EFFECT OF GENETIC AND NON-GENETIC FACTORS ON AGE AT FIRST FERTILE SERVICE IN *MALVI* HEIFERS

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ABSTRACT

The data for the present investigation pertained to 409 observations of age at first fertile service (AFFS) on *Malvi* cattle maintained at Govt. Cattle Breeding Farm, Agar, District Shajapur (M.P.), covering a period of 48 years from 1962 to 2009 (both years inclusive). The least squares analysis of variance revealed the mean AFFS in these cows to be 1451.81±41.23 days and the trait was significantly affected by sire ($P< 0.01$), period ($P< 0.01$) and inbreeding ($P< 0.05$). Heritability estimates for AFFS was obtained as 0.56±0.26 and phenotypic correlation between AFFS and first dry period were positive and significant ($P<0.05$) while it was non significant with first service period, first calving interval, first lactation yield and first lactation length. It was concluded that inbreeding had deteriorating effect on the age at first fertile service and hence to improve the age at first fertile service in this herd, avoidance of inbreeding along with ameliorative managerial practices should be adopted.

KEY WORDS : *Malvi* heifers, inbreeding, age at first fertile service, heritability, correlation

INTRODUCTION

Age at first fertile service is an important economic trait of dairy cattle which influences the economy of dairy enterprise. By reducing the age at first fertile service, the productive life of a cow can be increased. The lower age at first fertile service decreases generation interval and thus increases the genetic gain. In India, most of the herds of cattle are small in size. In small population maintained for long time inbreeding is inevitable. Therefore, there is a need to study the incidence and degree of inbreeding at organized farms and its impact on age at first fertile service. In view of lack of information on effect of inbreeding on age at first fertile service of *Malvi* cows, the present study was taken up.

MATERIALS AND METHODS

The data for the present investigation pertained to 409 observations of age at first fertile service (AFFS) on *Malvi* cattle maintained at Govt. Cattle Breeding Farm, Agar, District Shajapur (M.P.), spanning a period of 48 years from 1962 to 2009. Inbreeding coefficient for each animal was calculated using path coefficient method (Wright, 1922). It was observed that all the inbred animals under study had an inbreeding coefficient of 0.25 as they were all produced by sire-daughter mating. Therefore, on the basis of level of inbreeding, animals were classified into two groups only viz., non-inbred (IL_1) and inbred (IL_2). The entire period of 48 years was divided into eight periods of six years and each year was divided into four seasons, viz., spring (February – March), summer (April – June), rainy (July - September) and winter (October – January). To study the effect of genetic and non-genetic factors the data were analyzed by least squares technique of fitting constants using “Mixed Model Least Square and Maximum Likelihood Computer Programme PC-2” (Harvey, 1990) employing the statistical model which included the effects of sire, period of birth, season of birth and the level of inbreeding. Heritability estimates of AFFS and its genetic and phenotypic correlations with other traits were obtained by paternal half sib correlation method.

RESULTS AND DISCUSSION

Out of 409 animals, 11.00% incidence of inbreeding in the herd was observed. The inbreeding coefficient of each inbred cow came out to be 0.25. The higher coefficient of inbreeding (0.25) of all the inbred animals is due to the limited number of sires. Out of 12 sires, three sires were used continuously for 4 to 7 years, thus enhancing chances of daughter x sire mating. Varied incidences of inbreeding have been reported in various breeds and herds by different workers in India and abroad. In NDRI Karnal herd, *Sahiwal* has the maximum percentage of inbreds (82%), followed by *Karan Swiss* (36%) and *Karan Fries* (20%) (Saha *et al.*, 2001).

The least squares mean for AFFS in the herd was found to be 1451.81±41.23 days (Table 1). The higher AFFS in this study might have been due to inbreeding and poor management in the herd.

The least squares analysis revealed that sire had significant ($p<0.01$) effect on age at first fertile service. The significant ($p<0.01$) effect of period on age at first fertile service obtained in the present study is in consonance with the findings of Chaturvedi (1991) in *Malvi* cows. The age at first fertile service showed steady declining trend from period 1 to 5 and then it increased significantly in period 7 and again declined significantly to the lowest value in period 8. The significant difference in age at first fertile service during different periods is suggestive of difference in management and other environmental condition over different periods.

The effect of season was found to be non-significant in this study which is in agreement with Chaturvedi *et al*. (1999) in *Malvi* cows. However, the heifer born in rainy season had the lowest age at first fertile service. This may be attributed to better feeding and management during the season because of availability of *ad lib* green fodder which enabled the heifer to grow at a faster rate during early life.

