Genetic parameters of lactation performance traits in Hariana cattle

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ABSTRACT

The data pertinent to lifetime traits on 762 Hariana cows calving during 1966 to 2000, progeny of 23 sires maintained at Government Livestock Farm, Hisar were considered. First lactation MY, LL and PY had high positive genetic correlation with fourth lactation MY, LL and PY except the relationship of first lactation length with fourth lactation MY and PY. First lactation DP, CI and SP had high negative genetic correlation with fourth lactation MY, LL and DP barring fourth lactation length association with first SP and CI. First lactation MY and LL had positive correlations with all the fourth lactation performance traits except with fourth dry period. Second lactation MY and PY had high positive genetic correlation with fourth lactation MY and PY, while these traits had negative association with fourth lactation DP, SP and CI. Moreover, third MY, LL and PY had negative genetic correlations with fourth lactation DP, SP and CI barring low and positive association of third LL with fourth SP. In addition to this, third DP, CI and SP had high and negative genetic correlations with fourth lactation MY and PY, while these traits had high positive genetic correlations with fourth DP, CI and SP. This suggested that selection on the basis of PY1 will also bring out genetic improvement in MY of each lactation. This will not only reduce the generation interval by early selection but also reduce the unproductive life of the animal by reducing DP.

Key words: Lactational traits, genetic and phenotypic correlations, Hariana cattle.

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INTRODUCTION

The ability to produce and reproduce for many years is a desirable trait in dairy cattle since it takes 3-4 years of production for a cow to repay her cost of rearing. A long productive life is financially beneficial and also allows the genetically superior animals to leave more offspring. 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 traits of different lactations 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 genetic and phenotypic correlations of mature lactation traits with that of earlier lactations in Hariana cattle.

MATERIALS AND METHODS

In order to achieve the objective, the data pertinent to lifetime traits on 762 Hariana cows calving during period 1966 to 2000, progeny of 23 sires maintained at Government Livestock Farm, Hisar were considered. The duration of 35 years was divided into 7 periods of five years each (first period = 1966 – 70, second period = 1971 – 75, third period = 1976 – 80, fourth period = 1981 – 85, fifth period = 1986 – 90, sixth period = 1991 – 95 and seventh period = 1996 - 2000). The four seasons were delineated as summer (April-June), rainy (July-September), autumn (October-November) and winter (December-March) on the basis of geo-climatic conditions prevailing in the region. The traits recorded were: lactation milk yield (MY), lactation length (LL), peak yield (PY), dry period (DP), calving interval (CI) and service period (SP). Sires with at least five progenies were considered for this study. Records of cows with some specific or non-specific diseases, reproductive disorder and physical injury were excluded from the present investigation. The least-squares solutions were obtained according to Harvey (1987) using the model given below:

$Yijkl = \mu + Si + Pj + SEk + b(Aijkl - \bar{A}) + eijkl$

Where: Yijkl = is the lth record of individual of ith sire in jth period and kth season; μ = is the overall population mean; Si = is the fixed effect of ith sire; Pj = is the fixed effect of jth period of calving; SEk = is the fixed effect of kth season of calving; b is linear regression coefficients of age at first calving (AFC) on the trait (s); Aijkl = is the age at first calving; Ā = is the mean for age at first calving; and eijkl = is the random error associated with each observation and assumed to be normally and independently distributed with mean zero and variance $\sigma e2$.

The least-squares and maximum likelihood computer program of Harvey (1987) was used to standardize the data for significant effects on lactation traits. 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

Correlations between first and fourth lactation traits: The genetic and phenotypic correlations of performance traits between first lactation and fourth lactation traits are presented in Table 1. The analysis revealed that first lactation MY, LL and PY had high positive genetic correlations with fourth lactation MY, LL and PY except the relationship of first lactation length with fourth lactation MY and PY. First lactation DP, CI and SP had high negative genetic correlations with fourth lactation MY, LL and DP barring fourth lactation length correlations with first SP and CI. First lactation MY and LL had positive correlations with all the fourth lactation performance traits except with fourth dry period. First DP, SP and CI had high positive genetic correlations with fourth DP, SP and CI except the genetic correlation of first dry period with fourth CI and SP. First lactation MY and PY had positive phenotypic correlations with all the performance traits of

