



Genetic evaluation of sires using test day yield

S P TAILOR¹ and BACHCHU SINGH²

Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan 313 001 India

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The major constraint playing significant role in sire evaluation programme is the unavailability of sufficient data, which institutional herds alone can not provide. Therefore, for genetic improvement, it becomes necessary to record and utilize field data. However, recording of 305 days milk yield under field condition in India is very difficult and costly. Therefore, more emphasis should be given on alternative approach i.e. evaluation of sires on the basis of test day milk yield.

First lactation records (1976–2004) of 554 farm bred, Surti buffaloes, sired by 51 bulls maintained at Net-work Project on Buffaloes, Livestock Research Station, Vallabhnagar, Udaipur (Rajasthan) were utilized. Milk yield recorded on fifth day of calving was taken as first test day yield (TDMY₁). Next 9 test day milk records were taken at 15 days interval from first test day (TDMY₂ – TDMY₁₀). The first lactation milk yield: total (TMY) and 305 days or less (305 FLMY) was also used for the study.

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 test day milk yield. Heritability and genetic correlations were computed through paternal half-sib correlation method while the standard error of these parameters was computed after Swiger *et al.* (1964) and Robertson (1959), respectively. The phenotypic correlations were calculated using conventional statistical procedure (Snedecor and Cochran 1968).

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

The higher variability for test day yield during later lactation indicated that production after 3 months of calving

is determined more by temporary environment and less by permanent environmental differences. Pregnancy might also create variation in the production after 3 months of calving (Table 1).

The differences in test day milk yield due to period of calving were observed in TDMY₁, TDMY₄, TDMY₆ and TDMY₇ only. On the other hand, all the test day milk yield traits included in the study were significantly affected by season of calving and sire. El-Arian (1986) also reported that season of calving had a significant effect on test day milk yield in Murrah buffaloes.

The heritability of test day milk yield at fifth day (TDMY₁) was moderate and significant at 0.327 ± 0.129 whereas it reduced 0.191 ± 0.110 (low and nonsignificant) for TDMY₂.

The heritability estimates for TDMY₃ to TDMY₁₀ were moderate. Lidauer *et al.* (2003), Salim *et al.* (2003) and Geetha (2005) also reported moderate to high heritability estimates for test day milk yield. However, Machado *et al.* (1998) observed low to moderate estimates of heritability for test day milk yield. The heritability estimates were moderate and significant during TDMY₃ to TDMY₆ i.e. 35, 50, 65 and 80 days of lactation. However, the estimates for TDMY₇ to TDMY₁₀ were nonsignificant.

The estimates were generally lowest at early and highest in mid lactation was reported by Pander *et al.* (1992). Firat

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

Traits	Mean (kg)	SD	SE	C V (%)
TDMY ₁	4.77	1.28	0.05	26.83
TDMY ₂	5.33	1.37	0.06	25.70
TDMY ₃	5.33	1.55	0.07	29.08
TDMY ₄	5.34	1.59	0.07	29.78
TDMY ₅	5.35	1.67	0.07	31.21
TDMY ₆	5.40	1.72	0.07	31.85
TDMY ₇	4.79	1.84	0.08	38.41
TDMY ₈	3.92	1.64	0.07	41.84
TDMY ₉	3.72	1.40	0.06	37.63
TDMY ₁₀	3.57	1.40	0.06	39.22

Present address: ¹ Project Investigator (e mail: sptailor07@yahoo.co.in), AICRP on Poultry Breeding, Department of Animal Production, Rajasthan College of Agriculture, Udaipur.

²Assistant Professor, KVK, Bundi Box No. 4.

Table 2. Estimates of heritability (on diagonal), phenotypic correlation (above diagonal) and genetic correlation (below diagonal) among test day milk yield

