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Lifetime performance of Phule Triveni synthetic cows at an organized farm

G S AMBHORE[1], AVTAR SINGH[2], D K DEOKAR[3], MANVENDRA SINGH[4] and S K SAHOO[5]

ICAR-National Dairy Research Institute, Karnal, Haryana 132 001 India

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ABSTRACT

The performance records of 509 Phule Triveni cows maintained at RCDP, MPKV, Rahuri (Maharashtra) during 1976 to 2012 were used to estimate heritability and genetic and phenotypic correlation of lifetime performance traits. The mixed model analysis using LSML used for estimation of variance components considering sire as a random effect, season and period of birth and age at first calving groups as fixed effects. Period of birth was significantly influencing almost all the lifetime performance traits, whereas season of birth did not influence any of the trait considered in the study. Age at first calving significantly influenced the LTMY3 and 4, HL and BE. The overall least squares means of 8712±271 kg, 12093±265 kg, 12767±207 kg for LTMY3, LTMY4, ALTMY and 2863±29 days, 1875±28 days and 77.00±0.71% were observed for HL, PL and BE, respectively. Heritability estimates for LTMY3, LTMY4 and ALTMY were medium (0.41±0.26, 0.36±0.32 and 0.15±0.11) for milk yield traits indicating that sire selection on the basis of their progeny performance along with improved management is likely to bring desirable improvement in the herd. Whereas the heritability estimates for HL, PL and BE (0.10±0.12, 0.10±0.12 and 0.01±0.11) were low and had high SE indicating that these traits were influenced by non-genetic causes and can be improved through better management. The genetic and phenotypic correlations of actual lifetime milk yield (ALTMY) with herdlife (HL) and productive life (PL) were very high close to 1 and were comparatively higher than the other lifetime performance traits under study.

Key words: Genetic and phenotypic correlations, Heritability estimates, Lifetime performance traits, Phule Triveni cattle

The main aim of any breeding programme is to improve the profitability through production of superior animals which can transmit the economic characters to their progeny. Milk production and reproduction performance are the two major factors with respect to overall efficiency and profitability of dairy animals. So animal breeder is interested in improvement of lifetime milk production and reproduction of dairy cows for overall profitability. Decline in reproduction performance is likely to have negative effect on herdlife of animal as productivity of the animals in terms of lifetime milk production will be lowered (Togashi and Lin 2004). Herdlife indicate that the cow possess all the desired characteristics that are required to successfully complete its life in the herd, till it attain desired age of disposal as predetermined by the herd management. Therefore, the present study was designed and conducted to study the influence of genetic and non-genetic factors on various lifetime performance traits of Phule Triveni synthetic cattle strain at an organised farm.

Present address: [1]SMS (drgsambhore@gmail.com), CBF, Igatpuri, MAFSU, Maharashtra. [2]Principal Scientist (Retd.) (avtar54@gmail.com), [4]Ph.D. Scholar (manav21vet@gmail.com), AGB Division; [3]Assistant Professor (deokardk68@gmail.com), (AGB), RCDP, MPKV, Rahuri, Maharashtra. [5]Assistant Professor (saroj6804@gmail.com, AGB Division, GADVASU, Ludhiana, Punjab.

MATERIALS AND METHODS

The milk production, reproduction and disposal data of Phule Triveni synthetic cow's (Holstein Friesian 50% + Jersey 25% + Gir 25%) pertained to 509 cow's for a period of 37 years (1976 to 2012) was obtained from Research-Cum Development Project (RCDP) on Cattle, Mahatma Phule Krishi Vidyapeeth, Rahuri District, Ahmadnagar (Maharashtra) was utilized. Animals were managed under uniform managemental conditions, standard feeding schedule based on age, production level, stage of pregnancy and other physiological conditions was provided to the animals. All the animals were reared in loose housing and adequate prevention measures were taken against diseases prevalent in the area. The traits considered for evaluation of lifetime performance of Phule Triveni cows were LTMY3 (lifetime milk yield up to termination of 3rd lactation), LTMY4 (lifetime milk yield up to termination of 4th lactation), actual lifetime milk yield (ALTMY): sum of milk yield for all the lactations, Productive life (PL): date of first calving to date of last lactation dry, Herdlife (HL): date of birth to date of disposal and breeding efficiency (BE). To examine the influence of various non-genetic factors, the research data was classified into 12 periods of

