

## Genetic and phenotypic correlations among lactation traits in Haryana cattle

S. Singh\*, Z.S. Rana<sup>1</sup>, R. Kumar<sup>1</sup>, B.L. Pander<sup>1</sup>, S.S. Dhaka<sup>1</sup> and B. Prakash<sup>2</sup>  
Krishi Vigyan Kendra, Sangaria, Hanumangarh (Rajasthan) - 335063

## ABSTRACT

The study was conducted on 762 Haryana cows maintained at Government Livestock Farm, Hisar, Haryana (India) with the objectives to study the genetic and phenotypic relationship of first lactation with first four lactation traits like MY, LL, WA, MCI, PY, DP. The estimates of heritability of all lactation traits were of low to moderate magnitude indicating that additive genetic variability for these traits is less. The genetic and phenotypic correlation between lactation traits indicated that PY of first lactation has high genetic and significant phenotypic correlations with MY of each lactation and negative genetic and phenotypic correlations with DP of each lactation. The results suggested that selection on the basis of MY1 and PY1 would bring genetic improvement in MY of following lactations.

**Key Words:** MY=Milk Yield LL=Lactation Length, WA=Wet Average, MCI=Milk yield per day of Calving Interval, PY=Peak Yield, DP=Dry Period.

## INTRODUCTION

Haryana is one of the best dual-purpose breeds of cattle in India. Genetic improvement of Haryana cattle through selective breeding is an important aspect for conservation, preservation and propagation of valuable germplasm as a part of national heritage. The animals of this breed have been maintained at several farms and research work is going on for the development of this breed since long. But the advancement in selection methodology demands further research on this breed. It may not be beneficial to select animals for lifetime traits directly as they are expressed later in life leading to increased generation interval. An animal gives its best production only upto the fourth lactation. An early prediction of production traits from the genetic and phenotypic correlation in early lactation would reduce the generation interval and hence increase genetic gain per unit of time. The study was thus undertaken to study the genetic and phenotypic relationship of first lactation traits with subsequent four lactation traits like milk yield, lactation length, wet average, milk yield per day of calving interval, peak yield and dry period.

## MATERIAL AND METHODS

The data for the present investigation were collected from the first to fourth lactation records of 762 Haryana cows sired by 68 males maintained at Government Livestock Farm, Hisar over a period of 35 years from 1966 to 2000. Total duration of 35 years was divided into 7 periods each having five years on the basis of environmental variations affecting the availability and quality of feed and fodder. Year to year variation within periods were assumed to be non-significant. Each year was further delineated into four seasons on the basis of fluctuation in the atmosphere temperature and relative humidity viz. summer (April-June), rainy (July-September), autumn (October-November) and winter (December-March). Cows having incomplete (less than 100 days) and abnormal lactation record due to abortion and sickness were excluded. Early performance traits like lactation milk yield (MY), lactation length (LL), calving interval (CI), wet average (WA), milk yield per day of calving interval (MCI), peak yield (PY) and

dry period (DP) were considered. The effect of various non-genetic factors and sire and residual variance and covariance components for performance traits were obtained using least squares analysis techniques described by Harvey (1987) with the model given below:

$$Y_{ijklm} = m + S_i + P_j + SE_k + L_l + b(A_{ijklm} - A) + e_{ijklm}$$

Where,

$Y_{ijklm}$  = The observation on  $m^{\text{th}}$  daughter of  $i^{\text{th}}$  sire within  $j^{\text{th}}$  period and  $k^{\text{th}}$  season of calving of  $l^{\text{th}}$  lactation.

$m$  = Overall population mean

$S_i$  = Random effect of  $i^{\text{th}}$  Sire

$P_j$  = Fixed effect of  $j^{\text{th}}$  period ( $j=1$  to 7)

$SE_k$  = Fixed effect of  $k^{\text{th}}$  season ( $K=1$  to 4)

$L_l$  = Fixed effect of  $l^{\text{th}}$  order of lactation

$b$  = Linear regression coefficient of a trait on age at first calving

$A_{ijklm}$  = Age at first calving (days) pertaining to  $Y_{ijklm}$

$A$  = Mean age at first calving (days)

$e_{ijklm}$  = Residual error associated with  $m^{\text{th}}$  observation of  $k^{\text{th}}$  season,  $j^{\text{th}}$  period of calving of  $l^{\text{th}}$  lactation and  $i^{\text{th}}$  sire assumed to be NID ( $0, s^2_e$ )

## RESULTS AND DISCUSSION

*Between First Lactation and Second Lactation:* Production traits (MY, LL, PY) had high positive genetic correlations among first and second lactation (Table 1). Milk yield traits had negative genetic correlations with DP, SP and CI irrespective of lactation, barring the genetic correlations of LL with CI and SP, which were low and positive. Furthermore, DP, CI and SP of first lactation had high negative genetic correlations with second lactation MY and PY, while these traits had negative and moderate genetic correlations with LL. Moreover, DP, SP and CI of first and second lactation had high positive genetic correlations among themselves.