Traits	TDMY ₁	TDMY ₂	TDMY ₃	TDMY ₄	TDMY ₅	TDMY ₆	TDMY ₇	TDMY ₈	TDMY ₉	TDMY ₁₀
TDMY ₁	0.327 ±0.129	0.410 ± 0.038**	0.287 ± 0.040**	0.222 ± 0.41**	0.202 ± 0.042**	0.185 ± 0.041**	0.165 ± 0.041**	0.063 ± 0.042	0.003 ± 0.042	0.037 ± 0.042
TDMY ₂	0.737 ± 0.242	0.191 ± 0.110	0.588 ± 0.034**	0.422 ± 0.039**	0.321 ± 0.040**	0.289 ± 0.040**	0.222 ± 0.041**	0.133 ± 0.042**	0.121 ± 0.042**	0.194 ± 0.041**
TDMY ₃	0.485 ± 0.273	0.978 ± 0.162	0.261 ± 0.120	0.630 ± 0.033**	0.528 ± 0.036**	0.491 ± 0.037**	0.340 ± 0.040**	0.260 ± 0.041**	0.239 ± 0.041**	0.281 ± 0.040**
TDMY ₄	0.662 ± 0.254	0.650 ± 0.268	0.99 ± 0.116	0.275 ± 0.122	0.678 ± 0.031**	0.606 ± 0.034**	0.388 ± 0.039**	0.320 ± 0.040**	0.365 ± 0.039**	0.378 ± 0.039**
TDMY ₅	0.353 ± 0.276	0.881 ± 0.246	0.99 ± 0.133	0.98 ± 0.091	0.336 ± 0.130	0.774 ± 0.026**	0.525 ± 0.036**	0.393 ± 0.039**	0.382 ± 0.039**	0.398 ± 0.039**
TDMY ₆	0.156 ± 0.283	0.808 ± 0.252	0.99 ± 0.136	0.99 ± 0.102	0.99 ± 0.051	0.387 ± 0.137	0.605 ± 0.034**	0.430 ± 0.038**	0.417 ± 0.038**	0.399 ± 0.039**
TDMY ₇	0.623 ± 0.372	0.863 ± 0.412	> 1.0	> 1.0	> 1.0	> 1.0	0.136 ± 0.102	0.571 ± 0.035**	0.501 ± 0.037**	0.453 ± 0.038**
TDMY ₈	- 0.28 ± 0.347	0.130 ± 0.407	0.530 ± 0.311	0.686 ± 0.270	0.701 ± 0.235	0.638 ± 0.230	0.933 ± 0.229	0.218 ± 0.114	0.668 ± 0.032**	0.583 ± 0.034**
TDMY ₉	0.018 ± 0.298	- 0.061 ± 0.353	0.378 ± 0.286	0.505 ± 0.249	0.518 ± 0.229	0.498 ± 0.220	0.642 ± 0.275	> 1.0	0.255 ± 0.133	0.718 ± 0.030**
TDMY ₁₀	0.073 ± 0.305	-0.032 ± 0.366	0.228 ± 0.309	0.606 ± 0.236	0.647 ± 0.210	0.559 ± 0.217	0.706 ± 0.282	> 1.0	> 1.0	0.223 ± 0.129

** P < 0.01.

et al. (1997) on the other hand, observed higher estimates of heritability during beginning and end of lactation. The highest heritability estimates for test day milk yield between 5 to 7 months was observed by Machado *et al.* (1998).

The moderate and significant heritability estimates for TDMY₃ to TDMY₆ showed considerable genetic variability among these test day yield and same may be improved through mass selection. Further, these traits can be effectively used as selection criteria, because the heritability of these traits is slightly lower than 305 FLMY (0.412±0.140).

The genetic correlations among TDMY₃ to TDMY₆ were higher than correlations among other test day yields. The associations of TDMY₃ to TDMY₆ with TDMY₈ to TDMY₁₀ were also higher than association of TDMY₁, and TDMY₂ with TDMY₈ to TDMY₁₀ (Table 2). Meyer *et al.* (1989) observed that the genetic relationship among test days in mid lactation usually was highest and close to unity in Australian black and white cows. Similar trend was also reported by Pander *et al.* (1992) and Rekaya *et al.* (1999).

The phenotypic correlations among test day milk yield ranged between 0.003±0.042 and 0.774±0.026, which is in consonance with the results obtained by Meyer *et al.* (1989) in Australian black and white cows, Lidauer *et al.* (2003) in Ayre sire, Holstein-Friesian and Finn cattle and Geetha (2005) in Murrah buffaloes. The phenotypic correlations between consecutive test day were found higher throughout. Similar results were also reported by Machado *et al.* (1998).

The coefficients of phenotypic correlation of test day with first lactation milk yield (TMY) and (305 FLMY) were

positive and significant, showing increasing trend over test day period advanced (Table 3). Salim *et al.* (2003) reported correlation coefficients of test day milk yield with total lactation milk yield ranged from 0.84 to 0.50. They also reported that associations of test day yield during middle part of lactation (3 to 6 tests) were higher than those during initial and terminal part of lactation.

The relative efficiency of selection on the basis of TDMY₁ to TDMY₂ over TMY and 305 FLMY was considerably lower than selection based on TDMY₃ to TDMY₁₀ (Table 4). Among these TDMY₃ to TDMY₆ were more appropriate criteria to assess production potential of buffaloes in early stage of lactation. Hence, these test day yields i.e. TDMY₃ to TDMY₆ were used for evaluation of sires.

