Biological Forum – An International Journal **13(4): 402-405(2021)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Estimates of Genetic and Phenotypic Parameters for Milk Yield and Reproduction Traits in Karan-Fries Cattle

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(Received 18 August 2021, Accepted 16 October, 2021)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The records of 1481 Karan-Fries cows on first lactation data of production and reproduction traits, progenies of 82 sires were utilized to estimate the heritability, genetic and phenotypic correlations among these traits. The heritabilities for FL305MY, PY305MY, 180DMY, AFC and FSP traits were 0.346 ± 0.10, 0.271 ± 0.094, 0.343 ± 0.101, 0.546 ± 0.131 and 0.064 ± 0.07 respectively. The moderate to high heritability estimates of milk yield and AFC traits indicated ample scope of their genetic improvement through selection and breeding. The heritability of FSP trait was estimated low in magnitude which indicated that the improvement in FSP may be achieved by providing better managemental practices. The phenotypic (r_p) and genetic (r_g) correlations among FL305MY, PY305MY and 180DMY traits were of high magnitude, positive and highly significant. It had indicated close association among them and the predicted and part lactation milk yield traits can be used for animal evaluation in field condition. The estimates of phenotypic (r_p) and genetic (r_g) correlations of AFC and FSP with FL305MY, PY305MY and 180DMY indicated undesirable associations. The estimates of phenotypic (r_p) and genetic (r_g) correlations of AFC with FSP indicated undesirable associations. This may be due to environmental effects. The optimization of milk yield traits with reproduction traits and among reproduction traits is necessary.

Keywords: Parameters, milk yield, reproduction trait, Karan-Fries cattle.

INTRODUCTION

Increased milk yield in the shortest possible time with routinely initiated lactations is a high priority breeding objectives of genetic improvement programme for dairy animals. The breeding policy adopted to improve the Karan Fries (KF) cattle was mainly directed to enhance the milk production so far and the reproduction traits were not given due consideration in genetic improvement programmes. The first lactation 305-day or less milk yield (FL305MY) is the most important economic trait of the dairy animal productivity which determines profitability, culling and genetic progress of animals in the herd. Sire evaluation based on part lactation yield has been reported to be useful in early evaluation, reducing the generation interval and increasing the rate of genetic improvement (Van Vleck, 1962; Iype and Nagarcenkar, 1992). Further, the use of part lactation records and test day records for predicting the total lactation milk yield has great advantage in the field conditions as well as on the organized herds. Rashia (2010) reported high and positive genetic and phenotypic correlation of 180-day cumulative milk yields with first lactation 305-day or less milk yield and predicted 305-day milk yield based on 180 days cumulative milk yield with an accuracy of 75% in Karan Fries cattle. Therefore, the predicted 305-day milk yield based on first lactation 180 days cumulative milk yield fitting best regression model and part lactation record viz. first lactation 180 days cumulative milk yield may be used for animal evaluation. The age at first calving (AFC) is the one trait which gives an indication about the ability of a heifer to conceive and give birth to a calf. Lower age at first calving (AFC) is desirable for early returns as it increases the lifetime production and reduces the generation interval. This lowered generation interval helps in earlier evaluation of sires and results in faster genetic gain. If the age at first calving is below optimum, it will lead to weak calves, difficulty in calving and less milk production in first lactation. The service period has a direct effect on length of calving interval and thereby affects the production efficiency. Any variability in service period is directly reflected into variation in calving interval. Longer service period also affects the lactation length and dry period. The reproduction (AFC and FSP) traits had indicated the possibility of their genetic improvement through selection in Karan-Fries cattle (Divya, 2012). The potential for genetic improvement of a trait utilize genetic variation as raw material of the breeding population. The genetic parameters estimation dictates the method of selection and breeding systems to be adopted for future improvement and for to prediction of direct and correlated response to selection. The heritability estimate of a trait measures genetic variability for a population in a given environmental conditions. If genetic correlation between the two traits is high, the selection for one trait would result in an improvement/deterioration for the other trait as a correlated response. The phenotypic correlation is an expression of observed relationship between the phenotypic performance of different traits while the degree of association between genes responsible for the additive variance of different traits is measured through genetic correlation. The genetic correlations give the information that genes affecting one trait also affect the other traits. The accurate and precise estimates of heritability, genetic and phenotypic correlations are required for development, formulation, execution and evaluations of genetic improvement programme. Therefore, the present investigation was aimed to examine genetic parameters (heritability, genetic and phenotypic correlation estimates) for milk yield and reproduction traits of first lactation Karan-Fries cattle.

