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Research Article

GENETIC EVALUATION OF CROSSBRED CATTLE FOR PRODUCTION TRAITS

SUNIL KUMAR*, D.S. DALAL, B.L. PANDER and C.S. PATIL
Department of Animal Genetics and Breeding, College of Veterinary Sciences
Lala Lajpat Rai University of Veterinary and Animal Sciences
Hisar-125 004, India

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ABSTRACT

The present study was conducted on 333 HF crossbred cows maintained in the Department of Animal Genetics and Breeding, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana over a period of 24 years from 1991 to 2014. The data were analyzed for studying the effect of genetic factor i.e. sire group and non genetic factors i.e. period and season of calving and to estimate genetic and phenotypic parameters for production traits. The effect of age at first calving (AFC) was studied by taking it as covariate. The production traits studied were first lactation milk yield (FLMY; kg), first lactation length (FLL; days), first lactation peak yield (FPY; kg) and first dry period (FDP; days). The least squares mean for FLMY, FLL, FPY, FDP were observed as 2177.61±62.06 kg, 305.80±6.41 days, 10.23±0.20 kg and 110.97±6.47 days, respectively. The Period of calving had significant effect on FLMY and FPY, while season of calving had significant effect on FLMY, FPY and FDP. The AFC had significant ($P<0.05$) effect only on FDP. The estimates of heritability of first lactation performance traits were moderate. FLMY had high positive genetic correlation with FLL and FPY (0.68 and 0.86, respectively). The corresponding phenotypic correlations were significant positive whereas, significant and negative with FDP. These results indicated that preliminary selection of animals should be based on FPY to improve FLMY.

Key words: Correlation, genetic factor, heritability, production traits

It is well known that average yield of an Indian cow is usually very low, at about 1000 litres/lactation. Cross breeding with exotic breeds is the best alternative to improve the milk producing capability of the low yielding Indian cows. In India, cross breeding of indigenous cows with exotic dairy breed bulls has enhanced milk production in cattle and also resulted in development of some new strains/breeds through crossbreeding which are well adapted to tropical climatic conditions. The success of dairy industry is much dependent on level of production performance of the animals. Knowledge of genetic and non-genetic factors influencing the performance traits is essential to obtain correct estimates of genetic parameters and for developing a suitable selection criterion. The success of any breeding programme lies on the accuracy of selection and genetic correlation between performance traits. Therefore, the present investigation was undertaken to estimate genetic and phenotypic parameters of different first lactation production traits and to evaluate the effect of genetic and non-genetic factors on these traits.

MATERIALS AND METHODS

The data were collected on HF crossbred cattle from the history-cum-pedigree sheets maintained over the period from 1991 to 2014 in the Department of Animal Genetics and Breeding, LUVAS, Hisar. The production traits studied were first lactation milk yield (FLMY), first lactation length (FLL), first lactation peak yield (FPY) and first dry period (FDP). A total of 333 first lactation records of cows spread over 24 years were collected. Abnormal lactation records due to specific causes like abortion and sickness were excluded. The entire duration of 24 years from 1991 to 2014 was divided into 8 periods; each period of three years duration. Year to year variation within the period was assumed to be non-significant. Each year was divided into four seasons viz. summer (April to June), rainy (July to Sept.), autumn (Oct. to Nov.) and winter (Dec. to March) on the basis of fluctuations in atmospheric temperature and relative humidity.

To study the effect of genetic factor i.e. sire group and non-genetic factors i.e. period and season of calving on different production traits and to obtain sire and residual variance -covariance components for various production traits, least squares analysis technique (Harvey, 1990) was used with the following mixed model:

$$Y_{ijklm}=\mu+G_i+T_{ij}+P_k+S_l+b(A_{ijklm}-\overline{A})+e_{ijklm}$$

Where, Y_{ijklm} = Observation of m^{th} progeny of j^{th} sire belonging to i^{th} sire group, k^{th} period and l^{th} season of calving; μ=Overall population mean; G_i=Fixed effect of i^{th} sire group; T_{ij}=Random effect of j^{th} sire within i^{th} sire group assumed to be normally and independently distributed with mean zero and variance σ^2_e; P_k=Fixed effect of k^{th} period of calving (k = 1 to 8); S_l=Fixed effect of l^{th} season of calving (l = 1, 2, 3, 4); b=Linear regression coefficient of a trait on age at first calving; A_{ijklm}=Age at first calving pertaining to $Y_{ijklm}{}^{th}$

