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Effect of Non-Genetic Factors on Pooled Productive and Reproductive Traits in Sahiwal Cattle

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ABSTRACT

Introduction
The present study investigated the influence of various non-genetic factors on various economic traits to plan better management practices for higher milk production in Sahiwal cattle.

Materials and Methods
The data for the present investigation were collected over a period of 71-years (1944-2014) from pedigree sheets of 1367 Sahiwal cows born to 112 sires maintained at Government Livestock Farm, Chak-Ganjeria, Lucknow were utilized. 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).

Result
The overall performance levels of cows for total milk yield (TMY) and lactation length (LL) were 1815.192±12.87 kg and 300.77 ±1.58 days, respectively. The overall least-squares means estimated for all the reproduction traits in this study were 192.60±2.35 days for service period, 163.74±2.31 days for dry period and 475.64±2.78 days for calving interval. The least-squares analysis of variance for the pooled lactation traits showed the significant (p<0.01) effect of season of calving on total milk yield, whereas it was significant (p<0.05) for total dry period and non-significant for other pooled lactation traits i.e. lactation length, service period and calving interval. The effect due to period of calving on all the pooled lactation traits was found to be significant (p<0.01). The effect due parity on all the pooled lactation traits was also significant (p<0.01).

Conclusion
Analysis of variance for the pooled milk production traits showed that the effect due to season of calving was significant for total milk yield and total dry period. The effect due to period of calving on all the pooled milk production traits was found to be significant. The effect due parity on all the pooled milk production traits was also significant effect of non-genetic factors on pooled milk production and reproduction traits revealed that managemental practices were not similar during different periods.

Keywords
Pooled lactation traits; Total milk yield; Lactation length; Productive life; Herd life.

INTRODUCTION

Sahiwal is one of the most preferred breed of cattle for genetic improvement various descript and non-descript cattle population of our country. Sahiwal is regarded as one of the improver breed of cattle in our country. There is a great need to evaluate the performance of Sahiwal at organized dairy farm. The present economic conditions demand that a dairy animal should be profitable and overall profitability of dairy animals depends upon more on the return through the milk production during its life-time than on its first lactation alone. Evaluation of sires for life-time production traits not only delays selection decision but also reduces the rate of genetic progress. To overcome this, life-time milk production was computed indirectly from some early observable traits. Early

calving with higher milk yield, shorter calving interval and dry period in dairy animals ensure early returns of the capital and lower the generation interval, resulting in large annual genetic gains from selection, which is only effective way of improving our dairy cattle.

The low milk production of indigenous cow is due to low genetic potential of milk production, inadequate feeding and nutrient availability, poor management, prevalence of diseases combined with tropical climate. Another important reason of low production is rearing of cattle for draught purposes. Though the indigenous breeds of cattle in India are late maturing and poor milk producers but they possess disease resistance, have ability to utilize coarse fodders and also adapted to harsh tropical climate. Increase in production and productivity at simultaneously maintaining the diversity is the objectives of cattle breeding in India. 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. The influence of various non-genetic factors on various economic traits is required to plan better management practices for higher milk production.

MATERIALS AND METHODS

The data for the present investigation were collected over a period of 71-years (1944-2014) from pedigree sheets of 1367 Sahiwal cows born to 112 sires maintained at Government Livestock Farm, Chak-Ganjeria, Lucknow were utilized. 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 8 periods. Out of 8 periods, 7 are of nine years each and 8th period was 8 years only. Each year was divided into four seasons namely Winter (November-February), Summer (March-June), and Rainy (July-October). 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 herd life.

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.[1] 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. The statistical model used for analysis is as given below.

$$Y_{ijklm}=\mu + S_i + P_j + G_k + L_l + e_{ijklm}$$

Where,

Y_{ijklm}=observation of m^{th} individual belonging to i^{th} season, j^{th} period, k^{th} sire and l^{th} lactation number

μ= Overall population mean

S_i= Fixed effect of i^{th} season (i=1, 2, 3)

P_j= Fixed effect of j^{th} period (j=1, 2..9)

G_k= Effect of k^{th} sire (k=1, 2...112)

L_l= Effect of l^{th} lactation number (l=1, 2..7)

e_{ijklm}= Random error, assumed to be distributed normally and independently with mean zero and constant variance i.e. NID (0, σe^2).

Duncan's Multiple Range Test

Duncan's multiple range tests (DMRT) as modified by[2] was applied for testing differences among least-squares means of the non-genetic factors.

