Haryana Veterinarian (Dec., 2025) **64(2),** 1-6 ISSN 0033-4359 (P) **Research Article**

GENETIC STUDY OF IMPORTANT REPRODUCTIVE TRAITS IN HARIANA CATTLE

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ABSTRACT

The present investigation was undertaken to study age at first calving (AFC), first calving interval (FCI) and first service period (FSP) in Hariana cattle. Breeding information were obtained from the history sheet registers and herd inventory registers of Hariana cattle maintained at Uttar Pradesh Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya evam Go Anudandhan Sansthan (DUVASU) farm, Mathura. Data on productive animals born between 1962 and 2024 were gathered and a total of 929 animal records were collected. The overall averages for AFC, FCI and FSP were estimated as 1690.3 days, 608 days and 320 days, respectively. The overall least-squares mean of 1688.05 ± 14.24 days, 601.7 ± 9.22 days and 313.71 ± 9.22 days were observed, respectively for the above traits. Season of birth and period of birth had highly significant effect on age at first calving. Season of calving and period of calving had highly significant effect on first calving interval and first service period. AFC age group had non-significant effect on FCI and FSP of Hariana cattle. The heritability for FSP was low in Hariana cattle.

Keywords: AFC, FCI, FSP, Hariana cattle, Least-squares mean, Reproductive traits

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India with cattle population of 193.46 million has highest cattle population. Hariana is well recognized dual purpose indigenous breed and is known for its adaptability, hardiness and has contribution to both milk and draught power. One of the prominent features of the Hariana breed is its adaptability to different environmental conditions. Hariana cattle are well-suited to hot and humid climates, making them resilient to tropical conditions widespread in many parts of India. Their capability to thrive in tough environments has made them invaluable to farmers facing diverse climatic challenges. The economic significance of the Hariana breed is multifaceted. Hariana breed population in its native region declined due to indiscriminate crossbreeding, decreased demand for draft animal power, intense and more mechanized agriculture, and shrinking grazing areas. The Hariana cattle declined as crossbred cattle and buffaloes gradually replaced them from their bastion. The breed may face extinction if the current declining trend in population continues unabated.

Reproductive performance is a critical factor in the productivity and profitability of cattle farming. It directly influences the number of calves produced, which affects milk production in dairy herds. Proficient reproduction ensures a stable supply of replacements and helps maintain optimal herd size. Superior reproductive performance also reduces costs related to veterinary care, extended calving intervals and poor fertility. Overall, improving reproductive efficiency leads to improved herd management, augmented economic returns and sustainable cattle production. Keeping in view of the above, the present investigation has been undertaken to evaluate the reproductive performance of Hariana cows maintained at DUVASU Mathura farm and to estimate their genetic parameters.

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MATERIALS AND METHODS

Data: In the present study, the breeding information were used from the history sheet registers and herd inventory registers of Hariana cattle maintained at DUVASU farm, Mathura. Data on productive animals born between 1962 and 2024 were gathered. Total 929 animal records were collected from farm. To ensure the normal distribution, the outliers were removed and data within the range of mean±3 standard deviation were considered for the study.

Means, standard deviations, standard errors and coefficients of variations of the traits were calculated according to the statistical method 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 and AFC age group 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 models used were as follows:

Age at first calving:

$Y_{ijk} = \mu + P_i + S_j + e_{ijk}$

Where,

Y_{ijk} - k^{th} observation in j^{th} season and i^{th} period of birth

- Overall mean

P_i - Effect of i^{th} period of birth (i = 1 to 6)

S_j - Effect of j^{th} season of birth (j = 1 to 4)

e_{ijk} - Random error

FCI and FSP:

$Y_{ijkl} = \mu + P_i + S_j + Ak + e_{ijkl}$

Where,

Y_{ijkl} - l^{th} observation in k^{th} age group, j^{th} season and i^{th} period of calving

- 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)

e_{ijkl} - Random error

Mean comparison: Duncan's multiple range test (DMRT), as modified by Kramer (1957), was used to compare the least-squares means.

