

## Relationship between sires' estimated breeding values for first lactation and lifetime traits in Haryana cattle

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### ABSTRACT

Best linear unbiased prediction (BLUP) procedure was used to obtain the estimates of sires' breeding values from performance records of 601 daughters of 28 sires of Haryana cattle maintained during 1976 to 1996 at the Government Livestock Farm, Hisar, Haryana. First lactation traits included were age at first calving (AFC), lactation milk yield (FLMY), lactation length (LL), peak yield (PY), service period (SP), dry period (DP) and calving interval (CI); and lifetime traits were herd life (HL), lifetime milk yield (LTMY), productive life (PL), no. of days in milk (ND) and milk yield/day of productive life (MY/PL). Model for BLUP included year-season of calving and sire genetic group as fixed effects and sire within sire genetic group as random effect. The estimated breeding values (EBV's) showed large variation between sires for first lactation traits whereas, the EBV's of sires for lifetime traits showed less variation. The EBV's of sires for AFC had negative product moment correlations with FLMY, LL, PY and DP. The EBV's of sires for FLMY had significant positive product moment correlations with LL and PY but negative with DP. The product moment correlations among sires' estimated breeding values for HL, LTMY, PL and ND were high and positive (0.67 to 0.93). Product moment correlations of sires' EBV's for FLMY and LL with EBV's for HL, LTMY, PL and ND were significant and positive (0.53 to 0.83). Rank correlations among EBV's of sires indicated that all sires would not rank same for first lactation and lifetime performance traits. However, the ranks of sire for different traits revealed that 4-5% of top sires almost had similar rank for first lactation and lifetime traits. Results suggest that to improve lifetime productivity major culling of bulls to breed cows should be done on the basis of their daughter's first lactation milk yield.

**Key words :** Breeding value, First lactation yield, Lifetime milk yield, Rank correlations

The present economic conditions demand that a dairy animal should be profitable and overall profitability of a dairy animal depends more on the returns through the milk production during its lifetime than on its first lactation alone. Evaluation of sires for lifetime production traits not only delays selection decisions but also reduces rate of genetic progress. To overcome this, lifetime milk production was computed indirectly from some early observable traits (Singh and Yadav 1986). Relationship between sires' breeding values for first lactation traits and lifetime performance traits in dairy cattle is important in determining whether recommendation to select dairy sire based on performance of their daughter's first lactation would improve the total lifetime production or not. Little is known about relationships between estimates of breeding value for first lactation and lifetime performance. Therefore, the purpose of this study was to estimate the breeding value of sires for first lactation and lifetime performance traits using best linear unbiased prediction

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(BLUP) procedure (Henderson 1973) and to determine the relationship among estimates of sire's breeding values.

### MATERIALS AND METHODS

Performance records of 601 daughters of 28 sires of Haryana cows maintained at the Government Livestock Farm, Hisar, during 1976 to 1996 were used to estimate sire's breeding value for first lactation and lifetime performance traits. Cows with abnormal and incomplete records due to sickness or abortions were excluded from the study. Each year was divided into 4 seasons, viz. summer (March to June), rainy (July to mid-September), autumn (mid-September to November), and winter (December to February) based on climatological conditions. Year and season effects were combined to form a joint effect of year-season of calving.

Sires with less than 5 daughters were not included in the study. Sires were grouped into 4 sire genetic groups on the basis of year in which their first daughter was born. First lactation traits included in this study were age at first calving (AFC), milk yield (FLMY), lactation length (LL), peak yield

Table 1. Estimated breeding values of sires and their ranks for first lactation traits

