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Genetic studies on monthly test-day milk records in Sahiwal cattle

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Recording daily milk yields of cows under field conditions is not practically possible as performance recording under field conditions is an expensive proposition. It is most convenient to obtain test-day milk yields at monthly intervals, which can be used for predicting the standard lactation milk yield. Based on predicted milk yield from test-day records, the animal can be selected for future breeding. This would reduce the cost of milk recording under field conditions and help in assessing the breeding values of sires by incorporating the field data in sire evaluation programme. Further, the use of test-day yields will be useful in selecting sires at younger age resulting in reduced generation interval, increased intensity of selection attributed to the availability of more number of records on daughters having test-day records. The usefulness of test-day yield records depends upon the heritability estimates of these records as well as the genetic/phenotypic correlations amongst test-day milk yield records and 305–day milk yield. Hence, the present investigation was undertaken to estimate the genetic parameters namely heritability and genetic/phenotypic correlations of test day and first lactation 305–day milk yields in Sahiwal cattle.

The data on 713 Sahiwal cows maintained at National Dairy Research Institute, Karnal over 49 years (1961–2009) were used for the present study. The traits considered were 10 test-day milk yields (6^{th}, 35^{th}, 65^{th}, 95^{th},125^{th}, 155^{th}, 185^{th}, 215^{th}, 245^{th} and 275^{th} days) and first lactation 305–day milk yield (FL305DMY). The records of the animals with known pedigree and normal lactation were considered for this study. The records of animals with less than 300 kg of milk production or less than 100 days of lactation length were also discarded. The data were classified into seasons (4), periods (16) and age groups (12). Prior to estimation of genetic parameters, the data were adjusted for different significant non-genetic factors (seasons, periods and age groups). The heritability, genetic and phenotypic correlations and breeding values were estimated from 586 progeny of 43 sires having five or more daughters by analysis of variance/covariance using half sib data as suggested by Becker (1975). The genetic correlation was calculated from sire component of variance and covariance. The statistical significance of phenotypic correlation was tested by 't' test as given by Snedecor and Cochran (1967) at N - 2 degrees of freedom.

The estimates of heritability of various test-day yields ranged from almost zero for 6^{th}-day to 0.36 ± 0.14 for 245^{th} day (Table 1). However, lower range of heritability of test day yields were reported by Ribas and Parez (1989) and Machado *et al.* (1999). Higher ranges were reported by Geetha (2005). All the heritability estimates were statistically highly significant ($P<0.01$) except for 6^{th}-and 125^{th}-day test yields, which were having higher proportion of standard errors as compared to estimates (Table 1). Moderate to higher estimates of majority of test Day milk yields indicated that selection of cows/sires can be done on the basis of these yields individually or in combination with each other. Lower estimates of heritability of 6^{th}-day yield depicted higher role of environmental fluctuations in this trait suggesting that this test day yield should not be used for evolving selection criteria in Sahiwal cattle. Similar findings were reported by Swalve (1994) and Kokate (2009) in HF cows and Friesian crosses, respectively. The highest estimate of heritability was observed on 245^{th}-day (MTDY–9) under the investigation. This was contrary to the findings of Swalve (1994) and Kokate (2009), who reported highest estimate of heritability on 155^{th}-day (MTDY–6).

The heritability estimate of FL305DMY was higher and statistically highly significant ($P<0.01$). Heritability values near to the present estimate were reported by Gandhi and Gurnani (1995); while lower estimates of heritability of this trait were observed by Kumar (2007), Raja (2010) and Rehman and Khan (2012). On the other hand, Kannan (2002) and Singh *et al.* (2005) reported comparatively higher estimates of heritability for FL305DMY. The significantly higher estimate of heritability obtained in the present study indicated that this trait was highly influenced

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Table 1. Heritability, genetic and phenotypic correlation estimates of various test-day milk yields and first lactation 305–day milk yields