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.

RESULTS AND DISCUSSION

Performance for different reproduction traits are presented in Table 1 and period-wise descriptive statistics of important reproductive traits in Hariana cattle are presented in Table 2. In the present study, age at first calving was estimated as 1690.3 days. Total 929 animal's data were collected for Age at first calving. After normalization, 10 outliers were removed to estimate overall mean for age at first calving. AFC was 1690.3 days, with standard error and standard deviation of 13.10 and 397, respectively. The coefficient of variation estimated for AFC was 23.49. Similar mean of age at first calving reported by Dhoke *et al.* (1974) in Hariana cattle. Banerjee and Banerjee (2002) in F × S breed and Singh (2015) in Sahiwal cattle reported higher average estimate of age at first calving. The lower mean estimates of age at first calving were reported by Ahmad *et al.* (2007), Bala *et al.* (2017), Singh *et al.* (2011) in Zebu x Friesian cows, White Fulani, Vrindavani cattle, respectively. Kathiravan (2009), Hadge *et al.* (2009), Raja (2010), Sivamani *et al.* (2013) also reported lower mean estimates of age at first calving in Sahiwal cattle. Pal (2009) also estimated lower mean estimates of age at first calving in Hariana cattle. Lower mean estimates of age at first calving were also reported by Deb *et al.* (2009) in BCB-1 cattle, Nehra (2011) in Karan Fries cattle, Dangar and Vataliya (2014) in Gir cattle, Jawale (2015) in Phule Triveni cattle, Japheth *et al.* (2015) in Karan Fries cattle, respectively.

Total 769 animal's data were collected for first calving interval. After normalization, 12 outliers were removed to estimate overall mean for first calving interval. FCI was 608 days, with standard error and standard deviation of 6.79 and 186.6, respectively. The coefficient of variation estimated for FCI was 30.69. Similar mean of first calving interval was estimated by Pandey *et al.* (2001) in Hariana cattle. The lower estimates of average of first calving interval were reported by Pal (2009), Kumar (2009) in Hariana cattle. Singh *et al.* (2016a), Kumar *et al.* (2017), Verma *et al.* (2018) and Singh *et al.* (2020) in Frieswal cattle, Sahiwal cattle, Red Sindhi cattle and HF cattle, respectively also reported lower estimates average of first calving interval. The higher average estimates of first calving interval were reported by Kumar *et al.* (2019) in Hariana cattle.

Total 769 animal's data were collected for first service period. After normalization, 10 outliers were removed to estimate overall mean for first service period. FSP was 320 days, with standard error and standard deviation of 6.79 and 186.6 (Table 1), respectively. The coefficient of variation estimated for FSP was 58.32. Lower mean estimates of first service period was estimated by Kaushik (2000), Dhaka *et al.* (2002), Dahiya (2002), Singh (2002), Dalal *et al.* (2002), Kumar (2006), Pal (2009), Kumar (2009) in Hariana cattle.

Least-squares means along with standard errors for different reproduction traits are presented in Table 3 and Table 4. In the present study, estimated overall least-squares mean for age at first calving was 1688.05 ± 14.24 days in Hariana cattle and period of birth and season of birth had significant effect on age at first calving. Singh *et al.* (2010), Doharey (2012), Shetkar *et al.* (2021) had observed similar estimates of least-squares mean for age at first calving in Hariana cattle. Shetkar *et al.* (2021) reported significant effect of period of birth on age at first calving. Kaushik (2000), Singh (2001), Dahiya (2002), Singh (2002), Kumar (2006), Pal (2009), Tomar *et al.* (2022) in Hariana estimated lower estimates of least-squares mean for age at first calving in Hariana cattle. Balasubramaniam *et al.* (2013), Singh *et al.* (2016b), Bansal *et al.* (2018), Ratwan *et al.* (2019), Narwaria *et al.* (2021) also reported lower estimates of least-squares mean age at first calving in Sahiwal cattle. Deokar *et al.* (2017) in

Table 1. Descriptive statistics of important reproductive traits in Hariana cattle