Sire No.	AFC	FLMY	LL	PY	SP	DP	CI
01	402 (25)	199 (13)	34 (07)	0.40 (15)	136 (25)	49 (21)	112 (25)
02	444 (28)	214 (12)	29 (08)	0.41 (14)	143 (26)	51 (22)	110 (23)
03	438 (27)	220 (11)	26 (11)	0.53 (10)	113 (21)	44 (20)	095 (20)
04	237 (07)	224 (10)	06 (23)	0.76 (08)	093 (16)	44 (19)	075 (13)
05	340 (19)	174 (17)	21 (15)	0.46 (12)	065 (08)	20 (06)	054 (07)
06	365 (21)	195 (14)	09 (21)	0.45 (13)	081 (12)	38 (15)	071 (11)
07	297 (12)	237 (09)	26 (10)	0.39 (16)	103 (19)	35 (12)	084 (19)
08	374 (23)	145 (20)	09 (22)	0.48 (11)	086 (14)	38 (14)	071 (10)
09	431 (26)	170 (18)	06 (24)	0.65 (09)	078 (11)	37 (13)	065 (09)
10	401 (24)	155 (19)	20 (16)	0.23 (18)	098 (17)	39 (17)	083 (18)
11	314 (15)	336 (07)	34 (05)	0.91 (06)	092 (15)	23 (07)	080 (16)
12	277 (09)	523 (01)	53 (01)	1.39 (01)	157 (28)	57 (24)	133 (27)
13	287 (11)	350 (05)	21 (14)	0.95 (04)	076 (10)	40 (18)	079 (14)
14	281 (10)	394 (03)	41 (02)	1.04 (03)	124 (23)	35 (11)	098 (21)
15	311 (14)	467 (02)	34 (06)	1.16 (02)	086 (13)	23 (09)	073 (12)
16	337 (18)	347 (06)	24 (12)	0.92 (05)	099 (18)	38 (16)	081 (17)
17	317 (16)	192 (16)	19 (17)	0.23 (19)	131 (24)	78 (27)	117 (26)
18	269 (08)	379 (04)	39 (04)	0.76 (07)	112 (20)	60 (25)	104 (22)
19	372 (22)	264 (08)	40 (03)	0.12 (20)	119 (22)	57 (23)	111 (24)
20	351 (20)	134 (21)	27 (09)	-0.08 (27)	147 (27)	90 (28)	133 (28)
21	301 (13)	025 (25)	-01 (25)	-0.52 (28)	070 (09)	71 (26)	079 (15)
22	317 (17)	192 (15)	18 (18)	0.27 (17)	060 (07)	34 (10)	058 (08)
23	040 (06)	070 (22)	22 (13)	-0.04 (25)	035 (06)	-01 (03)	025 (06)
24	016 (04)	-034 (28)	-08 (27)	0.08 (21)	021 (05)	23 (08)	016 (05)
25	001 (03)	030 (23)	-04 (26)	0.07 (22)	011 (04)	08 (05)	011 (04)
26	-047 (01)	-010 (26)	10 (20)	0.04 (23)	-007 (02)	-16 (01)	-012 (01)
27	028 (05)	-025 (27)	-13 (28)	-0.06 (26)	-015 (01)	03 (04)	-008 (02)
28	-029 (02)	028 (24)	16 (19)	0.02 (24)	-001 (03)	-04 (02)	001 (03)

Figures in parentheses are ranks.

(PY), service period (SP), dry period (DP), and calving interval (CI). Lifetime traits were herd life (HL), lifetime milk yield (LTMY), productive life (PL), no. of days in milk (ND) and milk yield/day of productive life (MY/PL). Herd life was defined as the period between first calving to the date of disposal or the sixth calving if the cow remained in the herd. Total amount of milk produced by a cow from the initiation of first lactation till last day in milk in the herd or total yield up to 5 lactations was taken as lifetime milk yield. Productive life was defined as total number of days from the date of first calving to the date of disposal or the last dry date if the cow remained in the herd up to the completion of 5 lactations. Cows with less than 2 lactations were excluded for studying lifetime traits. Daughters of sires belonging to fourth sire genetic group did not have information on lifetime performance and therefore were excluded for estimating breeding values of lifetime traits.

Breeding values of sires for first lactation and lifetime traits were estimated by best linear unbiased prediction (BLUP) procedure described by (Henderson 1973) using the following model:

$$Y_{ijkl} = \mu + YS_i + G_j + S_{jk} + e_{ijkl}$$

where

$Y_{ijkl}$  = observation on  $l$ th progeny of  $k$ th sire belonging to  $j$ th sire genetic group and  $i$ th year-season of calving,

$\mu$  = over all mean,

$YS_i$  = fixed effect of  $i$ th year-season of calving,

$G_j$  = fixed effect of  $j$ th sire genetic group,

$S_{jk}$  = random effect of  $k$ th sire within  $j$ th sire genetic group, and,

$e_{ijkl}$  = random error associated with  $l$ th progeny of  $k$ th sire.

