

## Genetic parameters of production efficiency traits in Tharparkar cattle

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### ABSTRACT

The data on 303 Tharparkar cows, progeny of 13 sires calved during 1974 to 1993 maintained at Government Livestock Farm, Hisar were considered for the estimation of genetic parameters. The means for first lactation milk yield (FLY), wet average (WA), first lactation peak yield (FPY), first lactation milk yield per day of first calving interval (MCI) and first lactation milk yield per day of age at second calving (MSC) were 1300.73 Kg, 4.83 Kg/day, 7.49 Kg/day, 2.74 Kg/day and 0.682 Kg/day, respectively. The effect of period of calving was significant ( $P < 0.05$ ) on FLY and MSC while the effect of season of calving was significant on all the production efficiency traits. Monsoon calvers excelled in performance for all the production efficiency traits. The effect of age at first calving (linear) was significant only on MSC. Estimates of heritability for all the traits were low and ranged from 0.117 to 0.143 except for WA (0.273). All the genetic and phenotypic correlations among different production efficiency traits were high and positive. It may be inferred that selection on the basis of wet average will be more effective as the trait is expressed early in life and had reasonably moderate estimate of heritability.

**Key words:** Heritability, Correlations, Production efficiency traits, Tharparkar breed

### INTRODUCTION

High production efficiency in livestock production is an economically desirable attribute that targets ultimately for genetic up-gradation. In fact, the economy of dairy industry mainly relies upon the performance parameters of dairy animals. Therefore, it becomes more relevant to tackle out the means for ameliorating the performance efficiencies by developing certain guidelines for selection. Indeed, the knowledge of genetic variability with respect to each trait and co-variability existing among different traits are a beacon light for planning appropriate selection and breeding strategies for the genetic improvement of dairy animals. Therefore the present investigation was undertaken with a view to study the genetic variation in production efficiency traits in Tharparkar cattle, a prominent dual-purpose breed of Northwestern part of the country.

### MATERIALS AND METHOD

The data utilized in the study pertained to first lactation production efficiency traits on 303 Tharparkar cows which calved during 1974 to 1993, progeny of 13 sires maintained at government livestock farm, Hisar. The total duration of 20 years was divided into 4 periods of five years each. The three seasons were delineated as winter (November-February), summer (March-June) and monsoon (July-October) on the basis of geo-climatic conditions prevailing in the region. The production efficiency traits recorded were; first lactation milk yield (FLY), wet average (WA), first lactation peak yield (FPY), first lactation milk yield per day of first calving interval. Sires with at least five progenies were included in the analysis. Records of cows with some specific or non-specific diseases, reproductive disorders and physical injuries were excluded from the present investigation. The least-squares solutions were obtained using the model given below:

$$Y_{ijkl} = \mu + S_i + H_j + C_k + b_1 (A_{ijkl} - \bar{A}) + b_2 (A_{ijkl} - \bar{A})^2 + e_{ijkl}$$

Where:  $Y_{ijkl}$  = is the  $l$ th record of individual of  $i$ th sire in  $j$ th period and  $k$ th season;

$\mu$  = is the overall population mean;

$S_i$  = is the fixed effect of  $i$ th sire;

$H_j$  = is the fixed effect of  $j$ th period of calving (first period = 1974 -78, second period = 1979 - 83, third period = 1984 - 88 and fourth period = 1989 - 93);

$C_k$  = is the fixed effect of  $k$ th season of calving;

$b_1$  and  $b_2$  are linear and quadratic regression coefficients, respectively of age at first calving on MY/SC;

$A_{ijkl}$  = is the age at first calving;

$\bar{A}$  = is the mean for age at first calving; and

$e_{ijkl}$  = is the random error associated with each observation and assumed to be normally and independently distributed with mean zero and variance  $\sigma_e^2$ .

