Indian Journal of Animal Sciences **86** (7): 767–770, July 2016/Article

Optimisation of age at first calving in Karan Fries cattle

K PUHLE JAPHETH[1], R K MEHLA[2], S S LATHWAL[3], U S NARWARIA[4], DINESH M MAHER[5] and PRANAY BHARTI[6]

ICAR- National Dairy Research Institute, Karnal, Haryana 132 001 India

Received: 27 October 2015; Accepted: 8 December 2015

ABSTRACT

The study was conducted on the performance records of age at first calving (AFC) spread over a period of 15 years on Karan Fries crossbred cattle maintained at Livestock Research Centre. Data of 676 cows were collected and analysed by Least Squares Technique to examine the effect of non-genetic factors on age at first calving. Period of birth was classified into 5 periods (I-V) and season of calving into 4 seasons (winter, summer, rainy and autumn) to see the effect of non-genetic factors on age at first calving. Effect of period of birth was significant on age at first calving while season of calving showed non-significant effect on age at first calving. The overall least squares mean of age at first calving was 1043.40±6.64 days. For the optimisation of age at first calving with regard to milk productivity, analysis was carried out by class interval method. Age at first calving was classified into 7 classes and its average means of milk yield were obtained by using Least Squares Technique where optimum level of age at first calving was obtained at 885–1100 days based on higher milk yield and numbers of animal observed in different classes. From the study, it was concluded that optimum age at first calving could be achieved through proper nutrition and management practices. However, to determine the optimum level of age at first calving, much emphasis should be given to maximum profit rather than maximizing milk production.

Key words: Age at first calving, Environmental factors, Karan Fries, Non-genetic factors, Optimisation

India is bestowed with rich (199 million) cattle population producing 127.9 MT @ 290 g/day consumed by population of 1.2 billion (BAHFS 2013). The combination of growing demand for livestock products in the developing world and the demand in industrialized countries represent a major economic opportunity for mostly local livestock keepers in developing countries (GOI 2010). In spite of the presence of large and diverse cattle genetic resources, the productivity of indigenous cattle breeds remains low in the country for various reasons, such as inadequate nutrition, poor genetic potential, inadequate animal health services, the harsh climatic conditions and other management related problems. The productivity of dairy animals could be increased by crossbreeding the low yielding non-descript cows with high yielding suitable exotic breeds. Crossbreeding of local cattle breeds with exotic breeds such as Holstein Friesian is aimed to increase milk production yield to 4,000 kg milk/lactation (Lakshmi *et al*. 2009).

When sexual maturity is delayed, economic return will reduce in dairy cattle. The longer the animal remains unproductive the greater the loss to the farmer. The age at first calving changes the heifer from non-productive expensive item to an income generating cow. Early age at first calving reduces the unproductive period of the cow and thus increases the net return. Higher age at first calving causes the additional rearing cost of animal. So, it is essential to asses at what age the animal would be bred for the first time to get an optimum balance between expected increase in production and expected increase in additional rearing and other costs to maximise the production and net returns in the following lactation. The objective of this study was to observe the effect of environmental factors on age at first calving and to analyse milk production records of Karan Fries cows for obtaining optimum level of age at first calving.

MATERIALS AND METHODS

The crossbred cattle maintained at the Institute farm were exposed to extreme climatic stress due to wide range of meteorological factors. Loose housing system was followed. The nutritional requirement was met through both roughages and concentrate. The animals were bred through artificial insemination. All types of veterinary aids, prophylactic and sanitary measures were taken care.

Data comprising 676 lactation records of Karan Fries

Present address: [1]Ph.D Scholar (puhleveto7@gmail.com), [2]Principal Scientist (mehla@ndri.res.in), [3]Senior Scientist (lathwal@gmail.com), [4](drupendra@gmail.com), [5](dinesh.maher@gmail.com), [6](dr12pranay@gmail.com), Livestock Production and Mangement Department.

cattle from 1998 to 2012 (15 years) were utilized for the study. The records of known pedigree, normal calving and normal lactation (250 days and above in milking) were considered in the study. The collected data were classified and coded into 5 different period of birth; 1995–1997 (I), 1998–2000 (II), 2001–2003 (III), 2004–2006 (IV) and 2007–2009 (V) and into 4 different season of calving; winter (December - March), summer (April - June), rainy (July - September), autumn (October - November) in order to observe the effect of non-genetic factors on age at first calving.

