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Genetic study of important economic traits in Hariana cattle

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ABSTRACT

The present investigation was undertaken to access first lactation total milk yield, first lactation length, productive life, herd life and total life. Breeding information were used from the history sheet registers and herd inventory registers of Hariana cattle maintained at DUVASU farm, Mathura and Babugarh farm, Hapur. The data of productive animals with date of calving from 1966 to 2018 and date of birth from 1962 to 2013 were collected for the study. The overall averages for FLTMY, FLL, PL, HL and TL were estimated as 971.2±16.9 litres, 328.2±3.8 days, 2019.1±42.1 days, 2251.8±43.9 days and 3915.7±44.2 days, respectively. The overall least-squares mean of 961.3±24.1 litres, 331.6±5.9 days, 2285.2±64.9 days, 2489.9±69.1 days and 4219.4±70.0 days was observed respectively for the above traits. Season of calving had significant effect on first lactation length and period of calving had significant effect on first lactation total milk. Farm, period of birth and AFC age group had significant effect on PL, HL and TL of Hariana cattle. The heritability for FLTMY and FLL was moderate to high in Hariana cattle.

Keywords: First lactation length, Heritability, Herd life, Productive life, Total life

India is the largest producer of milk in the world with the highest cattle population. These cattle are playing an important role in strengthening India's economy (Shetkar *et al*. 2021a). Animal husbandry sector of India has a cattle population of 193.46 million in total among which indigenous cattle population is 142.11 million (20th Livestock Census 2019) which adds up to 73.46% of total cattle population of India with 53 recognized breeds of cattle (ICAR-NBAGR 2022) spread across the country and providing livelihood sustenance to millions of rural livestock keepers. The per-capita availability of milk in India is 394 g/day (Basic Animal Husbandry Statistics 2019) and India has the fastest growing market for milk and its products. Among indigenous cattle breeds, Hariana is the well-known dual-purpose indigenous breed of Haryana state (Shetkar *et al*. 2021b).

Lifetime performance of the dairy cattle determines the profitability of dairy enterprise because the overall productivity of dairy animals depends on their lifetime performance rather than single lactation performance. Dry period (DP) is an important economic trait which has the direct effect on lifetime milk production (Kumar 2015). Decrease in age at first calving decreases the cost of raising the animals to productive life, increases the annual genetic gain and raises the average productive life of the animal (Kumar *et al.* 2015). Arthur *et al*. (1992) reported that longer lifespan in dairy cows allows producers to be more selective in choosing replacement heifers because only a few have to be chosen each year. Higher longevity also reduces the cost of herd replacements, increases the number of animals available for marketing, and increases the proportion of the high producing, mature animals in the breeding herd (Arthur *et al*. 1992). The present study aimed at estimating the average and non-genetic factors affecting first lactation total milk yield, first lactation length, productive life, herd life and total life of Hariana cattle.

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MATERIALS AND METHODS

Source of data: In the present study, the breeding information were used from the history sheet registers and herd inventory registers of Hariana cattle. The data of productive animals with date of calving from 1966 to 2018 and date of birth from 1962 to 2013 were collected from DUVASU farm, Mathura and Babugarh farm, Hapur. To ensure the normal distribution, the outliers were removed and data within the range of mean±3SD were considered for the study. The records of animals with equal or more than 400 litres of milk production and equal or more than 100 days of lactation length were considered for the study.

Statistical analysis: Means, standard deviations, standard errors and coefficients of variations of the traits were estimated as per statistical procedures given by Snedecor and Cochran (1994).

Least-Squares analysis for adjustment of data: The

non-genetic factor effects such as period of birth/calving, season of birth/calving, AFC age group and farms on various traits were studied by least-squares analysis (mixed model least-squares and maximum likelihood computer program) using the technique suggested by Harvey (1987).

