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Effect of Genetic and Non-genetic Factors on First Lactation Reproduction and Production Traits in HF x Gir Halfbred

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The present investigation was carried out with the objective of performance appraisal of HF x Gir halfbred with respect to reproduction and production traits. The performance records of 349 HF x Gir halfbred sired by 44 bulls were collected for reproduction and production traits spread over a period of 46 years (1972-2017) from Research Cum Development Project on Cattle, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The overall least squares means for age at first calving (AFC), first service period (FSP), first dry period (FDP), first calving interval (FCI) and first lactation 300 days milk yield (FL300DMY) were 954.82± 7.80 days, 124.00 ± 3.72 days, 78.34 ± 2.58 days, 403.53 ± 3.78 days and 2446.20 ± 42.33 kg, respectively in HF x Gir halfbred. Further, the least square analysis revealed on non-significant effect of season of calving. The effect of period of birth/calving was found to be highly significant on AFC, FSP, FL300DMY, FDP and FCI. However, the sire was found to be significant ($P<0.05$) effect on AFC, FL300DMY and FDP, while non- significant in FSP and FCI. The heritability of all traits was moderate in magnitude which indicated these traits are more influenced by selection. The highly significant genetic and phenotypic correlation was found between production and reproduction traits.

Introduction

India is predominantly an agricultural country with nearly two third of its population being involved in agriculture and rearing of livestock. Livestock is part and parcel of agricultural system. In dairy cattle milk production is the most important economic trait. Low milk production in India is probably due to low genetic potential of animals for milk production, poor nutrition, farm management, unfavourable agro climatic conditions, poor veterinary and extension services (Dhara, *et al.,* 2006). The success of dairy industry is much dependent on level of reproduction and production performance of animals. Information on first lactation traits enables the breeder to predict the later lactation performance of animals as it is highly correlated with the future performance traits (Jairath, *et al.,* 1995). Economic traits are generally controlled by genetic factors. These environmental factors may suppress the animal's true genetic ability and create a bias in the selection of animals.

Heritability is required to calculate genetic evaluations to predict response to selection and to help producers decide if it is more efficient to improve traits through management or through selection. Therefore, present study was aimed to evaluate first lactation traits and estimates their genetic parameters in HF x Gir halfbred.

Materials and Methods

The data for present investigation were collected for a period of 46 years (1972 to 2017) from history sheet of 46 years of HF x Gir halfbred born from 44 sires maintained at Research Cum Development Project on Cattle, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra State). Only the sires having records at least 3 daughters were included in the present study. First lactation milk yield less than 1000 kg was not considered for the present investigation.

The total duration of the present study was divided into 6 periods. Each year divided into three namely Rainy (S_1), Winter (S_2), and Summer (S3) seasons various first lactation traits considered for the study which are age of first calving (AFC), first service period (FSP), first dry period (FDP), first calving interval (FCI) and first lactation 300 days milk yield (FL300DMY). For accurate estimation of genetic variation in present traits as well as to account for the effect of non-genetic factors, both the genetic and non genetic factors were considered.

Statistical analysis

The mixed model analysis using least squares maximum likelihood (LSML) programme (Harvey, 1990) was used for determining the influence of genetic and non-genetic factors on first lactation reproduction and production traits and estimation of genetic parameters, simultaneously.

The model incorporated seasons, period's, age at first calving as fixed effects and sires as random effects. The statistical significance of various fixed effects in the least squares model was determined by F test for significant effects the difference between pairs of levels of effects were tested by Duncan's multiple range test as modified by Kramer (1957). The heritability, genetic and phenotypic correlations were obtained from the above LSML software.

Results and Discussion

The overall least squares means for age at first calving (AFC), first service period (FSP), first dry period (FDP), first calving interval (FCI) and first lactation 300 days milk yield (FL300DMY) were 954.82± 7.80 days, 124.00 ± 3.72 days, 78.34 ± 2.58 days, 403.53 ± 3.78 days and 2446.20 ± 42.33 kg, respectively in HF x Gir halfbred (Table 2 and Table 3).