The least-squares and maximum likelihood computer program of Harvey (1987) was used to estimate the effects of various tangible factors on different production efficiency traits. Duncan's multiple range test as modified by Kramer (1957) was employed for making all possible pair wise comparison of means. Heritability estimates for different efficiency traits were obtained by the paternal half-sib correlation method. The standard errors of heritability estimates were obtained by using the formula of Swiger *et al.* (1964). Genetic correlations among different traits were calculated from sire components of variances and covariances. The standard error of genetic correlation was estimated by using the formula given by Robertson (1959). Phenotypic correlations among various traits were calculated from variance-covariance analysis. The standard error of phenotypic correlation was computed using the formula given by Snedecor and Cochran (1968).]

### RESULTS AND DISCUSSION

The least-squares constant and their standard errors for production efficiency traits, presented in Table 1, indicated that the

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means for FLY, WA, FPY, MCI and MSC averaged as 1300.73 Kg, 4.83 Kg/day, 7.49 Kg/day, 2.74 Kg/day and 0.682 Kg/day, respectively. Comparable results for averages of production efficiency traits were observed by Rana (1985) and Pundir and Raheja (1994). However, Ashraf et al. (2000) reported 1495.00 Kg and 5.25 Kg/day as averages for lactation yield and daily milk yield, respectively in Local x Hariara crossbred cattle.

availability of green fodders in monsoon season as well as in the ensuing winter season.

The effect of age at first calving (linear) was statistically significant ( $P < 0.05$ ) only on MSC while the effect of AFC (quadratic) was non-significant on all the traits. The regression of AFC on MCI was positive indicating that with every unit increase in AFC there would be corresponding increase in MCI. On the

Table 3. Polymorphic information content (PIC) equilibrium and heterozygosity in Mecheri sheep

Ind. Variable	Obs	FLY Mean±SE	WA Mean±SE	FPY Mean±SE	MCI Mean±SE	MSC Mean±SE
Overall	300	1300.73±25.21	4.83±0.14	7.49±0.17	2.74±0.10	0.682±0.014
Periods:						
1974-78	62	1279.54 <sup>ab</sup> ±79.18	5.00±0.25	7.58±0.37	2.57±0.23	0.664 <sup>ab</sup> ±0.042
1979-83	64	1128.24 <sup>b</sup> ±55.55	4.90±0.20	7.45±0.28	2.64±0.17	0.605 <sup>b</sup> ±0.029
1984-88	80	1353.99 <sup>a</sup> ±53.78	4.90±0.19	7.88±0.27	2.94±0.16	0.708 <sup>a</sup> ±0.028
1989-93	97	1441.14 <sup>a</sup> ±79.10	4.54±0.26	7.06±0.37	2.82±0.23	0.748 <sup>a</sup> ±0.042
Seasons:						
Winter	143	1253.14 <sup>b</sup> ±29.36	4.83 <sup>b</sup> ±0.14	7.72 <sup>a</sup> ±0.18	2.81 <sup>a</sup> ±0.10	0.659 <sup>b</sup> ±0.016
Summer	129	1203.55 <sup>b</sup> ±30.44	4.48 <sup>b</sup> ±0.15	7.12 <sup>b</sup> ±0.18	2.45 <sup>b</sup> ±0.11	0.629 <sup>b</sup> ±0.017
Monsoon	31	1445.49 <sup>a</sup> ±57.32	5.20 <sup>a</sup> ±0.20	7.62 <sup>ab</sup> ±0.28	2.98 <sup>a</sup> ±0.17	0.757 <sup>a</sup> ±0.031
Regressions:						
AFC (Linear)		-0.1689±0.1215	-0.00016±0.0004	-0.0002±0.0005	0.00007±0.00033	-0.0004±0.0001
AFC (Quadratic)		0.0001±0.0004	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

The least-squares analysis of variance, depicted in Table 1, showed that the effect of sire was non-significant on all the traits. The effect of period of calving was statistically significant ( $P < 0.05$ ) on FLY and MSC. Critical review of analysis of variance revealed that the performance of the cows calved during the fourth period (1989-93) was significantly better as compared with those calved during second period (1979-83) for FLY and MSC. This may be due to the improvement as a result of selection for the trait over the years. However, no definite trend was observed for production efficiency traits over the periods.

