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Non-genetic factors affecting production and reproduction traits in Indian cattle breeds

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Abstract
Majority of the economic important traits are quantitative in nature, hence highly influenced by environmental variables. The objectives of our study were to estimate the effect of non-genetic factors on production and reproduction traits of Sahiwal and Haryana cattle. The cattle were raised and maintained at livestock farm complex (LFC), DUVASU, Mathura, (U.P), India. The data representing 479 records of both the breeds for Milk Yield (MY), Lactation Length (LL), Dry Period (DP), and Calving Interval (CI) were collected over a period of 17 years (1998-2015). The Least squares procedures of Harvey using season, period, stage of lactation and breeds as the fixed effects were utilized for the analysis. The season was classified into three major seasons, period was classified into six periods, five classes of lactation and two breeds effect were taken into consideration. The overall least squares mean for milk yield, calving interval, dry period and lactation length was found to be 1538.63±43.12 kg, 501.39±10.31 days, 237.4±12.89 days and 282.22±5.59 days, respectively. Effects of season of birth, period of birth, stages of lactation and breeds effect were highly significant over the studied production and reproduction traits. Hence, it is necessary to consider these factors when estimating genetic parameters and selection of animals in Sahiwal and Haryana cattle.

Keywords: Calving interval, dry period, Indian cattle breeds, milk yield, lactation length

Introduction
Total 53 breeds of cattle (*Bos indicus*) are registered by ICAR-NBAGR (https://nbagr.icar.gov.in/en/new-breeds-lines/). Sahiwal and Haryana are well-known breeds, having its origin in the north-western region of the Indian subcontinent (Ratwan *et al*., 2019b) [17]. Sahiwal being high milk-producing cattle, its milk has high fat (4.6–5.2%) and solid non-fat (SNF: 8.9–9.3%) (Chopra *et al*., 2020) [4]. Owing to outstanding draught ability, Haryana is a dual-purpose breed with milk yield ranging from 809 to 1,731 kg. Both breeds have unique adaptability to hot and humid climatic conditions along with resistance to various microbial and parasitic tropical diseases (Ratwan *et al*., 2019a) [17]. Genetic improvement of cattle for its productivity is majorly reliant on concepts of quantitative genetics of various production and reproduction traits that promote more efficient and relatively accurate selection of cattle germplasm.

The profitability of dairy animals primarily hinges on milk production and their reproductive performance (Leblanc *et al*., 2010) [13]. The most crucial factor in a dairy animal's productivity is its milk yield. A high milk yield not only reduces the expenses associated with raising dairy cattle but also enhances the overall profitability of the farm (Berry *et al*., 2009) [2]. Additionally, reproductive efficiency plays a significant role in determining the overall profitability of dairy animal production. Within the context of reproductive performance, like protracted calving interval results in a reduced number of off spring throughout the productive lifespan of livestock, thereby diminishing the overall profitability of livestock farming. The scrutiny and enhancement of reproductive performance hold great significance due to the fact that, next to low milk production, inadequate fertility stands as the primary cause for culling dairy animals (Leblanc SJ *et al*., 2013; El-Tarabany *et al*., 2015) [14, 6, 7]. Minor genes predominantly regulate economic traits, and they are significantly impacted by environmental factors, diverse government policies, selection criteria evolution over time, fluctuations in food and fodder availability, and various climatic conditions, all of which influence the production and fertility of animals. Production traits exhibit moderate to low heritability, while fertility traits demonstrate low heritability. Consequently, a substantial portion of the variability in these traits is determined by non-genetic factors. Enhancing the production of dairy animals can be accomplished through either improving the animals' environmental conditions,

enhancing the average breeding values within the population, or employing a combination of both methods.

Crucial to determining the actual progress that can be made is the partitioning of the total phenotypic variance of economic traits in animals into genetic and non-genetic components (Johnson *et al*., 2018) [10]. Productive and reproductive traits are influenced by a combination of genetic and non-genetic factors. Analyzing these factors provides essential information for establishing effective breeding programs aimed at enhancing the genetic quality of the animal population (Yano *et al*., 2014; Marai *et al*., 2009) [22, 15]. This analysis aids in the increasing accuracy in selection of animals with superior genetic qualities based on their high breeding values. And increasing the overall genetic improvement. With this context in mind, the current study aims to assess the impact of different non-genetic factors on both production and reproductive traits. The information generated from this study will provide valuable information for improvement of Sahiwal and Haryana cattle germplasm.