*Corresponding author: sunnydayzz92@gmail.com

observation; $\overline{A}$ =Mean age at first calving; e_{ijklm}=Random residual error associated with observation of m^{th} progeny of j^{th} sire belonging to i^{th} sire group, k^{th} period and l^{th} season of calving assumed to be normally and independently distributed with mean zero and variance σ^2_e.

Genetic and phenotypic parameters for different production traits were obtained by paternal half-sib correlation method as per standard procedure. The standard errors of phenotypic correlations were computed by using the formula given by Snedecor and Cochran (1968).

RESULTS AND DISCUSSION

Least-squares Mean for Different Production Traits: The overall least squares mean for FLMY was 2177.61±62.06 kg (Table 1). The results of the present study are in close conformity to those reported by Lakshmi *et al.* (2010) and Kumar (2015) in Frieswal cattle. While, FLMY reported by Kharat *et al.* (2008) and Hassan and Khan (2013) in crossbred cattle were on lower side and the FLMY reported by Singh *et al.* (2008) in crossbred cattle, Nehra (2011) in Karan Fries cattle and Goshu *et al.* (2014) in HF cattle were on higher side. Overall least squares mean of FLL was 305.80±6.41 days in the present study. This estimate is comparable with those reported by Saha *et al.* (2010) and Kumar (2015). While, Lakshmi *et al.* (2010) and Nehra (2011) reported higher FLL in crossbred cattle and Kharat *et al.* (2008) and Hassan and Khan (2013) reported lower FLL than the present study in crossbred cattle.

The overall least squares mean for FPY in the present study was 10.23±0.20 kg. This estimate is in close conformity with those reported by Kumar (2015) in crossbred cattle. Comparatively lower estimates were reported by Dongre *et al.* (2011), whereas, higher estimates were reported by Lakshmi *et al.* (2010) in crossbred cattle. The overall least squares mean of FDP was 110.97±6.47 days. This estimate was supported by the findings of Chaudhari *et al.* (2013) and Kumar (2015) in crossbred cattle. Comparatively higher FDP was observed by Hassan and Khan (2013) and Goshu *et al*. (2014) whereas, Singh and Gurnani (2004) reported lower FDP than present study. The variation from previous reports might be due to different population having different genetic makeup and also due to different managemental practices followed in different herds.

Effect of Sire Group: The influence of sire group was non-significant on all first lactation production traits. Kumar (2015) also reported non-significant effect of sire group on these traits.

Effect of Period of Calving: The influence of period of calving was significant on FPY (P<0.01) and FLMY (P<0.05). Saha *et al.* (2010), Lakshmi *et al.* (2010) and Hassan and Khan (2013) also reported significant effect of period of calving on FLMY in crossbred cattle while Kharat *et al.* (2008), Nehra (2011) and Kumar (2015) reported its non-significant effect on FLMY. Period-wise least squares mean indicated that FLMY was the highest in period 8 (2769.40±254.46 kg) and lowest in period 2 (1797.02±300.93 kg). Second period onwards there was an increasing trend for FLMY. It might be due to introduction of Frieswal sires in the population from 1996 onwards and better management practices.

Effect of Season of Calving: The effect of season of calving was significant (P<0.05) for all production traits except FLL. Saha *et al.* (2010) and Lakshmi *et al.* (2010) also reported significant effect of season of calving on FLMY and non-significant effect on FLL. Chaudhari *et al.* (2013) and Kumar (2015) reported significant effect of season of calving on FDP. FLMY and FPY were highest for cows calving in autumn season. It might be due to better availability of feed and fodder and better adaptability of crossbred cattle to favourable climate.

