Haryana Vet. **52** (December, 2013) pp 75-78 **Research Article**

GENETIC STUDIES ON REPRODUCTION TRAITS IN CROSSBRED CATTLE

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ABSTRACT

The present study was conducted on 782 crossbred cows sired by 35 bulls, maintained over the period from 1985 to 2009. The data was analyzed for estimation of averages, effect of period and season of calving, heritability and genetic and phenotypic correlations. The economic traits studied were age at first calving (AFC; days), first calving interval (FCI; days), first service period (FSP; days) and first dry period (FDP; days).The averages for AFC, FCI, FSP and FDP were 1213.54±8.85, 420.08±3.41, 131.26±3.15 and 105.00±2.73 days, respectively. Effect of period of calving was significant ($P<0.05$) for all the economic traits. Effect of season of calving was significant for all the economic traits (FCI, FDP and FSP) except AFC. It may be inferred that maximizing the number of calvings between October and March may be exploited to utilize the genetic potential of crossbred cattle for all the traits. High estimates of heritability were obtained for all the traits except FCI. Genetic correlations of AFC with all other traits were very low. It may be inferred from the estimates of heritability, genetic and phenotypic correlations that age at first calving with other production traits may be used in simultaneous selection for overall improvement in traits of economic importance.

Key words: Crossbred cattle, correlation, heritability, reproduction traits

India has witnessed a white revolution in eighties and nineties of the last century, which is largely due to manifold increase in milk production attributed largely to crossbred cows. Cross breeding of indigenous cows (*Bos indicus*) with exotic (*Bos taurus*) bulls was started to enhance genetic potential of milk production. The basic theme was to confluence the milk yield potential of exotic breeds and stress sustainability and disease resistance capabilities of indigenous breeds within the crossbred progenies, which would be desirable to maintain them under tropical climatic conditions.

For establishing any selection or breeding programme the knowledge of genetic properties of traits of economic importance is the pre-requisite. It is therefore, essential to understand the genetic and phenotypic association among these traits and the extent to which the genetic variation exist in them. Genetic improvement of a population under selection is highly dependent on heritability of each trait. Estimation of genetic parameters is essential in animal breeding and genetics because these are location and time-specific and it may not be appropriate to apply estimates from other populations. Additionally, differences in management, feeding conditions and statistical methodology as well, may offer different results.Therefore, the present investigation was undertaken to estimate genetic and phenotypic parameters of different reproduction traits and to evaluate the effect of genetic and non-genetic factors on these traits.

MATERIALS AND METHODS

The data were collected on crossbred cattle from the history-cum-pedigree sheets maintained over the period from 1985 to 2009 in the Department of Animal Genetics and Breeding, LUVAS, Hisar. The reproduction traits studied were age at first calving (AFC), first calving interval (FCI), first service period (FSP) and first dry period (FDP). A total of 782 lactation records of cows sired by 35 bulls, spread over 25 years were collected. Abnormal lactation records due to specific causes like abortion, culling and pre-mature birth were excluded. The entire duration of 25 years from 1985 to 2009 was divided into 8 periods each having three years duration except 8th period which was of four years duration (1985-88). Year to year variation within the period were 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 and non-genetic factors on different economic traits and to obtain sire and

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residual variance, co-variance components for various performance traits, the mixed model least-squares analysis technique (Harvey, 1987) was used with the following model :

Y_{ijkl} = $\mu + S_i + P_j + T_k + b\ (X_{ijkl} - \overline{X}) + e_{ijkl}$

Y_{ijkl} = l^{th} observation on the progeny of the i^{th} sire, j^{th} period and k^{th} season of calving

μ = Overall population mean

S_i = Random effect of i^{th} sire assumed to be normally and independently distributed NID (0,).

P_j = Fixed effect of j^{th} period of calving (j = 1 to 8)

T_k = Fixed effect of k^{th} season of calving (k = 1 to 4)

b_1 = Linear regression of trait on age at first calving

X_{ijkl} = Age at first calving pertaining to y_{ijkl}^{th} observation

$\overline{X}$ = Mean age at first calving

e_{ijkl} = Random error associated with each observation assumed to be NID (0,)

However, to study the effect of various factors on AFC, and for estimation of heritability, phenotypic and genetic correlations, the above model were used after deleting effect of regression on AFC. Least squares means were compared pair-wise using Duncan's multiple range test as modified by Kramer (1957).