The influence of various non-genetic factors on age at first calving was studied by Least Square Analysis of variance for non-orthogonal data using the technique described by Harvey (1975). The statistical model used for age at first calving is given below.

$$Y_{ijk} = \mu + S_i + P_j + e_{ijk}$$

where, Y_{ijk},overall mean; S_i, effect of i^{th} season of birth (i=1–4); P_j, effect of j^{th} period of birth (j=1–5); e_{ijk}, random error, assumed to be normally and independently distributed with mean zero and constant variance i.e. NID (0, σ_e^2).

Class intervals of age at first calving: For optimisation of age at first calving with regard to milk production, the data were classified into different classes and used class interval with the help of Sturges formula.

$$C = R/1+3.322 \log_{10} N$$

where, C, width of class/class interval; N, number of observation; R, range (maximum-minimum); $1+3.322\log_{10}N$, number of classes.

The significant difference among means of different classes of age at first calving was studied by using least squares analysis. The model used is given below:

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

where, Y_{ij}, j^{th} observation of i^{th} class of AFC; C_i, effect of i^{th} class of AFC; i, 1, 2, ...7 classes of AFC; e_{ij}, random error, assumed to be normally and independently distributed with mean zero and constant variance i.e. NID (0, σ_e^2).

RESULTS AND DISCUSSION

Age at first calving is an important economic trait. The early the cow matures, better is the profit. In this study, the overall least squares means for age at first calving was 1043.40±6.64 days (Table 1), which was in agreement with Reddy and Basu (1985) and Rana (1991) in various crosses of HF. However, in contrast to our findings, Patil *et al.* (1980), Yadav and Balaine (1980), Arora (1986) and Singh *et al*. (1988), reported lower average means of age at first calving in various HF crosses, while Nayak and Raheja (1996) and Elemam and Nekheila (2012) reported higher average of age at first calving in HF cross with Zebu cow.

Effect of period of birth on age at first calving: Period of birth was statistically significant (P<0.01) on AFC which is in agreement with Nagarcenkar and Rao (1982),Singh *et al.* (1988) and Nayak and Raheja (1996) in various HF crosses, while Sharma *et al.* (1982) reported non-significant effect on Holstein crosses with Sahiwal. Those cows which were born in the period (1995–1997) had the lowest average means of AFC (997.15±14.21 days), while those cows born during the period (1998–2000) had the longest average means of age at first calving (1053.18±14.14 days). The variation in age at first calving observed during these periods might indicate level of management as well as environmental effects on this economic trait. The level of management varies according to the ability of the farm manager, his efficiency in the supervision of the staff, system of crop husbandry, method and intensity of culling.

Effect of season of calving on age at first calving: The effect of season of birth on age at first calving was statistically non-significant and similar reports were also given by Rana (1991) in HF crosses with SW/T and Singh (1995) in Karan Swiss and Karan Fries crossbred cattle. The cows born in winter had the lowest average age at first calving (1035.94±10.28 days), compared to autumn born cows which had the highest average age at first calving (1049.60±15.17 days) which might be due to availability of good quality fodder and favourable climatic condition during winter season.

Optimisation of age at first calving with regard to milk productivity: To find out the optimum level of age at first calving with regard to milk productivity, age at first calving was divided into 7 different classes. The average mean values of 305 days or less milk yield (305DMY), total milk yield (TMY), milk yield/day of lactation length (MY/LL) and milk yield/day of calving interval (MY/CI) for each class of age at first calving were estimated (Table 2).