Effect of age at first calving (AFC): Effect of AFC was significant (P<0.05) on FDP, while it was non-significant on other traits.

Heritability Estimates: The heritability estimate of FLMY in the present study was moderate (0.28±0.02). Estimates of similar magnitude were also reported by Kumar *et al.* (2008) in Frieswal cattle and Goshu *et al.* (2014) in HF cattle. However, low heritability estimates were reported by Singh *et al.* (2008), Lakshmi *et al.* (2010) and Kumar (2015) and higher estimates were reported by Nehra (2011). The heritability estimate of FLL was 0.29±0.18. Similar estimates of heritability were also reported by Saha *et al.* (2010) and Kumar (2015) in crossbred cattle. However, lower estimates of heritability of FLL were reported by Kumar *et al.* (2008), Lakshmi *et al.* (2010) and Nehra (2011). The estimate of heritability of FPY in the present study was 0.31±0.23. The estimate of similar magnitude was also reported by Kumar (2015). The moderate estimates of heritability for FLMY, FLL and FPY indicated that additive genetic variance exist in the population for these traits, which can be exploited through individual selection and /or progeny testing. The heritability estimate for FDP was moderate and this finding is in close agreement with that reported by Chaudhari *et al*. (2013) and Kumar (2015) in

Table 1
Least squares means along with standard errors for different production traits

Effect		Least Squares (Mean ± S.E.)			
		FLMY (kg)	FLL (days)	FPY (kg)	FDP (days)
Overall mean		2177.61±62.06 (333)	305.80±6.41 (333)	10.23±0.20 (333)	110.97±6.47 (333)
Sire group	SG 1	2298.43±520.36 (50)	318.85±53.76 (50)	11.31±1.71 (50)	132.98±54.25 (50)
	SG 2	2118.25±394.76 (11)	276.22±40.78 (11)	11.13±1.29 (11)	127.02±41.15 (11)
	SG 3	2151.44±346.54 (26)	275.19±35.80 (26)	10.98±1.13 (26)	112.46±36.12 (26)
	SG 4	2109.16±246.77 (46)	316.43±25.49 (46)	9.81±0.81 (46)	108.59±25.72 (46)
	SG 5	2017.19±253.85 (90)	304.72±26.23 (90)	9.64±0.83 (90)	93.01±26.46 (90)
	SG 6	2157.99±290.18 (27)	304.04±29.98 (27)	9.34±0.95 (27)	118.62±30.25 (27)
	SG 7	2182.10±291.80 (51)	336.09±30.15 (51)	8.88±0.59 (51)	100.46±30.42 (51)
	SG 8	2386.27±302.33 (32)	314.84±31.23 (32)	10.73±0.99 (32)	94.60±31.51 (32)
Period of calving	P1 (1991-93)	1975.08ab±364.04 (44)	303.88±58.28 (44)	9.22ab±1.85 (44)	101.78±58.80 (44)
	P2 (1994-96)	1797.02a±300.93 (10)	311.34±51.76 (10)	8.68a±1.64 (10)	101.15±52.22 (10)
	P3 (1997-99)	1829.83a±357.06 (31)	346.08±36.89 (31)	8.49a±1.17 (31)	98.98±37.22 (31)
	P4 (2000-02)	2007.27ab±240.50 (23)	283.53±24.85 (23)	10.04bc±0.79 (23)	117.99±25.07 (23)
	P5 (2003-05)	2163.77b±232.41 (68)	303.92±24.01 (68)	10.24c±0.76 (68)	127.62±24.23 (68)
	P6 (2006-08)	2400.00c±245.49 (51)	298.35±25.36 (51)	11.53de±0.80 (51)	115.72±25.59 (51)
	P7 (2009-11)	2478.48c±276.13 (35)	285.92±28.53 (35)	11.22d±0.90 (35)	124.44±28.78 (35)
	P8 (2012-14)	2769.40d±254.46 (71)	313.37±26.29 (71)	12.40e±0.83 (71)	100.08±26.52 (71)
Season of calving	Summer	2249.54b±82.84 (96)	310.57±8.56 (96)	10.54b±0.27 (96)	122.69b±8.63 (96)
	Rainy	1971.63a±105.85 (54)	290.63±10.93 (54)	9.46a±0.34 (54)	111.37b±11.03 (54)
	Autumn	2304.38b±113.26 (51)	312.27±11.70 (51)	10.56b±0.37 (51)	88.86a±11.80 (51)
	Winter	2184.87b±74.42 (132)	309.72±7.69 (132)	10.35b±0.24 (132)	120.96b±7.75 (132)
Regression on AFC		0.20	0.02	0.002	-0.04