Heritability estimates for different economic traits were obtained by paternal half-sib correlation method. Standard error of heritability was estimated by the formula given by Swiger *et al.* (1964). Phenotypic correlations between different economic traits were calculated from components of variances and co-variances while sire components of variances and co-variances were used to estimate genetic correlations.

RESULTS AND DISCUSSION

Least-squares means along with standard errors for different reproduction traits are presented in Table 1.

Averages for Reproduction Traits: The least-squares mean for AFC in crossbred cattle was 1213.54 days with 14.10% coefficient of variation which was in agreement with Yadav *et al.* (2004) but of lower magnitude than that estimated by Islam *et al.* (2004) and Sinha *et al.* (2009) in crossbred cattle. However, Thomas and Anil Kumar (2009) and Saha *et al.* (2010) reported comparatively lower estimates in crossbred cattle. The least-squares mean for FCI was obtained as 420.08 days with 19.06% coefficient of variation, which was in close agreement with those of Singh and Gurnani (2004) and Saha *et al.* (2010) and of lower magnitude than those reported by Singh *et al.* (2008). However, Thakur and Singh (2000) reported lower estimate than that observed in the present study.The least-squares mean for FSP was 131.26 days with 52.94% coefficient of variation. This value was in close conformity with that of Saha *et al.* (2010). However, Das *et al.* (2001) reported lower and Sinha *et al.* (2009) reported higher estimates as compared to this study. The least-squares mean for FDP was estimated as 105.00+2.73 days with 59.85% coefficient of variation. This estimate was higher than that reported by Akhter *et al.* (2003) and Saha *et al.* (2010). On the other hand, Dubey and Singh (2005) and Sinha *et al.* (2009) reported wide deviation towards higher side than the present estimate.

Effect of Period and Season of Calving on Different Reproduction Traits: The influence of period of calving was highly significant ($P<0.01$) for AFC and FDP and significant ($P<0.05$) for FCI and FSP. The period wise least squares means indicated that AFC was maximum during 1998-2000 and subsequently decreased by 2007-09. These variations might be due to differences in management and breeding practices over these years. The effect of season of calving was highly significant ($P<0.01$) for all reproduction traits except AFC. Lowest values of FSP and FDP were observed in autumn season followed by winter season, which shows better adaptability of crossbred cattle to the favourable climate.

Effect of Regression on AFC: Regression on AFC was significant ($P<0.05$) for FSP, while it was non-significant for FCI and FDP.

Estimates of Heritability for Different Reproduction Traits: The estimate of heritability for AFC in present study was 0.467+0.208. Similar estimates have been reported by Filho Vercesi *et al.* (2006) for this trait. Comparatively higher estimate was reported by Singh and Gurnani (2004) in Karan Fries and Karan Swiss crossbred cattle. The high heritability estimate for AFC indicated that age at first calving can be reduced by individual selection.

Estimate of heritability for FCI was 0.158, as also reported by Singh and Gurnani (2004). Low heritability for FCI was indicative of the presence of lesser additive genetic variance, so selection on individual's own performance will not be effective in improving this trait. Better managemental practices could be the alternate

Table 1
Least-squares means along with standard errors for different reproduction traits (in days)

