International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 11, 2018, pp.-6257-6260.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

EFFECT OF NON-GENETIC FACTORS ON MILK YIELD AND MILK CONSTITUENTS IN SAHIWAL CATTLE

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Received: May 01, 2018; Revised: June 06, 2018; Accepted: June 07, 2018; Published: June 15, 2018

Abstract: The study conducted to records on milk constituent's traits of 100 Sahiwal cattle over a period of 13 years from 2004 to 2016, collected from Animal Genetics and Breeding division of ICAR-National Dairy Research Institute, Karnal, Haryana. The effect of various non-genetic factors on milk yield and milk constituent's traits mixed model least square analysis was used for analysis of data. Overall least square mean for all lactation traits revealed the first lactation 305 days milk yield, first lactation total milk yield, first lactation 305 days fat yield, first lactation 305 days SNF yield, first lactation 305 days protein yield in Sahiwal cattle was found to be 2034.99 ± 111.14 kg, 2314.56 ± 155.89 kg, 95.28 ± 5.19 kg, 172.72 ± 9.80 kg and 45.19 ± 3.95 kg, respectively. In the present study non-significant effect of season of calving, period of calving and age at first calving were found on first lactation 305 days milk yield in Sahiwal cattle. Period of calving and age at first calving had significant effect on FLTMY while, season of calving had non-significant effect on FLTMY in Sahiwal. In this study effect of period of calving was found to be significant on first lactation 305 days fat yield and season of calving and age at first calving had non-significant effect on first lactation 305 days fat yield. The period of calving, season of calving and age at first calving had non-significant effect on FL305DSNFY. In this study period of calving had significant effect on FL305DPY

Keywords: Sahiwal Cattle, Non-genetic factors, Milk Yield, Milk Constituents traits

Citation: Yadav Alok Kumar, *et al*., (2018) Effect of Non-Genetic Factors on Milk Yield and Milk Constituents in Sahiwal cattle. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 10, Issue 11, pp.- 6257-6260.

Academic Editor / Reviewer: Dr Kaiser Parveen

Introduction

India is a rich reservoir of genetic diversity in cattle with 41 recognized cattle breeds. The total number of cattle population was 190.90 million (37.28% of total livestock population) out of which indigenous cattle population comprised of 151.17 million [1]. The total milk production in India was 132.43 million tons (cattle contributes 43.11% with 59.92 million tons milk) in 2012-13 [2] and in terms of milk production, India ranks first in the world and as far as milk production is concerned Sahiwal is the best dairy breed of the Indian subcontinent. The Sahiwal breed had been termed due to its habitat in Montgomery district of Pakistan which is now name as Sahiwal and in India, number of herds of this breed is maintained. This is a comparatively heavy breed with a symmetrical body and loose skin. This breed is therefore, also known as Lola (loose skin), Lambi Bar, Montgomery, Multani, Teli [3]. Tough for increasing the productivity of dairy animals, augmenting the lactational milk yield has been emphasized; however, milk constituents have so far received little attention in breed improvement programme. The information is scanty on non-genetic factors influencing milk constituent's traits in Sahiwal cattle. The present investigation was therefore carried out to examine the effect and influence of non-genetic factors on milk yield along with milk constituent's traits.

Material and methods

The data for present study pertained to various milk production and milk constituent traits were collected from history sheets and milk constituent's registers, data on milk production and milk constituent's records of 100 Sahiwal cattle with spread over a period of 13 years from 2004 to 2016 were collected from Animal Genetics and Breeding division of ICAR-National Dairy Research Institute, Karnal, Haryana. All lactation traits considered in the present study were: study of the first lactation 305 days milk yield, first lactation total milk yield, first lactation 305 days fat yield, first lactation 305 days SNF yield, first lactation 305 days protein yield. As the performance records pertained to different month, year of calving and lactations data were classified in various categories as four periods *i.e*., 1st (2004-2006), 2nd (2007-2009), 3rd (2010-2012), 4th (2013-2016). Four seasons *i.e*., Winter (December-March), Summer (April-June), Rainy (July-September) and Autumn (October-November); In order to examine the effect of various non-genetic factors on milk yield and milk constituents, least squares analysis of variance for unequal and non-orthogonal data using the technique described by Harvey [4] was used to study effect of non-genetic factors. The model was used with assumptions that different components being fitted into the model are linear, independent and additive.