Sire and residual variance components needed for BLUP were obtained from the same data using Henderson method 3 (Henderson 1953). The estimated breeding value of sire for each trait was taken as twice the sire genetic group solution plus sire solution within sire genetic group for that trait. The product moment and rank correlations among sires' estimated breeding values of different traits were calculated according to Steel and Torrie (1980).

## RESULTS AND DISCUSSION

The estimated breeding values (EBV's) of sires and their ranks for first lactation and lifetime traits (Tables 1, 2) showed

Table 2. Estimated breeding values of sires and their ranks for life-time traits

Sire No.	HL	LTMV	PL	ND	MY/PL
01	05 (12)	-189 (17)	33 (08)	-34 (15)	-0.18 (12)
02	19 (08)	-186 (16)	40 (05)	-25 (13)	-0.22 (16)
03	-26 (18)	-125 (14)	12 (11)	-34 (16)	-0.09 (05)
04	-33 (20)	-168 (15)	-12 (17)	-60 (22)	-0.12 (06)
05	-53 (22)	-301 (21)	-21 (21)	-58 (21)	-0.22 (17)
06	-30 (19)	-307 (22)	-01 (14)	-52 (18)	-0.25 (19)
07	12 (10)	-115 (12)	33 (09)	-28 (14)	-0.19 (14)
08	-50 (21)	-285 (20)	-21 (22)	-55 (20)	-0.18 (11)
09	07 (11)	-238 (19)	-18 (20)	-53 (19)	-0.18 (13)
10	-15 (16)	-215 (18)	08 (13)	-45 (17)	-0.20 (15)
11	75 (02)	378 (02)	79 (01)	39 (02)	-0.14 (07)
12	38 (06)	449 (01)	57 (03)	53 (01)	0.03 (01)
13	36 (07)	343 (06)	24 (10)	07 (07)	0.01 (03)
14	78 (01)	371 (03)	70 (02)	35 (03)	-0.16 (09)
15	38 (05)	366 (05)	39 (06)	21 (06)	-0.03 (04)
16	72 (03)	367 (04)	57 (04)	28 (04)	-0.23 (18)
17	12 (09)	-008 (10)	11 (12)	-03 (10)	-0.28 (20)
18	-10 (14)	073 (07)	-15 (19)	-02 (09)	0.02 (02)
19	-11 (15)	037 (09)	-10 (16)	-02 (08)	-0.17 (10)
20	42 (04)	-051 (11)	39 (07)	-16 (11)	-0.32 (21)
21	-23 (17)	-124 (13)	-14 (18)	-20 (12)	-0.62 (22)
22	-10 (13)	073 (08)	-10 (15)	27 (05)	-0.15 (08)

Figures in parentheses are ranks.

Table 3. Product moment (below diagonal) and rank (above diagonal) correlations among estimates of sire's breeding values for first lactation traits

Traits	AFC	FLMY	LL	PY	SP	DP	CI
AFC	1.00	0.53	0.19	0.41	0.08	0.00	-0.02
FLMY	-0.43	1.00	0.72	0.76	-0.26	0.15	-0.22
LL	-0.13	0.75**	1.00	0.36	-0.63	-0.07	-0.62
PY	-0.32	0.89**	0.51**	1.00	0.03	0.39	0.17
SP	0.12	0.28	0.65**	0.11	1.00	0.59	0.93
DP	-0.03	-0.28	0.01	-0.51*	0.57*	1.00	0.73
CI	0.08	0.24	0.63**	-0.01	0.96**	0.70**	1.00

\*P<0.01; \*\*P<0.001.

Table 4. Product moment (below diagonal) and rank (above diagonal) correlations among estimates of sire's breeding values for lifetime performance traits

Traits	HL	LTMV	PL	ND	MY/PL
HL	1.00	0.12	0.48	0.14	0.34
LTMV	0.81**	1.00	0.76	0.85	0.79
PL	0.89**	0.69**	1.00	0.65	0.94
ND	0.77**	0.93**	0.67**	1.00	0.68
MY/PL	0.44	0.47*	0.44	0.43	1.00

\* P<0.01; \*\*P<0.001.