RESULTS

The overall performance levels of cows for total milk yield (TMY) and lactation length (LL) were 1815.192±12.87 kg. and 300.77± 1.58 days, respectively, (Table 1). Analysis of variance reveals that (Table 1) season of calving was significantly affecting (p<0.01) total milk yield (TMY), whereas it has no significant effect on lactation length (LL). The cows calving during rainy season (July to October) had highest total milk yield of 2038.52±17.34 kg, whereas cows calving during summer season (March to June) had lowest average TMY of 1959.30±19.94 kg. In case of lactation length, the winter calvers having longest lactation length of 304.93± 2.00 days, while rainy season calvers had slightly lower lactation length of 299.49±1.96 days in Sahiwal cattle. The effect of period was highly significant (p<0.01) on all the pooled lactation production traits (Table 2). The cows calving during the P2 had highest least-squares mean for TMY (3413.62±29.56 kg), whereas cows calving during P7 had lowest least- squares mean for TMY (1349.53±25.20 kg). The lactation length was longest (333.23±9.41 days) for the cows calving during P1 whereas lactation length was shortest (279.23±2.82 days) for P3. The parity was one of the most important non-genetic factors, significantly (p<0.01) affecting all the pooled lactation production traits. The least-squares mean for total milk yield was found to be maximum (2049.77±33.55 kg) in 6^{th} parity whereas lowest mean (1879.00±27.29 kg) was recorded in 7^{th} parity. The lactation length was longest (326.61±2.50 days) in first parity whereas it was shortest (287.65±3.09 days) in 7^{th} parity. Least-squares analysis of variance and least-squares means for pooled service period (SP), dry period (DP) and calving interval (CI) are presented in Table 1 and 2. The study revealed that except season all the non-genetic factors had significant (p<0.01) influence on all the reproduction traits.

The overall least-squares means estimated for all the reproduction traits in this study were 192.60±2.35 days for service period, 163.74±2.31 days for dry period and 475.64±2.78 days for calving interval. The season of calving had significant effect on dry period (DP), whereas it had non-significant effect on service period (SP) and calving interval (CI). The cows calving during win-

Table 1. *Least- Squares Means with S.E. for Pooled Lactation Production and Reproduction Traits*

Source	LL	TMY	DP	SP	CI
			OVERALL MEAN		
Overall mean	300.77±1.58 (7010)	1815.192±12.87 (7010)	163.74±2.31 (5640)	192.60±2.35 (5641)	475.64±2.78 (5642)
			SEASONS		
S1-Summer (March- June)	301.66±2.26 (1789)	1959.30^{b}±19.94 (1789)	162.72^{a}±2.72 (1391)	183.05±3.77 (1391)	466.36±3.53 (1391)
S2- Rainy (July-Oct.)	299.49±1.96 (2754)	2038.52^{a}±17.34 (2754)	156.01^{b}±2.34 (2240)	178.28±3.24 (2240)	463.29±3.04 (2241)
S3- Winter (Nov-Feb)	304.93±2.00 (2467)	1988.16^{a}±17.68 (2467)	154.98^{b}±2.39 (2009)	186.38±3.30 (2010)	468.64±3.09 (2010)
			PERIODS		
P1(1944-51)	333.23^{a}±9.41 (82)	3081.78^{b}±83.15 (82)	121.13^{e}±10.13 (82)	159.07^{b}±14.02 (82)	442.08^{a}±13.14 (82)
P2 (1952-59)	291.91^{c}±3.34 (655)	3413.62^{a}±29.56 (655)	133.55^{de}±3.90 (563)	141.48^{c}±5.40 (563)	424.68^{a}±5.06 (563)
P3 (1960-67)	279.23^{d}±2.82 (921)	1880.28^{c}±24.90 (921)	136.49^{de}±3.35 (760)	130.56^{c}±4.63 (760)	415.60^{a}±4.34 (760)
P4 (1968- 75)	308.99^{b}±2.95 (835)	1830.00^{c}±26.03 (835)	137.96^{d}±3.49 (695)	167.38^{b}±4.82 (695)	448.92^{a}±4.52 (695)
P5 (1976- 83)	319.40^{b}±2.58 (1102)	1657.00^{d}±22.82 (1102)	159.44^{c}±3.08 (907)	214.08^{a}±4.26 (907)	492.71^{a}±4.00 (907)
P6 (1984-91)	290.23^{cd}±2.33 (1364)	1491.54^{e}±20.62 (1364)	192.24^{b}±2.83 (1106)	216.35^{a}±3.92 (1107)	500.79^{a}±3.67 (1107)
P7 (1992-99)	286.40^{cd}±2.85 (884)	1349.53^{f}±25.20 (884)	206.15^{a}±3.51 (675)	230.35^{a}±4.86 (675)	514.32^{a}±4.56 (675)
P8 (2000-07)	314.95^{b}±3.17 (720)	1718.60^{d}±27.99 (720)	169.66^{c}±3.77 (593)	208.16^{a}±5.21 (593)	493.54^{a}±4.88 (594)
P9 (2008-14)	293.92^{c}±4.03 (447)	1535.59^{e}±35.61 (447)	164.53^{c}±5.70 (259)	175.70^{b}±7.89 (259)	462.22^{a}±7.40 (259)
			PARITY		
LN1	326.61^{a}±2.50 (1369)	1958.88^{a}±22.10 (1369)	166.92^{a}±2.72 (1369)	213.77^{a}±3.76 (1369)	495.94^{a}±3.52 (1369)
LN2	307.18^{b}±2.47 (1369)	1970.79^{a}±21.79 (1369)	155.88^{ab}±2.83 (1189)	184.11^{b}±3.92 (1189)	466.67^{a}±3.67 (1190)
LN3	300.67^{bc}±2.65 (1189)	2031.14^{a}±23.45 (1189)	149.41^{b}±3.15 (957)	169.99^{b}±4.35 (957)	453.96^{a}±4.08 (957)
LN4	297.86^{c}±2.93 (957)	2042.08^{a}±25.86 (957)	156.83^{ab}±3.59 (720)	176.86^{b}±4.96 (721)	461.27^{a}±4.65 (721)
LN5	294.44^{cd}±3.33 (721)	2035.61^{a}±29.39 (721)	159.43^{ab}±4.08 (542)	177.59^{b}±5.64 (542)	460.10^{a}±5.29 (542)
LN6	299.79^{bc}±3.80 (542)	2049.77^{a}±33.55 (542)	155.67^{ab}±4.79 (385)	180.09^{b}±6.63 (385)	463.15^{a}±6.22 (385)
LN7	287.65^{d}±3.09 (863)	1879.00^{b}±27.29 (863)	161.20^{ab}±4.35 (478)	175.58^{b}±6.02 (478)	461.58^{a}±5.64 (478)

