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Genetic evaluation of Surti sires for part and complete lactation milk yield

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In dairy animals, major genetic improvement is attained through selection of sires rather than selection of dams but progeny testing of sires takes longer time. The use of partial records of daughters would reduce testing period (Parmar *et al.* 1984, and Shelke *et al.* 1992). The present study was planned to find out the relationship between estimates of breeding values based on part and complete lactation milk yield in addition to estimate genetic parameters of part lactation milk yield traits.

First lactation records (1976–2004) of 554 farm bred Surti buffaloes, sired by 51 bulls maintained at Network Project on Buffaloes, Livestock Research Station, Vallabhnagar, Rajasthan, were utilized. The monthly milk yield records of each buffalo were computed for the first 5 months of lactation. The individual monthly milk yield were considered as part lactation (MMY_1-MMY_5), while total (TMY) and 305 days first lactation (305 FLMY) milk yield were considered as complete lactation milk yield.

The genetic parameters were estimated by mixed model least-squares and maximum likelihood computer programme PC-1 designed by Harvey (1987). The year and season of calving (fixed effect) and sire (random effect) were considered as the factors affecting part lactation milk yield. Heritability and genetic correlations were computed through paternal half sib correlation method while the standard error of these parameters were computed after Swiger *et al.* (1964) and Robertson (1959), respectively. The phenotypic correlations were calculated using conventional statistical procedure (Snedecor and Cochran 1966). Duncans new multiple range test (DMRT) was used to compare sub-means.

The breeding values of sires for part lactation records and 305 FLMY were estimated by regressed least-squares (RLS) method. The product moment and rank correlation among sires breeding value of part lactation and complete lactation were calculated according to Steel and Torrie (1980).

The peak monthly milk yield was attained in second month and thereafter it declined (Table 1). The results are in confirmation with the findings of Tailor and Banerjee (1996). The values of monthly milk yield in the present study were lower than that reported by Kushwaha *et al.* (1972), Singh (1985) and Khan and Johar (1988) in Murrah, Kumar *et al.* (1979) and Singh (1985) in Nili-Ravi and Farrag *et al.* (1984) in Egyption buffaloes, which indicates breed differences. Singh (1985), Khan and Johar (1988) and Tailor and Banerjee (1996) also observed peak in second month of freshening. However, Kushwaha *et al.* (1972) observed peak yield during fourth month of lactation.

Table 1. Mean, standard deviation, standard error and coefficient of variation of monthly milk yield

Traits	Means (kg)	SD	SE	C V (%)
MMY_1	151.61	36.77	1.56	24.25
MMY_2	163.28	40.24	1.71	24.64
MMY_3	163.06	45.18	1.92	27.71
MMY_4	129.41	41.61	1.77	32.15
MMY_5	110.14	37.78	1.60	34.30

The coefficient of variation showed increasing trend from first to fifth month. Similar findings of higher coefficient of variation during later months were reported by Khan and Johar (1988) and Tailor and Banerjee (1996). The results indicated that production during the later months of lactation is determined more by temporary environmental influences and less by permanent differences. In other words, the persistency of production is determined primarily by extrageneous environmental sources and is not affected much by the inherent qualities of buffalo itself.

Period and season of calving had significant effect on all the monthly milk yield, a finding in agreement with Khan and Johar (1988) and Tailor (1995). The variation with respect to sire was also significant on all the monthly milk yield traits under study, a finding supported by Tailor (1995). The results of DMRT test over seasonal means of monthly milk yield indicated that buffaloes that calved during summer produced significantly higher milk during all segments as compared to buffalo that calved during other seasons.

The heritability estimates for MMY_3 to MMY_5 were moderate, significant and varied within a narrow range (Table 2). Tailor and Banerjee (1996) reported that the

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heritability estimates for monthly milk yield of first 4 months varied within a narrow range of 0.307 to 0.362 and it decreased for sixth month milk yield. The highest heritability was observed in fourth month. Similarly Kushwaha *et al.* (1972) and Singh and Yadav (1987) also reported the highest estimates of heritability for the fourth month milk yield in buffaloes. However, Kumar *et al.* (1979) observed that the heritability estimates of monthly milk yield increased with the stage of lactation up to sixth month in Indian buffaloes.

Kushwaha *et al.* (1972), Kumar *et al.* (1979) and Tailor and Banerjee (1996) obtained moderate to high estimates of heritability for monthly milk yield, which is in consonance with the results obtained in the present study. The low estimates of heritability for monthly milk yield were reported by Singh and Yadav (1987) while very high estimates of heritability (0.47 to 0.82) were reported by Iqbaluddin *et al.* (1970) in Murrah buffaloes.

The genetic and phenotypic correlations among monthly milk yield traits were positive and significant (Table 2). Positive and high genetic and phenotypic correlation coefficients were also reported by Kumar *et al.* (1979), Jain *et al.* (1986) and Tailor (1995). Positive and high genetic association among monthly milk yield indicated that these segments of monthly milk yield (MMY_1 to MMY_5) are governed by the same set of genes.

Table 2. Estimates of heritability (on diagonal), phenotypic correlation (above diagonal) and genetic correlation (below diagonal) for monthly milk yield

Traits	MMY_1	MMY_2	MMY_3	MMY_4	MMY_5
MMY_1	0.254± 0.119	0.455± 0.038**	0.318± 0.040**	0.149± 0.042**	0.156 ± 0.042**
MMY_2	0.961± 0.143	0.551± 0.156	0.777± 0.027**	0.545± 0.036**	0.449± 0.038**
MMY_3	0.839± 0.207	0.999± 0.042	0.377± 0.136	0.680 ± 0.031**	0.544± 0.036**
MMY_4	0.799± 0.255	0.999± 0.090	0.965± 0.078	0.362± 0.134	0.803± 0.025**
MMY_5	0.409± 0.292	0.692± 0.162	0.795± 0.143	0.907± 0.069	0.360± 0.134

** P< 0.01.; MMY, Monthly milk yield

The genetic and phenotypic correlations of MMY_1 with TMY and 305 FLMY were positive and moderate to high, which were lower than genetic correlations of MMY_2 to MMY_5 with TMY and 305 FLMY (Table 3). Moderate to higher genetic association between monthly milk yield and complete lactation milk yield was also reported by Singh (1985) and Tailor and Banerjee (1996) in buffaloes.

