Genetic and phenotypic parameters of first lactation and life time traits in Sahiwal cows

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ABSTRACT

The present study was conducted on first lactation and life time performance traits of Sahiwal cattle from Government Livestock Farm, Chakgangaria, Lucknow. First lactation and life time performance records of 927 Sahiwal cows born to 75 sires spread over a period of 28 years from 1978 – 2007 were utilized for the present study. The overall least squares mean of first lactation traits viz. AFC, FSP, FDP, FCI, FLMY, LTMY, PL and HL were estimated to be 1308.83 ± 11.65 days, 248.67 ± 4.94 days, 185.73 ± 50.50 days, 527.55 ± 4.93 days, 1424.23 ± 26.74 kg, 7943.38 ± 97.88 kg, 3277.93 ± 21.00 days and 3818.64 ± 23.54 days, respectively. Season effect was significant on most of the first lactation and life time production traits except first lactation milk yield. In contrast different periods of calving were found not to have significant influence on all the traits except life time milk yield. Similarly, sire effect was found significant on all the traits except first service period and first calving period. The heritability estimates of different first lactation and life time traits were low to high. The genetic and phenotypic correlations observed among all the traits were very low to high.

Key words: Sahiwal, genetic, phenotypic, heritability, life time milk yield, productive life

INTRODUCTION

The primary objective of animal breeder is to maximize genetic improvement in economically important traits which can be achieved through proper selection and utilization of breeding system. Selection for enhancing milk production in dairy animals has been practiced for many years because of economic importance. The potential for genetic improvement in a trait largely depends upon genetic variation existing in a population of interest. The variability for a particular trait in a population is measured by heritability estimates of traits under given environmental condition.

Variance and covariance are of prime importance to the breeder for estimating the genetic parameters and then utilizing these estimates for selection of animals. Estimates of genetic parameters are needed for the prediction of breeding values and planning of selection strategies for desired genetic advancement. Keeping this object in view, the present investigation was conducted for estimating the genetic and phenotypic parameters of first lactation and life time performance traits.

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MATERIAL AND METHODS

The data for the present investigation were collected over a period of 28 years (1978 – 2007) from pedigree sheets of 927 Sahiwal cows born to 75 sires maintained at Government Livestock Farm, Chakganjaria, Lucknow and were utilized for analysis. Only the sires having records on at least 5 daughters were included in the present study. The records of only those animals with known pedigree and normal lactation were considered. The lactation records of less than 150 days were considered as abnormal and were not included in the analysis. The total duration of the present study was divided into 7 equal periods of four years each. Each year was divided into four seasons namely winter (January- March), Summer (April – June), Rainy (July – September) and Autumn (October – December). In order to classify the data for different periods and seasons, year and season of calving was considered for all the traits. The traits considered in the present study were age at first calving, first service period, first dry period, first calving interval, first lactation milk yield, lifetime milk yield, productive life and herdlife.

Statistical Analysis: The influence of non genetic factors on different traits were studied by least squares analysis of variance for non orthogonal data using mixed model least squares and maximum likelihood programme described by Harvey (1990). The model for the least squares analysis of variance to estimate the influence of non genetic factors on different first lactation and lifetime traits included the effect of periods, seasons and sires. Prior to estimation of genetic parameters, the data were adjusted for different significant non genetic factors. The data after adjustment for different significant non genetic factors were utilized for estimation of genetic parameters. Paternal half sib correlation method was used to estimate heritability of different traits (Becker, 1975). The standard error of heritability was estimated by the formula given by Swiger et al. (1964). The genetic and phenotypic correlations among different traits were estimated from the analysis of variance/covariance using half sib data as suggested by Becker (1975). The standard error of genetic correlation was estimated according to the formula given by Robertson (1959). The standard error of phenotypic correlation was estimated according to the formula given by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Mean and standard errors for first lactation and life time traits are presented in Table-2. The average AFC, FSP, FDP, FCI and FLMY were found to be 1308.83±50.51 days, 248.67±4.94 days, 185.73 ±50.51 days, 527.55 ±4.93 days and 1424.23±26.74 kg respectively. These estimates are in close agreement with those reported by Kumar (2003), Kathiravan (2009) and Kumar and Singh (2010).

Table 1. Analysis of Variance for the factors affecting first lactation traits

Source of variance	Mean sum of squares (MS values)								
	D.F	AFC	FSP	FDP	FCI	FLMY	LTMY	PL	HL
Period	6	721957.6**	47148.5*	59327.2**	55738.9**	738699.1	22588619.3**	500432.6*	642322.9*
Season	3	102756.6	9744.3	8991.7	10773.9	179509.8	11852929.5*	13251.9	292546.7
Sire	99	80450.7**	18281.4	17547.9**	18459.3	413540.1**	5656384.7**	236262.6**	304949.6**
Error	818	51655.1	19263.7	10554.9	17648.3	250506.2	3602034	115501	161732.7

** P<0.01; *P<0.05; AFC=Age at First Calving; FSP=First Service Period; FDP=First Dry Period; FCI= First Calving Interval; FLMY= First Lactation Milk yield; LTMY=Life-Time Milk Yield; PL= Productive Life; HL= Herd Life.

