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Lifetime Performance of HF x GIR Half breed Cows in Intensive Management Conditions

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A B S T R A C T

The research data spread over a period of 41 years (1974 to 2015) were utilized to study the heritability, genetic and phenotypic correlation of life time performance traits. The mixed model analysing using LSML were 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 highly significant on LTMY3, LTMY4, ALTMY, HL and PL whereas non-significant on BE. Season of birth did not influence any of the trait considered in the study. Age at first calving group had non-significant effect expect PL. The sire had significant effect on HL and PL and non-significant effect on LTMY3, LTMY4, ALTMY and BE. The overall least squares means of life time traits were 8770.95 149 kg (LTMY3), 12127.85 233 kg (LTMY4), 14920.46 525.16 kg (ALTMY), 2771.78 52.26 (HL), 1688.59 52.05 (PL) days and 82.62 0.83 (BE %), respectively. Heritability estimates of LTMY3, LTMY4 and ALTMY were (0.23 0.13; 0.29 0.10 and 0.17 0.43). Whereas the heritability estimates for HL, PL and BE (0.23 0.14, 0.14 0.13 and 0.06 0.11). The heritability estimates of lifetime traits had low to medium magnitude indicating that these traits can be improved through selection. While low heritability of BE indicating that this trait was influenced to a greater extent by non-genetic causes and can be improved through better management. The genetic and phenotypic correlations of LTMY3 and LTMY4 with other lifetime traits were high and positive.

Keywords

Heritability estimates, Life time performance traits, HF x Gir cattle

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Introduction

Animal husbandry and dairying has been an integral part of Indian culture since time immemorial. The majority of the vegetarian population of the country depends mainly on the milk and milk products to meet their requirement of animal protein of high biological value and trace nutrients. It forms an important livelihood activity for most of

the farmers, supporting agriculture in the form of critical inputs, contribute into the health and nutrition of the household, supplementing income, offering employment opportunities, and finally being a dependable "bank on hooves" in times of need. Milk production and reproductive performance are the two major factors with respect to overall efficiency and profitability of the dairy animals. Nonetheless, for many years dairy cattle breeding programmes are mainly oriented towards improving the production traits and have not given due weightage to the reproduction traits. However, the rise in milk production has been shadowed by a decline in reproduction over the years.

The overall productivity of a dairy animal depends on its lifetime performance rather than on a single lactation performance. A number of factors, viz., total period of stay of a cow in a herd, number of calves dropped during entire lifetime determine the economic productivity of a cow. Once the genetic constitution of a cow is established, genetic and other non-genetic factors come into play over her lifetime performance.

Moreover, the animal breeder is also interested in improvement of lifetime production and reproduction of dairy cows for overall profitability. Further, decline in reproduction performance is likely to have a negative effect on herd life or stayability of the animals, as productivity of the animals in terms of lifetime milk production will be lowered (Togashi and Lin, 2004). Therefore, the present study was conducted to study the influence of genetic and non-genetic factors on various lifetime performance traits of HF x Gir half bred.

Materials and Methods

The performance records of 421 daughter of 48 sires maintained at Research Cum Development Project on Cattle of Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar of Maharashtra(India) during 1974 to 2015 were analyzed. Cows with abnormal and incomplete records were excluded from the study. Animals were managed under uniform managemental conditions and standard feeding practices. All the animals were reared in loose housing and adequate prevention measures were taken against diseases. The traits considered for evaluation of lifetime performance of HF x Gir halfbred cows were LTMY3(Life time milk yield upto 3rd lactation), LTMY4(Life time milk yield upto 4th lactation),actual life time milk yield(ALTMY): Sum of milk yield for all the lactation. Productive life(PL): Date of first calving to date of last lactation dry period, herd life(HL): Date of birth to date of disposal and breeding efficiency(BE) by BE(%) = [365(N-1) 100/D] Wicox(1957) formula.

