GENETIC STUDY OF SOME REPRODUCTIVE TRAITS OF JERSEY CATTLE UNDER SUBTROPICAL CONDITIONS

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ABSTRACT

A part of the purebred Jersey cattle was shifted to Cattle Breeding and Dairy Farm Harichand in 1993, from an imported herd maintained at National Agricultural Center Islamabad during early eighties. The genetic analysis was carried out utilizing its records until 2003 in order to investigate the reproductive performance under subtropical environment. Age at first calving (AFC), calving interval (CI) and dry period (DP) were found to be 1010.73 ± 1.84, 487.31 ± 19.08 and 169.26 ± 16.45 days, respectively. The effect of year, sire and season of calving on various traits was also studied. Year had a significant (P < 0.05) effect on AFC while sire and season of calving had not. The effect of sire, season and year of calving on CI and DP was non significant. Heritability estimates for AFC, CI and DP were found to be 0.4802 ± 0.3553; 0.1011 ± 0.1998; 0.1013 ± 0.2123, respectively. The findings suggested the lower limit of age at first calving of Jersey cows showed their better adaptation in the subtropical environment of NWFP. Distribution of cows regarding minimum range of the length of calving interval should be emphasized in selection programs as calving interval is the most crucial reproductive trait which could be minimized with careful detection of estrus and successful mating. More records on reproductive traits of half sibs should be included in the analysis in order to minimize standard errors associated with the parameters estimated.

Key Words: ***Jersey cows, age at puberty, reproductive performance***

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INTRODUCTION

The productive and reproductive traits in dairy animals are influenced by several genetic and environmental factors. Any breed development programme would be based on the exploitation of the genetic variation. Emphasis was given in the national breeding policy on the up-gradation of local cattle through cross breeding using semen from Jersey and Friesian breeds. Jersey cattle is a high potential breed of milk and is well adopted in rain-fed as well hilly areas. Because of its relatively small size the breed is suitable for hilly areas of the country. To ensure constant supply of exotic semen at relatively cheaper rate for crossbreeding programme, maintenance and breeding of exotic dairy breeds in the country were stressed. The productive performance of indigenous cattle is generally low in comparison to exotic breed mainly due to unexploited genotype. Therefore, government of Pakistan imported purebred Jersey cattle in early eighties to National Agriculture Research Council (NARC) in order to increase the milk production potential of the local animals in the country. Keeping in view the same objective of increasing milk production, the government of North West Frontier Province (NWFP) introduced some animals of this breed to Cattle Breeding and Dairy Farm, (CB & DF) Harichand in the year 1993 from the parent stock kept at NARC, where already Holstein Friesian herd was maintained. Estimation of heritability is the key tool for the determination of genetic improvement among individuals and herds. It is imperative to know the contribution of additive genes under different climatic conditions regarding performance traits. Thus, the present study was initiated to evaluate the factors affecting some reproductive traits and their heritabilities in Jersey cows reared in the subtropical environment of NWFP.

MATERIALS AND METHODS

Source of Data

The data on Jersey cows maintained at Cattle Breeding and Dairy Farm (CB&DF) Harichand were utilized in the present study from the year 1993 through 2003. The effect of sire, season and year of calving affecting various reproductive traits were studied. History sheets of individual cow were scrutinized and the required information was stored in the computer for estimation of other traits.

Data Collection

Following information's on cows was collected:

Name and number of cow, date of birth, sire of cow, date of service, services per conception, date calved and date dried.
Following traits were used to estimate correlation between these traits:
Age at first calving, calving interval and dry period..
To investigate the effect of season of calving on various traits year was split into four seasons as follows.