Age at first calving in relation to 305 days milk yield and total milk yield: The averages of 305DMY and TMY for each class of age at first calving were estimated (Table 2). The result with maximum 305DMY (3685.93±137.63 kg) and TMY (4652.83±229.08 kg) was observed in seventh class (>1317 days) and sixth class. While, minimum for both 305DMY (3222.93±232.64 kg) and TMY

Table 1. Least square means±SE value and effects of non-genetic factors on age at first calving

Parameters	No. of obs.	Age at first calving (days)
Overall means	676	1043.40±6.64
Period of birth *		
I	130	997.15±14.21^c
II	127	1053.18±14.14^b
III	110	1001.52±15.19^c
IV	225	1049.42±10.68^b
V	84	1115.72±17.41^a
Season of calving		
Winter	256	1035.94±10.28
Summer	151	1039.05±13.08
Rainy	158	1049.00±12.63
Autumn	111	1049.60±15.17

The values with different superscript within the column differs significantly 5% (*) and 1 %(**)

Table 2. Classes of age at first calving and average 305DMY, TMY, MY/LL and MY/CI

AFC class	No.	Average	Average 305DMY (kg)	Average TMY (kg)	No. MY/LL (kg)	Average MY/ CI (kg)
<776	14	3222.93± 232.64	4233.12± 435.59	10.15± 1.76	11	9.49± 4.49
777–884	106	3332.32± 84.54	4271.01± 152.54	10.44± 0.64	79	9.59± 1.67
885–992	168	3340.04± 67.15	4319.96± 121.17	10.59± 0.50	114	9.62± 1.39
993–1100	188	3400.59± 63.48	4364.85± 114.54	10.79± 0.48	121	9.57± 1.35
1101–1208	117	3445.71± 80.47	4248.98± 145.19	10.81± 0.61	78	10.34± 1.68
1209–1316	47	3670.14± 126.97	4652.83± 229.08	11.09± 0.96	27	10.10± 2.86
>1317	40	3685.93± 137.63	4534.32± 248.32	11.36± 0.04	14	10.37± 3.98

(4233.12±435.59 kg) was observed in first class (<776 days). Maximum number of animal observations (27.64%) was observed in fourth class (993–1100 days) while, minimum number of animal observations (2.05%) was in first class (<776 days).

Age at first calving and milk yield per day of lactation length: Milk yield/day of lactation length is a better indicator to assess productive performances of dairy animals, as it includes both milk yield and lactation length. The averages of milk yield/day of lactation length for each class of age at first calving was estimated (Table 2). Animals in the seventh class (>1317 days) had the maximum MY/LL (11.36±0.04 kg), while cows in first class (<776 days) showed minimum MY/LL (10.15±1.76 kg). Highest number of animal observations was in the fourth class (993–1100 days) with 27.64%, while minimum number of animal observations was in first class (<776 days) with 2.05%.

Age at first calving and milk yield per day calving interval: Milk yield/day of calving interval is one of the best indicators to assess productive as well as reproductive performance of a dairy cow. This includes lactation length (service period plus gestation period) and dry period. The averages of milk yield/day of calving interval for each class of age at first calving was estimated (Table 2). Maximum MY/CI (10.37±3.98 kg) was observed in seventh class (>1317 days) while minimum MY/CI (9.49±4.49 kg) was observed in first class (<776 days). Highest number of animal observations was in the fourth class (993–1100 days) with 27.64%, while minimum number of animal observations was observed in first class (<776 days) with 2.05%.

The rate of change in various milk production parameters (305DMY, TMY, MY/LL and MY/CI) with respect to age at first calving showed that milk production increases with increase in age at first calving. Cows in early age lactation showed inferior performance which might be due to sudden exposure to calving, lactation stress and incomplete physiological and mammary development. Whereas, milk production of cows was better with higher age at first calving which might be due to more maturity in their physiological and mammary system.