Materials and Methods

The present investigation was carried out using 479 records of Sahiwal and Haryana cattle breeds for production and reproduction over the period of 17 years (1998-2015), collected from the livestock farm complex (LFC), DUVASU, Mathura. Traits included were Milk Yield (MY), Lactation Length (LL), Dry Period (DP), and Calving Interval (CI). The data were classified and coded according to different seasons; summer (March to July), monsoon (August to October) and winter (November to February). The period was classified into five subclasses according to the year of birth as, before 2010 (I), 2011-2012 (II), 2013-2014 (III), 2015-2016 (IV) 2017-2018 (V) and 2019-2020 (VI). The lactation were classified into five groups as per lactation while 5th class includes records of 5th and more lactation. Finally, the breed effect was also given due consideration. The outliers were removed and data were standardized for the downstream analysis.

Least-squares analysis

The effect of fixed effects such as period, season, lactations and breed effect on normalized production and reproduction traits were estimated by least- squares analysis for unequal and non-orthogonal data using the technique described by Harvey, 1990 [9]. The model used was:

$$\mathbf{Y_{ijklm} = \mu + A_i + B_j + C_k + D_l + e_{ijklm}}$$

Where

Y_{ijklm} = The observed values; MY, CI, DP and LL in ith season of calving, jth period of calving, kth lactation, lth breed

μ = Population mean

A_i = Fixed effect of ith season of calving

B_j = Fixed effect of jth period of calving

C_k = Fixed effect of kth lactation

D_l= Fixed effect of lth breed

eijklm = Random error assumed to be normally and independently distributed with zero mean and constant variance i.e., NID (0, σ^2e)

Duncan's Multiple Range Test (DMRT)

The difference of means between any two subclasses of the period, season, lactations and breed effect groups was tested for significance using Duncan's Multiple Range Test (DMRT) as modified by Kramer (1957) [11].

$$(Y_i - Y_j) = \sqrt{\frac{2}{C_{ii} + C_{jj} + 2C_{ij}}} > \sigma_e Zpn_2$$

Where,

$(Y_i - Y_j)$	= Difference between any two subclass means
C_{ii}	= Corresponding diagonal element of ith subclass
C_{jj}	= Corresponding diagonal element of jth subclass
C_{ij}	= Corresponding off-diagonal element of ijth subclass.
Zpn_2	= Significant Studentised Range (SSR) value at p and n_1 and n_2 degree of freedom
P	= Numbers of means in the range considered
n_2	= Error degree of freedom

Results and Discussions

The least-squares mean for milk yield, calving interval, dry period and lactation length in present study for Sahiwal and Haryana cattle was estimated as 1538.63±43.12 kg, 501.39±10.31 days, 237.4±12.89 days and 282.22±5.59 days, respectively (Table 1). The present estimates for calving interval and dry period were higher, whereas lactation length and milk yield estimates were lower compared to Singh *et al*. (2018) [19] study in Sahiwal cattle. Likewise, milk yield estimates were lower compared to Kumar *et al*. (2020) [4].

Table 1: Least- Squares Means with S.E. for Production and Reproduction Traits

Factor	Milk yield	Calving Interval	Dry Period	Lactation length
μ	1538.63±43.12 (380)	501.39±10.31 (361)	237.4±12.89 (314)	282.22±5.59 (391)
Season	*	*	NS	NS
1	1629.50±57.01^{a} (150)	480.04±12.52^{b} (151)	219.67±16.04 (126)	285.25±7.8 (140)
2	1480.66±59.66^{b} (144)	502.70±14.04^{ab} (126)	236.96±16.65 (117)	278.52±7.68 (159)
3	1505.75±76.43^{ab} (86)	521.41±16.47^{b} (84)	255.56±19.87 (71)	282.88±9.72 (92)
Period	**	**	**	**
1	1278.69±142.72^{c} (21)	700.87±27.62^{a} (23)	399.51±33.82^{c} (19)	263.84±18.69^{ab} (22)
2	1685.28±110.89^{ab} (35)	493.02±20.93^{ab} (42)	237.3±24.28^{b} (39)	292.14±14.6^{bc} (35)
3	1842.90±85.33^{a} (62)	503.80±16.41^{ab} (66)	212.03±19.85^{ab} (56)	314.25±11.84^{c} (56)
4	1674.19±65.46^{ab}	489.28±13.25^{ab}	195.31±16.06^{ab}	294.41±8.72^{bc}