Table 1 Genetic and phenotypic correlation of performance traits between first lactation and fourth lactation

Traits	G/P	MY4	LL4	PY4	DP4	CI4	SP4
MY1	G	0.85±0.10	0.78±0.30	0.69±0.14	-0.56±0.33	0.02±0.32	0.01±0.33
	P	0.46±0.04**	0.36±0.05**	0.36±0.05**	-0.03±0.05	0.21±0.05*	0.22±0.05*
LL1	G	0.26±0.31	0.85±0.40	0.05±0.31	-0.02±0.46	0.37±0.36	0.30±0.39
	P	0.19±0.05	0.23±0.05*	0.10±0.05	0.02±0.05	0.15±0.05	0.15±0.05
PY1	G	0.81±0.04	0.56±0.35	0.96±0.05	-0.69±0.30	-0.19±0.30	-0.17±0.31
	P	0.43±0.04**	0.24±0.05*	0.43±0.04**	-0.03±0.05	0.14±0.05	0.16±0.05
DP1	G	-0.64±0.21	-0.61±0.41	-0.58±0.20	0.57±0.32	0.19±0.32	0.15±0.34
	P	-0.06±0.05	0.02±0.05	-0.13±0.05	0.21±0.05*	0.20±0.05*	0.19±0.05
CI1	G	-0.71±0.31	-0.06±0.60	-0.88±0.28	0.77±0.41	0.73±0.32	0.50±0.39
	P	0.07±0.05	0.18±0.05	-0.05±0.05	0.20±0.05	0.28±0.05**	0.27±0.05**
SP1	G	-0.70±0.23	-0.25±0.48	-0.74±0.22	0.80±0.32	0.63±0.27	0.47±0.33
	P	0.05±0.05	0.18±0.05	-0.08±0.05	0.20±0.05*	0.30±0.05**	0.28±0.05**

P= Phenotypic; G= Genetic; * P<0.05; ** P<0.01

Table 2 Genetic and phenotypic correlation of performance traits between second and fourth lactation

Traits	G/P	MY4	LL4	PY4	DP4	CI4	SP4
MY2	G	0.83±0.10	0.58±0.34	0.75±0.12	0.90±0.28	-0.30±0.29	-0.31±0.30
	P	0.52±0.04**	0.34±0.05**	0.49±0.04**	-0.06±0.05	0.14±0.05	0.17±0.05
LL2	G	0.23±0.27	0.34±0.41	0.11±0.26	-0.64±0.35	-0.23±0.32	-0.21±0.34
	P	0.29±0.05**	0.27±0.05**	0.20±0.05	-0.06±0.05	0.09±0.05	0.12±0.05
PY2	G	0.92±0.07	0.20±0.39	0.91±0.05	-0.79±0.29	-0.40±0.27	-0.38±0.29
	P	0.50±0.04**	0.21±0.05*	0.59±0.04**	-0.07±0.05	0.06±0.05	0.09±0.05
DP2	G	-0.49±0.31	-0.26±0.54	-0.51±0.30	0.41±0.43	0.12±0.41	0.06±0.43
	P	-0.04±0.05	0.06±0.05	-0.14±0.05	0.22±0.05*	0.22±0.05*	0.23±0.05**
CI2	G	-0.57±0.36	0.77±0.44	-0.31±0.32	0.43±0.46	0.60±0.33	0.68±0.32
	P	0.19±0.05	0.24±0.05*	0.04±0.05	0.13±0.05	0.26±0.05**	0.28±0.05**
SP2	G	-0.65±0.33	0.53±0.55	-0.84±0.32	0.50±0.49	0.53±0.39	0.53±0.41
	P	0.12±0.05	0.22±0.05*	-0.01±0.05	0.15±0.05	0.27±0.05**	0.28±0.05**

P= Phenotypic; G= Genetic; * P<0.05; ** P<0.01

fourth lactation except with fourth dry period. First LL had low and positive phenotypic correlations with all the fourth lactation performance traits except with fourth lactation length. First lactation SP and CI had low to moderate positive phenotypic correlations with all the fourth lactation performance traits except with fourth lactation PY. Likewise, first DP, SP and CI had low to moderate associationship with fourth DP, SP and CI. Fourth PY had negative correlations with first DP, CI and SP.

