HERITABILITY ESTIMATES OF AGE AT FIRST CALVING AND CALVING INTERVAL IN SAHIWAL COWS

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The statistical study of data on the Sahiwal herd maintained at Allahdad Cattle Farm at Jahanian, District Multan, was made. The data comprised 992 records of age at first calving, 908 records of first and 722 records of second calving intervals spread over a period of 40 years (1926-66). The number of sires used were 47. Only the normal records were used. The average age at first calving was 1463.9 ± 12.22 days. The average first and second calving intervals were 481.3 ± 4.20 and 484.3 ± 4.88 days respectively. The heritability estimates of age at first calving were .1227 ± .0213 and .0129 ± .0632 computed from half sib correlation and intra-sire regression of daughter on dam methods respectively. The heritability estimates of first and second calvings were .1987 ± .0812 and .2176 ± .0955 respectively by half sib correlation method. The corresponding values for the same traits computed from intra-sire regression of daughter on dam method were .0371 ± .1012 and .1712 ± .1104 respectively. The age at first calving was not correlated with first calving interval.

INTRODUCTION

Reduced fertility in dairy cattle is a serious economic problem. Very little is known concerning the effectiveness of selection for high fertility and relative importance of fertility and other economic traits in selection. Quantitative measures of the heritability of fertility and the genetic correlations between fertility and other important traits are needed to answer these questions. Two important measures of fertility from economic point of view are the age at first calving and calving intervals. To improve the economic prospects of dairying in the tropics where the milk yield of most breeds is low, a reduction in age at first calving and calving intervals are highly desirable.

REVIEW OF LITERATURE

The knowledge of heritability of reproductive traits of cattle is necessary for devising an efficient selection and breeding plans. The work done by various workers regarding age at first calving and calving intervals is reviewed below:

Age at First Calving: Stonaker (1953) calculated the heritability of age at first calving in Red Sindhi dairy cattle of the Allahabad Agricultural Institute.

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He reported the heritability estimate to be .39 ± .16 for 91 cows by intra-sire regression of daughter on dam method. Singh (1957) worked out the heritability of age at first calving of 140 daughter dam pairs of 16 sires of Tharparker breed by half sib correlation and intra-sire regression of daughter on dam method. The estimates were reported as .048 ± .09 and —.361 ± .10 respectively. Amble *et al.* (1958) analysed the data relating to six dairy herds in India. They used 193 records of Red Sindhi cows maintained at Hosur, 135 records of another Red Sindhi Herd kept at Bangalore, 282 records of Kangayam cattle reared at Hosur, 30 records of Gir raised at Bangalore, 42 records of Kankroj maintained at Anand and 216 records of Tharparker cattle kept at Patna. The average age at first calving for these herds was calculated and was reported to be 41.7 ± .4, 41.7 ± 4, 44.1 ± .4, 47.0 ± .8, 47.4 ± .8 and 49.4 ± .4 months respectively. The method of intra-sire regression of daughter on dam was used to work out the heritability of age at first calving and was reported to be —.09 ± .17, .16 ± .29, —.08 ± .16, —1.24 ± .58, .66 ± .24 and .48 ± .16 respectively. Kohli *et al.* (1961a) studied some economic characters in the Hariana herd maintained at Hissar. The age at first calving was found to be 54.3 ± .81 months. The heritability of age at first calving was close to zero. Singh and Desai (1961) reported the heritability of age at first calving as .3403 ± .1216 by intra-sire regression of daughters on dams using 244 daughter dam pairs of 24 bulls and .3412 ± .196 and .404 ± .018 by paternal half sibs using 244 and 322 half sibs respectively. Acharya (1966) using methods of intra-sire regression of daughter on dam and half sib correlation analysed the data from a closed herd of Hariana cattle and found the heritability of age at first calving as .04 ± .18 and .14 ± .12 respectively.

