MULTIVARIATE RESTRICTED MAXIMUM LIKELIHOOD ESTIMATES OF GENETIC AND PHENOTYPIC PARAMETERS OF LIFETIME PERFORMANCE TRAITS FOR MURRAH BUFFALO

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SUMMARY

Data on 2107 Murrah buffaloes maintained at 4 military dairy farms and 3 UP State Government farms during 1961-88, were used to estimate heritabilities, genetic and phenotypic correlations between early and lifetime performance traits. Model used for estimation of sire and residual (co)variance components included year-season of first calving and farm as fixed effects, sires within farms as random effect. The heritability of first lactation milk yield was 0.23. The ranges of heritability estimates for lifetime performance traits were 0.05 to 0.19 with lowest for lifetime number of services per conception and highest for milk yield per day of herd life. Genetic and phenotypic correlations among lifetime performance traits ranged from -0.31 to 0.93. First lactation milk yield was genetically highly correlated with lifetime milk yield. Lifetime days open was negatively correlated with milk yield per day of herd life. High genetic correlation of first lactation milk yield with lifetime milk yield suggest that selection on first lactation milk yield seems to be desirable to increase lifetime milk yield.

Keywords: Murrah,heritability, genetic, and phenotypic correlations, performance traits.

INTRODUCTION

Economic returns from a dairy animal depends on lifetime performance rather than on a single lactation performance. The prediction of expected correlated response to selection based on ealry performance and development of selection scheme for genetic improvement in lifetime performance requires the knowledge of relationship between ealry performance and lifetime performance traits. Therefore the purpose of this study was to estimate genetic and phenotypic relationship of first lactation milk yield with lifetime performance traits.

MATERIALS AND METHODS

Lactation records (7838) collected from 2107 Murrah buffaloes maintained at 4 military dairy farms (Ambala, Ferozpur, Lucknow and Meerut) and 3 UP State Government farms (Babugarh, District Dairy Farms, Mathura and Madurikund, Mathura) during 1961-88, were used. Traits included in this study are given in Table 1. Only those buffaloes which completed at least 3 lactations in herd were included. LTMY for individual buffalo were obtained by accumulation of individual lactation yield. Buffalo was assumed to enter herd as soon as it

calved and therefore HL was taken as total number of days from first calving to date of disposal or last day of dry, if buffalo remained in herd. MYPDHL was obtained by dividing the LTMY by HL.

Sire and residual (co)variance components among traits were estimated from multivariate restricted maximum likelihood procedure for mixed model with an equal design matrix (Meyer, 1985). Multi-trait model included year-season of first calving and farm as fixed effects, sires within farms as random effect. Starting values of sire and residual variance components needed for mixed model multitrait equations were obtained from same data using Henderson Method 3 (Henderson, 1953). Sire (**G**) and residual (**R**) variance-covariances matrices required for mixed model equations were obtained according to Schaeffer (1986). The canonical transformation (Anderson, 1984) of data was applied to make **R** and **G** into an identity and diagonal matrices, respectively. Solution to mixed model equations was obtained without explicity constructing the equations; but by using an iterative techinque (Schaeffer and Kennedy, 1986). Solutions were assumed to converge when sum of squares of change in the sire solution was less than or equal to 0.000001. Co(variance) components were assumed to converge when change was below 0.5% for **G** and 0.1% for **R**. The estimates of heritabilities, genetic and phenotypic correlations were computed from converged estimates of sire and residual (co)variances.

RESULTS AND DISCUSSION

Means corrected for farm effect for first lactation milk yield and lifetime performance traits are given in Table 1. Mean of LTMY was low for these herds as compared with other reports (Sharma and Basu, 1986; Dutt and Taneja, 1994). A comparison of mean of HL obtained in this study to other reports in literature is difficult to make due to differences in defining of HL and editing of data. No estimates of means of LTDO, LTNSPC and NLAC were available in literature to compare with these results. Coefficient of variation for LTDO was highest (61.4%).

