



Performance of crossbred cattle (HF × Sahiwal) under tropical farming conditions of Punjab

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ABSTRACT

The present study was focused to estimate the effect of certain genetic and non-genetic factors, viz. sire, season and period on the AFC, MY, PY and fat% of crossbred cattle of farmers reared under the tropical conditions of Punjab state of India. The records on first lactation milk yield and reproduction performance of 3,008 crossbred cattle spread over a period of 18 years (1995–2012) were used for the study to assess the impact of crossbred cattle performance in this area. The production traits considered were age at first calving (AFC), first lactation 305-days or less milk yield (FL305DMY), peak yield (PY) and fat%. The overall least squares means for AFC, MY, PY and fat% were estimated as 1092.009±07.96 (days), 3214.488±26.58 kg, 12.922±0.10 kg and 3.739±0.01%, respectively. The effect of sire was highly significant on all the traits while the effect of season was significant on MY, peak yield and fat%. However, the effect of period was highly significant on MY and fat% only. It is also reflected that the fluctuations in extreme climatic conditions did affect these traits in milch crossbred cattle maintained under tropical farming conditions. The heritability estimates of different production traits, viz. FL305DMY, PY and fat% were 0.316±0.054, 0.177±0.042 and 0.064±0.032, respectively.

Key words: Crossbred cattle, Non-genetic factors, Punjab, Production performance, Tropical farming

India ranks first in milk production, accounting for 18.5% of world production, achieving an annual output of 146.3 million tonnes during 2014–15 as compared to 137.69 million tonnes during 2013–14 recording a growth of 6.26%. Whereas, the Food and Agriculture Organization (FAO) has reported a 3.1% increase in world milk production from 765 million tonnes in 2013 to 789 million tonnes in 2014. The per capita availability of milk in India has increased from 176 g/day in 1990–91 to 322 g/day by 2014–15. It is more than the world average of 294 g/day during 2013. This represents a sustained growth in availability of milk and milk products for the growing population. Dairying has become an important secondary source of income for millions of rural households engaged in agriculture. However, in summer season, there is scarcity of milk availability under the field conditions of this state due to hot and humid climatic conditions. The present study would also envisage the various problems associated with the upkeep of crossbred cows, and to formulate an effective and suitable breeding strategy for this purpose, precise and accurate information on the first lactation production and reproduction performance is highly essential as selection is primarily done on the basis of first lactation economic traits. Variations in climatic conditions over the years

influence the production and reproduction performance of the animals leading to alteration in the estimates of genetic parameters. Considering the above facts, present investigation was undertaken to study the effect of certain genetic and non-genetic factors, viz. sire, season and period on first lactation production and reproduction traits in crossbred cattle rearing under tropical farming condition in Punjab.

MATERIALS AND METHODS

A field progeny testing (FPT) project was started by ICAR-CIRC, Meerut in 8th Five-Year Plan to improve the performance of crossbred cattle through utilization of high quality germplasm of genetically superior breeding bulls under the field conditions available at 4 different ecological regions of our country. The programme is implemented in collaboration with Kerala Veterinary and Animal Sciences University, Thrissur, (Kerala); Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana (Punjab); BAIF Development Research Foundation, Uruli-Kanchan, Pune (Maharashtra) and G B Pant University of Agriculture and Technology, Pantnagar (Uttarakhand), India. The present investigation was undertaken on the crossbred cows maintained under AICRP- Field Progeny Testing Project in the field conditions of Punjab, India. This is an advance state in the crop production as well as in the modern cattle farming. The mostly farmers fed balanced feed and fodder throughout the year. Concentrate was also provided to

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crossbred cows as per their milk production.

Data generation and standardization: The records on production and reproduction performance of 3,008 progenies of crossbred cattle sired by 172 HF crossbred bulls spread over a period of 18 years (1995–2012) were used for the study. The reproduction trait considered was age at first calving (AFC), and production traits considered were first lactation 305-day or less milk yield (FL305DMY), peak yield (PY) and fat%. The calving season was categorised into 3 season; winter (November–February), summer (March–July) and rainy season (August–October) to assess the impact of season on crossbred cattle performance in this area. Data were also classified in to six periods in the interval of three years to assess the effect of period on reproduction and production traits. Data were also recorded and categories sire wise, season and period wise accordingly.