Winter = December through February
Spring = March and May
Summer = June through August
Fall = September through November

Statistical Model

The data were analyzed through GLM. The General Linear Model for the given study was defined as:

$Y_{ijkl} = \mu + \alpha_i + \beta_j + \gamma_k + \in_{ijkl}$

Where:

Y_{ijkl} = the l-th record of the cow, calved in i-th year and j-th season of the k-th sire;
μ = the population mean;
α_i = the effect of i-th year of calving, i =1993, ……2003;
β_j = the effect of j-th season of calving, j = winter, spring, summer and fall;
γ_k = the effect of k-th sire, k =1,2,…,5:
$\in_{ijkl}$ = the residual term,

Estimation of Heritability

Heritability is defined as the proportion of phenotype attributed to genetic factor. According to the statistical random model:

$$Y_{ik} = \mu + \alpha_i + e_{ik}$$

Where:

i =1, 2, 3… S (number of sires)
k =1, 2, 3… ni (number of offspring of kth sire)
μ = the common mean,
α_i = the effect of the i-th sire.
e_{ik} =the uncontrolled environment and genetic deviation attributed to the individuals in the sire groups.

The first step in the estimation of heritability was to calculate the components of variance attributed to differences between sires and differences between the offspring within sires.

The following analysis of variance table was used to calculate between and within sires mean squares.

Source of Variation	d.f	Sum Square (SS)	Mean Square (MS)
Correction Term (CT)	1	$Y^2_{..}/n.$	-
Between Sires	S-1	$(\sum_i Y^2_i/n_i) - C.T$	$SS_s/(s-1) = MS_s$
Progeny Within sires n.	-S	$\sum_i\sum_k Y^2_{ik} - \sum_i Y^2_{i.}/ n_i$	$SS_w/(n.-s) = MS_w$

Becker (1975)

Where:
S: the total number of sires,
n_i : the number of observation for the i-th sire,
n: the total number of observations,
The following formula was used for calculating the between and within sires' variance:
Where:

$$Var_s = (MS_s - MS_w)/K_1$$
$$Var_w = MS_w$$

Where:
MS_s = the between sire mean square
MS_w = the within sire mean square

On individual basis, the phenotypic variance is equal to the summation of the estimated variance between and within sires:

$$Vp = Var_s + Var_w$$

Where:
Vp is the phenotypic variance,
Var_s is the between sires variance,
Var_w is the within sires variance.

The following model was used for calculating heritability.

$$h^2 = 4\, var_s / Vars + Varw$$

Where:
h^2 = heritability
Var_s = the between sire variance,
Var_w = the within sire variance.

The component $4var_s$ represented the additive genetic variance (var_A), while ($Var_s + Var_w$) equaled the phenotypic variance, var_P. The component var_S is multiplied by 4, because the additive relationship among half sibs equal to 1/4 and the covariance between half sibs needs to be multiplied by the reciprocal of additive relationship between relatives, whose records will be used in computation.

The standard error of heritability (unequal numbers of progeny per sire) was calculated using the following formula.

$$S.E.(h^2) = 4\sqrt{\frac{2\,(n.-1)\,(1-t)^2\,[1 + (K_1 -1)\,t]^2}{K^2_1\,(n.-S)\,(S-1)}}$$

(Swiger, *et al.* 1964)

Where:
S = number of sires:
t = the intra class correlation:

$$t = \frac{Var_s}{Var_s + Var_w}$$

Where

$$K_1 = \frac{1}{S-1}\left(n. - \frac{\sum n_i^2}{n.}\right)$$

Computer Packages

Computer software including spread sheet program M.S. Excel and SAS (Statistical Analysis System, SAS Inc., 1997) were used.

