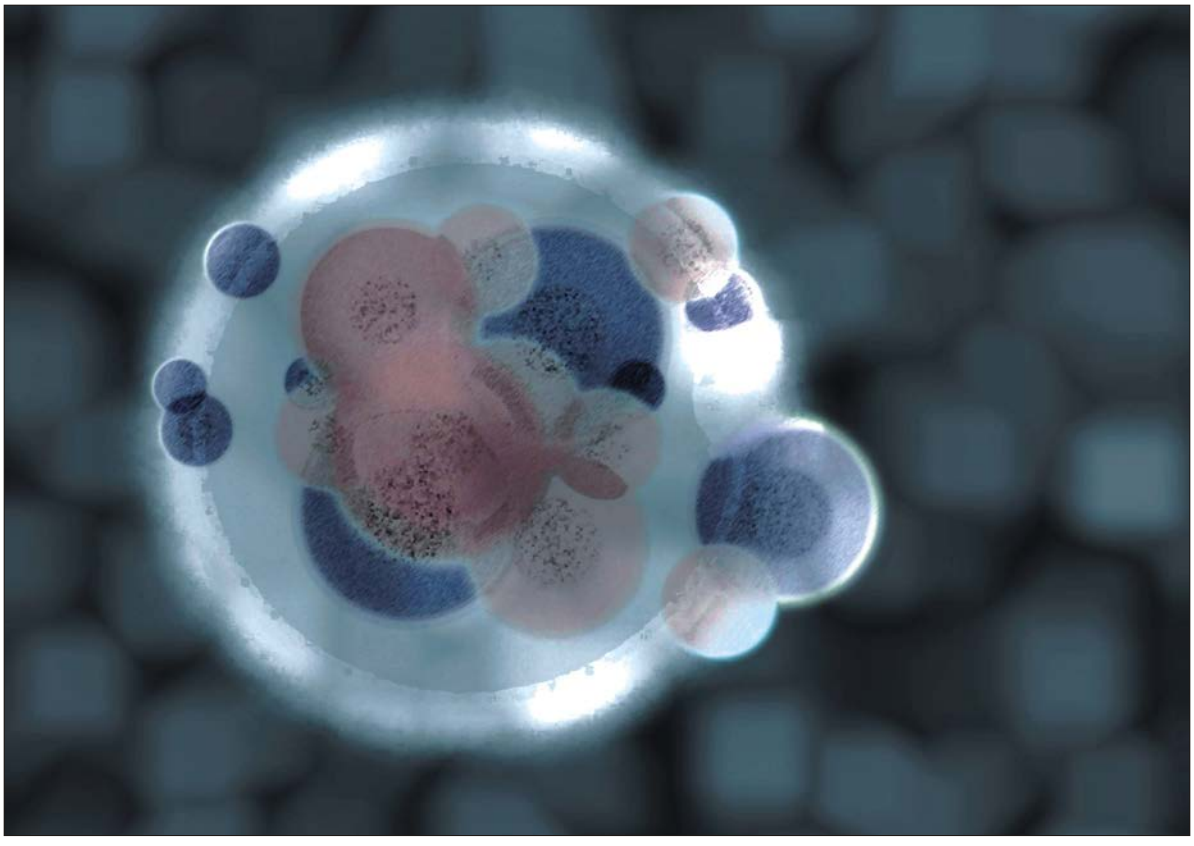

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Genetic and Phenotypic Parameters of Milk Production Traits of Crossbred Cattle in a Selected Farm of Bangladesh

[1]Ali Reza Ahmed, Sarder Safiqul Islam, [2]Nargis Khanam and [3]Ayesha Ashraf
Agrotechnology Discipline, Khulna University, Khulna-9208, Bangladesh
[1]Milk and Cattle Improvement Farm, Bogra, Bangladesh
[2]Upazila Livestock Office, Dhunat, Bogra, Bangladesh
[3]Biotechnology and Genetic Engineering Discipline, Khulna University, Khulna-9208, Bangladesh

Abstract: The study was conducted in Milk and Cattle Improvement Farm, Bogra, Bangladesh from 1995 to 2003 with a view to estimate genetic and phenotypic parameters of milk production traits of crossbred cattle. The milk production traits considered in the study were lactation length, yield per lactation, pick yield per day and daily milk yield. Heritability was calculated from parental half-sib relationship. The average mean of lactation length, yield per lactation, pick yield per day and daily milk yield were 338.19±9.98 days, 1336.88±60.23, 6.02±0.17 and 3.93±0.12 kg, respectively. The heritability estimates of lactation length, yield per lactation, pick yield per day and daily milk yield were 0.028±0.01, 0.44±0.10, 0.24±0.08 and 0.20±0.07, respectively, where the repeatability estimates of those traits were 0.10±0.09, 0.14±0.09, 0.36±0.10 and 0.35±0.10, respectively. The effects of genetic groups on various traits were non-significant except lactation length ($P<0.01$). The effects of parity on all traits under consideration were non-significant.