	(100)	(100)	(87)	(98)
5	1537.92±56.70^{ab} (133)	460.15±12.00^{ab} (121)	167.21±14.24^{a} (106)	292.25±7.33^{bc} (143)
6	1212.83±119.64^{c} (29)	361.20±42.40^{c} (9)	213.04±53.16^{ab} (7)	236.42±14.09^{a} (37)
Lactation	NS	**	*	**
1	1644.43±72.23 (89)	560.60±15.03^{c} (98)	241.12±17.63^{ab} (89)	308.04±9.29^{c} (90)
2	1577.50±69.51 (104)	515.51±15.34^{b} (92)	250.8±17.69^{ab} (86)	302.85±9.27^{c} (99)
3	1612.30±79.68 (70)	475.23±17.96^{ab} (60)	203.12±22.28^{a} (51)	284.63±10.39^{bc} (73)
4	1441.58±91.77 (55)	465.08±19.7^{a} (51)	205.26±23.90^{a} (43)	271.87±12.44^{ab} (53)
5	1417.35±89.98 (62)	490.51±19.25^{ab} (60)	286.69±25.33^{b} (45)	243.7±11.05^{a} (76)
Breed	**	**	NS	**
1	1345.88±50.10^{b} (202)	475.20±11.55^{b} (196)	222.76±13.98 (172)	265.73±6.31^{a} (216)
2	1731.39±60.34^{a} (178)	527.58±13.36^{a} (165)	252.04±16.69 (142)	298.71±8.01^{b} (175)
Sig: **(p<0.01), * (p<0.05), NS-Non significant (p>0.05)				

Effect of season on traits

The analysis of variance revealed significant ($P \leq 0.05$) effect of season of calving on MY and CI whereas non-significant effect on DP and LL. Similar results were observed by Singh *et al*. (2018) [19] who reported that season of calving was significantly affecting MY and no significant effect was reported on LL in Sahiwal cows whereas it had significant effect on DP, and non-significant effect on CI. Contrary to our results, Kumar *et al*. (2020) [4] showed that there was no season effect on TMY in Sahiwal cattle. In line with our findings, Yadav *et al*. (1992) [21] indicated that the calving season had a notable influence on the calving interval. Contrary to our results, Gandhi *et al*. (1995) [8] and Chaudhary *et al*. (1995) [3] noted a lack of statistically significant impact of the calving season on the calving interval revealed no effect of season on milk yield traits in Sahiwal cows that was contrary to our results revealed similar findings in Haryana cattle where significant effect of season of calving on few milk yield traits. In present study maximum MY was in summer season and minimum MY was seen in monsoon season. CI was maximum in monsoon season and minimum during summer season in current study. The variation in the availability of fodder and the optimal temperature range, which influences the animals' productivity differently in each season, could be the contributing factors.

Effect of period on traits

The analysis of variance revealed highly significant ($P \leq 0.01$) effect of period of calving on MY, CI, DP and LL. Similar finding were reported by Singh *et al*. (2018) [19] that reported highly significant effect of period on all the pooled lactation production and reproduction traits. Reddy *et al*. (1983) [18], Yadav *et al*. (1992) [21] and Gandhi *et al*. (1995) [8] also showed similar findings for MY, LL, DP and CI in Sahiwal cattle also showed similar findings in Haryana cattle where significant effect of period of calving was noted on all milk yield traits. In present study, the maximum milk yield was observed during 3rd period while least milk yield found in 1st period. Similar trends were found for CI, DP and LL traits with either seasons being maximum and minimum days. This suggests that significant changes have been implemented in the management and control of managerial factors over the years. Over the period implement of various policies, selection and culling of animals, rain patterns, various disease outbreaks withing herds as well as various change in the management of the animals leads to change the production and fertility parameters over the period.

Effect of stage of lactation on traits

The analysis of variance revealed highly significant ($P \leq 0.01$) effect of stages of lactation on CI and LL, whereas significant ($p \leq 0.05$) effect on DP and non-significant effect on MY. Similar findings were obtained by Kumar *et al*. (2020) [4] who reported highly significant ($p \leq 0.01$) effect of stages of lactation on milk yield traits in Sahiwal cows revealed significant ($p \leq 0.05$) effect of stage of lactation on milk yield traits that was contrary to our results. In present study, lowest CI was accounted in 4th lactation and highest CI was reported in 1st lactation. Lowest LL was seen in 5th lactation and highest LL was seen in first lactation. Whereas, for DP maximum was in first lactation and minimum was in 5th lactation.

Effect of breeds on traits

The analysis of variance revealed highly significant ($p \leq 0.01$) effect of breeds on MY, CI and LL and no effect on DP. It can be clearly seen that Sahiwal breed has higher milk yield along with higher LL compared to Haryana breed. The CI was significantly higher for Sahiwal breed compared to Haryana breed. This suggests that there exists substantial difference between Sahiwal and Haryana breed for the studied reproduction and production traits.

Conclusion

The season of birth, period of birth, stages of lactation, and breed differences had a noteworthy impact on Milk Yield, Lactation Length, Dry Period, and Calving Interval in Sahiwal and Haryana cattle. These effects are likely attributed to variations in feeding and fodder availability, as well as distinct feeding and management practices influencing these traits. Consequently, it is crucial to account for these factors when estimating genetic parameters and conducting subsequent evaluations of Sahiwal and Haryana cattle.