Effect of period of birth/ calving on first lactation reproduction and production traits

Period of birth/calving had a significant influence on age at first calving, (AFC) and

FL300 days milk yield. Whereas non-significant effect on FSP, FDP and FCI (Table 1). The lowest AFC lowest AFC were found in period first 816.10 ± 9.67[d] days (Table 2). Higher estimates of for FL300 day's milk yield were found in period first 3314.30 ± 65.39[a] (Table 3). The present results were in accordance with the reports of Bhoite (1996) reported in FJG, JFG and BFG triple crosses. Reproduction traits were significantly affected by period of calving. These significant finding were in accordance with Saha (2001), Singh and Gurani (2004) in KF cattle, Rathi (2015) in Frieswal and Ambhore (2017) in Phule Triveni.

Effect of season of birth/ calving on first lactation reproduction and production traits

The influence of season of calving was found to be non-significant on all production and reproduction traits of first lactation in HF x Gir halfbred. The non-significant effect of season of calving on first lactation traits was also reported by many workers (Rashid, 2010; Nehra, 2011 and Divya, 2012) in KF cattle. Contradictory to the present study significant effect of season of calving of FL300DMY has been documented by Mukhrjee (2005) and Rathee (2015) in frieswal cattle.

Table.1 Analysis of variance of various first lactation reproduction and production traits as affected by genetic and non genetic factors in HF x Gir halfbred

Source of variation	AFC	FSP	FDP	FCI	FL300DMY
Period of birth for AFC/ Period of calving	573946.76**	2366.39	3312.18	3137.99	12829319.53**
Season of birth for AFC/ Season of calving	2551.92	1361.68	1005.12	1784.64	574101.84
Age at first calving group	_	1844.34	1555.56	2058.93	193962.12
Sire	22226.04**	3236.25	2067.04*	3783.85	572496.27*
Error	13546.72	3163.09	1526.93	3279.63	409426.42

** P < 0.01

Table.2 Least squares means of age at first calving as affected by various factors in HF x Gir halfbred

Source of variation	N	Mean ± S.E.
Overall mean (μ)	349	**954.82± 7.80**
Periods of birth		
P_1 (1972-1978)	145	**816.10± 9.67[d]**
P_2 (1979-1985)	52	**919.65± 16.15[c]**
P_3 (1986-1992)	52	**965.76± 16.33[bc]**
P_4 (1993-1999)	51	**1046.78± 16.30[a]**
P_5 (2000-2006)	34	**1025.19± 20.00[ab]**
P_6 (2007-2015)	15	**955.47± 30.20[bc]**
Season of birth		
S_1 : Rainy	122	**954.92 ± 11.96**
S_2 : Winter	109	**950.02 ± 12.13**
S_3 : Summer	**118**	**959.54 ± 11.40**

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

Table.3 Least squares means of first lactation reproduction and production traits in HF x Gir halfbred

Source of variation	N	FSP (days)	FCI (days)	FDP (days)	FL300DMY (kg)
		Mean ± S.E.	Mean ± S.E.	Mean ± S.E.	Mean ± S.E.
Overall mean (μ)	349	124.00 ± 3.72	403.53 ± 3.78	78.34 ± 2.58	**2446.20 ± 42.33**
Periods of calving					
P_1 (1974-1980)	144	124.19 ± 5.74	403.51 ± 5.85	75.57 ± 3.99	**3314.30 ± 65.39^a**
P_2 (1981-1987)	52	117.43 ± 7.81	391.59 ± 7.95	64.99 ± 5.43	**2774.70 ± 88.93^b**
P_3 (1988-1994)	46	128.59 ± 8.34	407.34 ± 8.49	80.48 ± 5.79	**2272.74 ± 94.91^c**
P_4 (1995-2001)	53	131.59 ± 8.42	413.31 ± 8.57	73.28 ± 5.85	**2035.35 ± 95.79^c**
P_5 (2002-2008)	37	112.25 ± 9.47	395.60 ± 9.65	76.61 ± 6.58	**2243.13 ± 107.83^c**
P_6 (2009 -2017)	17	129.94 ± 13.72	409.85 ± 13.97	99.10 ± 9.53	**2037.00 ± 156.09^c**
Season of birth					
S_1 (Rainy)	107	122.02 ± 5.86	399.79 ± 5.97	75.30 ± 4.07	**2512.59 ± 66.77**
S_2 (Winter)	108	122.10 ± 5.89	403.24 ± 5.99	81.44 ± 4.09	**2452.60 ± 67.01**
S_3 (Summer)	134	127.88 ± 5.31	407.57 ± 5.41	78.28 ± 3.69	**2373.42 ± 60.50**
Age group					
A_1 (< 860 days)	152	118.70 ± 6.49	397.81 ± 6.60	74.96 ± 4.50	**2409.89 ± 73.83**
A_2 (861-1000 days)	92	125.14 ± 6.24	405.89 ± 6.35	76.56 ± 4.33	**2424.67 ± 71.01**
A_3 (1001 days and above)	**105**	**128.15 ± 5.95**	**406.90 ± 6.06**	**83.50 ± 4.13**	**2504.05 ± 67.70**