Present Addresses: \*Corresponding Author: Dr. Satbir Singh, Subject Matter Specialist, Krishi Vigyan Kendra, Sangaria- 335063 Hanumangarh (Raj); <sup>1</sup>Deptt of Animal Breeding, CCS Haryana Agricultural University, Hisar-125004; <sup>2</sup> Principal Scientist, NBAGR, Karnal- 132 001.

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

Traits	MY <sub>2</sub>	LL <sub>2</sub>	PY <sub>2</sub>	DP <sub>2</sub>	CI <sub>2</sub>	SP <sub>2</sub>
MY <sub>1</sub>						
G	0.958±0.051	0.434±0.233	0.864±0.085	0.822±0.257	0.027±0.357	-0.374±0.374
P	0.528±0.031**	0.284±0.035**	0.447±0.032**	0.053±0.036	0.111±0.036	0.058±0.036
LL <sub>1</sub>						
G	0.689±0.214	0.403±0.303	0.403±0.278	0.856±0.350	0.103±0.440	0.186±0.486
P	0.208±0.035*	0.256±0.035**	0.154±0.036	0.027±0.036	0.117±0.036	0.040±0.036
PY <sub>1</sub>						
G	0.918±0.063	0.208±0.262	0.903±0.029	0.758±0.260	-0.221±0.339	-0.780±0.332
P	0.488±0.032**	0.175±0.036	0.531±0.031**	0.071±0.036	0.045±0.036	-0.013±0.036
DP <sub>1</sub>						
G	-0.977±0.117	-0.359±0.273	-0.845±0.145	0.997±0.176	0.481±0.313	0.662±0.326
P	-0.100±0.036	-0.012±0.036	-0.137±0.036	0.310±0.034**	0.278±0.035**	0.244±0.035*
CI <sub>1</sub>						
G	-0.925±0.259	-0.302±0.377	-0.980±0.269	0.797±0.343	0.658±0.375	0.955±0.394
P	0.128±0.036	0.145±0.036	0.009±0.036	0.263±0.035**	0.321±0.034**	0.253±0.035**
SP <sub>1</sub>						
G	-0.970±0.160	-0.299±0.317	-0.950±0.172	0.802±0.269	0.586±0.332	0.840±0.337
P	0.066±0.036	0.094±0.036	-0.055±0.036	0.255±0.035**	0.282±0.035**	0.243±0.035*

Milk yield of first lactation had positive and significantly high phenotypic correlations with second lactation MY and PY, whereas it had low positive phenotypic correlations with DP, SP and CI. First dry period had low negative association with second lactation MY, LL and PY. First lactation SP, DP and CI had moderate and significant phenotypic association with second lactation DP, SP and CI (Table 1).

**Between First Lactation and Third Lactation:** First lactation MY, LL and PY had high positive genetic correlation with third lactation MY, LL and PY barring first lactation PY correlation with third lactation length and first lactation length with third lactation PY (Table 2). Third lactation MY and PY had high negative genetic correlations with first lactation DP, CI and SP, while third lactation length had low to moderate genetic correlation with first lactation DP, CI and SP. In addition to this, first lactation PY had high

negative genetic correlations with third lactation DP, CI and SP. Moreover, first lactation DP, CI and SP had high positive genetic correlations with third lactation DP, CI and SP barring moderate positive genetic correlations of DP of first lactation with SP of third lactation.

Corresponding to genetic correlations, the first lactation MY and PY had highly significant (P<0.01) and positive phenotypic association with third lactation MY and PY (Table 2). In general, first lactation MY and PY had positive phenotypic association with all third lactation performance traits except with third lactation DP, whereas first lactation length had positive phenotypic correlations with all the third lactation traits. Moreover, first lactation DP, CI and SP had low positive phenotypic relationship with third lactation DP, CI and SP. Third lactation PY had low negative phenotypic correlations with first lactation DP, CI and SP.

Table 2. Genetic and phenotypic correlation of performance traits between first lactation and third lactation