The following model was used for all lactation traits:

$$Y_{ijkl} = \mu + P_i + S_j + A_k + e_{ijkl}$$

Where,

Y_{ijkl} = k^{th} observation in i^{th} period, j^{th} season at k^{th} group of age at first calving
μ = Overall mean
P_i = Effect of i^{th} period of calving (i=1-4)
S_j = Effect of j^{th} season of calving (j=1-4)
A_K = Effect of k^{th} group of age at first calving (k=1-5)
e_{ijkl} = Random error NID (0, $\sigma^2 e$)

Duncan's multiple range test as modified by Kramer [5], was used for testing differences among least squares means. The differences were considered significant, if

$$(Yi - Yj)\sqrt{\frac{2}{(Cii + Cjj - 2\,Cij)}} > \sigma eZp, n_2$$

Where,

$(Y_i - Y_j)$ = Difference between two constants
C_{ii} = Diagonal element of i^{th} subclass

C_{jj} = Diagonal element of j^{th} subclass
C_{ij} = Diagonal element of ij^{th} subclass.
Z_p = Significant studentised value in Duncan's table at p, $n_2$df
p = Numbers of means in range chosen
n_2 = Degree of freedom of error

Results and Discussion

The overall least squares mean and analysis of variance of all the first lactation milk yield and its constituent traits in Sahiwal cattle are depicted in table 1, 2, 3, 4, 5, 6, 7, 8, 9 and 10. The least squares mean in the present study of the first lactation 305 days milk yield, first lactation total milk yield, first lactation 305 days fat yield, first lactation 305 days SNF yield, first lactation 305 days protein yield were found to be 2034.99 ± 111.14 kg, 2314.56 ± 155.89 kg, 95.28 ± 5.19 kg, 172.72 ± 9.80 kg, and 45.19 ± 3.95 kg, respectively.

First lactation 305 days milk yield

The overall least square mean for first lactation 305 days milk yield (FL305DMY) in Sahiwal Cattle was found to be 2034.99 ± 111.14 kg [Table-2]. While, the FL305DMY in Sahiwal cows has been reported 1303.88± 18.47 kg [6] to 2189.16 ± 47.60 kg [7] in the past. Non-significant effect of season of calving, period of calving and age at first calving were found in the present study in Sahiwal Cattle on first lactation 305 days milk yield [Table-1]. This indicates that season and period does not play a vital role in the expression of this trait in the present study conducted on Sahiwal cattle. However, many workers reported significant influence of season of calving [8, 9] and [7] on this trait. whereas Kumar, [10], Banik, [6], Kannan and Gandhi, [11], Singh, *et al*. [12], Dubey and Singh, [13], Kumar, [14], Raja, *et al*. [15], Raja, [16] Monalisa, *et al*. [17], Manoj, *et al*. [18], Verma, [19], Dongre, *et al*. [20] and Gupta [21] reported non-significant effect of season of calving on FL305DMY. The influence of period of calving on FL305DMY was non–significant reported by Banik, [6] and Mundhe, *et al*., [7] on the other hand Mohanty [8], Kumar, [10], Banik [6] Kannan and Gandhi, [11], Singh, *et al*., [12], Kumar, [14], Raja, *et al*. [15], Sentitula, *et al*., [22], Raja, [16], Monalisa, *et al*., [17], Manoj, *et al*. [18], Verma, [19], Dongre, *et al*., [20] and Gupta, [21] reported highly significant (P<0.01) effect of period of calving on this trait. Similarly, age at first calving does not seems to influence much for improvement in this trait in Sahiwal cattle in present study.