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

Table.4 Estimates of heritability, phenotypic and genetic correlations among first lactation reproduction and production traits HF x Gir halfbred

Traits	AFC	FSP	FL300DMY	FDP	FCI
AFC	0.31±0.15	0.16±0.05**	-0.88±0.03**	0.05±0.05	0.24±0.05**
FSP	0.07±0.05	0.14±0.16	-0.28±0.05**	0.22±0.05**	0.98±0.01**
FL300DMY	-0.33±0.05**	0.05±0.05	0.61±0.05	-0.26±0.05**	0.05±0.05
FDP	0.10±0.05	0.46±0.05**	-0.19±0.05**	0.24±0.14	0.52±0.05**
FCI	0.08±0.05	0.95±0.02**	-0.19±0.05**	0.26±0.05**	0.14±0.15

Estimates above the diagonal are the genetic correlations and below diagonal are phenotypic correlations. The diagonal values are the estimates of heritability
** P < 0.01

Effect of sire on first lactation reproduction and production traits

The sire had significant (P<0.05) effect on AFC, FL300DMY and FDP while non-significant in FSP and FCI. Similar results were reported by Akhtar *et al.,* (2003) in 5/8 HF x 3/8 SW cattle, Singh *et al.,* (2004) in frieswal and Divya (2012) in Karan fries cattle.

Effect of age at first calving on first lactation reproduction and production traits

The non-significant effects of AFC groups were found on all first lactation reproduction and production traits. This finding was similar to the results reported by Singh (1995), Divya (2012) and Singh (2013) in Karan fries cattle. Whereas, the significant effect of age of groups on FL300 DMY were reported by Ambhore (2017) in Phule Triveni.

Heritability estimates of reproduction and production traits

The heritability of AFC and FL300DMY were moderate. This indicates that these traits were more influenced by additive genetic variability and could be improved by selection and improved management. Whereas, the heritability (h^2) of FDP, FSP and FCI were very low and associated with high standard error indicating that performance of this traits could be enhanced by improving management and environments factors. The higher heritability of AFC and FL300DMY in HF x Gir halfbred indicates that selections based on these two traits are more desirable than other traits. The present results were in agreement with the finding reported by Mukhujee (2005) in Frieswal cattle, Nehra (2011) and Dash (2004) in KF cattle and Ambhore (2017) in Phule Triveni (Table 4).

Phenotypic and genetic correlations among reproduction and milk production traits

In HF x Gir halfbred, genetic correlation of FL300DMY with AFC, FSP and FDP were negative (-0.88±0.03, -0.26±0.05 and -26 ± 0.05) and significant. However, the genetic correlation of FCI with FL300DMY was 0.05±0.05. In HF x Gir halfbred, phenotypic correlation of FL300DMY with AFC, FDP and FCI were negative (-0.33±0.05, -0.19±0.05 and -0.19±0.05) and significant. However, the phenotypic correlation of FL300DMY with FSP was positively non-significant (0.05±0.05). Similar to the present findings, Mukherjee (2005) and Nehra (2011) also reported higher genetic and phenotypic correlation.

In conclusion the average least squares means of first lactation of HF x Gir halbred were AFC 954.82±7.80 days, FSP 124.32±3.72 days, FDP 78.34±2.58 days, FCI 403.53±3.78 days and FL300DMY 2446.20±42.33 kg. In HF x Gir halfbred negative genetic and phenotypic association between AFC and FL300DMY indicated that selection of animal on the basis of for AFC can improve the FL300DMY in HF x Gir halfbred. The high magnitude of heritability was noticed for FL300DMY in HF x Gir halfbred. However, it was low to medium for the AFC, FSP, FDP and FCI. The heritability estimates of AFC, FSP, FDP, FCI and FL300DMY were 0.31±0.15, 0.14 ± 0.16, 0.24 ± 0.14, 0.14±0.15 and 0.61±0.05 respectively.

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