The model used was as follows:

Lifetime traits: $Y_{ijklm} = \mu + P_i + S_j + A_k + F_l + e_{ijklm}$

Where Y_{ijklm}, m^{th} observation in l^{th} farm, k^{th} age group, j^{th} season and i^{th} period of birth; μ, overall mean; P_i, effect of i^{th} period of birth (i = 1 to 5); S_j, effect of j^{th} season of birth (j = 1 to 4); A_k, effect of k^{th} age group (k = 1 to 2); F_l, effect of l^{th} farm (l = 1 to 2); e_{ijklm}, random error, NID $(0, \sigma^2_e)$.

First lactation traits: $Y_{ijklm} = \mu + P_i + S_j + A_k + F_l + e_{ijklm}$

Where Y_{ijklm}, m^{th} observation in l^{th} farm, k^{th} age group, j^{th} season and i^{th} period of calving; μ, overall mean; P_i, effect of i^{th} period of calving (i = 1 to 6); S_j, effect of j^{th} season of calving (j = 1 to 4); A_k, effect of k^{th} age group (k = 1 to 2); F_l, effect of l^{th} farm (l = 1 to 2); e_{ijklm}, random error, NID $(0, \sigma^2_e)$.

Mean comparison: Least-squares means were compared using Duncan's multiple range test (DMRT) as modified by Kramer (1957).

Estimation of heritability: Heritability was estimated by paternal half-sib (PHS) correlation method as suggested by Becker (1975). The following model was used to estimate the heritability.

$$Y_{ij} = \mu + s_i + e_{ij}$$

Where Y_{ij}, observation of the j^{th} progeny of the i^{th} sire; μ, overall mean; s_i, effect of the i^{th} sire; e_{ij}, random error, NID $(0, \sigma^2_e)$.

RESULTS AND DISCUSSION

In the present study, first lactation total milk yield was estimated as 971.2±16.9 litres. The higher estimates of FLTMY were observed by Gautam *et al*. (1966), Gehlon and Singh (1966), Chandiramani and Dadlani (1967), Dadlani and Prabhu (1968), Johar and Tylor (1973), Yadav and Balaine (1980), Sharma *et al*. (1980), Jegam and Tomar (1983), Rana (1985), Vinayak (1989), Kumar (1991) and Dalal *et al*. (2002). Whereas Sharma *et al*. (1951), Kohli and Acharya (1961), Kohli *et al*. (1961), Singh *et al*. (1964), Yadav and Rawat (1967), Bhasin and Desai (1967), Singh *et al*. (1967), Balaine (1971), Gill and Balaine (1971), Dutt and Singh (1971), Tomar and Balaine (1973), Mishra *et al*. (1980) and Arora (1980) observed lower FLTMY estimates than the present study. Chhikara (1974) observed similar FLTMY as of the present study. The variation in the results may be due to the environmental variation and management practices followed in the farm.

The means for FLL of Hariana cows was estimated as 328.2±3.8 days. Soof and Singh (1970), Dhoke and Johar (1977) and Kumar (1991) observed similar first lactation length as that of present study. The higher estimates were observed in PDC-Annual report (1991-92), whereas Kohli and Acharya (1961), Gehlon and Sekhon (1969), Sharda and Lohia (1966), Chandiramani and Dadlani (1967), Dadlani and Chandiramani (1968), Tomar *et al*. (1972), Tomar (1975), Das (1978), Hingane (1980), Rana (1985), Vinayak (1989) and Dalal *et al*. (2002) observed lower estimates of first lactation length. The environmental variations and management practices followed in the farms may vary the average performance of FLL.

The means for productive life was estimated as 2019.1±42.1 days. Kohli and Suri (1957) and Kumar (1991) observed higher productive life than the present study. Singh *et al*. (1964) and Dalal *et al*. (2002) observed lower productive life in Hariana cattle. The means for herd life of Hariana cows were estimated as 2251.8±43.9 days. The higher HL was observed by Kohli and Suri (1957) and Kumar (1991) in Hariana cattle. Vinayak (1989) and Dalal *et al*. (2002) observed lower HL than our observation in Hariana cattle. Bhattacharjya *et al*. (2000) observed higher HL in Tharparkar cattle; in Jersey crossbreed, Raut *et al*. (2003) observed the higher values for HL. The means for total life of Hariana cows was estimated as 3915.7±44.2 days. Singh *et al*. (1964) observed lower total life in Hariana cattle, whereas Kohli and Suri (1957) observed higher total life in Hariana cattle.

