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Effect of Season, Parity and Stage of Lactation on Productive Performance of Sahiwal Cattle

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ABSTRACT

The study was conducted to understand the effect of season, parity and stage of lactation on productive performance of Sahiwal cattle. The data of productive traits of 133 Sahiwal cattle from 2016 to 2018 maintained at the Livestock Research Center, Karnal, Haryana, were used for this study. The production data were analyzed using least-square procedures based on season, parity and stage of lactation. Results indicated that the parity had significant ($p<0.05$) influence on monthly milk yield (MMY) whereas, the stage of lactation had highly significant ($P<0.01$) influence on monthly milk yield (MMY) and test day milk yield (TDMY). However, there was no significant effect of season on different productive performance traits in Sahiwal cattle. The phenotypic parameter estimates indicated that the parity and stage of lactation of cattle can be used as a selection tool for improvement of productive traits considering its high positive phenotypic correlations with succeeding productive traits in Sahiwal cows.

Key words: Parity, Productive traits, Sahiwal, Season, Stage of lactation.

INTRODUCTION

Sahiwal is one of the most important dairy cattle breed of India. Due to its heat tolerance and disease resistant qualities, Sahiwal has gained international recognition. This may be evident from the eight synthetics (Australian-Friesian-Sahiwal, Australian Milking Zebu, Frieswal, Jamaica Hope, Karan Swiss, Mafriwal, Mpwapwa and Taurindicus) produced for tropical/subtropical conditions (Ilatsia *et al*., 2012). In the home country, however, performance of the breed has not improved over the years (Dahlin *et al*., 1998) due to lack of knowledge among farmers regarding artificial insemination, selective breeding lack of any breeding program and selection of breeding bulls on the basis of performance of their dams, instead of progeny performance may be some of the reasons for this situation (Bhatti *et al*., 2007).

Milk yield is the most important economic trait determining economic returns to the dairy farmers and is influenced by several factors. When the genetic component of variance is low for a trait, it shows low heritability and the environment has the greatest influence on that trait (Price *et al*., 1991). Non-genetic factors include feeding (nutrition), housing and management conditions; climate, including ambient temperatures; calving year, season and age; number of lactations; body weight; estrus; number of pregnancies; disease; and milking frequency and duration (Cunha *et al*., 2008; Alpan and Aksoy, 2015) tend to suppress or inhibit the expressivity of the true genetic ability of the animals in various ratios according to climatic conditions.

Hence, to find out the true genetic ability of the animals it is essential to estimate the contribution of environmental factors in milk production in the model. With this background, this study aimed to evaluate the effects of season, parity and stage of lactation on productive performance of Sahiwal cattle, which will help to formulate suitable evaluation procedures especially in organized farms for improving economic traits of this breed.

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MATERIALS AND METHODS

Location of the study

The experiment was conducted at the National Dairy Research Institute, Karnal located at an altitude of 250 meters above the sea level, in the indo-gigantic alluvial plains at 29°42′N and latitude 72°54′E longitude. The climate is subtropical in nature with temperature ranging between 2°C winter and 45°C in summer respectively. The area receives an annual rainfall of 760 - 960 mm and relative humidity 41-85%.

Parameters studied

Data comprises of milk production trait of Sahiwal cattle from 2016 to 2018 were utilized (2 years) for the studies. Data of productive traits (including monthly milk yields (MMY), test

day milk yield (TDMY), 305 days or less milk yield (305DMY), total milk yield (TMY) were collected and utilized for this study. The data were analyzed to examine the effects of season, period and stage of lactation on different productive traits.

Each year was divided into four major seasons, *viz*. winter (December - March), summer (April - June), rainy (July - September) and autumn (October - November) depending on prevalent meteorological factors as recorded in CSSRI, Karnal (Singh, 1983). The entire parity was grouped into five parity (1-5). The stage of lactation was divided into Class 1 (0-90 days), Class 2 (90-180 days), Class 3 (180-270 days) and Class 4 (more than 270 days).