Key words: Genetic, phenotypic, parameters, crossbred, cattle

INTRODUCTION

Cattle population of Bangladesh consists of indigenous non-descriptive zebu (*Bos indicus*) called "Local" and their crossbred. Crossbreds of Bangladesh commonly include Friesian-Local and Sahiwal-Local crosses. Crossbred cows usually exceed the average performance levels of potential pure-breeds and thus play an important role in livestock improvement. They have enough economic importance in terms of total production potentialities. Crossbred cattle exhibit greater production and reproductive fitness than their parents. For these advantages, Bangladesh undertook innumerable attempts to improve the milk production capacity of zebu cattle through crossbreeding with exotic breeds. However, crossbred cattle of Bangladesh cannot achieve their production potentialities properly due to indiscriminate breeding policy, harsh environmental conditions, non-availability of green fodder and forage, unskilled management and lack of knowledge about health care.

The rate of genetic gain that could be made by selection is depends on the heritability (h^2) of the trait. Estimation of h^2 and repeatability (R) of the traits are essential genetic parameters required in animal breeding research and in the design and application of practical breeding program[1]. The majority of the genetic parameters estimates available in the literature are based upon records obtained from temperate breeds (*Bos taurus*). Genetic parameters are specific to population, i.e., estimates of genetic parameters from one breed may not appropriate when applied to other breeds[2]. Keeping this in view, the present study was undertaken to estimate h^2 and R of some milk production traits of crossbred dairy cattle from the data available at a government dairy farm of Bangladesh.

MATERIALS AND METHODS

The study was conducted in Milk and Cattle Improvement Farm, Sherpur, Bogra, Bangladesh. Department of Livestock Services, Bangladesh established the farm in 1995 with a view to improve the Local zebu cattle (*Bos indicus*) of Bangladesh. Crossbreeding program has been carried out since the establishment of the farm. The feeding and management system of the farm is as uniform as possible through out the year. The average body weight of the milking cows was 315 kg. Average 3.6 kg of concentrate feed was provided per cow per day. The concentrate feed contained 18.38% crude protein (CP) and 2359 Kcal ME

Corresponding Author: Sarder Safiqul Islam, Associate Professor, Agrotechnology Discipline, Khulna University, Khulna-9208, Bangladesh Tel: +88-041-810904 E-mail: sarderislam613@hotmail.com

per kg feed. The ingredients of concentrate feed were wheat bran (*Triticum aestivum*), rice polish (*Oryza sativa*), sesame oil cake (*Sesamum indicum*), grass pea (*Lathyrus sativus)*, black gram (*Vigna mungo*), gram (*Cicer arietinum*) and common salt. Rice straw was supplied at 3.5 kg per cow per day. Both concentrate and rice straw were supplied twice daily. Six kg of green grass was allocated daily for each cow. The milking cows were entirely confined into the shed, where dry cows and heifers were allowed to graze 2 h per day. After 5 months of pregnancy, the cows were allowed 0.5 kg of concentrate feed in addition to the above-mentioned quantity.

Data: Records on milk production performances of crossbred cows kept at the farm were used for the study that covered 1995 to 2003. The genotypes of the cows considered in the study were Local×Friesian (F_1), Local×Sindhi (F_1), Sahiwal×Friesian (F_1) and Local×Friesian (F_2). The milk production traits considered in the study were lactation length, yield per lactation, pick yield per day and daily milk yield.

Statistical analysis: Data were analyzed using statistical package for social science[3] for mean, standard error (SE) and analysis of variance (ANOVA). Variance components from ANOVA table were computed according to Becker[4]. The statistical model used to estimate the variance components was as follows:

$$Y_{ik} = \mu + \alpha_i + e_{ik}$$

Where:

μ = the overall mean
α_i = the effect of ith sire or ith record of individual
e_{ik} = the random error and
Y_{ik} = the individual record of kth individual of the ith sire or kth measurement of the ith individual.