RESULTS AND DISCUSSION

Age at First Calving

Age at first calving ranging between 760 to 1628 days with a mean of 1010.73 ± 21.84 days and a coefficient of variation 15.579 per cent (Table I). Year had a significant ($P < 0.0001$) effect on age at first calving while sire and season of calving had not (Table II). Murdi and Tripathi (1990) reported average age at first calving in Jersey cows to be 839.7 ± 4.48 days, which was lower than the findings of the present study. Also Govindaiah *et al.* (1998) reported lower age at first calving of 883.23 days in Jersey cattle at the government breeding center in Karnataka, India. Rahumathullah *et al.* (1994) reported average age at first calving for Jersey and Therparker cows to be 1184.0 ± 4.8 days, which was much higher than the present results. Season of calving had a significant effect on age at first calving which is not in agreement with the present findings. Heritability estimate of age at calving was 0.4802 ± 0.3553 (Table III). Thomas and Choudhary (1982) estimated heritability of age at first calving to be 0.63 in Red Dane cattle. Gaikward and Narayankedkar (2000) investigated 564 crossbred cows (Gir XHF and Giv X Jersey) in India and reported heritability estimate 0.39 ± 0.28 for age at first calving, which was lower than the findings of the present study. A high heritability estimate for age at first calving in the present study indicated that the correlation between phenotype and genotype of the individual was high and therefore, selection on the basis of the individual's own phenotype should be effective. Direct selection for age at calving should be considered in selection program.

Calving Interval

The average length of calving interval in Jersey cows was 487.31 ± 19.08 days (Table I) ranged from 301 to 904 days, with a coefficient of variation of 26.260%. Analysis of variance revealed that sire, season and year of calving had no significant effect on calving interval (Table II). Jain *et al.* (2001) reported the average mean for calving interval in Jersey cows to be 460.33 ± 15.31 days which was in agreement with the findings of the present study. Heritability estimates for calving interval was 0.1011 ± 0.1998 in Jersey cows (Table III). Methekar et al. (1993) reported heritability estimates of 0.16 ± 0.075 in Jersey cows, which was in close agreement with the findings of the present study. Gaikward and Narayankedkar (2000) investigated crossbred cows (Gir X HF and Gir X Jersey) in India and reported estimate of heritability of 0.89 ± 0.39 of first calving interval, which was much higher than the findings of the present study. The present study suggests that if the reproductive efficiency of the farm animals be properly managed and the animals are efficiently fed the calving interval could be considerably shortened. Longer calving interval affects overall life time production and reproduction performance through reduced milk production and less number of calves being born. The shorter the length of calving interval in turn the higher will be life time productivity. Length of calving interval depends on reproduction management of the herd. Timely heat detection and proper insemination would ensure conception. The lower heritability estimate (10%) of calving interval suggested relatively smaller contribution of genetic factors to this trait. Thus, direct selection for this trait is expected to bring slower progress.

Dry Period

Average dry period of Jersey cows was 169.26 ± 16.45 days, ranging between 22 to 465 days, with a coefficient of variation of 63.719 per cent. (Table I). The effect of sire, season and year of calving on dry period was non significant (Table II). Murdi and Tripathi (1990) reported average dry period in Jersey cows to be 93.8 ± 1.73 days which was lower than the present findings. Heritability estimates for dry period was found to be 0.1013 ± 0.2123 in Jersey cows (Table III). Katoch *et al.* (1990) reported heritability estimates to be 0.092 ± 0.080 in Jersey cattle. Similarly, Deokar and Ulmek (1997) reported heritability estimates to be 0.08. Dry period is a function of postpartum service period. Cows having longer postpartum service period would have longer dry periods and cows having smaller postpartum service period would have shorter dry periods. Better nutrition and reproductive management of the herd will certainly help shorten length of postpartum breeding thereby decreasing length of the dry period.