Statistical analysis

The data were subjected to Least squares analysis of variance using LSMLMW PC-2 VERSION software package (Harvey, 1990) for the effects of seasons, parity and stage of lactation on monthly milk yields (MMY), test day milk yield (TDMY), 305 days or less milk yield (305DMY) and total milk yield (TMY) Table 1. The model was used with assumptions that different components being fitted into the model are linear, independent and additive. Duncan's multiple range test (DMRT), as modified by Kramer, (1957) was used for testing the differences among least-squares means (using inverse coefficient matrix) between subclasses of seasons, parity and stage of lactation. All the experiment procedures were duly approved by the Institute Animal Ethics Committee (Indian Council of Agricultural Research - NDRI). The Least Squares Analysis model used is given below:

$$Y_{ijkl} = \mu + L_i + P_j + S_k + e_{ijkl}$$

Where,

Y_{ijkl} = l^{th} Observation of cow in i^{th} stage of lactation, j^{th} parity and k^{th} season of calving

μ = Overall mean

L_i = Fixed effect of i^{th} stage of lactation (i=1 to 4)

P_j = Fixed effect of j^{th} parity j = 1 to 5)

S_k = Effect of k^{th} season of calving (l=1 to 4)

e_{ijkl} = Random error NID (0, σ^2_e)

RESULTS AND DISCUSSION

Monthly milk yield (MMY)

The overall least squares means for MMY was 206.89±19.04 kg (Table 2). The results shows that the season was not having significant influence on monthly milk yield. Stage of lactation had highly significant (P<0.01) influence on monthly milk yield. Cows calved during first stage of lactation had maximum MMY followed by 2nd stage of lactation and minimum MMY was observed in third stage of lactation. Parity was also having significant (P<0.05) influence on monthly milk yields of Sahiwal cattle. Cows, calved in the first parity showed lower MMY as compared to those cows in the fourth parity, which showed maximum MMY and also those cows calved in summer season had maximum MMY, while rainy season had lowest MMY.

Test days milk yield (TDMY)

The overall least squares means of TDMY was 7.71±4.10 kg (Table 2). The season of calving had no influence on test day milk yield. Highest test day milk yield and lowest test day milk yield were observed in autumn and winter season, respectively. Parity also did not influence the test day milk yield. But, test day milk yield was highest in third parity and lowest test day was observed in fourth parity. Stage of lactation had highly significant (P<0.01) influence on test day milk yield and highest TDMY was observed in first stage of lactation followed by second stage of lactation and least test day milk yield was observed in third stage of lactation.

305 day milk yield (305 DMY)

The overall least squares means for 305 days milk yield in the present study was 1817.51±965.87 kg (Table 2). The significant influence effect of non-genetic (Season, Stage of lactation and parity) was not observed on 305 DMY. It was observed that autumn calvers showed highest 305 DMY and cows calved in rainy season showed the least 305DMY. The animals in third parity had maximum 305 DMY and animal in fifth or more parity had lowest 305DMY.

Total milk yield (TMY)

The overall least squares mean of total milk yield was 1934.35 ±1062.23 kg (Table 2). The season of calving had no significant effect on TMY. It was observed that autumn calvers showed highest 305DMY, while minimum was in rainy season. The parity also did not influence the TMY and highest TMY was observed in fourth parity followed by third parity and least TMY was observed in fifth or more parity.

The stage of lactation had highly significant (p<0.01) effect on monthly milk yield in Sahiwal cattle. In the present study, monthly milk yield showed a decreasing trend up to third stage of lactation followed by increasing trend with lactation stage in Sahiwal cattle. The parity had significant (p<0.05) effect on monthly milk yield. Jinger *et al.* (2014) and Japheth *et al.* (2015) also reported significant (P<0.01) influence of parity on milk yield in Karan Fries cows whereas by Kumari (2019) and Sinha (2019) in Sahiwal cows. Monthly milk yield showed an increasing trend up to 4th parity and decreases after that as parity increases in Sahiwal cattle.