Table-1 Analysis of Variance of FL305DMY in Sahiwal Cattle

Source of Variation	df	SS	MSS	F
SOC	3	972908.60	324302.86	0.68
POC	3	3064833.61	1021611.20	2.15
AFC	4	3783044.61	945761.15	1.99
Error	89	42254298.58	474767.39	
Total	99	49589459.67		

Table-2 Least Square Mean and Standard Error of FL305DMY in Sahiwal Cattle

Factors	N	LSM (Kg)± SE
μ	100	2034.99 ± 111.14
SOC		
Dec-Mar	47	2076.89 ± 123.40
April-June	28	1860.78 ± 145.81
July-Sept	15	2128.58 ± 205.06
Oct-Nov	10	2073.71 ± 243.98
POC		
2004-06	5	2445.38 ± 318.26
2007-09	38	2032.28 ± 123.16
2010-12	35	1689.37 ± 159.11
2013-16	22	1972.94 ± 174.58
AFC		
<970	6	1750.50 ± 312.06
971-1074	17	1812.59 ± 197.45
1075-1178	33	2295.33 ± 149.96
1179-1282	20	2287.04 ± 172.34
>1282	24	2029.50 ± 166.58

First Lactation Total Milk Yield

First lactation total milk yield (FLTMY) in Sahiwal Cattle was observed to be 2314.56±155.89 kg in the present investigation [Table-4]. The season of calving had a significant effect (P < 0.05) on first lactation total milk yield as reported by Basu and Gupta [23], Narayankhedkar *et al*. [24], Singh [25], Rao [26], Singh [27] and Singh *et al*. [12] in Sahiwal and Sahiwal crosses, respectively. On the contrary, non-significant influence of season of calving on this trait was observed by Nagpal and Acharya [28], Chawla and Mishra [29], Reddy [30], Raja [31], Banik [6] and Bajetha [32] and Nehra [33] in Sahiwal and its crosses. In the present investigation, period of calving and age at first calving had significant effect on FLTMY while, season of calving had non-significant effect on FLTMY in Sahiwal. [Table-3]. The influence of period of calving on FLTMY was significant reported by Jadhav *et al*. [34], Tomar *et al*. [35], Kumar [14], Manoj [36] and Raja [16] whereas Chawla and Mishra [29] and Rao [26] reported non-significant effect of period of calving on First lactation total milk yield. In Sahiwal and its crosses period of calving was found to have a significant effect [37]. Lindstrom and Solbu [38] reported significant effect of year of calving on this trait in Sahiwal and Sahiwal crosses in Kenya. Singh [39], Singh [27] and Javed, *et al*., [40] reported highly significant (P < 0.01) effect of year of calving on this trait. Period of calving had significant effect on FLTMY as reported by Nagpal and Acharya [28], Reddy [30]; Kannan [41], Raja [31], Banik [6], Singh, *et al*. [12] and Bajetha [32] reported highly significant effect of period of calving on First lactation milk yield. on the other hand, Mohanty [8], Kumar [10], Banik [6] Kannan and Gandhi [11], Singh *et al*. [12], Kumar [14], Raja *et al*. [15], Sentitula, *et al*. [22], Raja [16], Monalisa *et al*. [17], Manoj, *et al*. [18], Verma [19], Dongre, *et al*. [20] and Gupta [21] reported highly significant (P<0.01) effect of period of calving on this trait.

The influence due to this non-genetic factor is due to change in managemental conditions including feed fodder availability, managemental practices employed over the period and also probably due to change in the environmental conditions like temperature, rain fall and winter climatic conditions. Since this is a quantitative trait governed by many pairs of gene and classically trait expression is largely due to above mentioned factors.

Table-3 Least Square ANOVA for FLTMY in Sahiwal Cattle

Source of Variation	df	SS	MSS	F
SOC	3	1509305.24	503101.74	0.539
POC	3	10181639.80	3393879.93	3.633*
AFC	4	11334972.74	2833743.18	3.034*
Error	89	83131521.03	934062.03	
Total	99	103787025.94		

*Significant (p<0.05)

