0.54	4.84 \pm 0.07	94.34 \pm 9.34
AFC I (\leq 1020 days)	70	1712.91 \pm 100.92	6.32 \pm 0.29	4.83 \pm 0.03	83.53 \pm 4.93
AFC II (1021-1110)	105	1862.99 \pm 88.28	6.59 \pm 0.25	4.81 \pm 0.03	87.71 \pm 4.31
AFC III (1110-1200)	73	1920.61 \pm 96.80	6.90 \pm 0.27	4.82 \pm 0.03	90.76 \pm 4.73
AFC IV (\geq 1200)	80	1999.68 \pm 87.51	7.09 \pm 0.25	4.78 \pm 0.03	92.99 \pm 4.28

Means with different superscripts in a column differ significantly

Average Test Day Milk Yield (ATDMY)

The overall least-squares mean for first lactation average test day milk yield was 6.72 ± 0.17 kg (Table 3). Analysis of variance (Table 2) showed that period of calving had highly significant effect ($p < 0.01$) on first lactation average test day milk yield. However, the effect of season of calving and age at first calving group was found to be non-significant. Shyam (2015) also reported significant effect of period of calving on ATDMY in Sahiwal cattle. The highest and lowest daily milk yield values (8.53 kg and 5.70 kg) were recorded for animals which calved in period-2 and period-5, respectively.

Average Test Day Fat Percentage (ATDFP)

Average test day fat percentage in Sahiwal cattle was observed to be 4.81 ± 0.02 % in the present investigation (Table 3). The period of calving had highly significant effect ($p < 0.01$) on first lactation ATDFP (Table 2). Average test day fat percentage was found to be highest (5.11 %) in period-1 and lowest (4.59 %) in period-8. Non-significant effect of season of calving and age at first calving group was observed on first lactation ATDFP. Non-significant effect of season of calving on lactational fat percentage was reported by Kunaka *et al.* (2001) in Holstein Friesian cattle and Kunaka and Makuza (2005) in Jersey cattle. In agreement with the present study, non-significant effect of age at first calving group on lactational fat percentage was observed by Djemali and Berger (1992).

Lactational Fat Yield (LFY)

The overall least-squares mean for first lactation fat yield was 88.75 ± 2.99 kg (Table 3). The highest and lowest values (122.36 kg and 70.56 kg) were recorded for animals which calved in period-2 and period-5, respectively. The influence of period of calving was found to be highly significant ($p < 0.01$) on LFY (Table 2). Similar to the present finding many workers also observed significant effect of period of calving on lactational fat yield in different cattle breeds (Djemali and Berger, 1992; Musani and Meyer, 1997; Kunaka *et al.*, 2001 and Barbosa *et al.*, 2008). However, season of calving and age at first calving group had non-significant effect on first lactation fat yield.

Conclusion

In the present study significant effect of period of calving was found on first lactation milk yield and milk composition traits. It may be attributed to change in managerial conditions including feed fodder availability, managerial practices employed over the period and also probably due to change in the environmental conditions like temperature, rain fall and winter climatic conditions. Suitable measures should be adopted to nullify the effects of these factors to prevent the variation in lactation performance over the years.

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