To examine the influence of various non-genetic factors the data was classified into 7 period of birth *viz*., P_1(1974-80), P_2(1981-87), P_3(1988-94), P_4(1995-2000), P_5(2001-2008) and P_6(2009-2015). Season of birth viz., rainy, winter and summer and 3 different age at first calving groups. The mixed model analysis using least squares minimum likelihood(LSML) programme Harvey(1990) was used for determining the influence of genetic and non-genetic factors on life time performance traits and estimation of genetic parameters simultaneously in which period of birth, season of birth and age at first calving group as fixed effects and sires as random effect.

Results and Discussion

The overall least squares mean for LTMY3, LTMY4 and ALTMY were estimated as 8770.95 ± 149 kg, 12127.85 ± 233 and 14920.46 ± 525.16 kg, respectively.

Dash(2014) reported higher estimates for LTMY3 and LTMY4(12715 ± 227 kg and 17720 ± 339 kg) in Karan Fries cattle at NDRI farm than the present study. Rathee (2015) reported similar estimates for LTMY3 and LTMY4 (9100.81 ± 187.85 and 1869.91 ± 375.09) in Frieswal cattle. Katore (2004) reported similar ALTMY as 13880.41 ± 1180.20 kg in Gir halfbreds. Whereas Raheja (1994) and Joshi (2009) reported higher ALTMY as 20833 ± 227 kg in HF Sahiwal crosses and 25819.07 ± 887.4 kg in FG crossbred, respectively.

The ANOVA revealed that the effect due to season of birth on all the lifetime performance trait except BE were non-significant the findings were in agreement with Ambhore *et al.*, (2017) in Phule Triveni cattle. However, Raheja (1994) and Khan and Kachwaha (2008) reported significant effect of season of birth in HF x S crossbred and in Rathi cattle, respectively. The period of birth had significant effect on all life time traits. Similar findings were observed by Dash (2014) in Karan Fries cows Ambhore *et al.*, (2017) in Phule Triveni cattle. However, Kharat *et al.*, (2008) reported non-significant effect in HF crossbred cattle.

The DMRT showed that lifetime total milk yield in cows born during period P_3(14744.46 ± 1210 kg), P_4(14204.72 ± 1215 kg) and P_6(11850.68 ± 15.57 kg) was significantly higher than cows born in P_1 and P_2 and at par with P_5 period. Whereas highest LTMY3 and LTMY4 was observed in period P_1 and lowest in period P_3 indicating that differential management practices over the period as well as the set of sires used.

The overall least squares means for HL, PL and BE were 2771.78 ± 52.26 days, 1688.59 ± 52.05 days and 82.62 ± 0.83 %, respectively (Table 1). Dash (2014) and Rathee (2015) reported herd life 2571.25 ± 27.31 and 2928.29 ± 145.43 days in Karan fries and Frieswal cattle, respectively. Rathee(2015) reported higher productive life than the present study(2008.81 ± 107.82 days).

The higher estimates of BE than the present study were reported by Zol *et al*., (2009) and Kolhe(2011) in Phule Triveni and 5/8 Gir crossbred as 92.71 ± 0.66 % and 83.47 ± 0.81 %, respectively. Period of birth had significant effect on all trait. However, season of birth had significant on BE and non-significant on PL and HL. Effect of age at first calving group had significant effect on PL and non-significant on HL and BE and effect of sire had significant on HL and PL and non- significant on BE.

(Figures along the diagonal are the heritability estimates. The value above and below the diagonal are genetic and phenotypic correlations).

The heritability estimates for milk yield traits viz., LTMY3, LTMY4 and ALTMY were found to be 0.23 ± 0.13, 0.29 ± 0.10 and 0.11 ± 0.12, respectively indicating low to medium. Whereas, the heritability estimates for HL, PL and BE were 0.23 ± 0.14, 0.14 ± 0.13 and 0.06 ± 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 upto 3 lactation (LTMY3) with actual lifetime milk yield (ALTMY), herd life (HL) and productive life (PL) ranged between 0.13 ± 0.46 to 0.36 and phenotypic correct were 0.09 ± 0.32 to 0.39 ± 0.04. Genetic and phenotypic correlation LTMY4 with other traits viz., ALTMY, HL, PL and BE ranged between -0.15 ± 0.10 to 0.89 ± 0.50 and 0.14 ± 0.64 to 0.48 ± 0.61, respectively. The high positive and strong genetic correlations with in these traits indicated that these traits are near

identical traits and performing selection on one measure will increase the genetic values of other measures.