Table-4 Least Square Mean and Standard Error of FLTMY in Sahiwal Cattle

Factors	N	LSM (Kg)± SE
μ	100	2314.56 ± 155.89
SOC		
Dec-Mar	47	2383.53 ± 173.08
April-June	28	2101.01 ± 204.53
July-Sept	15	2335.51 ± 287.62
Oct-Nov	10	2438.20 ± 342.22
POC		
2004-06	5	3015.03 ± 446.41^{c}
2007-09	38	2265.70 ± 172.75^{b}
2010-12	35	1681.63 ± 223.17^{a}
2013-16	22	2295.90 ± 244.87^{b}
AFC		
<970	6	1813.29 ± 437.72^{a}
971-1074	17	1905.57 ± 276.95^{a}
1075-1178	33	2736.57 ± 210.34^{c}
1179-1282	20	2781.96 ± 2781.96^{c}
>1282	24	2335.43 ± 233.66^{b}

The mean values with different superscript alphabet indicate highly significant difference (p<0.05) among themselves.

First Lactation 305 Days Fat Yield (FL305DFY)

The overall least square means for first lactation 305 days fat yield (FL305DFY) in Sahiwal Cattle in the present study were found to be 95.28± 5.19 kg [Table-6]. Verma [42] estimated 305 days fat yield (305 DFY) in Sahiwal cattle which is as 96±1.2 kg. In this study effect of period of calving was found to be significant on first lactation 305 days fat yield in Sahiwal cattle and season of calving and age at first calving had non-significant effect on first lactation 305 days fat yield in Sahiwal cattle [Table-5]. The effect of period of calving on fat percent was observed significant by most of workers [19]. Verma [42] observed a highly significant (P<0.01) effect of period of calving and significant effect of season of calving on 305DFY.

Table-5 Least Square ANOVA for FL305DFY in Sahiwal Cattle

Source of Variation	df	SS	MSS	F
SOC	3	2912.18	970.72	0.94
POC	3	8827.24	2942.41	2.84*
AFC	4	8929.48	2232.37	2.15
Error	89	92320.15	1037.30	
Total	99	111530.98		

*Significant (p<0.05)

Table-6 Least Square Mean and Standard Error of FL305DFY in Sahiwal Cattle

Factors	No	LSM (Kg)± SE
μ	100	95.28 ± 5.19
SOC		
Dec-Mar	47	98.36 ± 5.76
April-June	28	86.13 ± 6.81
July-Sept	15	99.98 ± 9.58
Oct-Nov	10	96.65 ± 11.40
POC		
2004-06	5	118.04 ± 14.87^{c}
2007-09	38	94.45 ± 5.75^{b}
2010-12	35	76.66 ± 7.43^{a}
2013-16	22	91.97 ± 8.16^{b}
AFC		
<970	6	80.94 ± 14.58
971-1074	17	85.22 ± 9.22
1075-1178	33	107.75 ± 7.00
1179-1282	20	108.09 ± 8.05
>1282	24	94.42 ± 7.78

Table-7 Least Square ANOVA for FL305DSNFY in Sahiwal Cattle

Source of Variation	df	SS	MSS	F
SOC	3	7022.36	2340.78	0.63
POC	3	16617.49	5539.16	1.49
AFC	4	25252.09	6313.02	1.70
Error	89	329055.47	3697.25	
Total	99	375589.95		

Table-8 Least Square Mean and Standard Error of FL305DSNFY in Sahiwal Cattle

Factors	No	LSM (Kg)± SE
μ	100	172.72 ± 9.80
SOC		
Dec-Mar	47	176.98 ± 10.88
April-June	28	158.62 ± 12.86
July-Sept	15	181.53 ± 18.09
Oct-Nov	10	173.75 ± 21.50
POC		
2004-06	5	190.47 ± 28.08
2007-09	38	178.06 ± 10.86
2010-12	35	148.83 ± 14.04
2013-16	22	173.53 ± 15.40
AFC		
<970	6	154.03 ± 27.53
971-1074	17	152.36 ± 17.42
1075-1178	33	193.13 ± 13.23
1179-1282	20	192.86 ± 15.20
>1282	24	171.24 ± 14.70

First Lactation 305 days Solid Not Fat Yield (FL305DSNFY)

The overall Least Square means and standard error of FL305DSNFY in Sahiwal Cattle was 172.72 ± 9.80 kg [Table-8]. Verma [42] reported FL 305 days SNF yield in Sahiwal cattle was 177± 2.3 kg. In this study Period of calving, season of calving and age at first calving had non-significant effect on FL305 DSNFY in Sahiwal Cattle [Table-7]. Verma [42] observed that the period of calving had highly significant (P<0.001) effect on 305DSNFY whereas season of calving had significant effect on this trait. The influence of season of calving on SNF percent have been observed non-significant by most of the workers, although some workers Suman, [43] have observed significant effect also. The effect of period of calving on SNF percent was observed significant by most of researchers.