Heritabilities were calculated from parental half-sib relationship according to the following formula[4] outlined below:

$$h^2 = 4\,\sigma^2_s/\sigma^2_s + \sigma^2_w$$

and repeatability was calculated by the following formula:

$$R = \sigma^2_B/\sigma^2_s + \sigma^2_w.$$

Where:

σ^2_w = the within sire component of variance/ within component of variance
σ^2_s = the between sire component of variance
σ^2_B = the between component of variance

Standard error of estimated h^2 and R was also calculated according to the formula outlined by Becker[4].

RESULTS AND DISCUSSION

Lactation length: The average lactation length in the study was 338.19±9.98 days. According to the genotypes the longest lactation length was in Local×Friesian (F_2) (489.67±41.36 days) and shortest was in Local×Sindhi (F_1) (315.55±45.24 days) (Table 1). Ashraf *et al.*[5] found lower lactation length of Local×Sindhi (F_1) (224.44±12.64 days) and Local×Sahiwal (F_1) (299.38±9.74 days). The effect of genetic groups on this trait was found significant (P>0.01). Significant effect of genetic groups on this trait was also found by Ashraf *et al.*[5], Islam and Bhuiyan[6], Bhuiyan and Sultana[7], Nahar *et al.*[8]. According to parity, the highest and lowest lactation length was 359.52±28.06 and 278.00±17.51 days in 4th and 5th lactation, respectively. The effect of parity on this trait was found non-significant (Table 2).

The heritability estimates of the trait was 0.028±0.01 (Table 3). This result was inconsistent with the findings of Bhuiyan *et al.*[9], Ageeb and Hillers[10] and they found the heritability estimates for lactation length of 0.27±0.51 in Friesian and 0.34±0.25 in Friesian-Sudanese crossbred, respectively. The lower heritability estimates of the trait indicate the greater influence of environment in the population. The repeatability estimate of lactation length was 0.10±0.09 (Table 3). This result was almost similar with the result of Ageeb and Hillers[10] and they found the repeatability estimate of 0.08 in Friesian-Sudanese Local crossbred cattle. However, higher repeatability was observed by Bhuiyan *et al.*[9] where the repeatability estimates were 0.15±0.11 and 0.19±0.09 from Friesian and Friesian-Local crossbred cattle, respectively.

Yield per lactation: The average yield per lactation in the study was 1336.88±60.23 kg. According to the genotypes the highest yield per lactation was in Local×Friesian (F_2) (1647.83±347.89 kg) and lowest was in Local×Sindhi (F_1) (1254.91±226.00 kg) (Table 1). Ashraf *et al.*[5] observed highest and lowest yield in Local×Sahiwal (F_1) (1863.00±14.00 kg) and in Local×Sindhi (F_1) (937.00±183.00 kg), respectively. Least-squares analysis of variance showed non-significant effect of genetic groups on lactation yield, which was inconsistent with the findings of Ashraf *et al.*[5], Islam and Bhuiyan[6], Chaudhry *et al.*[11] and Nahar *et al.*[8]. They found significant effects of genetic groups on the trait. Yield per lactation according to parity on this trait was found non-significant (Table 1).

The heritability estimates of the trait was 0.44±0.10 (Table 3). Hoekstra *et al.*[12] observed similar trend of heritability in Friesian-Black Pied crossbred cattle (0.48).

Table 1: Mean of milk production traits according to the genotypes of cow

Traits	Genotypes	N	Mean	Std. Error	F-value
Lactation length (days)	Local×Friesian (F_1)	93	329.72[a]	11.98	3.95 (**)
	Local×Sindhi (F_1)	11	315.55[a]	45.24	
	Sahiwal×Friesian (F_1)	26	343.12[a]	16.41	
	Local×Friesian (F_2)	6	489.67[b]	41.36	
	Total	136	338.19	9.98	
Yield per lactation (kg)	Local×Friesian (F_1)	93	1348.32	76.66	0.55 (NS)
	Local×Sindhi (F_1)	11	1254.91	226.00	
	Sahiwal×Friesian (F_1)	26	1258.85	97.95	
	Local×Friesian (F_2)	6	1647.83	347.89	
	Total	136	1336.88	60.23	
Pick yield (kg/day)	Local×Friesian (F_1)	93	6.14	0.20	0.39 (NS)
	Local×Sindhi (F_1)	11	5.79	0.39	
	Sahiwal×Friesian (F_1)	26	5.78	0.41	
	Local×Friesian (F_2)	6	5.58	0.99	
	Total	136	6.02	0.17	
Daily milk yield (kg/day)	Local×Friesian (F_1)	93	3.99	0.14	0.78 (NS)
	Local×Sindhi (F_1)	11	3.89	0.33	
	Sahiwal×Friesian (F_1)	26	3.78	0.28	
	Local×Friesian (F_2)	6	3.51	0.94	
	Total	136	3.93	0.12	