Calving Interval: Amble *et al.* (1958) analysed the data relating to six dairy herds in India. They used 156 calving interval records of a Red Sindhi herd maintained at Hosur, 126 records of another Red Sindhi herd kept at Bangalore, 224 records of Kangayam cattle reared at Hosur, 24 records of Gir raised at Bangalore, 26 records of Kankrej herd maintained at Anand and 205 records of Tharparker cows kept at Patna. The average interval between the first two calvings was calculated and was found to be 18.0 ± .3, 14.7 ± .3, 16.7 ± .3, 15.7 ± .5, 16.2 ± .4 and 14.8 ± .2 months respectively. The heritability estimates of calving intervals were reported to be —.08 ± .29, .13 ± .20, .11 ± .19, —.37 ± .48, —.31 ± .40 and —.01 ± .16 respectively by the method of intra-sire regression of daughter on dam. Kohli *et al.* (1961 a) studied the records of 230 cows, 16 bulls and their daughters from the Hariana herd at Hissar during 1944-59. The heritability of calving interval was .30 ± .18. Singh and Desai (1962) studied the inheritance of some economic characters in Hariana cattle. The average calving interval calculated from

596 records of 286 cows was 458 ± 4 days with a coefficient of variation of 26.2 per cent. The heritability of calving interval was .022 ± .058 and —.337 as calculated by intra-sire regression of daughter on dam and half sib correlation respectively. Kushwaha (1964) reported average calving interval in Sahiwal dairy cattle based on 827 lactations for 265 cows to be 439 ± 3.09 days. The heritability of calving interval was 19.7 per cent. Acharya (1966) estimated the heritability of first calving interval from a closed herd of Hariana cattle to be .24 ± .12 and .40 ± .20 based on intra-sire regression and half sib correlations respectively.

Correlation Between Age at First Calving and Calving Interval:

Rognoni and Pasti (1955) calculated correlation coefficient between age at first calving and calving interval in Friesian cattle to be .04. Singh (1957) indicated after analysing the data of 209 Tharparker cows that age at first calving had no influence on the first calving interval. Singh and Sinha (1960) analysed the records of 131 cows with three lactations from 1939 to 1952. No correlation was found between age at first calving and calving interval. Acharya (1966) got an estimate of .109 between age at first calving and first calving interval in a study of closed herd of Hariana cattle maintained at Hissar. He reported that age at first calving was positively and significantly related to first calving interval phenotypically.

MATERIAL AND METHODS

The study under report was designed to obtain information on heritability of age at first calving and calving intervals in Sahiwal cows maintained in Allahdad Cattle Farm at Jahanian, District Multan for the years 1926 to 1966. Only the normal and complete records of the cows were included in the study. There were 994 records on the age at first calving of cows who were daughters of 47 sires. As regards calving intervals 907 records of first and 722 records of second calving intervals were available. The heritability estimates were obtained by the methods of half sib analysis and intra-sire regression of daughters on dams (Becker, 1964). The standard errors of heritability estimates calculated by method of half sibs and intra sire regression of daughters on dams were worked out following procedures described by Swiger *et al.* (1964) and Becker (1964) respectively for the purpose.

RESULTS AND DISCUSSION

The data pertaining to the age at first calving, first and second calving intervals of Sahiwal cows were analysed. The average age at first calving and calving intervals are shown in Table 1.

TABLE 1.—*Showing Mean and Variance of Reproductive Traits*

Trait	No. of Records used	Mean (days)	Standard error (days)
Age at first calving	994	1463.9	12.22
First calving interval	908	481.3	4.20
Second calving interval	722	484.3	4.88

It is evident from the data in Table 1 that the average age at first calving was 1463.9 days (48.8 months) in the herd under study. This estimate is higher than the one reported by Singh and Choudhury (1961) who reported the estimate as 41.1 ± .6 months in Sahiwal herd. Amble *et al.* (1958) reported an estimate of 45.8 ± 1.1 months (1374 days) as average age at first calving in Sahiwal cattle, 41.7 ± .4 months (1251 days) in Red Sindhi and 49.4 ± .4 months (1251 days) in Red Sindhi and 49.4 ± .4 months (1482 days) in Tharparker herd. Acharya (1966) reported this estimate as 57.7 ± .4 months (1731 days) in the closed herd of Hariana cattle. The first calving interval was 481.3 ± 4.20 days while the average second calving interval was 484.3 ± 4.88 days in the study under report. The estimates are quite close to one reported by Singh and Choudhury (1961), who reported average first calving interval in Sahiwal cows as 16.2 ± .34 months (488 days). Kishwaha (1964) reported the average calving interval of Sahiwal cows as 439 ± 3.09 days.