MATERIALS AND METHODS

The records of 1481 Karan-Fries cows on first lactation data of production (305-day or less milk yield and daily milk yield) and reproduction (AFC and FSP) traits, progenies of 82 sires spread over a period of 26 years from 1984 to 2009 were collected from the history-cum pedigree sheet and daily milk yield registers maintained at National Dairy Research Institute (NDRI), Karnal. The first lactation predicted 305-day milk yield (PY305MY) was predicted using regression equation PY305MY = 463.16 + 1.297(X_1) based on first lactation 180-days cumulative milk yield (180DMY). 180-day cumulative milk yield (180DMY) was calculated by summing up the daily milk yield after calving till 180th days (excluding first five days of colostrum). Age at first calving (AFC) trait of reproduction trait group was calculated as the difference between date of birth and date of first calving. First service period (FSP) of reproduction trait group was estimated as the difference between date of first calving and date of next successful service. Culling in the middle of lactation, abortion, still-birth or any other pathological causes which affected the lactation yield were considered as abnormalities and thus, such records were not taken for the study. The records of progenies of only those sires were included in present study which had minimum five or more progenies in data records. The outliers beyond two-standard deviation on both the tail ends of normal distribution were excluded from the data. The cows that had produced milk for at least 100 days and maximum 305 days in the first lactation were considered for the study. A total of 15% records were discarded on account of these restrictions. The cows were maintained under uniform condition of feeding, housing, breeding milking, health cover and other managemental conditions. Paternal half sib correlation method (Becker, 1975) under least-squares mixed model (LSML) using Harvey (1990) was used to estimate the heritability of different traits. The standard error of heritability of different traits was estimated using the formula given by Swiger *et al.,* (1964). The genetic correlations among traits were estimated from the analysis of variance and covariance among sire groups as given by Becker, (1975). The standard error of genetic correlation was derived by using the formula of Robertson, (1959). The phenotypic correlations among different traits were computed as per Snedecor and Cochran (1964).

RESULTS AND DISCUSSION

The results of heritability, phenotypic and genetic correlations estimates for various traits are presented in Table 1.

Heritability estimates: The heritability of FL305MY was 0.346 ± 0.10 (Table 1). The estimate of heritability of FL305MY was close to the estimate (0.30 ± 0.02) reported by Saha (2001) and (0.39 ± 0.09) by Kokate (2009) in Karan Fries cattle. However, higher heritability estimates of FL305MY have been reported as 0.44 ± 0.13 by Sivakumar, (1998); 0.41 ± 0.13 by Sahana and Gurnani (2000); 0.45 ± 0.18 by Singh, (2006); 0.48 ± 0.01 by Nehra (2011) and 0.49 ± 0.09 by Tripathy *et al.* (2017) and lower heritability estimates of FL305MY have been reported as 0.20 ± 0.06 by Rashia (2010) and 0.21 ± 0.14 by Divya, (2012) in Karan Fries cattle. The heritability of PY305MY was 0.271 ± 0.094 (Table 1). However, lower heritability estimates of PY305MY have been reported as 0.138 ± 0.115 by Jain (1996) in Murrah buffaloes. The heritability of 180DMY was 0.343 ± 0.101 (Table 1). The estimate of heritability of 180DMY was close to the estimate range (0.41-0.44) of mid part lactation reported by Kumar *et al.* (1992); Hariana and Singh (2006) in Karan Fries cows. However, higher estimate of heritability (0.43 ± 0.09) of 180DMY was reported by Rashia (2010) and lower estimate of heritability (0.27 ± 0.15) of 180DMY was reported by Singh (2006) in Karan Fries cattle. The heritability of AFC was 0.546 ± 0.131 (Table 1) which was in agreement with Nehra (2011); Divya (2012) who reported heritability of 0.43 ± 0.13 and 0.54 ± 0.17, respectively in Karan Fries cattle. However, Singh (1995) for AFC reported higher heritability of 0.86 ± 0.21 in Karan Fries cattle and lower values of 0.36 ± 0.19 and 0.17 ± 0.09 had been reported by Panja, (1997); Saha, (2001) in Karan Fries cattle. The heritability of FSP was 0.064 ± 0.07 (Table 1). Similar estimates were also reported by Sahana (1996); Panja (1997) and Divya (2012). They reported heritability of FSP as 0.04 ± 0.06; 0.05 ± 0.14 and 0.05 ± 0.13, respectively in Karan Fries cattle. However, Saha (2001); Sahana and Gurnani (2000) for AFC reported higher heritability of 0.16 ± 0.7 and 0.23 ± 0.11, respectively in Karan Fries cattle.