The average breeding value estimated by regressed least-squares method (RLS) was 1161.43 kg. In all 15 sires (29.4%) had breeding value more than average breeding value, while 36 sires (70.6%) were below the average breeding value. The sire no. 34 ranked, first having breeding value of 1750.91 kg which was 50.75% higher than overall average breeding value. On the other hand, 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 for breeding value estimated by all 305 FLMY, TDMY₃, TDMY₄, TDMY₅ and TDMY₆ respectively.

Table 3. Estimates of genetic (r_g) and phenotypic correlations (r_p) of test day milk yield with first lactation milk yield

	First lactation milk yield			
	TMY		305 FLMY	
	r_g	r_p	r_g	r_p
Test day milk yield				
TDMY ₁	0.220 ± 0.260	0.162 ± 0.042**	0.297 ± 0.266	0.207 ± 0.042**
TDMY ₂	0.241 ± 0.303	0.273 ± 0.041**	0.298 ± 0.311	0.314 ± 0.048**
TDMY ₃	0.542 ± 0.220	0.406 ± 0.039**	0.592 ± 0.216	0.454 ± 0.038**
TDMY ₄	0.619 ± 0.193	0.484 ± 0.037**	0.734 ± 0.171	0.532 ± 0.036**
TDMY ₅	0.705 ± 0.162	0.487 ± 0.037**	0.781 ± 0.146	0.539 ± 0.036**
TDMY ₆	0.699 ± 0.154	0.499 ± 0.037**	0.744 ± 0.145	0.554 ± 0.036**
TDMY ₇	0.880 ± 0.231	0.502 ± 0.037**	0.984 ± 0.222	0.533 ± 0.036**
TDMY ₈	0.797 ± 0.107	0.568 ± 0.035**	0.857 ± 0.147	0.603 ± 0.034**
TDMY ₉	0.845 ± 0.107	0.632 ± 0.033**	0.855 ± 0.106	0.656 ± 0.032**
TDMY ₁₀	0.902 ± 0.090	0.681 ± 0.031**	0.951 ± 0.078	0.704 ± 0.030**

** (P < 0.01)

Table 4. Relative efficiency of selection on the basis of test day milk yield over TMY and 305 FLMY

Selection over	Test day									
	1	2	3	4	5	6	7	8	9	10
TMY	0.275	0.230	0.605	0.708	0.892	0.950	0.709	0.813	0.933	0.930
305 FLMY	0.265	0.203	0.471	0.599	0.705	0.721	0.566	0.623	0.673	0.699

The product moment correlation between breeding value of sires for 305 FLMY and test day milk yield (TDMY₃ and TDMY₆) were 0.863, 0.893, 0.907 and 0.894 respectively. The corresponding rank correlations were 0.841, 0.873, 0.880 and 0.899 respectively. The results revealed that sires could be selected on the basis of these test day milk yield records (TDMY₃ and TDMY₆) of their daughters.

The rank correlations between estimated breeding value based on 305FLMY and test day milk yield (TDMY₃ and TDMY₆) were less than one. This indicated that ranking would change slightly and therefore, to bring genetic improvement, sire should be evaluated for first lactation milk yield of their daughters. The major objection to evaluation of sires, based on first lactation milk yield, has been increase in generation interval resulting in slowing down of 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 done on the basis of either of test day milk yield from TDMY₃ to TDMY₆ and finally on the basis of first lactation milk yield where complete records are available.

SUMMARY

Genetic evaluation of sires was done using test day yield. First lactation records (1976–2004) of 554 farm bred, Surti buffaloes, sired by 51 bulls maintained at Net-work project on Buffaloes, Livestock Research Station, Vallabh Nagar, Udaipur (Rajasthan) were utilized. Milk yield recorded on

fifth day of calving was taken as first test day yield (TDMY₁). Next 9 test day milk records were taken at 15 days interval from first test day (TDMY₂ – TDMY₁₀). The first lactation milk yield: total (TMY) and 305 days or less (305 FLMY) was also used for the study.

The variability of test day milk yield ranging from 25.70 to 41.84%. The heritability estimates for all the test day yields were moderate while for TDMY₁ and TDMY₃ and TDMY₆ were significant. The genetic correlations among TDMY₃ to TDMY₆ were higher than correlations among other test day yields. The phenotypic correlations among test day milk yield ranged between 0.003±0.042 and 0.774±0.026. The coefficients of phenotypic correlation of test day with first lactation milk yield (TMY, 305FLMY) were positive and significant. Based on relative efficiency of selection on the basis TDMY₃ to TDMY₆ were more appropriate criteria to assess production potential of the buffaloes in early stage of lactation. The results of product moment and rank correlations indicated that initial selection may be done on the basis of either of test day milk yield from TDMY₃ to TDMY₆ and finally on the basis of first lactation milk yield where complete records are available.

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