Traits	6th day	35th day	65th day	95th day	125th day	155th day	185th day	215th day	245th day	275th day	FL305DMY
6th day	0.0489 ± 0.0763	NE	0.8611** ±0.1474	0.7571** ±0.2572	0.8729** ±0.1379	0.7619** ±0.3274	NE	NE	0.3156 ±0.907	NE	NE
35th day	0.4027** ±0.0376	0.2621** ±0.1130	0.9742** ±0.0539	0.8930** ±0.0652	0.7365** ±0.1580	0.6667** ±0.1680	0.6942** ±0.1629	0.4516 ±0.2454	0.5428** ±0.1967	0.6077** ±0.1792	0.8408** ±0.0814
65th day	0.3241 ±0.0389	0.7942** ±0.0249	0.2733** ±0.1149	NE	0.9709** ±0.1300	0.7711** ±0.1183	0.8380** ±0.0920	0.5307** ±0.2154	0.6890** ±0.1433	0.6442** ±0.1596	0.8130** ±0.0934
95th day	0.2537 ±0.0397	0.6889** ±0.0296	0.7972** ±0.0247	0.2204** ±0.1061	0.9553** ±0.0326	0.8997** ±0.0602	0.9897** ±0.0069	0.8837** ±0.0719	0.9630** ±0.0224	0.7693** ±0.1282	0.9969** ± 0.0018
125th day	0.2551 ±0.0399	0.6171** ±0.0324	0.7140** ±0.2885	0.8106** ±0.0241	0.1802 ±0.0999	0.9944** ±0.0037	NE	NE	NE	0.8522** ±0.0928	NE
155th day	0.2551 ±0.0419	0.5947** ±0.0337	0.6742** ±0.0310	0.7569** ±0.0274	0.8173** ±0.0241	0.2927** ± 0.1209	NE	0.8576** ±0.0921	0.9097** ±0.0568	0.8567** ±0.0855	0.9360** ± 0.0346
185th day	0.1936 ±0.0419	0.5243** ±0.0363	0.6138** ±0.3367	0.6925** ±0.0373	0.7266** ±0.0293	0.8077** ±0.0251	0.2585** ± 0.1172	0.9766** ±0.0144	0.9689** ±0.0179	0.9478** ±0.0316	0.9666** ± 0.0201
215th day	0.2190 ±0.0428	0.4677** ±0.0386	0.5458** ±0.0366	0.6240** ±0.0341	0.6698** ±0.0324	0.7516** ±0.0288	0.8032** ±0.0260	0.3122** ± 0.1296	0.9693** ± 0.0171	0.9845** ±0.0099	0.8278** ±0.0968
245th day	0.1798 ±0.0968	0.4219** ±0.0405	0.4482** ±0.0399	0.4925** ±0.0389	0.5489** ±0.0373	0.6247** ±0.0349	0.7279** ±0.0306	0.7917** ±0.2732	0.3645** ± 0. 1411	NE	0.9421** ±0.0321
275th day	0.2275 ±0.0473	0.3911** ±0.0445	0.3904** ±0.0446	0.4244** ±0.0438	0.4896** ±0.0422	0.5387** ±0.0408	0.5951** ±0.0389	0.6757** ±0.0359	0.7943** ±0.0293	0.3492** ± 0.1505	0.8857** ± 0.0604
FL305 DMY	0.3373 ±0.0387	0.7006** ±0.0292	0.7809** ±0.0256	0.8202** ±0.0234	0.8489** ±0.2176	0.8505** ±0.0220	0.8365** ±0.0233	0.8111** ±0.0255	0.7507** ±0.0295	0.6824** ±0.0354	0.3581** ± 0.1282

Figures along the diagonal in bold scripts are the heritability estimates; figures above the diagonal are the genetic correlations, figures below the diagonal are the phenotypic correlations; NE, Not estimable; **significant at 1% level (P< 0.01); significant at 5% level (P< 0.05).

by genetic factors and offers better scope for genetic improvement through selection.

The genetic and phenotypic correlations among test-day milk yields are presented in Table 1. The genetic correlation amongst various test-day milk yields ranged from 0.3156 (6^{th} day with 245^{th} day) to 0.9944 (125^{th} day with 155^{th} day). However, some of the genetic associations amongst test day milk yields were not estimable. No increasing or decreasing trend in genetic correlations among test day yields was observed during different months. However, most of the estimates were higher and statistically highly significant (P<0.01). Similar findings were reported by Meyer (1989), Ribas and Parez (1989), Machado *et al*. (1997) and Kokate (2009).

The phenotypic correlations among monthly test-day milk yields were found to be positive, higher and statistically highly significant (P£0.01). The estimates of phenotypic correlations among all the test-day milk yields ranged from 0.1798 (6^{th} with 245^{th} day) to 0.8173 (125^{th} with 155^{th} day). Higher ranges of phenotypic correlations amongst test-day milk yields were reported in literature (Meyer 1989, Geetha 2005, Kokate 2009). The genetic correlations of test day milk yields with first lactation 305-day milk yield were found to be higher, positive and highly significant (P<0.01) for all first lactation 305–day milk yield except for 125^{th} day yield, which was not estimable. Higher genetic correlations of first lactation 305–day milk yield with test day milk yields have been reported by various workers (Meyer 1989, Ribas and Parez 1989, Machado *et al.* 1999, Kokate 2009).

The phenotypic correlations of test-day milk yields with first lactation 305–day milk yield were positive, higher and highly significant (P<0.01) except for 6^{th} test-day (Table 1). Higher estimate of phenotypic correlations of first lactation 305–day milk yield with test day milk yields were also reported by Ribas and Parez (1989) and Kokate (2009).

Higher estimates of genetic and phenotypic correlations amongst test-day milk yields and their higher association with first lactation 305-day milk yield as well as higher estimates of heritability of all these traits revealed that all the milk yields (test days and FL305DMY) can be used to evolve multi trait selection criteria for cow/sire evaluation in Sahiwal cattle.

SUMMARY

Data on 713 Sahiwal cows maintained at the Institute over a period of 49 years (1961–2009) were used to estimate the genetic and phenotypic parameters of first lactation 305-day or less milk yield and monthly test-day milk yields. The heritability estimates of first lactation 305–day milk yield and these 10 test day milk yields (6^{th}, 35^{th}, 65^{th}, 95^{th}, 125^{th}, 155^{th}, 185^{th}, 215^{th}, 245^{th} and 275^{th} day) were 0.3581, 0.0489, 0.2621, 0.2723, 0.2204, 0.1802, 0.2927, 0.2585, 0.3122, 0.3645 and 0.3492, respectively. All the heritability estimates were statistically highly significant except for 6^{th} and 125^{th} day test-yields. The genetic and phenotypic correlations of majority of test day milk yields with first lactation 305-day milk yield were higher, positive and highly significant. Higher estimates of genetic and phenotypic correlations amongst test-day milk yields and their higher association with first lactation 305-day milk yield as well as higher estimates of heritability of all these traits revealed that all the milk yields (test days and FL305DMY) can be used to evolve multi trait selection criteria for cow/sire evaluation in Sahiwal cattle.

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