ANALYSIS ON THE PRODUCTIVE AND REPRODUCTIVE TRAITS IN SAHIWAL COWS

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SUMMARY

The data on 909 Sahiwal cows sired by 97 bulls raised at three government Livestock Experiment Stations in Punjab (Pakistan), during the period 1968-1992 were analysed to study the performance of Sahiwal cattle. Six traits of economic importance (milk yield, lactation length, dry period, age at first calving, calving interval and service period) for first parity were included in this study. The average milk yield was 1613.1 ± 12.5 kg with an estimate of heritability as 0.276 ± 0.06. The means (days) for lactation length, dry period, age at calving, calving interval and service period were 270.7 ± 1.5, 190.4 ± 3.7, 1369.1 ± 6.7, 461.1 ± 3.6 and 175.4 ± 3.6, respectively. The heritability estimates for these traits were 0.142 ± 0.05, 0.045 ± 0.04, 0.147 ± 0.06, 0.110 ± 0.05 and 0.078 ± 0.05, respectively.

Keywords: Sahiwal cattle, milk yield, heritability, genetic correlations, Pakistan.

INTRODUCTION

Sahiwal is one of the best dairy cattle breed of tropical and sub-tropical regions (Philipsson 1992; Khan *et al.* 1992). Milk yield is the major trait of economic importance in dairy breeds. In order to increase production, it is important to improve the genetic potential of the animals. Knowledge of the heritability estimates and genetic correlations among various productive and reproductive traits can help to improve the production potential in the future breeding stock through selection. The present work was undertaken to evaluate the productive and reproductive performance of Sahiwal cattle at some government livestock farms in Punjab (Pakistan), and to estimate heritability of traits and genetic, phenotypic correlations among them.

MATERIALS AND METHODS

Data on 909 Sahiwal cows for first parity traits (up to second calving) kept at three Livestock Experiment Stations (Bahadurnagar, Jehangirabad, and Khizerabad) in Punjab (Pakistan) were used. These cows were progeny of 97 sires which were used across the herds by government artificial insemination service. The traits investigated were total milk yield, lactation length, dry period, age at first calving, first calving interval and service period after first calving. The milk yield of the cows is based upon the actual weekly milk records. Records of lactations of ≥150 days were included in the analysis. Short lactations or incomplete records of cows (about 4 %) or abnormal lactations affected by mastitis, metritis, etc., were excluded. Fixed effect for seasonal variation was based on calvings during Winter

(December to February), Spring (March to May), Summer (June to August) and Autumn (September to November). The effects taken into the model were sire (random), herd-year-season (fixed) and calving age as covariate for all other traits, except when calving age was analysed as a trait the effects were herd-year-season and sire (random). The General Linear Model Procedure (GLM) in SAS (1990) was used for analysis. Sire and error variance components were estimated by REML method using SAS. The genetic and phenotypic correlations were also calculated from SAS, MANOVA.

RESULTS AND DISCUSSION

The analysis of variance (Table 1) showed that the milk yield and lactation length were significantly affected by herd-year-season while this effect was non-significant on dry period service period and calving interval. The age at calving as covariate was also significant for milk yield, lactation length and dry period, while it was non- significant for service period and calving interval. Quadratic effects of calving age were examined and were non-significant. This could be expected because only first parity was used and short lactations were removed. When age at first calving was used as a trait, the effect of herd-year-season was found to be significant. The effect of sire (random) was found non-significant for all the traits. Similar results were reported by Khan *et al.* (1992) and Shafiq *et al.* (1994).

Table 1. Analysis of variance for production and reproduction traits (F-values with probability level)

Source of variation	Milk yield	Lactation length	Dry period	Calving interval	Service period	Age at first calving
Herd*year*season	3.63**	1.96**	1.17	1.13	1.13	2.98**
Age at calving	3.80*	4.18*	4.46*	1.70	1.77	-
Sire	1.05	1.08	1.02	1.09	1.08	-