The overall least-squares means for first lactation total milk yield (FLTMY) was estimated as 961.3±24.1 litres. Period of calving had significant effect. Swami *et al*. (2005) observed similar estimates for FLTMY. Doharey (2012) had observed similar estimates with significant effect of farm and period of calving and non-significant effect of AFC age group and season of calving. Kaushik (2000) observed higher estimates with significant effect of period of calving. Ashraf *et al*. (2000) observed higher estimates for first lactation total milk yield. Pandey *et al*. (2001) observed higher estimates with non-significant effect of period of calving and season of calving. Singh (2001) observed higher estimates with significant effect of period of calving and season of calving. Dahiya (2002) observed higher estimates with significant effect of AFC age group and non-significant effect of season of calving. Singh (2002) observed higher estimates with significant effect of AFC age group and non-significant effect of season of calving. Singh *et al*. (2004) observed higher estimates for FLTMY. Singh *et al*. (2005) observed higher estimates with significant effect of farm and period of calving and non-significant effect of AFC age group and season of calving. Kumar (2006) observed lower estimates with significant effect of farm and non-significant effect of AFC age group, period of calving and season of calving. Singh *et al*. (2008) observed lower estimates with non-significant effect of farm and significant effect of period of calving and season of calving. Kumar (2009) observed higher estimates with significant effect of farm, period of calving and season of calving. Singh *et al*. (2010) observed lower estimates with significant effect of period of calving. Singh *et al*. (2011) observed higher estimates with significant effect of farm and period of calving and non-significant effect of season

of calving.

The overall least-squares mean for first lactation length (FLL) was estimated as 331.6±5.9 days. Season of calving had significant effect. Singh *et al*. (2004) observed similar estimates for FLTMY. Singh *et al*. (2005) observed similar estimates with significant effect of farm, period of calving and season of calving and non-significant effect of AFC age group. Kaushik (2000) observed lower estimates with significant effect of AFC age group. Ashraf *et al*. (2000) observed lower estimates for first lactation length. Pandey *et al*. (2001) observed higher estimates for first lactation length. Dahiya (2002) observed lower estimates with significant effect of AFC age group and season of calving and non-significant effect of period of calving. Singh (2002) observed lower estimates with significant effect of AFC age group. Swami *et al*. (2005) observed lower estimates with non-significant effect of season of calving. Kumar (2006) observed lower estimates with significant effect of farm and non-significant effect of AFC age group, period of calving and season of calving. Kumar (2009) observed lower estimates with significant effect of farm and non-significant effect of period of calving and season of calving. Pal (2009) observed lower estimates for FLL with significant effect of farm and non-significant effect of season of calving. Singh *et al*. (2011) observed lower estimates with significant effect of farm and non-significant effect of period of calving and season of calving. Doharey (2012) had observed lower estimates for FLL with significant effect of farm.

The overall least-squares means for PL was 2285.2±64.9 days. Farm, period of birth and AFC age group had significant effect on PL. Singh (2002) observed lower estimates for productive life with non-significant effect of AFC age group, period of birth and season of birth in Hariana cattle. Kumar (2007) observed lower estimates for productive life with significant effect of AFC age group and period of birth in Hariana cattle. Jakhar *et al*. (2010) observed lower estimates for productive life with significant effect of AFC age group and period of birth in Hariana cattle. Doharey (2012) had observed lower estimates for productive life with significant effect of farm and period of birth in Hariana cattle. Dubey and Singh (2005), Abbas and Sachdev (2008) and Singh *et al*. (2011) had observed lower estimates for productive life in Sahiwal cattle. Ambhore *et al*. (2017) observed lower estimates for productive life in Phule Triveni cattle and had significant effects in period of birth. Vinothraj *et al*. (2016) observed lower estimates for productive life with significant effect of period of birth in Jersey × Red Sindhi crossbred cows.