A Heritability of Age at First Calving

(*a*) Method of Half Sib Analysis:

The records of age at first calving were analysed by the analysis of variance to find out the variation between sires and within sires and are presented in Table 2.

TABLE 2.—*Showing Analysis of variance of Age at First Calving.*

Source of Variation	D. F.	Sums of squares	Mean squares	Expected mean squares
Between sires	46	10969828.4	238474.5	$\sigma^2_e + 20.68\ \sigma^2_s$
Within sires	947	136499818.5	144139.2	σ^2_e

where $\sigma^2_s = 144139.2$

$\sigma^2_e = .4561.7$

$h^2 = .1227 \pm .0213$

As is clear from the data in Table 2 the heritability of age at first calving by half sib correlation was $.1227 \pm .0213$. Singh (1957) reported the estimate of heritability of age at first calving as $.048 \pm .09$ by half sib method in Tharparker cattle. Singh and Desai (1961) analysing the data of Hariana cattle by half sib analysis got the estimates of $.3412 \pm .196$ and $.404 \pm .018$, while Acharya (1966) got the estimate of $.14 \pm .12$ of the same breed using the same method.

(*b*) **Intra-Fire Regression of Daughter on Dam:**

The data on daughter dam pairs were arranged on intra-sire basis and analysed by the method shown in Table 3.

TABLE 3.—*Showing Age at first calving—Sums of Squares and Cross Products on Intra-Sire Basis for Regression Analysis* (*Becker*, 1964).

Source of variation	D.F.	Sums of squares XX	Sums of squares XY	Sums of squares YY
Between sires	35	1374635741.99	1395577092.50	1417316068.88
Between dams within sires	620	35765965.01	231166.50	28154835.12

$$b = \frac{231166.50}{35765965.01} = .00646$$

$h^2 = .0129 \pm .0632$

The estimate of heritability by this method was $.0129 \pm .0632$. Amble *et al.* (1958) reported the estimates of heritability of Red Sindhi cattle by the method if intra-sire regression of daughter on dam to be $-.09 \pm .17$ and $.16 \pm .29$, while Stonaker (1953) reported this estimate as $.39 \pm .16$. Singh (1957) got the estimate of $-.361 \pm .10$ in Tharparker cattle. The estimates of $.34 \pm .12$ and $.04 \pm .14$ were reported by Singh and Desai (1961) and Acharya (1966) respectively in Hariana cattle. Kohli *et al.* (1961 a) reported this value close to zero in the same breed.

B. Heritability of First and Second Calving Intervals:

(*a*) Method of Half Sib Analysis:

The estimates of heritability of first and second calving intervals by half sib analysis were .1987 ± .0812 and .2176 ± .0955 respectively. The estimates reported in this study compared quite well with the study made by Kushwaha (1964) in Sahiwal cattle who got the estimate of .197. Singh and Desai (1962) got an estimate of —.337 in Hariana cattle while Acharya (1966) reported the estimate of heritability as .40 ± .20 of the same breed by half sib method.

(*b*) Intra-Sire Regression of Daughter on Dam:

The estimates of heritability of first and second calving intervals worked out by this method were .0371 ± .1012 and .1712 ± .1104 respectively. Amble *et al.* (1958) reported estimates of heritability as —.08 ± .29 and .13 ± .20 in Red Sindhi herds. Kohli *et al.* (1961 a, b) reported heritability estimate of calving interval as .30 ± .18 and Acharya (1966) reported this estimate as .24 ± .12 in Hariana cattle. The estimate reported by Singh and Desai (1962) for Hariana cattle was quite low, being .022 ± .058.

C. Correlation Between Age at First Calving and First Calving Interval:

The phenotypic correlation between age at first calving and first calving interval was found to be .0488 in this study. This estimate was quite low and was comparable with Rennie (1952), Singh (1957) and Singh and Sinha (1960) who reported little or no influence of these traits on each other. Rognoni and Pasti (1955) found a similar estimate of .04. Acharya (1966) got an estimate of .109 between age at first calving and first calving interval in a closed herd of Hariana cattle.

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