Effects	FL305DMY (kg)	FLMY (kg)	FLL (days)	AFC (days)*	FSP (days)	FDP (days)	FCI (days)
Overall	1526.1±34.97	1785.3±49.49	322.2±6.82	1234.9±16.3	239.7±11.98	201.6±11.05	523.8±11.99
Herd							
Lucknow	1254.8±32.33 <sup>a</sup>	1476.9±45.76 <sup>a</sup>	322.47±6.31	1292.5±20.00 <sup>a</sup>	274.9±11.08 <sup>a</sup>	234.7±10.22 <sup>a</sup>	557.2±11.08 <sup>a</sup>
Karnal	1797.4±57.56 <sup>b</sup>	2093.7±81.47 <sup>b</sup>	321.9±11.23	1177.5±25.38 <sup>b</sup>	204.5±19.72 <sup>b</sup>	168.5±18.19 <sup>b</sup>	490.5±19.73 <sup>b</sup>
Season							
Summer	1476.0±36.94	1705.4±52.28	325.9±7.21	1236.1±31.98	216.7±12.66	175.8±11.68 <sup>b</sup>	501.8±12.66
Rainy	1581.2±55.38	1831.1±78.37	330.03±10.8	1240.8±29.04	217.3±18.97	171.7±17.50 <sup>b</sup>	501.7±18.98
Autumn	1473.4±117.75	1763.8±166.65	300.4±22.97	1239.2±36.49	306.2±40.34	289.1±37.22	589.6±40.35
Period							
1976-80	1642.6±88.16 <sup>b</sup>	2134.4±124.77 <sup>a</sup>	383.6±17.20 <sup>a</sup>	1231.8±50.99 <sup>bc</sup>	245.93±30.2	147.1±27.87 <sup>d</sup>	530.7±30.21
1981-85	1585.7±50.70 <sup>f</sup>	1888.9±71.76	353.7±9.89 <sup>b</sup>	1394.7±26.90 <sup>a</sup>	235.2±17.37	164.4±16.03 <sup>cd</sup>	518.1±17.38
1986-90	1665.1±48.65 <sup>b</sup>	1865.6±68.86 <sup>f</sup>	322.5±9.49 <sup>c</sup>	1199.7±24.41 <sup>cd</sup>	214.4±16.67	178.7±15.38 <sup>c</sup>	501.2±16.67
1991-95	1725.5±55.75 <sup>d</sup>	1950.6±78.91 <sup>b</sup>	312.4±10.88 <sup>cd</sup>	115.56±31.95 <sup>e</sup>	254.2±19.1	226.4±17.62 <sup>b</sup>	538.8±19.11
1996-2000	1433.9±52.70 <sup>d</sup>	1613.1±74.58 <sup>d</sup>	306.4±10.28 <sup>d</sup>	1259.7±29.57 <sup>b</sup>	239.7±18.05	215.6±16.66 <sup>b</sup>	522.0±18.06
2001-05	1103.78±128.53 <sup>e</sup>	1259.5±181.9 <sup>e</sup>	254.5±25.07 <sup>e</sup>	1169.4±60.85 <sup>de</sup>	249.0±44.03	277.7±40.62 <sup>a</sup>	532.3±44.05

*Between First Lactation and Fourth Lactation:* 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 (Table 3). 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 lactation 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 fourth lactation except with fourth dry period. First LL had low 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. Like earlier phenotypic correlations, first DP, SP and CI had low to moderate association with fourth DP, SP and CI. Fourth PY had negative correlations with first DP, CI and SP (Table 3).

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

Traits	MY <sub>4</sub>	LL <sub>4</sub>	PY <sub>4</sub>	DP <sub>4</sub>	CI <sub>4</sub>	SP <sub>4</sub>
MY <sub>1</sub>						
G	0.852±0.096	0.785±0.306	0.688±0.144	-0.557±0.329	0.024±0.316	0.005±0.329
P	0.458±0.043**	0.360±0.045**	0.363±0.045**	-0.025±0.047	0.212±0.045*	0.217±0.045*
LL <sub>1</sub>						
G	0.264±0.308	0.847±0.395	0.052±0.310	-0.023±0.458	0.374±0.357	0.259±0.388
P	0.190±0.046	0.227±0.045*	0.098±0.047	0.023±0.047	0.146±0.046	0.146±0.046
PY <sub>1</sub>						
G	0.805±0.044	0.557±0.352	0.958±0.047	-0.688±0.301	-0.189±0.298	-0.170±0.311
P	0.427±0.043**	0.244±0.045*	0.431±0.043**	0.028±0.047	0.139±0.046	0.161±0.046
DP <sub>1</sub>						
G	-0.637±0.207	-0.610±0.413	-0.582±0.205	0.570±0.316	0.192±0.322	0.150±0.338
P	0.064±0.047	0.017±0.047	0.133±0.047	0.208±0.046*	0.199±0.046*	0.190±0.046
CI <sub>1</sub>						
G	-0.709±0.306	-0.062±0.599	-0.884±0.283	0.772±0.405	0.735±0.320	0.503±0.389
P	0.070±0.047	0.177±0.046	-0.054±0.047	0.197±0.046	0.276±0.045**	0.270±0.045**
SP <sub>1</sub>						
G	-0.700±0.230	-0.247±0.482	-0.739±0.216	0.800±0.316	0.632±0.273	0.466±0.328
P	0.051±0.047	0.179±0.046	0.082±0.047	0.203±0.046*	0.296±0.045**	0.281±0.045**

The results of this study are in conformity with the investigations of Thakur (1997), Arora and Sharma (1981), Pundir (1991) and Singh *et al.* (2002). The genetic and phenotypic correlations between lactation traits indicated that MY<sub>1</sub> and PY<sub>1</sub> has high genetic and significant phenotypic correlations with MY of following lactations and negative genetic and phenotypic correlations with DP of following lactations. This suggested that selection on the basis of MY<sub>1</sub> and PY<sub>1</sub> would bring genetic improvement in MY of following lactations. This would not only reduce the generation interval by early selection but also reduce the unproductive life of the animal by reducing DP.

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