S.No	Trait	N	Mean	SD	SE	CV
1.	AFC (days)	919	1690.3	397	13.1	23.49
2.	FCI (days)	757	608	186.6	6.79	30.69
3.	FSP (days)	757	320	186.6	6.79	58.32

Table 2. Period wise means of important reproductive traits in Hariana cattle

Period	AFC (days)	FCI (days)	FSP (days)
1962-1970	1385 (141)	567 (139)	279 (139)
1971-1980	1594 (183)	562 (152)	274 (152)
1981-1990	1903 (209)	623 (175)	335 (175)
1991-2000	1649 (206)	713 (162)	425 (162)
2001-2010	1890 (71)	599 (59)	311 (59)
2011-2020	1787 (109)	515 (56)	227 (56)
Overall mean	1690	608	320

Table 3. Least-squares means and standard error of FCI and FSP in Hariana cattle

Effects	FCI (days)	FSP (days)
Overall mean (μ)	601.7 ± 9.22 (741)	313.71 ± 9.22 (741)
SEASON OF CALVING		
Winter	598.8 ± 9.61^{a} (378)**	310.85 ± 9.61^{a} (378)**
Summer	639.6 ± 12.8^{b} (221)	351.69 ± 12.8^{b} (221)
Rainy	613.1 ± 23.1^{bc} (61)	325.16 ± 23.1^{bc} (61)
Autumn	555.1 ± 20.7^{c} (81)	267.15 ± 20.7^{c} (81)
PERIOD OF CALVING		
1966-1970	531.2 ± 26.5^{a} (52)**	243.25 ± 26.5^{a} (52)**
1971-1980	562.1 ± 14.1^{ab} (205)	274.11 ± 14.1^{ab} (205)
1981-1990	638.0 ± 16.8^{b} (135)	350.03 ± 16.8^{b} (135)
1991-2000	635.8 ± 15.0^{c} (171)	347.82 ± 15.0^{c} (171)
2001-2010	719.0 ± 20.0^{c} (95)	431.00 ± 20.0^{c} (95)
2011-2022	524.0 ± 20.4^{d} (83)	236.08 ± 20.4^{d} (83)
AFC CLASS		
Lower AFC Class	599.6 ± 11.7 (410)	311.62 ± 11.7 (410)
Higher AFC Class	603.8 ± 12.2 (331)	315.81 ± 12.2 (331)

**Level of significance (P<0.01)

Phule Triveni cattle, Jadhav *et al.* (2019) in HF × Gir half breed, Singh *et al.* (2020b) in HF also estimated lower least-squares mean of age at first calving. Kumar *et al.* (2005) observed higher least-squares mean of age at first calving in Hariana cattle. Tomar *et al.* (2022) reported period of birth had highly significant effect on age at first calving while season of birth non-significantly affected the age at first calving in Hariana cattle. Singh *et al.* (2020a) also reported lower least-squares mean for age at first calving with significant effect of period and non significant effect of season in Sahiwal cattle. Singh *et al.* (2020a) also reported lower least-squares mean for age at first calving with significant effect of period and season in Holstein Friesian cattle.

In the present study the estimated overall least-squares mean for first calving interval was 601.7 ± 9.22

Table 4. Least-squares means and standard error of age at first calving in Hariana cattle

Effects	AFC (days)
Overall mean (μ)	1688.05 ± 14.24 (920)
SEASON OF BIRTH	
Winter	1738.37 ±17.32a (453)**
Summer	1634.98 ± 25.55ab (198)
Rainy	1703.29 ± 34.68bc (108)
Autumn	1675.58 ± 28.73c (161)
PERIOD OF BIRTH	
1962-1970	1368.43 ± 30.50a (141)**
1971-1980	1583.43 ± 26.72b (183)
1981-1990	1888.03 ± 25.58b (209)
1991-2000	1636.63 ± 25.81c (206)
2001-2010	1881.12 ± 43.26d (71)
2011-2018	1770.69 ± 34.40d (110)