Figures in parenthesis are number of observations; Mean with different superscripts differ significantly among themselves. FLMY=first lactation milk yield; FLL=first lactation length; FPY=first lactation peak yield; FDP=first dry period

crossbred cattle. However, Singh and Gurnani (2004) and Singh *et al*. (2008) reported lower estimate of heritability for this trait in crossbred cattle.

Phenotypic and Genetic Correlations: Estimation of phenotypic and genetic correlations between the traits is important to find out correlated response so that simultaneous improvement in more than one trait may be planned. Phenotypic and genetic correlations among different traits under study are presented in Table 2.

Association Between FLMY and FLL: Phenotypic correlation between these traits was high (0.69±0.04). Dalal *et al.* (2002), Kumar *et al.* (2008), Chaudhari *et al.* (2013) and Kumar (2015) also reported similar results. In contrast, Singh *et al.* (2008) found low (0.12±0.03) phenotypic correlation between these two traits. Genetic correlation between these traits was 0.68+0.10. Similar findings were reported by Dalal *et al.* (2002), Kumar *et al.* (2008), Chaudhari *et al.* (2013) and Kumar (2015) whereas, Saha *et al.* (2010) reported moderate genetic correlation between these traits.

Association Between FLMY and FPY: The phenotypic and genetic correlations between FLMY and FPY were estimated as 0.83±0.03 and 0.86±0.04, respectively. These findings were supported by Dalal *et al.* (2002). Kumar (2015) also reported high phenotypic (0.51±0.05) and genetic correlation (0.73±0.12) in Frieswal cattle.

Association Between FLMY and FDP: A negative phenotypic correlation (-0.28+0.05) between FLMY and FDP was observed in the present study. Dalal *et al.* (2002), Chaudhari *et al.* (2013), Goshu *et al.* (2014) and Kumar (2015) also reported negative phenotypic correlation between these traits. However, Saha *et al.* (2010) reported a low and positive phenotypic correlation (0.12+0.03) between these two traits in Karan Fries cattle. Genetic correlation between these traits was negligible in present study.

Association Between FLL and FPY: Phenotypic and genetic correlations between these traits were 0.19±0.06 and 0.36±0.15 respectively. Dalal *et al.* (2002) also reported similar correlations (0.27±0.04 and 0.39±0.68, respectively) in Hariana cattle. Kumar (2015) reported higher (0.47±0.21) genetic correlation between these traits in Frieswal cattle.

Association Between FLL and FDP: A negative and significant phenotypic correlation (-0.37+0.05) between FLL and FDP was observed in the present study which is desirable because unproductive life of the animal decreases by decrease in dry period and increase in lactation length. Chaudhari *et al.* (2013), Goshu *et al.* (2014) and Kumar (2015) also reported similar results.

Table 2

Estimates of heritability (along diagonal), genetic correlation (above diagonal) and phenotypic correlation (below diagonal) between different production traits

	FLMY	FLL	FPY	FDP
FLMY	**0.28±0.02**	0.68±0.10	0.86±0.04	-0.02±0.17
FLL	0.69**±0.04	**0.29±0.18**	0.36 ±0.15	-0.03±0.18
FPY	0.83**±0.03	0.19**±0.06	**0.31±0.23**	-0.01±0.16
FDP	-0.28**±0.05	-0.37**±0.05	-0.16**±0.05	**0.24±0.22**

FLMY=first lactation milk yield; FLL=first lactation length; FPY=first lactation peak yield; FDP=first dry period

Though genetic correlation between these traits was negative but it was negligible.