First Lactation 305 days protein yield (FL305DPY)

First lactation 305-days protein yield (FL305DPY) in Sahiwal Cattle was observed to be 45.19 ± 3.95 kg in the present investigation [Table-10]. In this study period of calving had significant effect on and FL305DPY in Sahiwal Cattle [Table-9]. The influence of season on FL305DPY in the present investigation was found to be non-significant [Table-10]. Verma [19] reported the lactation average protein percent among the progeny groups of different sires varies from 3.17±0.05% to 3.41±0.05% in Sahiwal cattle and autumn calvers had highest (3.30± 0.01%) and the rainy season calvers had lowest (3.24± 0.01%) in Sahiwal cattle. These differences among cows calved in different seasons were significant in Sahiwal cattle. Verma [19] found that cows calved in period (2005-06) had highest (3.48± 0.02%) and lowest (3.11± 0.01%) in period (2009-10) in Sahiwal cattle. These differences in protein percent over different periods of calving was Found to be significant in Sahiwal cattle.

Table-9 Least Square ANOVA for A305DPY in Sahiwal Cattle

Source of Variation	df	SS	MSS	F
SOC	3	1647.14	549.04	0.91
POC	3	7051.07	2350.35	3.90*
AFC	4	4229.41	1057.35	1.75
Error	89	2912.18	970.72	
Total	99	68676.25		

*Significant (p<0.05)

Table-10 Least Square Mean and Standard Error of FL305DPY in Sahiwal Cattle

Factors	N	LSM (Kg)± SE
μ	100	45.19 ± 3.95
SOC		
Dec-Mar	47	43.64 ± 4.39
April-June	28	37.42 ± 5.19
July-Sept	15	47.69 ± 7.30
Oct-Nov	10	52.01 ± 8.69
POC		
2004-06	5	47.09 ± 11.33^{b}
2007-09	38	56.97 ± 4.38^{c}
2010-12	35	37.35 ± 5.66^{a}
2013-16	22	39.35 ± 6.21^{b}
AFC		
<970	6	32.13 ± 11.11
971-1074	17	37.63 ± 7.03
1075-1178	33	54.76 ± 5.34
1179-1282	20	50.72 ± 6.13
>1282	24	50.71 ± 5.93

Conclusion

In the present study non significant effect of season of calving, period of calving and age at first calving were found on first lactation 305 days milk yield. Period of calving and age at first calving had significant effect on FLTMY while, season of calving had non-significant effect on FLTMY. In this study effect of period of calving was found to be significant on first lactation 305 days fat yield and season of calving and age at first calving had non-significant effect on first lactation 305 days fat yield. The period of calving, Season of calving and age at first calving had non significant effect on FL305 DSNFY.

In this study period of calving had significant effect on and FL305DPY. For all lactation traits, winter calvers produced higher quantity of milk with low milk constituent's percentage.

Application of research: Find out the effect of non-genetic factors on milk yield and milk constituents in Sahiwal cattle at ICAR-National Dairy Research Institute, Karnal, Haryana

Research Category: Dairy Research

Abbreviations:
SOC: Season of calving
POC: Period of calving
AFC: Age at first calving

Acknowledgement / Funding: Author thankful to ICAR-National Dairy Research Institute, Karnal, 132001, Haryana

***Research Guide or Chairperson of research: Dr Anupama Mukherjee**
University: ICAR-National Dairy Research Institute, Karnal, 132001, Haryana
Research project name or number: PhD Thesis

Author Contributions: All author equally contributed

Author statement: All authors read, reviewed, agree and approved the final manuscript

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.

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