Statistical analysis: The influence of various genetic and non-genetic factors on different production, reproduction and part lactation traits was studied by least squares analysis of variance for unequal non-orthogonal data using the technique described by Harvey (1966). The statistical model used for least squares analysis of variance for AFC, FL305DMY, FPY and fat percentage, was as follows:

$$Y_{ijkl} = \mu + S_i + A_j + P_k + e_{ijkl}$$

where, Y_{ijkl} , trait under study, viz. AFC, FL305DMY, FPY and fat percentage; μ , overall mean; S_i , effect of i^{th} sire; A_j , effect of j^{th} season; P_k , effect of k^{th} period; e_{ijkl} , random error, assumed to be normally and independently distributed with mean zero and constant variance i.e. NID $(0, \sigma^2)$.

Duncan's multiple range test as modified by Kramer (1957) was used for testing the differences among least squares means (using the inverse coefficient matrix).

RESULTS AND DISCUSSION

Age at first calving (AFC): The overall least squares mean for AFC was estimated as 1092.01 ± 07.96 days and found to be in accordance with the reports in higher side as 1321.82 ± 10.83 days by Dubey and Singh (2005) and lower as 921.35 ± 04.17 days by Rajeev (2016) in Frieswal cattle under farm management conditions and Simran *et al.* (2014) in crossbred cattle (29.72 ± 0.45 months). When the data were subjected to statistical analysis it was found that sire had highly significant effect on AFC. However, season and period had nonsignificant effect on AFC. while Rana (1991) reported nonsignificant effect of season and period of birth on AFC in Sahiwal crossbreds. Arora (1993) found nonsignificant effect of season and period of birth on AFC. Mukherjee (2005) obtained significant variation in AFC of Frieswal cattle maintained at different Military farms. The results of PDC, AR (2003), Rathee (2015) showed significant effect of season/month and period/year of birth on AFC while nonsignificant effect of season of birth on AFC was reported by Mukherjee (2005) and Simran *et al.* (2014) in various crossbred cattle.

FL305-day or less milk yield (FL305DMY): The least

squares analysis revealed average first lactation milk yield (FL305DMY) in the present study was 3214.49 ± 26.58 kg (Table 1) in crossbred cattle. The average estimate obtained in the present study was near to the average values reported by many workers. Singh *et al.* (2006) and Nehra (2011) reported average FL305DMY estimates lower than the present value. On the contrary, Rajeev (2016) reported a lower average of 2658.57 ± 42.59 kg and Rathee (2015) of 2765.91 ± 42.84 kg for FL305DMY in Frieswal cattle. The cows calved in winter season had the maximum FL305DMY of 3249.44 ± 29.82 kg followed by summer (3190.76 ± 28.51) and rainy season (3203.26 ± 32.43 kg). Season had statistically significant effect on milk yield. The milk yield of cows calved in different periods showed a wide variation ranging from 3353.19 ± 58.69 to 3074.58 ± 57.18 kg and the effect of period and sire was highly significant ($P < 0.01$). The present finding was in accordance with the reports of Siva Kumar (1998), Mukherjee (2005), Singh *et al.* (2006). Rathee (2015) and Rajeev (2016) also reported significant variation among the Frieswal cows calved in different years.

On the other hand, many workers (Bhattacharya *et al.* 2002, Nehra 2011, Radhika *et al.* 2012) reported nonsignificant effect of season and period of calving on the first lactation milk yield. On contrary, Mukherjee (2005) found significant seasonal variation in FLMY in various crossbred cattle. The studies of Mandal and Sachdeva (2001) revealed non-significant effect of sire on this trait. On the contrary, Rathee (2015) reported significant effect of sire on FLMY. Significant effect of sire on FL305DMY was also reported by Panja (1997) in KF cattle. Singh *et al.* (2006), Nehra (2011) and Rathee (2015) found nonsignificant effect of month/season of calving on this trait. However, study of Mukherjee (2005) revealed significant effect of season of calving on FL305DMY. The significant effect of year/period of calving on FL305DMY was reported by most of the workers (AR PDC 2003–04, Mukherjee 2005, Singh *et al.* 2006, Rathee 2015).