Table 5. Product moment (P) and rank (R) correlations between estimates of sire's breeding values for first lactation and lifetime performance traits

Traits		AFC	FLMY	LL	PY	SP	DP	CI
HL	P	-0.22	0.60*	0.53*	0.48	0.37	-0.01	0.34
	R	0.40	0.72	0.46	0.69	-0.02	0.18	0.02
LTMV	P	-0.52*	0.83**	0.62*	0.64**	0.18	-0.10	0.20
	R	0.24	0.51	0.57	0.38	-0.40	0.02	-0.43
PL	P	-0.13	0.58*	0.61*	0.49	0.50*	0.08	0.43
	R	0.60	0.73	0.63	0.48	-0.25	-0.04	-0.36
ND	P	-0.44	0.72**	0.65**	0.46	0.25	0.01	0.29
	R	0.14	0.56	0.65	0.37	-0.53	0.03	-0.50
MY/PL	P	-0.39	0.43	0.33	0.59*	-0.12	-0.46	-0.19
	R	0.42	0.64	0.64	0.36	-0.24	-0.02	-0.36

\*P<0.01; \*\*P<0.001.

large genetic differences between sires for first lactation traits. The EBV's for AFC ranged from -47 to 444 days; FLMY, -34 to 523 kg; LL, -13 to 53 days; PY, -0.52 to 1.39 kg; SP, -15 to 157 days; DP, -16 to 90 days; and CI, -12 to 133 days. In general, breeding values of sires belonging to last sire genetic group were lower than the sires of previous groups for production traits whereas, reverse was the case for reproduction traits. Similar trend was also observed by Gaur and Raheja (1996) for first lactation 300 days milk yield in Sahiwal cattle. The EBV's showed less variation among sires for lifetime traits. The small difference between the estimated breeding values of the sires for lifetime traits revealed low variation in this herd. This might be due to the fact that this herd has been maintained as close herd and animals with less production might have not continued in the herd.

Product moment and rank correlations among EBV's of first lactation traits, among EBV's of lifetime traits, and between EBV's of first lactation and lifetime traits are presented in Tables 3, 4, 5. The estimated breeding values of sires for AFC had negative product moment correlations with the EBV's for FLMY, LL, PY and DP whereas, low and positive product moment correlations with the EBV's of sires for SP and calving interval (Table 3). Favourable correlation between EBV's for AFC and FLMY suggest that AFC can effectively be used as a selection criteria for increased first lactation milk production. In contrast to our results, Pundir and Raheja

Table 6. Ranks of 5 top sires on the basis of estimated breeding values of sires for first lactation and lifetime traits

Sire No.	FLMY	PY	LTMV	MY/PL
12	1	1	1	1
13	5	4	6	3
14	3	3	3	9
15	2	2	5	4
18	4	7	7	2

(1994) and Dutt *et al.* (1996) reported positive product moment correlations of EBV's for AFC with EBV's for FLMY and LL. The EBV's of FLMY had negative product moment correlations with the EBV's of sires for DP and moderate positive product moment correlations for SP and CI. The product moment correlations among sire's EBV's for HL, LTMY, PL and ND were high and positive (Table 4). Similar results were also reported by Pundir and Raheja (1994) and Dutt *et al.* (1996).

The EBV's of sires for AFC had negative product moment correlations (-0.13 to -0.52) with EBV's of sires for lifetime performance traits (Table 5). Similar findings were also reported by Dutt *et al.* (1996). Product moment correlations between sire's EBV's for FLMY and LL with HL, LTMY, PL and ND were significant and positive. Pundir (1991) also reported higher product moment correlations between EBV's of these traits whereas, Pundir and Raheja (1994) reported lower product moment correlations between EBV's of FLMY and LL with the EBV's of HL, PL and LTMY. These results suggested that AFC and FLMY either alone or in combination can be used for evaluation of sires for LTMY. This would help in reducing generation interval and thereby higher annual genetic gain in LTMY.

The rank correlations between the EBV's of sires for first lactation reproduction and production traits with the EBV's of sires for lifetime traits ranged from -0.53 to 0.60 and 0.36 to 0.73, respectively. The rank correlations between estimates of breeding value based on first lactation milk yield and lifetime traits were less than 1. This indicated that sire ranking would change from first lactation to lifetime traits and therefore sire should be evaluated for lifetime performance of their daughters to bring genetic improvement in lifetime productivity. The major objection to evaluation of sires, based on

lifetime production traits, has been increased generation interval and thereby slowing down genetic progress. Sire evaluation is generally aimed at selecting first few top-ranking sires. The first 5 top sires almost ranked similar with respect to FLMY, PY, LTMY and MY/PL (Table 6). These results suggested that major culling could be done on the basis of performance of daughters in first lactation for bulls used to breed cows.

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