birth viz. P_1 (1974–1976), P_2 (1977–1979), P_3 (1980–1982), P_4 (1983–1985), P_5 (1986–1988), P_6 (1989–1991), P_7 (1992–1994), P_8 (1995–1997), P_9 (1998–2000), P_{10} (2001–2003), P_{11} (2004–2006) and P_{12} (2007≥2009); 3 seasons of birth, viz. winter, October-January; summer, February-May and rainy, June-September and 5 different age at first calving groups (Age) according to Sturges (1926) as AGE_1 (≤804), AGE_2 (805–904), AGE_3 (905–1021), AGE_4 (1022–1169) and AGE_5 (≥1170). The mixed model analysis using Least Squares Maximum Likelihood (LSML) Program (Harvey1990) was used for determining the influence of genetic and non-genetic factors on lifetime performance traits and estimation of genetic parameters simultaneously. The model incorporated seasons and periods of births, age at first calving groups as fixed effects and sires as random effect. For significant effects, the differences between pairs of levels of effects were tested by Duncan's multiple range tests as modified by Kramer (1957).

RESULTS AND DISCUSSION

The overall least squares mean for LTMY3, LTMY4 and ALTMY were estimated as 8712±271 kg, 12093±265 kg and 12767±207 kg, respectively (Table 1). Dash (2014) reported somewhat higher estimates for LTMY3 and LTMY4 (12715±227 kg and 17720±339 kg) in Karan Fries cattle at ICAR-NDRI farm than the present study. Shinde (2002) reported higher ALTMY as 16382±363 kg; whereas, Deshmukh (2008) and Vinothraj *et al*. (2016) reported lower ALTMY as 11186±358 kg and 4411±194 kg in Phule Triveni and Jersey × Red Sindhi cattle as compared to the finding of ALTMY in present study. These differences may be attributed to differences in breed groups and culling policies adopted at different farm.

The ANOVA revealed that the effect due to season of birth on all the lifetime performance traits were non-significant, the findings were in agreement with Deshmukh (2008) in Phule Triveni cattle, Dash (2014) in Karan Fries cattle and Vinothraj *et al*. (2016) in Jersey × Red Sindhi crossbred cows. The period of birth had significant effect on all milk production traits, similar findings were observed by Shinde (2002) and Deshmukh (2008) in Phule Triveni and Dash (2014) in Karan Fries cows. Maximum LTMY3 was observed in P_4 and least in P_8, the high estimate of LTMY4 was found in P_1 and least in P_9, whereas maximum ALTMY was observed in P_3 and least in P_{12} indicating that differential management practices over the years, as well as the set of sires used and exercise of differential culling over the years are the causative factors for indefinite trends in milk production traits.

The overall least squares means for HL, PL and BE were 2863±29 days, 1875±28 days and 77.00±0.71% respectively (Table 1). Shinde (2002) and Deshmukh (2008) reported herdlife as 2885.20±55.46 days in Phule Triveni cattle which was in agreement with the present study, however, lower estimates for herdlife was reported by Dash (2014) in Karan Fries cattle as 2573±97 days. Deshmukh (2008) reported

Table 1. Least squares means along with SE of various factors affecting lifetime performance traits of Phule Triveni cattle