** P<0.01, NS = Non-significant, [abc] Mean with uncommon superscripts differ significantly (P<0.05).

Table 2: Mean of milk production traits according to the parity of cow

Traits	Parity	N	Mean	Std. Error	F-value
Lactation length (days)	1.00	37	329.92	17.96	0.69 (NS)
	2.00	38	337.97	18.97	
	3.00	35	342.97	21.02	
	4.00	21	359.52	28.06	
	5.00	5	278.00	17.51	
	Total	136	338.19	9.98	
Yield per lactation (kg)	1.00	37	1419.92	133.59	0.54 (NS)
	2.00	38	1365.68	99.32	
	3.00	35	1217.57	112.67	
	4.00	21	1420.67	167.93	
	5.00	5	986.60	150.99	
	Total	136	1336.88	60.23	
Pick yield (kg/day)	1.00	37	6.15	0.34	0.21 (NS)
	2.00	38	6.55	0.34	
	3.00	35	5.54	0.30	
	4.00	21	5.67	0.36	
	5.00	5	5.80	0.75	
	Total	136	6.02	0.17	
Daily milk yield (kg/day)	1.00	37	4.19	0.26	1.52 (NS)
	2.00	38	4.16	0.26	
	3.00	35	3.50	0.18	
	4.00	21	3.84	0.26	
	5.00	5	3.50	0.48	
	Total	136	3.93	0.12	

NS = Non-significant

Table 3: Heritability (h^2) and Repeatability (R) estimates of milk productive traits of crossbred cattle

Traits	Heritability (h^2)	Repeatability (R)
Lactation length	0.028±0.01	0.10±0.09
Yield per lactation	0.44±0.10	0.14±0.09
Pick yield	0.24±0.08	0.36±0.10
Daily milk yield	0.20±0.07	0.35±0.10

However, Bhuiyan *et al.*[9] and Afifi *et al.*[13] reported the lower heritability estimates of 0.37±0.48 for Friesian-Local crossbred cattle and 0.30±0.08 in Friesian cattle, respectively. High magnitude of heritability estimate of the trait indicates additive genetic variance is pronounced and good response to selection can be achieved by selection. The repeatability estimate of yield per lactation was 0.14±0.09 (Table 3). This value was much lower than those of other workers. The repeatability estimates of lactation yield were 0.35-0.50, 0.40-0.55, 0.32±0.09 and 0.47 reported by Pirchner[14], Legates and Warwick[15], Bhuiyan *et al.*[9], Ageeb and Hillers[10], respectively.

Pick yield per day: Among different genotypes, higher pick yield (6.14±0.20 kg/day) was found in Local×Friesian (F_1) and lower (5.58±0.99 kg/day) was Local×Friesian (F_2). The effect of genetic group was found non-significant (Table 1) on this trait. On the other hand higher pick yield of milk was found in second parity (6.55±0.34 kg/day) (Table 2). The effect of parity on this trait was found non-significant. The heritability and repeatability estimates of the trait were 0.24±0.08 and 0.36±0.10, respectively.

Daily milk yield: Daily milk yield of Local×Friesian (F_1) and Local×Sindhi (F_1) were 3.99±0.14 and 3.89±0.33 kg, respectively, (Table 1) which was comparatively lower than that of Ashraf *et al.*[5] where they reported the daily milk yield of those genotypes were 5.81±0.40 and 4.17±0.55 kg, respectively. These variations may be due to variation in quality and quantity of feed supplied and management level differences. The effects of genetic groups and parity on this trait were non-significant (Table 1 and 2). The heritability and repeatability estimates of the trait were 0.20±0.07 and 0.35±0.10, respectively.

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