The average life time milk yield (LTMY), productive life (PL) and herd life (HL) were found to be as 7943.38±97.88 kg. 3277.62±27.52 days and 3818.64±23.54 days, respectively. The least squares analysis of variance to estimate different non genetic effects are presented in Table-1. The effect of season was found to have non-significant influence on all the first lactation and life time traits. It was found that cows calved in winter season (Jan-March) had lower age at first calving and first service period than the cows which calved in other seasons. Summer season calves had lowest first dry period, first calving interval, first lactation milk yield, life time milk yield and productive life. While herd life was lowest in rainy season calvers as compared to other season calvers. Highest value of age at first calving was observed in rainy season calvers than the other season calvers. Autumn season calvers had higher first service period, first dry period, first calving interval, lifetime milk yield, productive life and herd life than the other season calvers. While winter season calvers had highest first lactation milk yield than the other season calvers. Non significant influence of different season on various first lactation production and life time traits had been reported by Kuralkar et al. (1996), Kumar (2003) and Kumar and Singh (2010) which is in agreement with the findings of present study.

Table 2. Least Square Mean ± S.E. for Various Traits in Sahiwal Cattle

	No. of obs.	**AFC**	**FSP**	**FDP**	**FCI**	**FLMY**	**LTMY**	**PL**	**HL**
Over all means	927	1308.8±11.7	248.7±4.9	185.7±50.5	527.6±4.9	1424.2±26.7	7943.38±97.88	3277.93±21.00	3818.64±23.54
Seasons									
S1 (Jan-Mar)	340	1281.0±16.7	243.5±8.8	191.1±7.7	523.3±8.5	1452.9 ±37.4	8036.80 ±139.47	3276.62 ±27.52	3840.89 ± 31.58
S2 (Apr-Jun)	209	1297.6±19.8	245.9±10.9	180.9±9.1	522.1±10.6	1387.6 ±44.2	7623.47 ±165.54	3266.36 ±31.82	3798.70 ± 36.80
S3 (Jul-Sep)	173	1337.6±21.1	244.8±11.8	177.5±9.7	524.5±11.4	1449.1 ±47.2	7826.69 ±176.81	3278.89 ±33.70	3766.51 ± 39.08
S4 (Oct-Dec)	205	1319.1±20.3	260.5±11.3	193.4±9.3	540.3±10.9	1407.3 ±45.3	8286.55 ±169.67	3289.84 ±32.51	3868.48 ± 37.64

Periods									
P1 (1978-1982)	107	1154.8 ±28.7	220.7 ±13.4	171.3 ±13.5	493.1 ±13.2	1424.8 ±65.4	7644.29 ±240.82	3227.32 ±50.08	3782.72 ±56.62
P2 (1983-1986)	121	1326.9 ±33.2	263.6 ±12.9	174.7 ±15.8	544.4 ±13.1	1514.9 ±76.7	8343.24 ±279.17	3274.78 ±61.23	3810.33 ±68.27
P3 (1987-1991)	230	1279.8 ±24.1	242.5 ±9.2	187.9 ±11.5	521.4 ±9.4	1448.9 ±55.6	7818.36 ±202.41	3209.22 ±44.55	3761.78 ±49.62
P4 (1992-1995)	150	1316.3 ±27.6	256.1 ±11.5	171.5 ±13.1	540.0 ±11.5	1400.7 ±63.5	7508.50 ±232.05	3334.53 ±50.07	3922.31 ±56.05
P5 (1996-1999)	106	1364.2 ±27.6	255.9 ±13.6	231.3±12 .9	533.8 ±13.3	1260.8 ±62.6	7618.61 ±231.65	3360.40 ±47.24	3908.20 ±53.70
P6 (2000-2003)	76	1313.0 ±8.1	224.2 ±16.0	163.2 ±13.7	504.3 ±15.5	1498.5 ±66.5	8032.14 ±248.43	3218.70 ±48.47	3731.72 ±55.81
P7 (2004-2007)	137	1406.8 ±27.5	277.7 ±12.0	200.4±13 .0	555.9 ±11.9	1421.1 ±63.1	8638.50 ±231.22	3320.55 ±49.19	3813.44 ±55.27

The period of calving significantly influenced all the first lactation production and life time traits except first lactation milk yield. The present results are in close agreement with the reports of Khalid et al. (2000), Banik et al. (2006) and Raja and Narula (2008).