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Conflict of Interest

The authors have declared no conflict of interests exist.

References

1. Ali A, Javed K, Ahmad N, Rehman S. Environmental factors affect1ing some reproductive traits in Nili Ravi buffaloes. J Anim Plant Sci. 2011;21:868-871.
2. Berry D, Cromie A. Associations between age at first calving and subsequent performance in Irish spring calving Holstein–Friesian dairy cows. Livestock Sci. 2009;123:44-54
3. Chaudhary KB, Deshmukh DP, Deshpande KS. Genetic studies on reproductive traits in jersey, Sahiwal and jersey x Sahiwal crossbreds. Indian J Dairy Sci. 1995;48(2):172-177.
4. Chopra A, Ali SA, Bathla S, Rawat P, Vohra V, Kumar S, *et al*. High-resolution mass spectrometer–based ultra-deep profile of milk whey proteome in Indian Zebu (Sahiwal) cattle. Frontiers in Nutrition. 2020;11(7):150.
5. Dhaka SS, Chaudhary SR, Pander BL, Yadav AS, Singh S. Genetic studies on production efficiency traits in Haryana cattle. Asian-australasian journal of animal sciences. 2002;1;15(4):466-469.
6. El-Tarabany MS, El-Bayoumi KM. Reproductive performance of backcross Holstein× Brown Swiss and their Holstein contemporaies under subtropical environmental conditions. Theriogenology. 2015;83:444-448.
7. El-Tarabany MS, Nasr MA. Reproductive performance of Brown Swiss, Holstein and their crosses under subtropical environmental conditions. Theriogenology. 2015;84:559-565.
8. Gandhi RS, Gurnani M, Singh A. Influence of non-genetic factors on some of the economic traits of Sahiwal cattle. Indian J Dairy Sci. 1995;48(10):605-607.
9. Harvey WR. User guide for LSMLMW and MIXMDL package. Mix Model Least-squares and Maximum Likelihood Computer Programme. PC-2 Version Mimeograph, Columbia, Ohio, USA; c1990.
10. Johnson T, Eketone K, McNaughton L, Tiplady K, Voogt J, Sherlock R, *et al*. Mating strategies to maximize genetic merit in dairy cattle herds. J Dairy Sci. 2018;101:4650-4659.
11. Kramer CY. Extension of multiple range tests to group correlated adjusted means. Biometrics. 1957;1;13(1):13-18.
12. Kumar S, Gupta ID, Sharma N, Deginal R, Kumar A, Chauhan A, *et al*. Effect of season, parity and stage of lactation on productive performance of Sahiwal cattle. Indian Journal of Animal Research. 2021;55(5):597-602.
13. Leblanc SJ. Assessing the association of the level of milk production with reproductive performance in dairy cattle. J Reprod Develop. 2010;56:S1-7.
14. Leblanc SJ. Is a high level of milk production compatible with good reproductive performance in dairy cows? Anim Front. 2013;3:84-91.
15. Marai I, Daader A, Soliman A, El-Menshawy S. Non-genetic factors affecting growth and reproduction traits of buffaloes under dry management housing (In sub-tropical environment) in Egypt. Livestock Res Rural Develop. 2009;4:6.
16. Ratwan P, Chakravarty AK, Kumar M. Assessment of relation among production and reproduction traits in Sahiwal cattle at an organized herd of northern India. Biological Rhythm Research. 2022;53(1):70-78.
17. Ratwan P, Chakravarty AK, Kumar MA, Gupta AK. Genetic analysis of reproductive traits of Sahiwal cattle. Indian Journal of Animal Science. 2019-19b.;1(89):961-5.
18. Reddy KM. Breed Structure and Genetic Analysis of Pedigreed Sahiwal Cattle [PhD. Thesis]. Kurukshetra, India: Kurukshetra University; c1983.
19. Singh J, Singh CV. Effect of non-genetic factors on pooled productive and reproductive traits in Sahiwal cattle. Vet. Med. Open J. 2018;3(1):16-20.
20. Togla O, Bhardwaj S, Kadyan S, Yadav N, Gujral S. Influence of non-genetic factors on milk yield traits in Sahiwal cows.
21. Yadav AS, Rathi SS, Dahiya SP, Arora DN. Factors affecting some performance traits in Sahiwal cattle. Indian J Dairy Sci. 1992;45(10):522-527.
22. Yano M, Shimadzu H, Endo T. Modelling temperature effects on milk production: A study on Holstein cows at a Japanese farm. Springer Plus. 2014;3:129.