Although, milk production increases with increase in age at first calving, it is not economical for cow with higher age at first calving as it reduces the lifetime production couple with waste of extra feed cost and labour. Moreover, fewer number of animal observations fall under these classes. The least squares analysis showed that the effect of age at first calving class on milk production was non-significant. So, those animals which are having lower age at first calving would be more economical. So, when third and fourth classes (885–1100 days) were combined making a majority of animal observations (52.34%) with wider range of age at first calving showing better relative performance, which could be considered as more economical and achievable. The finding of this study was slightly higher than those reported by Singh (1986), 721–810 days in Jersey half-bred, 721–900 days in Friesian half-bred and 871–990 days in Brown Swiss half-bred. However, in comparison to indigenous cow, the same researcher reported higher optimum AFC (1321–1440 days) in Hariana purebred.

From the above discussion of milk production traits, it can be concluded that the age at first calving (885–1100 days) which fall under third and fourth class was the optimum level for Karan Fries cows. Early maturity cows showed poorer performance while late maturity cows showed higher performance although at the expense of more labour, more feeds and shorter productive lifetime. Therefore, in economical point of view, to determine the optimum range of age at first calving, more emphasis should be given to maximum profit rather than maximizing milk production.

ACKNOWLEDGEMENT

The authors express their heartfelt gratitude to the Director, A. K. Srivastava, for giving the opportunity to carry out the research work. Also, sincere thanks are given to Shri Gian Singh, Ulfina Galmessa and Records Room Unit for their help, without which the work would be left undone.

REFERENCES

Arora D N. 1986. 'Evaluation of crossbred dairy herd for reproductive and profit function.' Ph. D. Dissertation, Haryana Agri. University, Hisar, India.

Basic Animal Husbandry and Fisheries Statistics. 2013.

Elemam M B and Nekheila A M. 2012. Some productive traits of crossbred dairy cows in the farm of University of Khartoum, Sudan. *Emirates Journal of Food and Agriculture* **24** (2): 155–58.

Harvey WR. 1975. *Least squares analysis of data with unequal subclass numbers. ARS*, 2–28, U. S. D. A. Washington D. C.

Lakshmi B S, Gupta B R, Sudhakar K, Prakash M G and Sharma S. 2009. Genetic analysis of production performance of Holstein Friesian × Sahiwal cows. *Tamilnadu Journal of Veterinary and Animal Sciences* **5**: 143–48.

Nagarcenkar R and Rao M K. 1982. Performance of Tharparkar and exotic crosses for productive and reproductive traits. *Indian Journal of Animal Sciences* **52** (3): 129–38.

Nayak S K and Raheja K L. 1996. Performance of half-bred and three breed crosses of Hariana with exotic dairy breeds. *Indian Journal of Animal Sciences* **66** (2): 154–58.

Patil R R, Singh G, Parshad M, Sharma R K and Dhaka B S. 1980. Milk yield of crossbred (Friesian× Sahiwal) cows in relation to age at first calving, lactation length, service period and dry period. *Indian Journal of Dairy Sciences* **33** (2): 519–21.

Rana P S. 1991. A note on the performance cows at Military Dairy Farm. *Cheiron* **20**: 1–5.

Reddy C O and Basu S B. 1985. Factors affecting profit function and production traits in crossbred cattle. *Indian Journal of Animal Sciences* **55** (1): 35–41.

Report GOI. 2010. National Dairy Development Board. Estimates of milk production - State wise. Department of Animal Husbandry, Dairying & Fisheries, Ministry of Agriculture, GOI.

Sharma J M, Dhingra M M and Gurung B S. 1982. Factors affecting age at first calving in Friesian-Sahiwal crossbred cattle. *Livestock Advisor* **7** (10): 52–54.

Singh R, Tomar S S and Sadana D K. 1988. Genetic analysis of age at first calving in Karan Fries cattle. *Indian Veterinary Journal* **66** (5): 407–11.

Singh M K. 1995. 'Factors affecting trends in performance Karan Swiss and Karan Fries cattle.' Ph. D. Thesis, National Dairy Research Institute, Karnal. India.

Singh R. 1986. 'Selection of optimum combination of early traits for maximising genetic improvement in dairy cattle.' Ph. D. Thesis, National Dairy Research Institute, Karnal, India.

Yadav S B S and Balaine D S. 1980. Comparative performance of Hariana purebreds and halfbreds with some elite exotic breed. *Livestock Advisor* **55**: 33–37.