The mean performance of age at first calving and first service period was observed to be lowest in first period and increased over the period of time and it was highest in last period of calving that spread between 2004 and 2007. The first dry period increased slightly upto period 5 but subsequently decreased in period 6. Similarly, there was increase in first calving interval over the period and mean value was lowest for the period 1. The mean performance of the first lactation milk yield was highest in second period and decreased over the period of time and it was lowest in first period of calving. The mean value of life time milk yield was highest for the seventh period. However, no consistent trend was found for LTMY. The mean productive life and herd life were highest for the fifth period. However, no consistent trend was found, with fluctuations being observed over the period of calving. The variability in all the traits over the periods might be due to differences in managemental practices followed during different periods of time. These findings are in agreement with the reports of Raja and Narula (2008), Kumar et al. (2009) and Kathiravan et al. (2009).

The least squares analysis of variance showed highly significant effect of sire on all first lactation and life time traits except first service period. This revealed that superior sire could be used effectively for improvement of all the traits. These findings are supported by Haque et al (1999), Kumar (2003) and Kumar et al. (2009) in Sahiwal cattle.

The genetic correlation between first dry period and first calving interval was positive and significant (P<0.05) (Table 3). The genetic correlations of FDP with FLMY and LTMY were negative and non significant. Positive and non significant genetic correlations were observed with PL and HL.

The genetic correlations of first calving interval with FLMY and

Table 3. Heritability (diagonal), Genetic Correlation (above diagonal) and Phenotypic Correlation (below diagonal) among various traits in Sahiwal Cattle

Traits	AFC	FSP	FDP	FCI	FLMY	LTMY	PL	HL
AFC	0.252±0.09	0.723±0.15	-592±0.25*	-0.008±0.83	0.482±0.26	0.388±0.28	0.413±0.20*	0.457±0.21*
FSP	0.058	0.111±0.06	0.357±0.22	0.977±0.14**	0.021±0.25	0.123±0.25	-.074±0.24	-0.139±0.24
FDP	0.069*	0.251**	0.555±0.10	0.381±0.19*	- .093±0.15	-0.193±0.15	0.231±0.14	0.136±0.15
FCI	0.056	0.98**	0.265**	0.162±0.06	0.014±0.22	0.097±0.22	-.048±0.21	-0.102±0.21
FLMY	0.043	0.087**	- 0.036	0.084**	0.460±0.09	0.646±0.09**	0.073±0.15	0.038±0.16
LTMY	0.046	0.069*	- 0.074*	0.058	0.654*	0.482±0.09	0.239±0.15	0.252±0.15
PL	0.385**	0.124**	0.084**	0.135**	0.02	0.049	0.599±0.11	-0.876±0.03**
HL	0.344**	0.146**	0.122**	0.157**	0.019	0.081**	0.858**	0.517±0.10

**P< 0.01; *P<0.05

LTMY were observed positive and non significant while with PL and HL were negative and non significant. The genetic correlation between FLMY and LTMY was positive and highly significant. However, with PL and HL were positive and non significant.

The genetic correlations of LTMY with PL and HL were positive and non significant. The genetic correlation between productive life and herd life was estimated negative and significant ($P<0.01$). These findings are in close agreement with those reported by Singh et al. (1980), Ahmad et al. (2001), Dalal et al. (2002), Kumar et al. (2009) and Tiwari et al. (2010) in Sahiwal cattle.

The phenotypic correlations of age at first calving with first service period, first calving interval, first lactation milk yield, life time milk yield, were found positive with very low magnitude. However, positive and significant phenotypic correlations were observed with first dry period, productive life and herd life. The phenotypic correlations of first service period with first dry period, first calving interval, first lactation milk yield, life time milk yield, productive life and herd life were estimated as positive and significant.

The phenotypic correlations of first dry period with first calving interval, productive life and herd life were found positive and significant. However, negative phenotypic correlations were estimated with first lactation milk yield and life time milk yield.

The phenotypic correlations of first calving interval with first lactation milk yield, production life and herd life were found positive and highly significant. However, positive and non significant phenotypic correlation was observed with life time milk yield. The phenotypic correlation of first lactation milk yield with life time milk yield was observed positive and highly significant while with productive life and herd life were positive and non significant. The phenotypic correlation of life time milk yield with productive life was found positive and non significant. However, positive and highly significant with herd life. The phenotypic correlation of productive life with herd life was estimated highly positive and significant. The results of this study are in conformity with the investigations of Reddy and Nagarcenkar (1989), Singh et al. (1999), Singh et al. (2002), Kumar et al. (2009), Kathiravan et al. (2009) and Tiwari et al. (2010) in case of Sahiwal cattle.

Since very little opportunity exist for selection of cows for life time traits, it is desirable to select the animals on the performance of earlier lactation traits rather than traits express later in life.

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