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Age at first calving and lifetime performance of Hariana cattle at organized farms

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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. Milk yield is the single most important economic trait determining economic returns from the dairy animals (Patil *et al.* 2012). Indigenous breeds of cattle in India are late maturing but possess better endurance to withstand endemic disease, high temperature and adapted to harsh tropical climate. Among indigenous breeds, Hariana is the well-known dual-purpose cattle breed. 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). Improvement of fertility in lactating animals has become the key objective for selection programs in recent years in most countries (Patil *et al.* 2011). Due to current trend towards medicinal and therapeutic uses of milk, dung and urine of indigenous cows, our cows may play a pivotal role towards the economy of the country and it would be more economical and commercially viable unit for rural development.

The profitability in dairying depends upon the animal attaining optimum age at first calving. To decrease the costs, it is desirable that cows stay in a herd for a longer period (herd life) with high level of milk production. Thus, the profit from a cow depends directly on its productive life and herd life. The combination of high daily milk yield and long productive life (PL) emerges in a high level of lifetime milk production and an increase in the profitability. Herd life is one of the most important economic traits in dairy cattle populations. Herd life evaluates the genetic ability of cattle to stay in the herd and make cattle more profitable and sustainable. Longer herd life improves milk production as well as the total lifetime of a calf which in turn increases selection intensity. The productive life of dairy cattle in the herd is a function of both fertility and producing ability of the animal. Animals with higher productive life are bound to have a greater herd life and are highly economical for dairy farming. In any dairy cattle production enterprise, the length of life (total life) of a dairy cow has a substantial impact on economic performance. Besides, longer average life will lead to a higher proportion of cows in later high producing lactations and therefore, increases lifetime productivity of dairy cows, as lifetime production is one of the important parameters to obtain more economic return from a particular animal. Hence this investigation was done to study age at first calving and lifetime performance traits in Hariana cattle.

Source of data: In the present study, the breeding information of Hariana cattle maintained at DUVASU farm, Mathura and Babugarh farm, Hapur were used. The data of productive animals with date of birth from 1962 to 2013 were collected. To ensure the normal distribution, the outliers were removed and data within the range of mean ± 3SD were considered for the study.

Age at first calving (days) – AFC: It is the age of an animal when it calved for the first time. It is also defined as the days from date of birth to date of first calving.

Actual lifetime milk yield per day of productive life (litres/day) - ALT/PL: Calculated milk production by an animal per day of its productive life.

Actual lifetime milk yield per day of herd life (litres/day) - ALT/HL: Calculated milk production by an animal per day of its herd life.

Actual lifetime milk yield per day of total life (litres/day) - ALT/TL: Calculated milk production by an animal per day of its total life.

Least-squares analysis for adjustment of data: The non-genetic factors such as period of birth, season of birth, 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).

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The model used was as follows:
Age at first calving:

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

where Y_{ijklm}, l^{th} observation in k^{th} farm, 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); F_k, effect of k^{th} farm (k = 1 to 2); e_{ijkl}, random error, NID (0, σ^2_e)

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} AFC 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} AFC age group (k = 1 to 2); F_l, effect of l^{th} farm (l = 1 to 2); e_{ijklm}, random error, NID (0, σ^2_e)

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

The overall least-squares means for age at first calving was 1668.3±16.6 days. Farm and period of birth had significant effect on age at first calving. Singh *et al.* (2010) and Doharey (2012) had observed similar estimates for age at first calving. Doharey (2012) reported significant effect of farm and period of birth. Kaushik (2000), Singh (2001), Dahiya (2002), Singh (2002), Singh *et al.* (2004), Kumar (2006) and Pal (2009) observed lower estimates for age at first calving. Kumar *et al.* (2005) reported higher age at first calving in Hariana cattle.

The overall least-squares means for actual lifetime milk yield per day of productive life (ALT/PL) was estimated as 1.878±0.04 litres/day and only the period of birth had significant effect on actual lifetime milk yield per day of productive life. Ankuya *et al.* (2017) observed higher estimates for actual lifetime milk yield per day of productive life in Kankrej cattle. Effa *et al.* (2013) had observed higher estimates for ALT/PL in Boran crossbred cows. Dash *et al.* (2018) observed higher estimates for actual lifetime milk yield per day of productive life and observed significant effect in period of birth and AFC groups in Karan Fries cattle. Vinothraj *et al.* (2016) observed higher estimates for actual lifetime milk yield per day of productive life in Jersey × Red Sindhi crossbred cows. Thiruvenkadan *et al.* (2015) had observed higher estimates for actual lifetime milk yield per day of productive life in Murrah buffalo. Dev *et al.* (2016) observed higher estimates for actual lifetime milk yield per day of productive life in Murrah buffalo and only the period of birth had significant effect on actual lifetime milk yield per day of productive life.

The overall least-squares means for actual lifetime milk yield per day of herd life (ALT/HL) was estimated as 1.735±0.05 litres/day. Farm and period of birth had significant effect on actual lifetime milk yield per day of herd life. Effa *et al.* (2013) had observed higher estimate for actual lifetime milk yield per day of herd life in Boran crossbred cows, Vinothraj *et al.* (2016) observed higher estimates of actual lifetime milk yield per day of herd life in Jersey × Red Sindhi crossbred cows, Dev *et al.* (2016) observed higher estimates in Murrah buffalo and the effect of period, season of calving and age at first calving was statistically non-significant.

The overall least-squares means for actual lifetime milk yield per day of total life (ALT/TL) was estimated as 1.029±0.03 litres/day. AFC age group, farm and period birth had significant effect on actual lifetime milk yield per day of total life. Ankuya *et al.* (2017) observed higher estimates for actual lifetime milk yield per day of total life in Kankrej cattle. Effa *et al.* (2013) had observed higher estimates for actual lifetime milk yield per day of total life in Boran crossbred cows. Dash *et al.* (2018) observed higher estimates for actual lifetime milk yield per day of total life with significant effect on period of birth and AFC groups in Karan Fries cattle. Vinothraj *et al.* (2016) observed higher estimates for actual lifetime milk yield per day of total life in Jersey × Red Sindhi crossbred cows. Thiruvenkadan *et al.* (2015) had observed higher estimates of actual lifetime milk yield per day of total life in Murrah buffalo.

SUMMARY

The present investigation was undertaken to access age at first calving, actual lifetime milk yield per day of productive life, actual lifetime milk yield per day of herd life and actual lifetime milk yield per day of total life. The non-genetic factors such as period of birth, season of birth, AFC age group and farms on these traits were studied by least-squares analysis and the means were compared using Duncan's multiple range test. The least-squares means for age at first calving, actual lifetime milk yield per day of productive life, actual lifetime milk yield per day of herd life and actual lifetime milk yield per day of total life were estimated as 1668.3±16.6 days, 1.878±0.04 litres/day, 1.735±0.05 litres/day and 1.029±0.03 litres/day respectively. Farm and period of birth had significant effect on age at first calving, actual lifetime milk yield per day of herd life and actual lifetime milk yield per day of total life. In actual life time milk yield per day of productive life, period of birth had significant effect. AFC class had significant effect on actual lifetime milk yield per day of total life.

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