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Effect of genetic and non-genetic factors on milk yield and milk constituents of Sahiwal cattle

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ABSTRACT : The present study pertained to records on milk production and milk constituents of 259 Sahiwal cattle with 600 lactations spread over a period of 10 years from 2001 to 2010, collected from Dairy Cattle Breeding division of National Dairy Research Institute, Karnal, Haryana. To study the effect of various genetic and non-genetic factors on milk yield and milk constituents traits, mixed model least square analysis was used for analysis of data. Overall least square mean for all lactation traits of total milk yield (TMY), milk yield in 305 days or less (305MY), lactational average fat per cent (LFA) and lactational average solid not fat per cent (LSA) were 1880.39 ± 73.82 kg, 1782.97 ± 68.37 kg, 4.71 ± 0.01 per cent and 8.81 ± 0.01 per cent, respectively. Analysis of variance showed that the differences were statistically significant for the effect of sire on TMY and 305MY; period on all the traits except TMY; parity on 305MY. However, the effect of season of calving was not found significant on all the traits.

KEY WORDS : Genetic and non-genetic factors, Mixed model, TMY, 305MY, LFA, LSA

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INTRODUCTION

Livestock plays an important role in rural economy in India which contributes about 28-30 per cent to agricultural GDP (DADF, MOA, GOI, 2011). As per the 18th All India Livestock Census (DADF, MOA, GOI, 2011), out of the total cattle and buffalo population, India has 199.07 million (65.40 %) cattle, out of which166 million are indigenous cattle and approx 46 lacs are Sahiwal cattle (Kumar, 1984). This is the most important indigenous cattle milch breed in Indian scenario. 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 genetic and non-genetic factors influencing milk constituents traits in Sahiwal cattle (Patro and Bhat, 1979). The present investigation was, therefore, carried out to examine the effect and influence of genetic and non-genetic factors on milk yield along with milk constituents traits.

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MATERIAL AND METHODS

The data for present study pertained to various milk production and milk constituents traits were collected from history sheets and milk constituents registers, data on milk production and milk constituents records of 259 Sahiwal cattle with 600 lactations spread over a period of 10 years

from 2001 to 2010 were collected from Dairy Cattle Breeding division of National Dairy Research Institute, Karnal, Haryana. All lactation traits considered in the present study were: total milk yield (TMY), milk yield in 305 days or less (305MY), Lactational average fat per cent (LFA) and lactational average solid-not-fat per cent (LSA). As the performance records pertained to different month, year of calving and lactations data were classified in various categories as five periods *i.e.* 1st (2001-2002), 2nd (2003-2004), 3rd (2005-2006), 4th (2007-2008) and 5th (2009-2010); four seasons *i.e*. winter (December-March), summer (April-June), rainy (July-September) and autumn (October-November); six group in parities *i.e.* 1st (1st parity), 2nd (2nd parity), 3rd (3rd parity), 4th (4th parity), 5th (5th parity) and 6th (6th and above parity). In order to examine the effect of various genetic and non-genetic factors on milk yield and milk constituents, mixed model least square procedure (Harvey, 1975) was used for analysis of data.

The following model was used to discern the influence of effect of sire, season, period and parity order on milk production and milk constituents traits.

$$y_{ijklm} = \mu + c_i + s_j + p_k + l_l + e_{ijklm}$$

where, y_{ijklm} = Total lactation milk yield, milk yield in 305 days or less, lactational average fat per cent and lactational average solid-not-fat per cent of daughter of i^{th} sire in j^{th} season of k^{th} period under l^{th} parity.

μ = Overall mean

c_i = Effect of i^{th} sire (i = 1, 2, ……,30)

s_j = Effect of j^{th} season of calving (j = 1, 2, 3, and 4)

p_k = Effect of k^{th} period of calving

l_l = Effect of l^{th} order of parity

e_{ijklm} = Random error associated with y^{th}_{ijklm} observation, assumed to be NID (0, σ^2_e).

RESULTS AND DISCUSSION

Overall least squares mean and means in different periods, seasons and order of parities along with standard error of various milk and milk constituent traits are presented in Table 2 and analysis of variance is in Table 1.

Milk yield traits :

Among the progenies of different sires, least-squares means of TMY and 305MY ranged from 1322.80 ± 226.26 kg to 2858.63 ± 392.05 kg and 1168.78 ± 86.85 kg to 2538.63 ± 293.60 kg, respectively (Prakash and Tripathi, 1990 and Pyne *et al*., 1990). The variation in TMY and 305MY among the progenies of different sires was found to be statistically significant (P<0.01). The means among the different season showed that winter calvers produced non-significant higher quantity of milk in all parities as compared to those calved in other seasons (Table 2). This may be because of good quality and quantity of green fodder during the winter season. The effect of season of calving on TMY and 305MY was found to be statistically non-significant. Similar results were reported by Manoj (2009) and Raja (2010). Highest TMY and 305MY was found in 4th period (2007-2008), while it was lowest in 2nd period (2003-2004). The effect of period of calving on TMY was found to be statistically non-significant, the differences in 305MY were significant for the period of calving. Similar results were reported by Kumar (2007); Rohilla *et al.* (1992); Chhikara *et al.* (1994); Lal and Narayanan, 1984 ; Sarkar *et al.* (2006); Manoj (2009) and Raja (2010). When viewed across the different parities, 3rd parity showed highest TMY and 305MY whereas, 5th parity were found to be associated with lowest value for both TMY and 305MY traits. The result revealed that the optimum TMY and 305MY found in 3rd and 4th parity. The least square analysis of variance revealed non-significant effect of order of parity. Similar result were reported by Godara *et al.* (1990) and Dalal *et al.* (1993).