Effect	N	LTMY3 (kg)	N	LTMY4 (kg)	N	ALTMY (kg)	Herd life (HL) (days)	Productive life (PL) (days)	BE (%)
Overall (μ)	251	8712±271	208	12093±265	509	12767± 207	2863±29	1875±28	77.00±0.71
Season of birth									
Winter	99	8865±316	74	12179±386	196	13230±289	2905±39	1911±38	77.21±1.02
Summer	76	8563±340	64	12075±397	163	12503±30	2814±41	1835±40	76.05±1.09
Rainy	76	8709±337	70	12025±393	150	12569±301	2871±41	1880±40	77.64±1.07
Period of birth									
P_1	33	8608±1934^{c}	26	15772±3043^{a}	65	13375±1999^{ab}	2764±262de	1658±25^{fg}	94.37±7.29^{a}
P_2	29	10154±1399^{ab}	21	14909±1859^{a}	93	13479±1680^{ab}	2761±220de	1749±217^{ef}	95.23±6.13^{a}
P_3	30	10443±130^{ab}	25	14420±1755^{a}	69	13862±1548^{a}	2661±203^{ef}	1768±200^{def}	90.05±5.65^{b}
P_4	25	11060±1164^{a}	22	14270±1529^{a}	46	13462±1386^{ab}	2714±182^{ef}	1816±179de	84.39±5.05^{cd}
P_5	20	9534±1076^{bc}	15	12095±1381^{b}	59	13693±1261^{a}	2792±165de	1894±163^{cd}	86.49±4.59^{bc}
P_6	22	10137±974^{ab}	22	12673 ±1273^{b}	57	13136±1137^{ab}	2983±149^{c}	2038±147^{b}	86.89±4.14^{bc}
P_7	15	10076±1096^{ab}	19	12290±1452^{b}	31	12461±1222^{bc}	2949±160^{c}	1990±158^{bc}	80.44±4.45^{d}
P_8	10	7318±1288^{d}	14	11781±1376^{b}	34	11990±1313^{cd}	2890±172^{cd}	1854±170de	72.84±4.79^{e}
P_9	20	7531±965^{d}	13	8768 ±1726^{c}	23	13161±1509^{ab}	3335±198^{a}	2200±195^{a}	66.67±5.50^{f}
P_{10}	24	7456±1087^{d}	15	8771±1560^{c}	15	11391±1602de	3202±210^{b}	2177±207^{a}	58.32±5.84^{g}
P_{11}	16	8387±1267^{cd}	12	8812±1566^{c}	08	10353±2588^{e}	2604±339^{e}	1580±334^{g}	52.52±9.44^{h}
P_{12}	17	8434±1452^{cd}	14	10028±2110^{c}	09	12843±3421^{abc}	2702±448^{ef}	1779±441^{def}	55.34±2.99^{gh}
Age (days)									
AGE_1	49	8129±422^{b}	43	11007±547^{b}	108	12824±397	2615±33^{c}	1860±52	79.33±1.42^{a}
AGE_2	68	8828±354^{ab}	51	12398±464^{a}	133	12754±344	2732±46^{c}	1878±45	76.13±1.23^{ab}
AGE_3	60	9242±350^{a}	48	12523±444^{a}	117	12920±335	2846±45^{b}	1883±44	73.20±1.20^{b}
AGE_4	43	8082±400^{b}	32	11046±587^{b}	89	12410±379	2948±51^{b}	1898±50	78.82±1.36^{a}
AGE_5	31	9281±465^{a}	34	13489±669^{a}	62	12929±466	3149±62^{a}	1858±61	77.33±1.68^{a}

Means bearing different superscripts between rows within column differ significantly.

Table 2. Heritability, genetic and phenotypic correlations of lifetime performance traits of Phule Triveni cattle

Trait	LTMY3	LTMY4	ALTMY	HL	PL	BE
LTMY3	0.41±0.26	0.47±0.06**	0.43±0.05**	0.12±0.05**	0.14±0.16	–0.21±0.09*
LTMY4	0.52±0.44	0.36±0.32	0.42±0.06**	0.79±0.01**	0.80±0.01**	–0.21±0.07*
ALTMY	0.32±0.36	0.28±0.13	0.15±0.11	0.88±0.17**	0.90±0.10**	0.17±0.08*
HL	–0.03±0.42	–0.03±0.84	0.98±0.11**	0.10±0.12	0.98±0.01**	0.16±0.05**
PL	0.05±0.47	0.03±0.80	0.92±0.10**	0.99±0.07**	0.10±0.11	0.19±0.05**
BE	0.72±0.80	0.98±0.82	0.06±0.26	0.20±0.66	0.28±0.65	0.01±0.11

Figures along the diagonal are the heritability estimates. The value above and below the diagonal are genetic and phenotypic correlations.*P≤ 0.05 (significant) and **P≤ 0.01 (highly significant).

lower estimates for productive life as 1641.42±99.58 days in Phule Triveni cattle than the present study. Vinothraj *et al.* (2016) reported lower estimates of PL and HL as 886±37 and 1432±49 days in Jersey × Red Sindhi crossbred cows. The higher estimates of BE were reported by Zol *et al.* (2009) and Kohle (2011) in Phule Triveni and 5/8 Gir crossbred as 92.71±0.66% and 83.47±0.81%, respectively. Seasonal effects were non-significant on these traits, however, period of birth had significant variability in HL, PL and BE. The highest HL and PL were observed during P_9 and least during period P_{11}. No definite trend for increase or decrease in HL and PL revealed that the culling practices keep on changing with changes in the mangers of the farm with their different perceptions of level of culling and replacements. BE did not influenced by season of birth but period of birth significantly influencing the BE. BE was found to be highest in P_2 (95.23±6.13%) and lowest in P_{11} (52.52±9.44%) which showed declining trends over the years.