The least-squares means with same superscripts do not differ significantly

Table 2. *Least- Squares Analysis of Variances (Anova) of Different Pooled Milk Production and Reproduction Traits*

Traits	Season	Period	Parity	Error	R^2 (%)
LL	19224.612 (2)	182972.779 (8)**	171125.968 (6)**	7151.85 (6993)	5.0
TMY	3601965.00 (2)**	274564173.00(8)**	3395417.00 (6)**	558562.00 (6993)	36.44
DP	26791.58 (2)*	478002.75 (8)**	31512.934 (6)**	8256.45 (5623)	8.0
SP	34818.43 (2)	881175.42(8)**	235714.63(6)**	15808.61 (5624)	8.63
CI	15092.122 (2)	863316.238 (8)**	215201.977 (6)**	11047.6 (5625)	9.41

LL = Lactation length, TMY = Total milk yield, DP = Dry period, SP = Service period, CI = Calving interval
**Significant at 1% level
*Significant at 5% level

ter months (November to February) had longest SP (186.38±3.30 days), whereas rainy season (July to October) calvers had shortest SP (178.28±3.24 days). The shortest calving interval (463.29±3.04 days) was found for the cows calving in rainy season, whereas the calving interval did not differed significantly for the cows calving in summer and winter season with a value of 466.36±3.53 days and 468.64±3.09 days, respectively. The effect of period of calving was highly significant (p<0.01) on all the pooled reproductive traits i.e. dry period, service period and calving interval. The cows calving during the P7 had longest least-squares mean of 206.15±3.51 days for dry period, whereas the shortest dry period of 121.13±10.13 days was reported for P1. The calving interval was longest of 514.32±4.56 days for cows calving during the P7, while the shortest calving interval of 415.60±4.34 days was reported for the cows calving in P3. The longest service period was 230.35±4.86 days for cows calved during P7, whereas the cows calved during P3 had shortest service period of 130.56±4.63 days. Parity had highly significant (p<0.01) effect on all of the pooled lactation reproduction traits i.e. dry period, service period and calving interval. The longest least-squares mean for DP, SP and CI was found to be in cows of first parity with their values being 166.92±2.72 days, 213.77±3.76 days and 495.94±3.52 days, respectively. The shortest DP, SP and CI were in the cows of 3rd parity with their values being 149.41±3.15 days, 169.99±4.35 days and 453.96±4.08 days, respectively.