Dubey and Singh (2005), Ambhore *et al.*, (2017) also reported highly positive genetic correlations among different lifetime traits in Karan Swiss and Phule Triveni cattle, respectively. Breeding efficiency had negative genetic and phenotypic correlation with LTMY3, LTMY4, ALTMY and HL whereas positive with PL.

Herdlife and productive life had high positive genetic (0.78 ± 0.02) and phenotypic(0.59 ± 0.34) correlation. Phenotypic correlation between actual lifetime milk yield (ALTMY) and Herd life (HL), Productive life (PL) were (0.67 ± 0.60) and (0.19 ± 0.75) respectively.

However genetic correlation between ALTMY with HL and PL were high and significant (0.89 ± 0.50) and (0.59 ± 0.34). The genetic and phenotypic correlations between important lifetime performance traits were quite high this would help in culling the unproductive and remunerative animals at any stage of life (Table 3–4).

Table.1 Least squares analysis of variance of lifetime traits(LTMY3 and LTMY4)

Source of variation	Mean	
	LTMY3	**LTMY4**
	MSS	**MSS**
Period of birth	109835566.09**	156254013.11**
Season of birth	1600145.91	2502075.24
Age at first calving group	4805304.04	73715.84
Sire	5876144.67	9248550.58
Error	**6757344.73**	**11831268.31**

** P < 0.01

Table.2 Least squares analysis of variance of lifetime production and reproduction traits

Source of variation	Mean sum of squares			
	ALTMY	**Productive life**	**Herd life**	**BE(%)**
Period of birth	299196320.6**	1817796.89**	2394986.37**	**642.10****
Season of birth	7394621.90	16172.67	17458.24	**658.77***
Age at first calving group	95676973.09	1776241.07*	353591.50	**73.01**
Sire	75985700.54	1243623.41**	1429699.48**	**179.69**
Error	**59296003.77**	**520080.66**	**522161.46**	**208.22**

* P < 0.05 and ** P < 0.01

Table.3 Least squares means of lifetime milk production and reproduction traits as affected by various factors