Association Between FPY and FDP: A low and negative phenotypic correlation between these traits was observed in present study. Dalal *et al.* (2002) and Kumar (2015) also reported similar results. Genetic correlation between these traits was found to be negligible. The variation from previous reports might be due to different breeds having different genetic makeup and also due to different management practices followed in different herds.

It may be inferred from the estimates of heritability for production traits that additive genetic variance exist in the population for these traits, which can be exploited through individual selection and/or progeny testing. A critical appraisal of genetic correlations suggested that preliminary selection should be practiced on the basis of FPY in order to improve FLMY for necessary economic measures. In the present study, the period of 2012-14 was superior among all the periods for FLMY, FPY and FDP and 2nd best for FLL. In general, FLMY was higher in later periods than in previous periods, which is in favourable direction.

REFERENCES

Chaudhari, M., Kumar, R., Khanna, A.S. and Dalal, D.S. (2013). Genetic studies on production traits in crossbred cattle. *Indian J. Vet. Sci.* **1(2)**: 48-54.

Dalal, D.S., Rathi S.S. and Raheja, K.L. (2002). Estimates of genetic and phenotypic parameters of first lactation and lifetime performance traits in Hariana cattle. *Indian J. Anim. Sci*. **72**: 398- 401.

Dongre, V.B., Gandhi, R.S., Singh, A., Raja, T.V. and Singh, R.K. (2011). Effect of non-genetic factors on weekly test day milk yields and first lactation traits in Sahiwal cattle. *Indian J. Anim. Res.* **45**: 139-142.

Goshu, G., Singh, H., Peterson, K.J. and Lundeheim, N. (2014). Heritability and correlation among first lactation traits in Holstein Friesian cows at Holeta bull dam station, Ethiopia. *Int. J. Livest. Prod.* **5**: 47-53.

Harvey, W.R. (1990). Guide for LSMLMW, PC-1 Version, mixed model least squares and maximum likelihood computer programme, January 1990. Mimeograph Ohio State University, USA.

Hassan, F. and Khan, M.S. (2013). Performance of crossbred dairy cattle at military dairy farms in Pakistan. *J. Anim. Plant Sci.* **23(3)**: 705-714.

Kharat, A. S., Kuralkar, S.V and Ali, S.Z. (2008). Genetic studies on first lactation and lifetime traits in Holstein Friesian crossbred cows. *Indian J. Anim. Res.* **42**: 261-263.

Kumar, P. (2015). Genetic evaluation of Frieswal sires for test day milk records and first lactation traits. M.V.Sc thesis, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, India.

Kumar, S., Singh, Y.P. and Kumar, D. (2008). Genetic studies on performance traits in Frieswal cattle. *Indian J. Anim. Sci.* **78**: 107-110.

Lakshmi, B., Gupta, R., Gnana Prakash, B., Sudhakar, K. and Sharma, S. (2010). Genetic analysis of the production performance of Frieswal cattle. *Tamil Nadu J. Vet. Anim. Sci.* **6**: 215-222.

Nehra, M. (2011). Genetic analysis of performance trends in Karan Fries cattle. M.V.Sc. thesis, National Dairy Research Institute (Deemed University), Karnal, India.

Saha, S., Joshi, B.K. and Singh, A. (2010). Generation-wise genetic evaluation of various first lactation traits and herd life in Karan Fries cattle. *Indian J. Anim. Sci.* **80**: 451-456.

Singh, M.K. and Gurnani, M. (2004). Genetic analysis of production and reproduction traits in Karan-Fries and Karan-Swiss cattle. *Indian J. Anim. Sci.* **74**: 225-228.

Singh, V.K., Singh, C.V., Kumar, D. and Sharma, R.J. (2008). Genetic parameter for first lactation and life time performance traits in crossbred cattle. *Indian J. Anim. Sci.* **78**: 497-500.

Snedecor, G.W. and Cochran, W.G. (1968). Statistical Methods. (6th edn.). Oxford and IBH Publishing Co., New Delhi.