**Level of significance (P<0.01)

days. Age at first calving had non-significant effect on first calving interval. Period of calving and season of calving had highly significant effect on first calving interval in the present study. Lower least-squares mean of first calving interval was reported by Ekka *et al.* (2014) in Kankrej, Hussain *et al.* (2015) in Tharparkar cattle, Dash *et al.* (2016) in Karan Fries cattle, Jadhav *et al.* (2019) in HF × Gir half breed cows, Singh *et al.* (2020a) in Sahiwal and Tomar *et al.* (2022) in Hariana cattle, respectively. Ambhore *et al.* (2017) and Deokar *et al.* (2017) also reported lower least-squares mean of first calving interval in Phule Triveni cattle. Ambhore *et al.* (2017a) and Deokar *et al.* (2017) reported period of calving had significant effect and season of calving had non-significant effect on first calving interval in Phule Triveni cattle. Ekka *et al.* (2014) and Singh *et al.* (2020a) reported non-significant effect of period and season on first calving interval in Kankrej cattle and Sahiwal cattle, respectively.

The estimated overall least-squares mean for first service period was 313.71 ± 9.22 days in the present study. Age at first calving had non-significant effect on first service period. Period of calving and season of calving had highly significant effect on first service period. Hussain *et al.* (2015) in Tharparkar cattle, Deokar *et al.* (2017) in Phule Triveni, Singh *et al.* (2020a) in Sahiwal and Tomar *et al.* (2022) in Hariana cattle estimated lower least-squares mean for first service period. Ambhore *et al.* (2017) and Deokar *et al.* (2017) reported that period of calving had significant and season of calving had non-significant effect on first service period in Phule Triveni cattle. Singh *et al.* (2020a) reported season and period had non-significant effect on first service period in Sahiwal cattle.

Heritability: Heritability estimates for first service period was estimated 0.240 in the present study. Pal (2009) in Hariana observed the similar estimate for heritability of first service period. Similar estimate of heritability of first service period was also observed by Choudhary *et al.* (2003) and Singh *et al.* (2020) in Sahiwal cows. Tomar *et al.* (2022) observed lower estimates for heritability of first service period in Hariana cows. Banik and Gandhi (2007), Banik and Gandhi (2010) and Dongre *et al.* (2011) also reported lower estimates for heritability of first service period in Sahiwal cattle. Dubey and Singh (2005) reported higher estimates for heritability of first service period in Sahiwal cattle.

Association between AFC and FSP: The age at first calving had low positive genetic correlations with first service period (0.140±0.269). The age at first calving had positive phenotypic correlations with first service period with estimates as 0.029. Dalal *et al.* (2002) reported positive genetic correlation between AFC and FSP in Hariana cattle. Banik and Gandhi (2007), Banik and Gandhi (2010) also reported positive genetic correlation between AFC and FSP in Sahiwal cattle. Negative genetic correlation between AFC and FSP were reported by Dubey and Singh (2005) in Sahiwal cattle. Kaushik (2000), Dahiya (2002) and Tomar (2022) also estimated negative genetic correlation between AFC and FSP in Hariana cattle. Positive phenotypic correlation between AFC and FSP reported by Dalal *et al.* (2002) in Hariana cattle. Dubey and Singh (2005), Banik and Gandhi (2007), Banik and Gandhi (2010) also reported positive phenotypic correlation between AFC and FSP in Sahiwal cattle. Tomar (2022) reported negative phenotypic correlation between AFC and FSP in Hariana cattle.

CONCLUSIONS

The selection can be applied to improve these reproductive traits using good managemental practices, as low heritability among reproduction traits indicated that the presence of genetic variance. Effect of season of birth and period of birth were highly significant for age at first calving. Also effect of season of calving and period of calving were highly significant for FCI and FSP, hence by improving the management in the winter and rainy season we can get better AFC in Hariana cattle. Effect of age at first calving of a cow was non-significant for FCI and FSP. Knowing the present status of reproductive performance, we can go for further improvement in Hariana cattle performance.

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