Table 2 has the estimates of heritability, genetic and phenotypic correlations. The heritability of FLMY was 0.23. The estimate of heritabilities of lifetime performance traits ranged from 0.05 to 0.19 and were lower than the estimates of first lactation milk yield, as expected, because residual variation increases as the length of herd life increases. Variance components among sire progeny groups increases, but variation within sire progeny groups increased even more, resulting in lower heritabilities for lifetime performance traits.

Heritability of LTMY (0.15) was within range of heritability (0.13 to 0.19) reported by Kalsi and Dhillon (1984), Deshpande and Umrikar (1986) and Singh and Yadav (1987). The heritability of 0.05 for LTNSPC agreed with estimate reported by Prakash *et al.* (1989). The heritability of MYPDHL was higher than heritability of all other lifetime performance traits studied herein. Possible explanation seems to be that firstly, larger differences among means of progeny groups tend to increase heritability estimates for a lifetime traits if low yielding

buffaloes were culled and if mature survivors continued to yield with no increase in average days open. Secondly lifetime traits are affected by herd life which has low heritability, whereas MYPDHL are standardized for HL. Heritability estimates of lifetime reproduction traits (LTDO and LINSPC) were low. The low estimate of heritability of lifetime reproduction traits confirms the general observation that reproductive traits are mostly influenced by management practices and other environmental factors.

Table 1. Phenotypic means, standard errors and coefficients of variation for lifetime performance traits corrected for farm effect.

Trait	Abbreviation	Mean	SE	CV%
First lactation milk yield (kg)	FLMY	1863	11.5	28.3
Lifetime days in milk (days)	LTDIM	1027	9.2	41.1
Lifetime days open	LTDO	568	7.6	61.4
Herd life (days)	HL	2018	12.8	29.1
Lifetime milk yield (kg)	LTMY	6956	59.6	39.3
Number of lactations completed	NLAC	3.72	0.03	37.0
Lifetime number of services per conception	LTNSPC	2.93	0.02	31.3
Milk yield per day of herd life (kg)	MYPDHL	3.45	0.03	39.9

Table 2. Heritability (diagonal), genetic (above diagonal) and phenotypic (below diagonal) correlations among lifetime performance traits.

Trait		1	2	3	4	5	6	7	8
[1]FLMY	(1)	**0.23**	0.38	0.15	0.41	0.78	0.31	0.08	0.34
LTDIM	(2)	0.31	**0.12**	0.31	0.74	0.93	0.92	0.18	0.58
LTDO	(3)	0.07	0.26	**0.09**	0.42	0.36	0.37	0.25	-0.31
HL	(4)	0.29	0.66	0.33	**0.12**	0.74	0.81	0.34	0.32
LTMY	(5)	0.63	0.81	0.26	0.67	**0.15**	0.88	0.43	0.53
NLAC	(6)	0.16	0.80	0.29	0.72	0.74	**0.08**	0.42	0.41
LTNSPC	(7)	0.04	0.14	0.43	0.26	0.34	0.36	**0.05**	0.36
MYPDHL	(8)	0.17	0.49	-0.22	0.27	0.42	0.32	0.43	**0.19**

[1]For abbreviation see Table 1.

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Genetic correlation of FLMY with LTMY was high (0.78). High genetic correlation may be result of pleiotropy and also because FLMY is a part of LTMY (i.e. part to whole relationship). Corresponding phenotypic correlation was relatively low. Genetic correlation of LTDIM with LTMY was high (0.93). The corresponding phenotypic correlation was slightly lower. The importance of increasing the number of lactations to increase LTMY was indicated by the higher phenotypic correlations (0.74). High genetic correlation of LTMY with measures of longevity (NLAC and HL) indicated that buffaloes with longer HL were also high for genetic merit of total lifetime performance traits. This correlation is mostly due to number of lactations, in part, is a result of management and culling for yield. Genetic and phenotypic correlations between LTDO and LTMY were positive and low.

The low estimates of heritability for LTMY suggest that direct selection will not bring much genetic improvement in these traits. Moreover selection on lifetime performance traits is not practical because of long generation interval and the high costs of maintaining potential replacement stock. Moderate amount of heritability and high genetic correlation of first lactation milk yield with lifetime yield suggest that selection on first lactation yield would indirectly improve lifetime milk yield and hence would bring more economic returns.

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