Inbreeding had significant ($P< 0.05$) effect on age at first fertile service (Table 2) which is in agreement with the findings of Kumar (2009) in *Gir* heifers, Nandgawali *et al.* (1996) in *Sahiwal*, Silva *et al*. (2001) in *Mantiqueira* and Bhagat *et al*. (2007) in Crossbred cows. Mc Parland *et al*. (2007) in *Irish Holstein Friesian* breed of cattle have also reported similar findings for age at first calving, a trait closely correlated with age at first fertile service. Comparison of average at first fertile service in inbred and non-inbred groups (Table 1) revealed that age at first fertile service was significantly longer (1510.24±56.99 days) in inbred as compared to non-inbred group (1393.38±36.25 days). Significantly lower age at first fertile service in inbred females as compared to non-inbred females corroborate the generally accepted view that reproductive traits are adversely affected by inbreeding due to loss of heterozygosity as these traits are mainly governed by non-additive gene action.

Heritability and phenotypic and genetic correlations: Heritability estimates for AFFS were obtained as 0.56±0.26. Such higher estimate for heritability of AFFS was also reported by Chaturvedi *et al.* (1999) in *Malvi* cows (0.59±0.31). The high estimate of heritability of this trait could be due to confounding of sire effect with other possible non genetic factors in the model of least squares analysis. Further, the genes responsible for age at first fertile service may be at intermediate frequencies leading to higher additive genetic variance. This increase in additive genetic variance might have resulted in higher estimate of heritability for this trait. Thus, the individual selection can be successfully employed for improving this trait. The genetic correlation of age at first fertile service with first dry period was positive and non-significant and with rest of the traits included in the study, it was negative and non-significant. Phenotypic correlation of age at first fertile service with first dry period (0.13±0.09) was positive and significant ($P< 0.05$) but with first service period, first calving interval, first lactation yield and first lactation length the estimates were non-significant. Similar

Table 1. Least squares means and standard errors for age at first fertile service

Effect	No. of observations	Mean±S.E. (days)	Effect	No. of observations	Mean±S.E. (days)
Overall mean (μ)	409	1451.81±41.23	**Period**		
Sire			P_1 (1962-1967)	8	1779.46±186.01 [e]
S_1	36	796.39±136.23 [a]	P_2 (1968-1973)	30	1756.33±168.34 [e]
S_2	21	1082.95±71.35 [b]	P_3 (1974-1979)	54	1578.56±72.67 [d]
S_3	63	1225.99±65.87 [c]	P_4 (1980-1985)	70	1489.09±61.07 [c]
S_4	71	1232.49±64.93 [c]	P_5 (1986-1991)	71	1187.32±48.47 [b]
S_5	10	1319.45±98.32 [c]	P_6 (1992-1997)	76	1225.29±51.93 [b]
S_6	10	1318.12±101.73 [c]	P_7 (1998-2003)	84	1542.24±57.45 [cd]
S_7	33	1258.52±73.67 [c]	P_8 (2004-2009)	16	1056.23±84.59 [a]
S_8	11	1360.71±89.94 [c]	**Season**		
S_9	103	1602.92±82.37 [d]	S_1 (Spring)	58	1448.66±51.32
S_{10}	34	1928.91±97.28 [e]	S_2 (Summer)	66	1493.64±48.75
S_{11}	9	2068.83±113.43 [ef]	S_3 (Rainy)	86	1397.53±46.67
S_{12}	8	2226.55±117.05 [f]	S_4 (Winter)	199	1467.43±43.56
Inbreeding					
IL_1 (Non-inbred)	364	1393.38±36.25 [a]			
IL_2 (Inbred)	45	1510.24±56.99 [b]			

a, b, c, d, e, f: Least squares means for a particular class with at least one common alphabet as superscript do not differ significantly with each other

Table 2. Least squares analysis of variance for age at first calving

Source of variation	d.f.	S.S.	M.S.	F
Sire	11	5135949.72	466904.52	7.71**
Period of birth	7	7318121.02	1045445.86	15.92**
Season of birth	3	476754.81	158918.27	2.42
Inbreeding	1	272525.14	272525.14	4.15*
Error	386	25348122.06	65668.71	-

* Significant (P< 0.05) ** Significant (P< 0.01)

findings have been reported by Chaturvedi (1991) in *Malvi* breed. The positive phenotypic correlation between age at first fertile service and first dry period as observed in the present study is desirable as lower age at first fertile service will lead to shorter first dry period.

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