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

The means, variance components and heritability estimates for production and reproduction traits are given in Table 2. The mean total milk yield was 1613.1 ± 12.5 kg. The mean age at first calving (1369.1 ± 6.7 days) in the present study was similar to the earlier estimates of Khan *et al.* (1992). The age at first calving in indigenous cattle is generally later by about 365 to 485 days than that of the improved temperate breeds of cattle (Khan *et al.* 1992). Earlier calving could be achieved through better management besides genetic selection. This is

supported by the low heritability estimates for the trait. The mean estimates for other traits were partially in agreement with Khan *et al.* (1992) and Shafiq *et al.* (1994). The heritability estimates for total milk yield were 0.276 ± 0.06. These estimates were higher than the earlier estimates of Khan (1985) and Khan *et al.* (1992). The heritability of other traits were also high compared to many earlier reports. This could be due to the longer data set in this study and differences in the models used. In earlier reports most of the estimates were based on half-sib correlation method, compared to REML in the present study. REML allows fixed effects to be included in the model more efficiently. Moreover, some phenotypic variation in the present study was reduced by deleting the records of short lactation length.

Table 2. Estimates of sire and error components, heritability (h^2) and means for various productive and reproductive traits in Sahiwal cattle

Trait	Mean ± SE	Variance components Sire(σ^2s)	Error (σ^2e)	h^2 ± SE
Total milk yield (kg)	1613.1 ± 12.5	11043.7	149005.6	0.276 ± 0.06
Lactation length (days)	270.7 ± 1.5	76.5	2078.9	0.142 ± 0.05
Dry period (days)	190.4 ± 3.7	135.9	12137.8	0.045 ± 0.04
Age at first calving (days)	1369.1 ± 6.7	1756.6	45884.9	0.147 ± 0.06
Calving interval (days)	461.1 ± 3.6	98.3	11059.9	0.110 ± 0.05
Service period (days)	175.4 ± 3.6	227.5	11609.4	0.078 ± 0.05

Genetic and phenotypic correlations. The genetic and phenotypic correlations among different production and reproduction traits are presented in Table 3. The genetic correlations were found to be negative between dry period and service period (-0.56) and calving interval (-0.53). Similarly negative phenotypic correlations were observed for lactation length and dry period (-0.32), total milk yield and dry period (-0.21). The phenotypic correlations of age at first calving with milk yield was also negative. This negative correlation was desirable, since a reduction in age at first calving would increase the milk yield and the productive life of the cow. The phenotypic correlations of age at calving with other traits were also negative but non-significant. Highly positive genetic correlations of lactation length with dry period, service period and calving interval were obtained (0.72, 0.90 and 0.56 respectively). Similarly genetic correlations of total milk yield with service period, calving interval and dry period were 0.77, 0.86 and 0.55, respectively, which were also very high and positive. High positive phenotypic correlations were found between dry period and service period (0.88), dry period and calving interval (0.88), service period and calving interval (0.92). The results of the present study are partially in agreement with the results of Khan (1985) and Mohiuddin *et al.* (1991).

Table 3 Estimates of genetic correlations (rA, below diagonal) and phenotypic correlations (rP, above diagonal), among various productive and reproductive traits

Trait	Lactation length	Milk yield	Dry period	Calving interval	Service period	Age at first calving
Lactation length		0.16**	-0.32**	0.16**	0.16**	-0.05
Milk yield	0.18		-0.21**	0.15**	0.16**	-0.03
Dry period	0.72	0.55		0.88**	0.88**	-0.04
Service period	0.90	0.77	-0.56		0.92**	-0.06
Calving interval	0.56	0.86	-0.53	0.16		-0.06
Age at calving	0.28	0.27	0.17	0.28	0.26	

** Significant (P < .01)

Application. The mean milk yield was considered higher than several earlier estimates. The low heritability estimates for calving interval, service period and dry period suggested improvements in these traits through better management. By doing so, generation interval can be shortened and sires can be replaced every two or less years, leading to greater intensity of sire selection. The performance traits such as age at first calving, calving interval, service period and dry period would need further improvement in the herds under study. It is therefore, imperative to emphasise improvements in husbandry and introduction of genetic evaluation programmes at the same time. The progeny testing programme is recently introduced on these farms for the breeding of elite cows and selection of tested bulls on the basis of their breeding values. In the long run it will improve the performance of the Sahiwal breed in Pakistan.

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