Correlations between second and fourth lactation traits: Second lactation MY and PY had highly positive genetic correlations with fourth lactation MY and PY, while these traits had negative association with fourth lactation DP, SP and CI (Table 2). Second LL had low to moderate genetic correlations with fourth lactation MY, LL and PY whereas fourth DP, SP and CI had negative genetic correlation with second LL. Moreover, second DP, SP and CI had high positive genetic correlations with fourth DP, SP and CI barring low positive genetic relationship of second DP with fourth CI. Second lactation MY, LL and PY had significant positive phenotypic correlations with fourth MY, LL and PY while all other second lactation traits had positive phenotypic correlations with all the performance traits of fourth lactation except that of

Table 3. Genetic and phenotypic correlation of performance traits between third and fourth lactation

Traits	G/P	MY4	LL4	PY4	DP4	CI4	SP4
MY3	G	0.93±0.06	0.92±0.36	0.82±0.09	-0.94±0.28	-0.42±0.27	-0.36±0.29
	P	0.59±0.04**	0.34±0.05**	0.54±0.04**	-0.10±0.05	0.12±0.05	0.13±0.05
LL3	G	-0.04±0.33	0.33±0.46	-0.26±0.30	-0.29±0.46	-0.04±0.40	0.04±0.41
	P	0.36±0.05**	0.41±0.04**	0.16±0.05	-0.04±0.05	0.22±0.05*	0.23±0.05*
PY3	G	0.97±0.04	0.32±0.37	0.97±0.02	-0.78±0.28	-0.40±0.27	-0.34±0.28
	P	0.58±0.04**	0.20±0.05*	0.67±0.04**	0.12±0.05	-0.01±0.04	0.02±0.04
DP3	G	-0.78±0.17	-0.16±0.43	-0.75±0.16	0.94±0.23	0.59±0.25	0.53±0.28
	P	-0.10±0.04	0.02±0.04	-0.17±0.04	0.20±0.04*	0.20±0.05*	0.16±0.04
CI3	G	-0.81±0.17	-0.07±0.48	-0.91±0.15	0.90±0.28	0.57±0.27	0.57±0.28
	P	0.18±0.04	0.31±0.05**	-0.01±0.04	0.14±0.04	0.34±0.05**	0.31±0.04**
SP3	G	-0.65±0.22	0.04±0.49	-0.83±0.17	0.90±0.28	0.71±0.23	0.71±0.25
	P	0.16±0.04	0.28±0.05**	-0.02±0.04	0.15±0.04	0.32±0.05**	0.30±0.04**

P= Phenotypic; G= Genetic; * P<0.05; ** P<0.01

association of fourth DP with MY, LL and PY of second lactation. Second calving interval had low to moderate positive phenotypic correlations with all the fourth lactation performance traits. However, second DP, SP and CI had moderate significant positive phenotypic correlations with fourth CI and SP. Fourth DP had negative correlations with second MY, LL and PY while fourth PY had negative correlations with second DP and SP.

Correlations between third and fourth lactation traits: As in earlier discussion, the genetic correlations among MY and PY between preceding lactation and succeeding lactation were obtained as high and positive (Table 3). Moreover, third MY, LL and PY had negative genetic correlations with fourth lactation DP, SP and CI barring low and positive association of third LL with fourth SP. Also, third DP, CI and SP had high and negative genetic correlations with fourth lactation MY and PY, while these traits had high positive genetic correlations with fourth DP, CI and SP. Moreover, third DP, SP and CI had positive phenotypic correlations with all the traits except that of fourth lactation PY and that of third DP with fourth MY and PY which were low and negative. As earlier, third DP, SP and CI had low to moderate phenotypic correlations with fourth DP, CI and SP.

The genetic and phenotypic correlations between lactation traits indicated that PY1 has high genetic and significant phenotypic correlations with MY of each lactation and negative genetic and phenotypic correlations with DP of each lactation. This suggested that selection on the basis of PY1 will also bring out genetic improvement in MY of each lactation. This will not only reduce the generation interval by early selection but also reduce the unproductive life of the animal by reducing DP.

REFERENCES

Harvey WR. 1987. Least-squares Maximum Likelihood Computer Program. PC version - 1

Robertson A. 1959. *Biometrics*. 15: 469-485.

Steel RGD and Torrie JH. 1981. Principle and Procedures of Statistics, 2nd edn.