Stage of lactation had highly significant (p<0.01) effect on test day milk yield. Highly significant (p<0.01) effect of stage of lactation on TDMY in Sahiwal, Karan Fries, Tharparkar cows and Murrah buffaloes were reported by Sarkar *et al*. (2006) and in Holstein dairy cows by Cobanglu *et al*. (2017). Khan and Khan (2016) also reported the effect of stage of lactation on test day milk yield in Sahiwal cattle. In present study, test day milk yield showed a decreasing trend with lactation stage in Sahiwal cattle. The least squares analysis of TDMYs obtained in the present study were more or less neighboring with those reported by Galsar (2015) and Penchev *et al.* (2011) in Murrah buffaloes, but the estimates of present findings were slightly higher. Contrary

Table 1: Effect of non-genetic factors on milk production traits in Sahiwal cattle.

Source	df	MMY	TDMY	305 DMY	TMY
		3	3	3	3
Season	SS	40495.53	23.59	1175758.25	2134245.92
	MSS	13498.51	7.86	391919.41	711415.30
	df	4	4	4	4
Parity	SS	148280.30	33.95	858025.18	1309692.87
	MSS	37070.07*	8.48	214506.29	327423.21
	df	3	3		
Stage of lactation	SS	341653.10	261.92		
	MSS	113884.36**	87.30**		

** 1% level of significance; * 5% level of significance.

Table 2: Least squares means for milk production traits in Sahiwal cattle.

Effects	MMY (kg)	TDMY (kg)	305 DMY (kg)	TMY (kg)
Overall	234.36±141.86	7.71±4.10	1817.51±965.87	1934.35±1062.23
		Season		
Summer (52)	220.30±22.53	7.37±0.65	1839.11±184.46	1923.19±206.38
Rainy (29)	181.54±25.39	6.11±0.73	1727.70±207.88	1835.21±232.58
Autumn (5)	212.91±68.37	8.39±1.99	2186.27±559.74	2304.50±626.24
Winter(47)	212.83±22.33	6.98±0.65	1894.51±182.87	2162.51±204.60
		Parity		
1(23)	128.98^{a}±31.73	10.27±1.05	1734.41±237.45	1884.36±260.23
2(45)	183.50^{b}±24.94	9.64±1.11	1662.83±187.24	1781.17±205.20
3(26)	156.51^{ab}±30.08	11.76±1.28	1843.54±226.38	1794.64±248.10
4(15)	253.33^{c}±37.21	8.49±1.45	1771.35±280.88	2036.23±307.83
>5(24)	185.63^{b}±26.66	8.93±1.47	1602.59±204.95	1673.38±224.62
		Stage of lactation		
1(66)	268.01^{c}±24.56	8.58^{c}±0.74		
2(34)	192.71^{b}±31.56	6.72^{b}±0.95		
3(18)	125.15^{a}±31.14	4.53^{a}±0.94		
4(15)	140.49^{a}±37.47	4.93^{a}±1.13		

(Different superscripts indicate significant differences).

to present findings, Tailor and Singh (2011) reported the late decline in milk yield after TDMY with lower estimates for monthly test day milk yields in Surti buffalo.

The lactation performance of dairy cattle is usually measured by determining total milk yield per lactation or per year, average daily milk yield, lactation length, persistency of milk production and milk composition. Performance of dairy animal is judged from the milk it produces during a specified period of lactation. Overall least squares mean for 305 DMY in the present study was lower compared to an earlier report by Chauhan *et al*. (1976), who found the estimates ranging from 2146.2 to 2188.2 kg in Sahiwal, Tharparkar and Red Sindhi cows. This might be due to uniformity in the availability of feeds and fodders throughout the year and also due to adaptability of animals to local climatic conditions. Higher 305 DMY than present study were reported by Nagarcenkar and Rao (1982) in Holestein Friesien and Tharparkar crosses and by Parmar *et al.* (1986), Pyne *et al.* (1988), Kumar (1992) and Singh (1995) in various crossbred. Higher average 305DMY was given by Rahman and Alemam (2008) in HF and zebu cross. The higher 305 DMY of cows calved in autumn season might be because of availability of good quality green fodder and pleasant weather condition. Rainy season calvers showed the least 305 DMY might be due to non-availability of fresh fodder, higher humidity and unhygienic conditions which are predisposing factors for diseases leading to reduce productivity. Rashia (2006) and Divya (2012) in Karan Fries cattle also observed non-significant effect of season of calving on 305 DMY. However, in contrast to our finding Saha *et al.* (2010) found significant effect of season of calving on 305DMY, while Dalal *et al.* (1991), Jadhav *et al.* (1991) and Singh (1995) reported that the period of calving was highly significant (P<0.01) on 305DMY in various crossbred. Similar results were reported by Taneja and Sikka (1981) in Tharparkar, Sahiwal and Red Sindhi, by Rao *et al*. (1984) in Ongole, Tharparkar, Malvi and crossbreds. The least square analysis of variance revealed no significant effect of order of parity on 305 day milk yield. Similar results were observed by Verma *et al.*, (2016), where 3rd parity showed highest