Trait	AFC	FCI	FSP	FDP
Overall Mean	1213.54 ± 8.85 (782)	420.08 ± 3.41 (577)	131.26 ± 3.15 (553)	105.00 ± 2.73 (562)
CV (%)	14.10	19.06	52.94	59.85
Period of calving				
2007-09	1194.15^{d}±14.08 (135)*	400.50^{b}±7.22 (87)	115.31^{b}±7.60 (86)	93.23^{ab}±6.09 (87)
2004-06	1189.84^{d}±16.00 (192)	400.98^{b}±6.54 (146)	113.38^{b}±5.16 (142)	96.16^{ab}±5.20 (142)
2001-03	1312.52^{c}±34.35 (67)	433.46^{ab}±12.54 (50)	143.37^{ab}±11.87 (48)	122.17^{a}±10.06 (52)
1998-00	1720.65^{a}±52.06 (29)	422.22^{ab}±18.43 (18)	142.47^{ab}±19.09 (17)	107.30^{ab}±16.12 (19)
1995-97	1432.97^{b}±35.04 (48)	408.38^{b}±12.54 (31)	123.76^{ab}±12.07 (30)	105.13^{ab}±10.06 (29)
1992-94	1232.05^{d}±20.07 (101)	446.90^{a}±9.54 (83)	156.46^{a}±9.76 (77)	111.55^{ab}±7.03 (78)
1989-91	1127.27^{e}±12.09 (143)	424.50^{ab}±7.65 (112)	135.86^{ab}±7.32 (108)	120.73^{a}±5.65 (107)
1985-88	1001.06^{f}±19.05 (67)	447.78^{a}±12.87 (50)	155.31^{a}±11.54 (45)	88.79^{b}±8.32 (48)
Season of calving				
S1	1193.12^{b}±18.04 (181)	431.28^{a}±6.65 (131)	146.04^{a}±6.09 (126)	116.43^{a}±5.08 (125)
S2	1186.89^{b}±14.09 (217)	405.13^{b}±4.65 (162)	121.45^{b}±5.05 (159)	99.15^{bc}±5.87 (155)
S3	1195.28^{b}±22.23 (123)	409.03^{b}±8.05 (99)	113.04^{b}±6.32 (92)	87.52^{c}±5.32 (93)
S4	1258.46^{a}±16.36 (261)	431.94^{a}±7.05 (185)	139.84^{a}±6.54 (176)	110.90^{ab}±5.54 (189)

Means with different superscripts are significantly different ($P<0.05$) for a parameter within a column
* Figures in parentheses indicate number of observations; AFC=Age at first calving; FCI=First calving interval; FSP=First service period; FDP=First dry period; S1=Summer; S2=Rainy; S3=Autumn; S4=Winter; CV= Coefficient of variation (%)

choice for improvement in FCI. Heritability estimate for FSP in the present study was 0.404+0.135 (Table 2), which is in agreement with those of Dubey and Singh (2005) in Sahiwal crossbred. The high heritability estimate for this trait suggested that there was scope for reducing FSP by individual selection.The heritability for FDP was estimated as 0.322+0.120, which is on higher side than reported by Singh and Gurnani (2004); while estimate reported by Dubey and Singh (2005) was in agreement with the present estimate.

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

Association Between AFC and FCI: Phenotypic correlation between these traits was 0.039+0.041. Singh and Gurnani (2004) reported higher and significant correlation between the two traits. In contrast, Dubey and Singh (2005) found negative and very low (-0.04+0.15) correlation in these two traits. Genetic correlation between these traits was -0.265+0.270, which indicated that traits are negatively correlated at genetic level.

Association Between FSP and FCI: A high positive phenotypic and genetic correlation estimated as 0.878+0.020 and 0.902+0.092, respectively between these traits was supported by findings of Saha *et al.* (2010). They reported high phenotypic correlation (0.88+0.01) but low genetic correlation (0.26+0.23) in crossbred cattle.

Association Between AFC and FDP: A negative phenotypic correlation (-0.006+0.041) was observed in the present study. However, Singh and Gurnani (2004) reported a high and positive correlation (0.88+0.04) between these two traits. But a medium negative genetic correlation was estimated as -0.356+0.201. Similar findings were reported by Dubey and Singh (2005).

Association Between FDP and FCI: In the present study, the phenotypic correlation between these two traits was 0.434+0.037, which was similar to that reported by Singh and Gurnani (2004) and Dubey and Singh (2005). Genetic correlation between these two traits was estimated as 0.588+0.294. Similar findings were reported by Dubey and Singh (2005), while Singh and Gurnani (2004) reported lower genetic association between these two traits.