The principle diagonal values are the estimates of heritability, the estimates above the diagonal are the phenotypic correlations and those below diagonal are the genetic correlations

Table 1: Genetic and phenotypic correlations among milk yield traits and reproduction traits of Karan-Fries cattle.

TRAITS	FL305MY	PY305MY	180DMY	AFC	FSP
FL305MY	**0.346 ± 0.10**	0.804^{**} ± 0.01	0.804^{**} ± 0.02	0.117^{**} ± 0.03	0.109^{**} ± 0.04
PY305MY	0.897^{**} ± 0.07	**0.271 ± 0.094**	0.998^{**} ± 0.04	0.210^{**} ± 0.04	0.053 ± 0.03
180DMY	0.897^{**} ± 0.07	0.996^{**} ± 0.06	**0.343 ± 0.101**	0.210^{**} ± 0.04	0.210^{**} ± 0.03
AFC	0.156 ± 0.28	0.162 ± 0.34	0.163 ± 0.34	**0.546 ± 0.131**	0.031 ± 0.04
FSP	-0.36 ± 0.51	-0.527 ± 0.63	-0.527 ± 0.63	-0.014 ± 0.38	**0.064 ± 0.07**

* $P \leq 0.05$ and ** $P \leq 0.01$ level of significance

The heritability estimates of FL305MY, PY305MY, 180DMY and AFC traits were moderate in magnitude which indicated that different traits are more influenced by additive genetic variability and hence there is more scope of improvement by selection. The heritability estimate of FSP was very low in magnitude which indicates that FSP trait is influenced more by managemental and environmental factors than by genetic factors. The genetic improvement in FSP trait may be brought through improving the managemental practices followed for cattle.

Phenotypic and Genetic (r_g) correlations. The estimates of phenotypic (r_p) and genetic (r_g) correlations among FL305MY, PY305MY, 180DMY, AFC and FSP traits were given Table 1. The estimates of phenotypic (r_p) and genetic (r_g) correlations between FL305MY and PY305MY were positive, high (0.804 ± 0.01 and 0.897 ± 0.07, respectively) and significant ($p<0.01$). The estimates of phenotypic and genetic correlations between FL305MY and 180DMY were positive, high (0.804 ± 0.02 and 0.897 ± 0.07, respectively) and significant ($p<0.01$). The estimates of phenotypic and genetic correlations between PY305MY and 180DMY were positive, high (0.804 ± 0.01 and 0.996 ± 0.06, respectively) and significant ($p<0.01$). Similar estimates of phenotypic (r_p) and genetic (r_g) correlations between FL305MY and 180DMY (0.88 ± 0.01 and 0.95 ± 0.02, respectively) were also reported by Rashia (2010) in KF cattle. Hence, the results of phenotypic (r_p) and genetic (r_g) correlations among FL305MY, PY305MY and 180DMY traits were of high magnitude, positive and highly significant which indicated close association among them. Hence, the predicted and part lactation milk yield traits can be used for animal evaluation in field condition.

The estimates of phenotypic (r_p) and genetic (r_g) correlations between FL305MY and AFC were of low magnitude and positive 0.117 ± 0.03 and 0.156 ± 0.28, respectively. The estimates of phenotypic (r_p) and genetic (r_g) correlations between PY305MY and AFC were of low magnitude and positive 0.210 ± 0.04 and 0.162 ± 0.34, respectively. The estimates of phenotypic (r_p) and genetic (r_g) correlations between 180DMY and AFC were of low magnitude and positive 0.210 ± 0.04 and 0.163 ± 0.34, respectively. Similar estimate of phenotypic (r_p) correlation between milk yield and AFC traits was reported to be 0.04 ± 0.05, 0.33 ± 0.04, 0.15 ± 0.04, 0.21 ± 0.06, 0.06 ± 0.04 0.13 ± 0.12 and 0.04 ± 0.05, respectively by Singh (1995); Battacharya (1996); Panja (1997); Sivakumar (1998); Nehra (2011); Divya (2012) in KF cattle. The estimates of phenotypic (r_p) and genetic (r_g) correlations of AFC with FL305MY, PY305MY and 180DMY were positive and significant ($p<0.01$) and non-significant, respectively suggested that these traits are governed by similar set of genes and selection of animals on the basis of milk yield traits would lead to undesirable improvement in AFC trait. This may be due to environmental effects.