AFC had significant effect (P≤0.05) on LTMY3 and LTMY4 but the variation in actual lifetime milk yield (ALTMY) due to age at first calving was not significant in Phule Triveni cows which was in agreement with the findings of Singh *et al.* (2005) in Holstein Friesian cows and Dash (2014) in Karan Fries cattle. Herdlife (HL) and Breeding efficiency (BE) showed significant variability in different age at first calving groups. The significant of age at first calving on HL revealing that if the age at first calving was reduced by selection the herdlife would also be reduced. The highest (3149±62) HL was found in AGE_5 group and least (2615±33) in AGE_1 group.

Estimates of heritability, genetic and phenotypic correlations among different lifetime performance traits are given in Table 2. The heritability estimates for milk yield traits (LTMY3, LTMY4 and ALTMY) were found to be medium to low as 0.4±0.26, 0.36±0.32 and 0.15±0.11, respectively, indicating that sire selection on the basis of their progeny performance along with improved management is likely to bring desirable improvement in the herd for lifetime milk traits. Whereas, the heritability estimates for HL, PL and BE were low in magnitude as 0.10±0.12, 0.10±0.11 and 0.01±0.11, respectively, indicating that these traits were influenced to a greater extent by non-genetic causes and can be improved through better management.

The genetic correlations of lifetime milk yield up to 4 lactations (LTMY4) with actual lifetime milk yield (ALTMY), herdlife (HL) and productive life (PL) ranged between 0.42±0.06 to 0.80±0.01 and genetic correlation of actual lifetime milk yield (ALTMY) with herdlife (HL) and productive life (PL) were near 1. The high, positive and strong genetic correlations within these traits indicated that these traits are near identical traits and performing selection on one measure will increase the genetic values of other measures, so selection can be made on any of one of the trait. Dubey and Singh (2005), Kaushik *el al.* (1994) and Singh *el al.* (1995) also reported highly positive genetic correlations among lifetime traits in Karan Swiss and crossbred cattle's respectively. Breeding efficiency had negative but significant genetic correlations with lifetime milk yield up to 3 and 4 lactations (LTMY3 and 4), whereas positive, low and significant genetic correlation with actual lifetime milk yield (ALTMY) and positive, low and highly significant with herdlife (HL) and productive life (PL). Phenotypic correlations between actual lifetime milk yield (ALTMY) and herdlife (HL), productive life (PL) were high, positive and highly significant (0.98±0.11 and 0.92±0.10) indicating that selection on ALTMY would be sufficient to bring improvement in HL and PL. Herdlife and productive life had very high, positive and highly significant (0.99±0.07) phenotypic correlation, would help in culling the unproductive and remunerative animals at an any stage thus having an edge over selection at any stage of life. The genetic and phenotypic correlations between important lifetime performance traits were quite high as expected, due to nature of the characters which being governed by the same set of genes in additive manner.

The performance of Phule Triveni synthetic cattle was at par with other indigenous dairy breeds. Season of birth had non-significant effects on almost all lifetime performance traits of study. The period effects were significant, indicating thereby the effect of fluctuations in management over the periods under study. The effect of age at first calving on LTMY 3 and 4, HL and BE was significant whereas the variation in the actual lifetime milk yield due to differences in age at first calving was non-significant in Phule Triveni cattle. Estimation of heritability, genetic and phenotypic correlations among lifetime

performance traits under study showed that heritability estimates of LTMY3, LTMY4 and ALTMY (0.4±0.26, 0.36±0.32 and 0.15±0.11) were higher than those for HL, PL and BE (0.10±0.12, 0.10±0.11 and 0.01±0.11). However, the genetic and phenotypic correlations of actual lifetime milk yield (ALTMY) with herdlife and productive life were higher than those of lifetime milk yield up to 3 and 4 lactations (LTMY3 and 4). The higher heritability and correlations indicated that actual lifetime milk yield (ALTMY) was better representative trait among all lifetime performance traits under study. These results also suggested that selection of relatives on the basis of actual lifetime milk yield (ALTMY) would lead to positive genetic response.

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