It may be inferred from the estimates of heritability, genetic and phenotypic correlations that AFC with other economic traits may be used in simultaneous selection for

Table 2
Estimates of heritability (along diagonal), genetic correlation (above diagonal) and phenotypic correlation (below diagonal) between different economic traits

Traits	AFC	FCI	FSP	FDP
AFC	**0.467 ±0.208**	-0.265±0.270	-0.082±0.201	-0.356±0.201
FCI	0.039±0.041	**0.158 ±0.103**	0.902±0.092	0.588±0.294
FSP	0.056±0.041	0.878±0.020	**0.404 ±0.135**	0.339±0.250
FDP	-0.006±0.041	0.434±0.037	0.394±0.038	**0.322 ±0.120**

AFC=Age at first calving; FCI=First calving interval; FSP=First service period; FDP=First dry period

overall improvement in traits of economic importance. In the present study, the period of 1985-88 was superior among all the periods for AFC and FDP, as only during this period the synthetic base population was constituted by mixing of 3/4th exotic inheritance groups for further stabilization to 5/8 level of exotic inheritance. For maximum genetic improvement and their correlated response, it is necessary to include all the economic traits that lead to more accuracy in selection programmes.

REFERENCES

Akhter, J., Singh, H., Kumar, D.and Sharma, K. (2003). Factor affecting economic traits in crossbred cattle. *Indian J. Anim. Sci.* **73**: 464-465.

Das, G.C., Das, D., Roy, T.C.,Goswami, R.N.and Nahardeka, N. (2001). Comparative performance of Jersey, Red-Sindhi and their crosses with local cattle in respect of some economic traits. *Indian Vet. J.* **78**: 123-125.

Dubey, P.P. and Singh,V.V. (2005). Estimates of genetic and phenotypic parameter considering first lactation and lifetime performance trait in Sahiwal and crossbred cattle. *Indian J. Anim. Sci.* **75**: 1289-1294.

FilhoVercesi, A.E., Madalena, F.E., Albuquerque, L.G., Freitas, A.F., Borges, L.E., Ferreira, J.J., Teodoro, R.L. and Faria, F.J.C. (2006). Genetic relationships between milk traits, weight traits and age at first calving in crossbreed dairy cattle (*Bos taurus*×*Bos indicus*). 8th World Congress on Genetics Applied to Livestock Production, Belo Horizonte, MG. Brasil.

Harvey, W.R. (1987). Mixed model least-squares and maximum likelihood computer programme. User's Guide for SMLMW and MIXMDL PC-2 version.

Islam, S.S., Ahmed, A.R., Ashraf, A. and Khanam, N. (2004). Genetic and phenotypic parameters on reproductive traits of crossbred cattle in a selected farm of Bangladesh. *Pakistan J. Biol. Sci.* **7**: 1269-1273.

Kramer, C.Y. (1957). Extension of multiple range tests to group correlated adjusted means. *Biometrics* **13**: 13-18.

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.

Sinha, R.R.K., Dutt, T., Bhushan, B., Singh, R.R. and Singh, M. (2009). Production and reproduction profile of cattle and buffaloes in Bareilly district of Uttar Pradesh. *Indian J. Anim. Sci.* **79**: 786-787.

Swiger, L.A., Harvey, W.R., Everson, D.O. and Gregory, K.E. (1964). The variance of interclass correlations involving groups with one observations. *Biometrics* **20**: 818.

Thakur,Y.P. and Singh, B.P. (2000). Performance evaluation of Jersey×Zebu crossbreds involving different indigenous breed performance of Jersey×Tharparkar crossbreds. *Indian Vet. J.* **77**: 169-171.

Thomas, N. and Anil Kumar, K. (2009). Evaluation of ten sire families of crossbred dairy cattle of Kerela based on milk production and milk composition traits. *Vet. World* **2**: 10-12.

Yadav, J.S., Dutt, G. and Yadav, M.C. (2004). Genetic studies of some lactation traits in crossbred cows. *Indian J. Anim. Sci.* **74**: 1232-1233.