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DISCUSSION

The overall performance levels of cows for total milk yield (TMY) and lactation length (LL) were presented in Table 1. These estimates of total milk yield were comparable with the results reported by[3,4] in Sahiwal cattle.[5,6] observed a lower values of LMY in Sahiwal cattle.

SEASON EFFECT

Analysis of variance reveals that (Table 1) season of calving was significantly affecting (p<0.01) total milk yield (TMY), whereas it has no significant effect on lactation length (LL). The cows calving during rainy season (July to October) had highest total milk yield, whereas cows calving during summer season (March to June) had lowest average total milk yield (TMY). In case of lactation length, the winter calvers having longest lactation length, while rainy season calvers had slightly lower lactation length in Sahiwal cattle. In support of the above findings, most of the workers reported[5,7,8] that the effect of season was non-significant on lactation length.

PERIOD EFFECT

The effect of period was highly significant (p<0.01) on all the pooled lactation production traits (Table 2). The cows calving during the P2 had highest least-squares mean for total milk yield (TMY), whereas cows calving during P7 had lowest meanvalue for total milk yield (TMY). The lactation length was longest for the cows calving during P1, whereas lactation length was shortest for P3. These results are similar to the findings of[3,5,6] who observed the effect of period was significant (p<0.01) on pooled lactation production traits i.e. TMY and LL.

PARITY EFFECT

The parity was one of the most important non-genetic factors, significantly (p<0.01) affecting all the pooled lactation production traits. The least-squares mean for total milk yield was found to be maximum in 6th parity, whereas lowest mean was recorded in 7th parity. The lactation length was longest in first parity, whereas it was shortest in 7th parity.[3,6] also revealed that the effect of parity was significant on total milk yield and lactation length. Similar to our findings, the lactation length was reported to be longest in first lactation by.[3,5]

Least-squares analysis of variance and least-squares means for pooled service period (SP), dry period (DP) and calving interval (CI) are presented in Table 1 and 2. The study revealed that except season all the non-genetic factors had significant (p<0.01) influence on all the reproduction traits.

These levels of reproductive performance were comparable with the reports in the literature on Sahiwal cattle and their crosses in India.[3] Reddy (1983) observed the pooled service period of 148.0 days and pooled dry period of 153.8 days whereas,[9] reported higher values of dry period in Sahiwal cattle. On contrary to the present findings,[3,6] observed lower values of pooled calving interval. Whereas,[5] reported longer calving interval then the present findings in Sahiwal cattle.

SEASON EFFECT

The season of calving had significant effect on dry period (DP), whereas it had non-significant effect on service period (SP) and calving interval (CI). The cows calving during winter months (November to February) had longest SP, whereas rainy season (July to October) calvers had shortest SP. The shortest calving interval was found for the cows calving in rainy season, whereas the calving interval did not differed significantly for the cows calving in summer and winter season. Similar to these findings,[6,9] also observed a non-significant effect of season of calving on calving interval and[3] reported that the effect of season was not significant on service period and calving interval. On the contrary,[5] reported season of calving had significant effect on calving interval.

PERIOD EFFECT

The effect of period of calving was highly significant (p<0.01) on all the pooled reproductive traits i.e. dry period, service period and calving interval. The cows calving during the P7 had longest least-squares mean for dry period, whereas the shortest dry period was reported for P1. The calving interval was longest for cows calving during the P7, while the shortest calving interval was reported for the cows calving in P3. The longest service period for cows calved during P7, whereas the cows calved during P3 had shortest service period.[3] Also observed that effect of period was highly significant (p<0.01) on service period, dry period and calving interval.

PARITY EFFECT

Parity had highly significant (p<0.01) effect on all of the pooled lactation reproduction traits i.e. dry period, service period and calving interval. The longest least- squares mean for DP, SP and CI was found to be in cows of first parity. The shortest DP, SP and CI were recorded for cows calved during of 3rd parity. Similar to the present findings,[3] also found that the effect of parity was significant (p<0.01) on service period, dry period and calving interval.[5,6] indicated significant effect of parity on calving interval.

CONCLUSION

In present study least-squares analysis of variance for the pooled lactation traits showed that the effect due to season of calving was significant for total milk yield and total dry period and non-significant for other pooled lactation traits i.e. lactation length, service period and calving interval. The effect due to period of calving on all the pooled lactation traits was found to be significant. The effect due parity on all the pooled lactation traits was also significant. Significant effect of non-genetic factors on pooled milk production and reproduction traits revealed that managemental practices were not similar during different periods.

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