305 days whereas, Bajwa *et al*. (2004) reported that milk yield increases with increase in parity and maximum production was obtained around 4th and 5th parities there after there was a declining trends. Similarly anderson, (1985) and Pawar *et al*. (2012) also reported that production of cow reached the peak around fifth parity when an animal was seven to eight years old and gained the adult body size which was dissimilar from present findings. Bagnato and Oltenacu (1994) showed that cows of the same age but different parity have different production and that differences were particularly evident for the first and second parity. The highest 305 days MY was observed in animals in fifth parity with no consistent increase or decrease over the advancement of the parities was also a disagreement statement given by Ahmad *et al.* (1993) and Javed *et al*. (2001). Tilki *et al*. (2005), Bhuiyan *et al*. (2004), Prasad *et al*. (2010) and Deng *et al*. (2012) observed that udder measurements were affected by lactation number. This might be due to the continuous development of udder tissues up to 6th parity, after which the tissues start to regress as the age advances. Similarly, Lavania *et al*. (2011) found that gradual increment of udder measurement occurs with parity and it declined from 5th parity onwards in Surti buffaloes. There was an exception in the findings of Patel *et al*. (2016) who reported an increase in udder depth and width as the number of parity increased while he noticed a decline in udder length in 4th parity but then again it increased in 5th parity.

The overall least squares mean of total milk yield in the present study was similar to the reports of Sundaresan *et al.* (1965), but lower in comparison to that reported by Puri and Sharma (1965). Effect of season of calving was found to be non-significant, similar results were reported by Manoj (2009) and Raja (2010) in Sahiwal cattle and Bhatnagar *et al*. (1982) in Tharparkar cattle. Bhattacharya *et al.*, (1993), Nayak and Raheja (1996) in HF crosses and Singh (1995) in KF reported higher TMY in HF and SW crosses in contrast to present finding. However, in contrast to our finding Parmar *et al.* (1986) reported that season of calving was significant (P<0.01) on TMY in HF/Red Sindhi cross with SW, Singh and Tomar (1991) in KF cattle and Raheja (1994) in HF cross with Hariana. Cows might experience favourable climatic conditions and better availability of green fodder during autumn season. The least square analysis of variance revealed non-significant effect of order of parity on total milk yield. Similar result were reported by Godara *et al*. (1990) and Dalal *et al*. (1993) where as Rehman and Khan (2012) reported significant (P<0.01) influence on TMY in Sahiwal cows. The variation of milk yield in different periods could be due to management differences and climatic fluctuation from year to year. The lower TMY in primiparous cows might be still growing and underdeveloped udder. The other reasons attributed to variation in milk yield from lactation to lactation in the same animal might be due to the physiology of lactation when a given set of genes interacts with non-genetic factors.

CONCLUSION

In the present study it was concluded that parity and stage of lactation had significant effect on productive performance of Sahiwal cattle. However, there was no significant effect of season on different productive performance traits. The difference among the least-square means and effect of environmental factors (season, stage of lactation and parity) on the productive performance traits. Present study, suggested that parity and stage of lactation of Sahiwal cattle can be used as a selection tool for improvement of productive traits considering its high positive phenotypic correlations with succeeding productive traits.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

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