The genetic correlation of TMY and 305 FLMY with monthly milk yield traits increased from MMY_1 to MMY_3 and starts declining from MMY_4 onwards; while the phenotypic correlations of TMY and 305 FLMY with individual monthly milk yield increased with increase in monthly milk yield i.e. MMY_1 to MMY_5. Tailor and Banerjee (1996) observed that the genetic correlation of 305 FLMY was highest with MMY_6 (0.994 ± 0.059). However, the correlations of 305 FLMY with the monthly milk yield from second to sixth month varied within a narrow range (0.963 – 0.994). They also observed that phenotypic correlation of monthly milk yield with 305 FLMY and TMY increased with advance lactation. The high estimates of genetic and phenotypic correlation of TMY and 305 FLMY with monthly milk yield indicated the pleotropic effect of genes for monthly milk yield and TMY and 305 FLMY and it can be concluded that selection on the basis of part lactation will be nearly the same as selection on complete first lactation milk yield.

Table 3. Estimates of genetic (r_g) and phenotypic correlation (r_p) of part lactation milk yield with first lactation milk yield

Monthly milk yield	First lactation milk yield			
	TMY		305 FLMY	
	r_g	r_p	r_g	r_p
MMY_1	0.480 ± 0.246	0.271 ± 0.041**	0.573 ± 0.241	0.316 ± 0.040**
MMY_2	0.716 ± 0.130	0.550 ± 0.035**	0.802 ± 0.111	0.610± 0.034**
MMY_3	0.908± 0.098	0.580 ± 0.034**	0.962 ± 0.082	0.645 ± 0.033**
MMY_4	0.894 ± 0.088	0.668 ± 0.032**	0.956 ± 0.070	0.716 ± 0.029**
MMY_5	0.890 ± 0.075	0.758 ± 0.028**	0.906 ± 0.067	0.800 ± 0.026**

** (P < 0.01).

The relative efficiency of selection on the basis of monthly milk yield records from month first to fifth revealed that selection based on MMY_2 and MMY_3 would be expected to be as efficient as selection based on 305 FLMY. These results are in conformity with the results of heritability and correlation coefficients of monthly milk yield and TMY and 305 FLMY. Tailor and Banerijee (1996) also concluded that selection based on any monthly milk yield of MMY_2 and MMY_3 will be expected to be as effective as selection based on 305 FLMY. Hence, these part lactation traits ie. MMY_2 and MMY_3 were used for sire evaluation.

The average breeding value estimated by regressed least-squares (RLS) method was 1161.43 kg. In all, 15 sires had breeding value more than the average breeding value, while 36 sires were below the average breeding value. The sire No. 34 ranked first having the breeding value of 1750.91 kg, which was 50.75% higher than overall average breeding value. The sire No. 9 ranked at lowest place, which had breeding value 39.93% lower than the average breeding value. The difference of highest and lowest breeding value was 1053.2 kg. The number of sires having breeding value 20, 15, 10 and 5% above overall breeding value was 7 (13.73%), 2 (3.92%), 3 (5.88%) and 3 (5.88%), respectively. The sire No. 34 ranked first, second, first for breeding value based on 305 FLMY, MMY_2 and MMY_3, respectively.

The product moment correlation between breeding value of sires for 305 FLMY and part lactation milk yield (MMY_2 and MMY_3) were 0.900 and 0.936 respectively. The corresponding rank correlations were 0.881 and 0.913. The coefficients of product moment correlation were higher than corresponding rank correlation coefficients between sires breeding value.

The rank correlations between estimated breeding value based on 305 FLMY and part lactation milk yield (MMY_2 and MMY_3) were less than 1. This indicated that ranking would change and therefore, to bring genetic improvement, sire should be evaluated for 305 FLMY of their daughters. The major objection to evaluation of sires, based on first lactation milk yield, was increased generation interval and thereby slowing down genetic progress. Sire evaluation is generally aimed at selecting first few top ranking sires. From the results it is concluded that initial selection may be on the basis of either part lactation milk yield (MMY_2 and MMY_3) and finally on the basis of first lactation milk yield where complete records are available.

SUMMARY

First lactation records (1976–2004) of 554 farm bred Surti buffaloes, sired by 51 bulls maintained at Network Project on Buffaloes Vallabhnagar were utilized. The peak monthly milk yield was attained in second month and thereafter it declined. Period and season of calving and sire had significant effect on all the components of monthly milk yield. The heritability estimates for MMY_3 to MMY_5 were moderate, significant and varied within a narrow range. The genetic and phenotypic correlations of MMY_1 with TMY and 305 FLMY were positive and moderate to high, which were lower than genetic correlations of MMY_2 to MMY_5 with TMY and 305 FLMY. The relative efficiency of selection on the basis of monthly milk yield records from month first to fifth were 0.339, 0.745, 0.782, 0.755 and 0.748 over TMY and 0.450, 0.927, 0.917, 0.897 and 0.847 over 305 FLMY, respectively. The product moment and rank correlations between breeding value of sires for 305 FLMY and part lactation milk yield (MMY_2 and MMY_3) were 0.900,0.936 and 0.881, 0.913respectively.

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