Peak yield (PY): The overall average peak milk yield (PY) in crossbred was 12.92 ± 0.10 kg under the field conditions of Punjab (Table 1). Better management and feeding practices with the availability of superior germplasm under FPT programme may be the reason for enhancement of yield in this area. When the data was categorised season wise, highest peak yield (13.12 ± 0.12 kg) was found in winter season followed by rainy (12.86 ± 0.13) and summer season (12.79 ± 0.11). It is assumed that the difference in production may be due to the variations in level of management and climatic conditions so far. The effect of sire and season of calving were found highly significant on the Peak Yield (PY) trait. Significant effects of period of calving (Gaur *et al.* 2008) and season of calving (Gaur 2007) on milk yield were reported in earlier studies.

Fat percentage: In the present study, the average fat percentage of first lactation milk production was found as 3.74 ± 0.01 (Table 1) and showed a similar trend in various

Table 1. Least squares averages for various first lactation traits in crossbred cattle

Variable	No.	AFC	MY	PY	FAT%
Overall	3008	1092.01±07.96	3214.49±26.58	12.92±0.10	3.74±0.01
<i>Season wise</i>			*	**	*
Winter	1029	1092.68±10.53	3249.44±29.82	13.12±0.12	3.75±0.01
Summer	1236	1106.83±10.05	3190.76±28.51	12.79±0.11	3.73±0.01
Rainy	743	1076.52±11.55	3203.26±32.43	12.86±0.13	3.73±0.01
<i>Period wise</i>			**		**
1995–97	170	1053.66±49.09	3306.78±80.14	13.60±0.38	3.86±0.03
1998–00	468	1012.85±34.46	3353.19±58.69	13.48±0.27	3.86±0.22
2001–03	429	1078.52±30.63	3293.42±49.00	13.28±0.22	3.84±0.02
2004–06	551	1120.93±30.4431	3094.79±48.64	12.54±0.22	3.61±0.02
2007–09	655	1143.47±36.92	3074.58±57.18	12.24±0.26	3.63±0.02
2010–12	735	1142.63±43.50	3164.15±69.35	12.40±0.32	3.63±0.03

**Significant at 1% level (P<0.01); *Significant at 5% level (P<0.05).

Table 2. Genetic parameters for different first lactation traits in crossbred cattle

Trait	MY	PY	FAT%
MY	0.316±0.054	NE	0.221±0.222
PY	0.819±0.015	0.177±0.042	0.173±0.260
FAT%	-0.005±0.000	-0.027±0.001	0.064±0.032

NE, non-estimable; estimates above the diagonal represent genetic correlation and estimates below the diagonal represent phenotypic correlation.

season and period of calving beginning to the end of lactation. On the other hand, the least squares analysis of variance revealed that the period of calving had highly significant (P<0.01) and the sire and season had significant effect on Fat% in crossbred cattle. Similar finding ranged from 3.6 to 3.7 fat% also reported in Annual Report, CIRC, Meerut 2015–16.

Heritability, genetic and phenotypic correlations among various first lactation production traits: The heritability estimates for different first lactation production traits, viz. FL305DMY, FPY and fat% were 0.316±0.054, 0.177±0.042 and 0.064±0.032, respectively. The heritability estimates for FL305DMY and FPY were statistically highly significant (P<0.01). The perusal of literatures on the heritability estimates of various first lactation production traits in crossbred cattle showed that the FL305DMY in different crossbred cattle ranged from 0.20±0.04 (Mukherjee 2005) and 0.09±0.01 (Panja 1997) to 0.48±0.22 (Gaur 2008), respectively. The genetic correlation estimates of Fat% with FL305DMY and FPY were found as 0.221±0.222 and 0.173±0.260, respectively. The phenotypic correlation between FL305DMY and FPY was positive and highly significant (Table 2).

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