Table I ***Range, mean ± SE and coefficient of variation of some traits of Jersey cattle***

Trait	Mean ± SE	Range		CV (%)
		Minimum	Maximum	
Age at first calving (days)	1010.73 ±21.84	760	1628	15.579
Calving interval (days)	487.31 ± 19.08	301	904	26.260
Dry-period (days)	169.26 ±16.45	22	465	63.719

Table II ***Analysis of variance of AFC, CI and DP of Jersey cattle affected by sire, season and year of calving***

Source of variation	AFC			CI			DP		
	DF	MS	P	DF	MS	P	DF	MS	P
Sire	3	23557.96	0.1473	3	14269.88	0.4417	2	14305.90	0.2353
Season	3	21324.48	0.1804	3	16135.29	0.3876	3	17526.39	0.1581
Year	9	71054.46	0.0001	7	19148.85	0.3135	8	21234.84	0.0526
Residual	34	12363.87	-	30	15463.59	-	28	9386.00	-
Total	49	-	-	43	-	-	41	-	-

Table III ***Heritability estimates of AFC, CI and DP of Jersey cows***

Trait	Heritability Estimates ± SE
Age at first calving	0.4802±0.3553
Calving interval	0.1011±0.1998
Dry period	0.1013±0.2123

CONCLUSION AND RECOMMENDATIONS

It is concluded that cows reaching earlier age at first calving showed their better adaptation in the subtropics. Year of calving significantly affected age at first calving. Based upon the findings of the present study it may be recommended that age at first calving needs to be considered in selection program. Also, calving interval which is the most crucial reproductive trait could be minimized through efficient feeding and reproductive management of the herd. For more reliable estimates larger sample size on half sibs should be recorded because of the relatively high standard errors associated with the parameters estimated.

REFERENCES

Becker. 1975. Manual of quantitative genetics. Student Book Corp. N.E. 700 Thatuna, Pullman, Washington, USA.

Bharti, V., K. Shukla, V.P. Manglik and S.N. Maurya. 1996. Relationship between various traits of Sahiwal-Jersey crossbred cows in Tarai region of Uttar Pradesh. Indian J. Anim. Res. 30(1):70-72.

Deokar, D.K. and B.R. Ulmek. 1997. Genetic studies on dry period in Jersey cattle. J. Maharashtra Agric. Univ. 22(3): 327-329.

Gaikwad, I.S. and S.G. Narayankhedkar. 2000. Estimation of heritability of reproduction traits in crossbred cows. Indian Vet. J. 77(9): 811-812.

Govindaiah, M.G., S.N. Harish, H.N.N. Murthy, M.R. Jayashankar and M.G. Rao. 1998. Genetic studies on age at maturity and age at first calving in Jersey cattle. Indian Vet. J. 75(12): 1102-1105.

Jain, J.K, F.H. Khan, S. Ashok and A. Singh. 2001. Factors affecting calving interval in Jersey. Indian Vet. J. 78(5).

Katoch, S., M.C. Yadav and S. Gupta. 1990. Non-genetic factors affecting lifetime production traits in Jersey cattle. Indian Vet. J. 67(6): 520-523.

SAS Instt. Inc. 1997. SAS/STAT user's Guide. Release 6.03. Ed. carry, North Carolina, USA.

Singh, A.S. and M. Mishra. 1980. Physiological responses and economic traits of Holstein, Jersey, crossbred and Haryana cows in hot and humid environment. Indian J. Dairy Sci. 33: 174-181.

Swiger, L.A., W.R. Harvey, D.O. Everson and K.E. Gregory. 1964. The variance of interclass correlation involving groups with one observation. Biometrics. 20:818-826.

Methekar, K.U., A.D. Deshpande and K.S. Deshpande. 1993. Factors affecting service period and calving interval in Jersey cows. Indian J. Dairy. Sci. 46(10): 496-497.

Murdi, C.K. and V.N. Tripathi. 1990. Factors affecting reproductive performance of Jersey cattle in India. Indian J. Anim. Prod. & Mgt. 6(3): 135-139.

Rahumathullah, P.S., N. Natarajan, M.J. Edwin, S. Sivaselvam, A. Subramanian and M.M.H. Khan. 1994. Studies on first lactation traits in Jersey X Tharparkar cows. Cheiron. 23(1): 1-8.

Thomas, P.C. and M.R. Choudhary. 1982. Genetic studies of age at first calving in Red Dane dairy cattle. Amin. Breed. Abst. 51:133.