Source of variation	N	LTMY3 (kg)	N	LTMY4 (kg)	N	ALTMY(kg)	Herd life(HL)(days	Productive life(PL)(days	BE(%)
		Mean ± S.E.		Mean ± S.E.		Mean ± S.E.	Mean ± S.E.	Mean ± S.E.	**Mean ± S.E.**
Overall mean(μ)	314	8770.95 ± 149	233	12127.85 ± 233	421	14920.46 ± 525.16	2771.78 ± 52.26	1688.59 ± 52.05	**82.62 ± 0.83**
Periods of birth									
P_1(1974-1980)	114	11499.96 ± 290^{a}	93	15424.14 ± 426^{a}	157	19356.63 ± 1016^{a}	2563.91 ± 102^{c}	1551.93 ±102	**86.89 ± 1.63**
P_2(1981-1987)	37	9181.60 ± 371^{b}	21	13499.98 ± 658^{b}	61	12828.93 ± 1301^{bc}	2212.65 ± 117^{d}	1214.11 ± 116^{b}	**87.00 ± 1.86**
P_3(1988-1994)	44	7757.69 ± 345.7^{c}	33	10431.58 ± 528^{c}	54	14744.46 ± 1210^{bc}	3011.48 ± 125^{ab}	1910.75 ± 125^{ab}	**80.49 ± 2.00**
P_4(1995-2000)	46	7927.2 ± 347.0^{c}	35	11318.66 ± 516^{c}	70	14204.72 ± 1215^{bc}	2732.85 ± 113^{bc}	1596.08 ± 113^{bc}	**82.40 ± 1.81^{abc}**
P_5(2002-2008)	37	8458.2 ± 379.0^{bc}	30	11871.88 ± 555^{bc}	50	16537.32 ± 1327^{ab}	3203.28 ± 1.33^{a}	2022.98 ± 132^{a}	**80.90 ± 2.12^{bc}**
P_6(2009-2015)	26	7800.9 ± 444.6^{c}	21	10220.8 ± 653.2^{c}	29	11850.68 ± 1557^{c}	2906.50 ± 1.69^{abc}	1835.69 ± 169^{abc}	**78.05 ± 2.70**
Season of birth									
S_1: Rainy	110	8906.27 ± 242.7	82	12282.95 ± 354	137	15778.86 ± 849	2813.48 ± 84.(	1731.05 ± 84	**85.12 ± 1.34**
S_2: Winter	119	8769.43 ± 226.3	96	12201.83 ± 336	157	15040.47 ± 792	2827.66 ± 78.82	1757.91 ± 78	**81.01 ± 1.25**
S_3: Summer	85	8637.20 ± 250.7	55	11898.78 ± 412	127	13941.53 ± 878	2674.20 ± 83.63	1576.82 ± 83	**81.73 ± 1.33^{ab}**
Age group									
A_1: < 905 days	171	8587.13 ± 237.62	136	12124.13 ± 353.9	232	15935.32 ± 832	2806.20 ± 85	1831.91 ± 84^{a}	**81.61 ± 1.35**
A_2: 950-1050 days	53	8637.75 ± 313.28	41	12088.9 ± 469.2	75	15275.23 ± 1097	2826.63 ± 10	1753.87 ± 106^{a}	**82.87 ± 170**
A_3: 1051 days and Above	**80**	**9087.96 ± 270.08**	**56**	**12170.4 ± 426.9**	**114**	**13550.81 ± 945**	**2682.51 ± 93.30**	**1479.99 ± 93^{b}**	**83.39 ± 1.48**

Means under each class in the same column with different super scripts differ significantly

Table.4 Estimates of heritability, genetic and phenotypic correlations among different lifetime performance traits

Trait	LTMY3	LTMY4	ALTMY	HL	PL	BE
LTMY3	0.23 ± 0.13	0.48 ± 0.61**	0.23 ± 0.08**	0.13 ± 0.05	0.74 ± 0.36**	-0.14 ± 0.10*
LTMY4	0.38 ± 0.44	0.29 ± 0.10	0.52 ± 0.14**	0.89 ± 0.50**	0.59 ± 0.34**	-0.15 ± 0.10*
ALTMY	0.30 ± 0.15	0.37 ± 0.28**	0.11 ± 0.12	0.41 ± 0.04	0.40 ± 0.04	-0.24 ± 0.05
HL	0.10 ± 0.46	0.31 ± 0.47	0.67 ± 0.60	0.23 ± 0.14	0.78 ± 0.02	-0.39 ± 0.04
PL	0.09 ± 0.32	0.14 ± 0.64	0.19 ± 0.75	0.59 ± 0.34	0.14 ± 0.13	-0.22 ± 0.04
BE	**-0.39 ± 0.04**	**-0.47 ± 0.04****	**-0.19 ± 0.89**	**-0.49 ± 0.68**	**0.03 ± 0.88**	**0.06 ± 0.11**

*P < 0.05 and ** P < 0.01

Impact

The season of birth had non-significant effects on almost all life time performance traits of study. The period of birth were significant indicating fluctuations in management over the periods under study. Effect of age at first calving group on PL were significant in HF x Gir cattle. The heritability estimate of LTMY-3, LTMY-4 and ALTMY were 0.23 ± 0.13, 0.29 ± 0.10 and 0.11 ± 0.12, respectively which were higher than PL and BE. However, the genetic and phenotypic correlations of LTMY4 with herd life and productive life were higher than those of other traits. The higher heritability and correlations indicated that(LTMY4) lactation milk yield upto four lactation was better representative trait among all life time performance traits under study. These results suggested that selection of relatives on the basis of lactation milk yield upto four lactation may be more appropriate.

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