The effect of season of calving was significant on all the production efficiency traits. The performance of summer calvers (March-June) was the worst for all the production efficiency traits while the monsoon season calvers (July-October) performed better in terms of the production efficiency traits except in case of FPY, where winter calvers excelled in performance, but that too did not differ significantly from those calved during monsoon season. The better performance of monsoon calvers might be attributed to

other hand, the regression of AFC on FLY, WA and FPY was negative and non-significant. Negative and significant regression of AFC on MSC indicated that increase in AFC by one day would decrease the milk yield per day of age at second calving by 0.42 grams per day.

**Heritability estimates:** The estimates of heritability obtained for FLY, FPY, MCI and MSC were low (0.143, 0.133, 0.117 and 0.148, respectively, Table 2). The heritability estimate for wet average was moderate (0.273). These estimates indicated that these characters are controlled by factors other than additive gene action. The low to moderate estimates of heritability for these production efficiency traits revealed that there is inadequate scope for improvement in these traits through individual selection and it thus requires information from other relatives coupled with improvement in managerial practices to improve these traits. Singh (1994) and Katkade et al. (1995) also reported similar results for heritability estimates of MCI and MSC, respectively.

Table 2. Heritability, genetic and phenotypic correlations among various efficiency traits

Traits	FLY	WA	FPY	MCI	MSC
FLY	0.143 ± 0.125	0.645 ± 0.044*	0.581 ± 0.079*	0.603 ± 0.046*	0.953 ± 0.017*
WA	0.304 ± 0.451	0.273 ± 0.165	0.636 ± 0.044*	0.551 ± 0.048*	0.673 ± 0.043*
FPY	0.350 ± 0.430	> 1.000	0.133 ± 0.126	0.432 ± 0.052*	0.588 ± 0.047*
MCI	0.862 ± 0.239	0.929 ± 0.311	> 1.000	0.117 ± 0.121	0.673 ± 0.043*
MSC	0.924 ± 0.084	0.718 ± 0.503	> 1.000	> 1.000	0.148 ± 0.127

(\* $P < 0.05$ ); diagonal (bold) = heritability; above the diagonal = phenotypic correlations; below the diagonal = genetic correlations

**Genetic correlations:** First lactation milk yield had moderate positive genetic correlations with WA (0.304) and FPY (0.350). On the other hand, FLY and WA had high genetic correlations with MCI and MSC ranging from 0.718 (WA and MSC) to 0.929 (WA and MCI). The estimates of genetic correlations of FPY with WA, MCI and MSC had crossed the parameter space ( $\geq 1$ ) and thus no conclusion could be drawn from the results. This may be due to lesser number of observations in each period and some other non-genetic factors, which could not be corrected. High genetic

correlations have also been reported by Yadav (1988) and Dutt and Taneja (1994) among production efficiency traits in Hariara breed of cattle and Murrah breed of buffaloes, respectively. Moderate to high genetic correlations between FLY and the other efficiency traits are obvious because the later are derived from FLY i.e. all the efficiency traits have FLY as numerator.

**Phenotypic correlations:** Phenotypic correlations among all the production efficiency traits were high, positive and significant ranging from 0.432 to 0.953. This may be due to pleiotropic action

of genes. Hence selection for any one of the trait(s) will bring concurrent improvement in other traits as correlated response.

From the results of this study, it may be concluded that the wet average can be measured earlier than the first lactation yield and had moderate estimates of heritability. Moreover, WA had moderate to high genetic correlations with all efficiency traits. Thus selection based on wet average will reduce the generation interval considerably and hence the genetic gain per unit of time will be increased. This genetic gain will also be reflected in the other traits through correlated response.

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