The estimates of phenotypic (r_p) and genetic (r_g) correlations between FL305MY and FSP were of low magnitude and positive 0.109 ± 0.04 and -0.360 ± 0.51, respectively. The estimates of phenotypic (r_p) and genetic (r_g) correlations between PY305MY and FSP were of low magnitude and positive 0.053 ± 0.03 and -0.527 ± 0.63, respectively. The estimates of phenotypic (r_p) and genetic (r_g) correlations between 180DMY and FSP were of low magnitude and positive 0.210 ± 0.03 and -0.527 ± 0.63, respectively. Similar estimate of phenotypic (r_p) correlation between milk yield and FSP traits was reported to be 0.08 ± 0.06, 0.19 ± 0.05, 0.13 ± 0.04, 0.18 ± 0.04, 0.12 ± 0.04 and 0.18 ± 0.05, respectively by Singh and Tomar (1991); Singh (1995); Bhattacharya (1996); Sivakumar (1998) and Divya (2012) in KF cattle. However, contrary to the present study a negative phenotypic (r_p) correlation between milk yield and FSP traits was reported -0.06 ± 0.07 by Panja (1997) in KF cattle. Similar estimate of genetic (r_g) correlation between milk yield and FSP traits was reported -0.29 ± 0.99, -0.18 ± 0.34 and -0.17 ± 0.33 by Singh and Tomar (1991); Singh, (1995); Divya, (2012), respectively in KF cattle. However, contrary to the present study a positive correlation between milk yield and FSP traits was reported 0.51 ± 0.19 and 0.022 by Sivakumar (1998) in KF cattle. The estimates of phenotypic (r_p) correlations of FSP with FL305MY, PY305MY and 180DMY were positive and significant ($p<0.01$) indicated selection of animals for increased milk yield traits would lead to undesirable increase in FSP trait. Contrary to phenotypic (r_p) correlation its genetic (r_g) correlations of FSP with FL305MY, PY305MY and 180DMY were negative and non-significant indicated that selection of animals for increased milk yield traits would lead to desirable decrease in FSP trait. This may be due to environmental effects. The result suggested that the optimization of FSP with respect to FL305MY, PY305MY and 180DMY traits are necessary.

The estimate of phenotypic (r_p) and genetic correlation between AFC and FSP was positive, low (0.031 ± 0.04) and non-significant and negative, low (-0.014 ± 0.38) and non-significant, respectively (Table 1). Similar estimates of phenotypic correlation (r_p) between AFC and FSP was reported as positive, low (0.01 ± 0.04) and non-significant by Divya, (2012) in KF cattle. However, contrary to the present study a positive genetic (r_g) correlation between milk yield and FSP traits was reported as positive, high (0.65 ± 0.75) and non-significant by Divya, (2012) in KF cattle. The estimates of phenotypic (r_p) correlations between AFC and FSP were positive and significant ($p<0.01$) indicated that selection of animals for increased milk yield traits would lead to undesirable increase in FSP trait. Contrary to phenotypic (r_p) correlation its genetic (r_g) correlations between AFC and FSP were negative and non-significant indicated that selection of animals for increased milk yield traits would lead to desirable decrease in FSP trait. This may be due to environmental effects. The result suggested that the optimization of AFC with respect to FSP is necessary.

CONCLUSIONS

The moderate to high heritability estimate of milk yield and AFC traits indicated ample scope of their genetic improvement through selection and breeding. The improvement in FSP may be achieved by providing better managemental practices. The results of phenotypic (r_p) and genetic (r_g) correlations among FL305MY, PY305MY and 180DMY traits were of high magnitude, positive and highly significant which indicated close association among them. Hence, the predicted and part lactation milk yield traits can be used for animal evaluation in field condition. The estimates of phenotypic (r_p) and genetic (r_g) correlations of AFC and FSP with FL305MY, PY305MY and 180DMY indicated undesirable associations. The estimates of phenotypic (r_p) and genetic (r_g) correlations of AFC with FSP indicated undesirable associations. This may be due to environmental effects. The optimization of milk yield traits with reproduction traits and among reproduction traits is necessary.

Acknowledgements. We sincerely thank the Director, National Dairy Research Institute, Karnal and Head, Dairy Cattle Breeding Division for providing necessary facilities for conducting this research. Further, I greatly acknowledge the efforts extended by author Aakanksha Rathore for preparation of this manuscript.

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How to cite this article: Rathore, A.; Singh, R.K. and Singh, A. (2021). Estimates of Genetic and Phenotypic Parameters for Milk Yield and Reproduction Traits in Karan-Fries Cattle. *Biological Forum – An International Journal, 13*(4): 402-405.