The overall least-squares means for HL was 2489.9±69.1 days. Farm, period of birth and AFC age group had significant effect on HL. Doharey (2012) had observed lower estimates of HL with significant effect of farm and period of birth. Singh (2002) observed similar estimates for herd life in Hariana cattle with period of birth and season of birth had non-significant effect on herd life. Jakhar *et al*. (2010) observed higher estimates for herd life with significant effect of period of birth and non-significant effect of AFC age group on herd life in Hariana cattle. Dubey and Singh (2005) observed lower estimates for herd life in Sahiwal cattle. Abbas and Sachdev (2008) observed similar estimates for herd life in Sahiwal cattle. Singh *et al*. (2011) observed higher estimates for herd life in Sahiwal cattle. Singh *et al*. (2008) observed lower estimates for HL with significant effect of period of birth and season of birth in crossbred cattle. Vinothraj *et al*. (2016) observed lower estimates for herd life with significant effect of period of birth and non-significant effect of season of birth in Jersey × Red Sindhi crossbred cows.

The overall least-squares means for TL was 4219.4±70.0 days. Farm, period of birth and AFC age group had significant effect on TL. Kumar (2007) observed lower estimates with significant effect of age at first calving and period of birth on longevity (total life) in Hariana cattle. Kathiravan (2009) had observed lower estimates with significant effect of farm and period of birth on total life in Sahiwal cattle. Ankuya *et al*. (2017) observed lower estimates for total life in Kankrej cattle. Ambhore *et al*. (2017) observed lower estimates for total life in Phule Triveni cattle and had significant effects in period of birth and AFC age groups. Effa *et al*. (2013) had observed relatively similar estimate of total life in Boran crossbred cows. Dash *et al*. (2018) observed lower estimates for total life and reported significant effect only in AFC groups of Karan Fries cattle. Vinothraj *et al*. (2016) observed lower estimates of total life in Jersey × Red Sindhi crossbred cows. Thiruvenkadan *et al*. (2015) had observed lower estimates of total life in Murrah buffalo.

The heritability estimates for first lactation total milk yield was observed as 0.5. The similar estimates of heritability for first lactation total milk yield were reported by Kohli *et al*. (1961) and Soof and Singh (1970). The higher estimates of heritability were reported by Singh *et al*. (1969). The values indicate that the additive genetic variance has important role in governing the expression of the FLTMY. The lower estimates of heritability for first lactation total milk yield was reported by Singh and Desai (1961), Ahmed (1961), Acharya (1966), Tiwana (1967), Singh and Prasad (1967), Chandiramani and Dadlani (1967), Singh (1970), Bhasin and Desai (1967), Dadlani *et al*. (1969), Balaine *et al*. (1971), Gill *et al*. (1971), Johar and Taylor (1973), Chhikara (1974), Lal (1975), Khanna (1977), Narayankhedker (1978), Arora (1980), Hingane (1980), Mishra *et al*. (1980), Arora and Sharma (1981), Singh and Tomar (1983), Kumar (1991), Dhaka *et al*. (2002) and Doharey (2012). Chander *et al*. (2008) observed lower estimates of heritability for FLTMY in Sahiwal cattle. The lower estimates indicate that the environmental variance had greater role than additive genetic variance.

The heritability for first lactation length was observed as 0.224. Doharey (2012) observed similar estimates of heritability for first lactation length in Hariana cattle. Girimal *et al*. (2020) observed similar estimates of heritability for first lactation length in Sahiwal and

Crossbred cattle. Chander *et al*. (2008) observed higher heritability estimates for FLL in Sahiwal cattle. The values indicate that the additive genetic variance has important role in governing the expression of the FLTMY. Whereas, Kathiravan (2009) observed lower heritability estimate for FLL in Sahiwal cattle indicating that the environmental variance had greater role than additive genetic variance.

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