Milk constituent traits :

Differences in all lactation milk constituent traits due to sires were non-significant for both traits (LFA and LSA). The effect of season of calving and order of parity were found to be statistically non-significant. Effect of period of calving was found to be significant for both LFA and LSA trait (Table 1). The least square mean of LFA was found highest (4.82 ± 0.02) in 3rd period (2005-2006) and lowest (4.55± 0.02) in 5th period (2009-2010) (Table 2). Similar results were reported by Pandey *et al.* (1986). The mean of LSA was found highest (8.90 ± 0.03) in 1st period (2001-2002) and lowest (8.71 ± 0.01) in 5th period (2009-2010) (Table 2). Similarly Misra (2000) and Raja (2010) reported significant effect of period of calving on LSA and LFA, respectively.

Conclusion :

For all lactation traits, winter calvers produced higher quantity of milk with low milk constituents percentage,

Table 1 : Least square analysis of variance (mean square values) of all parities milk yield and milk constituent traits in Sahiwal cattle

Source of variation	Mean squares			
	TMY	305MY	LFA	LSA
Sire (29)	1443619.27**	1188823.96**	0.0267	0.0017
Season (3)	1384010.96	1070942.44	0.0083	0.0041
Period (4)	1686566.97	1431986.20*	0.7047**	0.2473*
Parity (5)	1031743.47	1422265.54*	0.0372	0.0048
Error (558)	808861.28	561903.90	0.0243	0.0031

Figures in parentheses indicate respective degrees of freedom; * and ** indicate significance of values at P=0.05 and P=0.01, respectively

Table 2 : Least square means of all parities milk yield and milk constituent traits in different seasons of calving, periods and parity

Effect	Traits			
	TMY (kg)	305MY (kg)	LFA (%)	LSA (%)
Overall (600)	1880.39 ± 73.82	1782.97 ± 68.37	4.71 ± 0.01	8.81 ± 0.01
Seasons of calving				
Winter (254)	2102.07 ± 138.24	1978.63 ± 119.02	4.69 ± 0.02	8.80 ± 0.01
Summer (78)	1833.14 ± 92.31	1739.25 ± 82.52	4.71 ± 0.01	8.81 ± 0.01
Rainy (114)	1781.53 ± 105.05	1697.24 ± 92.50	4.70 ± 0.02	8.79 ± 0.01
Autumn (54)	1804.80 ± 85.62	1716.76 ± 77.34	4.72 ± 0.01	8.82 ± 0.01
Period of calving				
2001-2002 (61)	1789.57 ± 155.75	1663.23^{a} ± 133.20	4.73^{c} ± 0.03	8.90^{e} ± 0.01
2003-2004 (99)	1671.20 ± 121.72	1567.00^{a} ± 105.75	4.77^{c} ± 0.02	8.85^{d} ± 0.01
2005-2006 (122)	1906.32 ± 112.03	1826.09^{b} ± 90.03	4.82^{d} ± 0.02	8.83^{c} ± 0.01
2007-2008 (153)	2084.17 ± 108.76	1952.70^{b} ± 95.43	4.66^{b} ± 0.02	8.74^{a} ± 0.01
2009-2010 (165)	1950.67 ± 125.22	1905.82^{b} ± 108.55	4.55^{a} ± 0.02	8.71^{b} ± 0.01
Order of parity				
1st (119)	1931.54 ± 113.42	1751.01^{bc} ± 99.13	4.69 ± 0.02	8.81 ± 0.01
2nd (120)	2015.66 ± 103.46	1938.86^{d} ± 91.25	4.74 ± 0.02	8.82 ± 0.01
3rd (86)	2018.47 ± 113.11	1942.41^{d} ± 98.96	4.72 ± 0.02	8.81 ± 0.01
4th (53)	1966.66 ± 129.56	1888.02^{cd} ± 112.03	4.69 ± 0.02	8.79 ± 0.01
5th (29)	1592.86 ± 168.31	1561.65^{a} ± 143.42	4.69 ± 0.02	8.79 ± 0.01
6th and above (37)	1757.12 ± 168.17	1615^{a} ± 143.29	4.70 ± 0.02	8.81 ± 0.01

Figures in parentheses indicate respective number of observation Means with same superscript do not differ significantly (P<0.05)

3rd and 4th lactation produce higher quantity with low milk constituents percentage in Sahiwal cattle.

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