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PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet

Asian Network for Scientific Information

308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 4 (11) 1421-1424, 2001

Effect of Different Genotypes on Milk Yield and Reproductive Performance of Cows

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Abstract: The study was designed to evaluate the suitable genotype for increasing milk yield with satisfactory reproductive performance in local environmental and managemental conditions. Data from a local private dairy farm on milk yield and different reproductive traits of cows were made available in this study to evaluate the effects of different genotypes on lactation length, milk yield, length of dry period, service per conception, gestation length and post-partum heat period. Statistical analysis of the results indicated that milk yield, length of dry period, service per conception and post-partum heat period were significantly affected ($P<0.01$) by different genotypes. Lactation length and service per conception were also significantly affected ($P<0.01$) by parity and interaction of genotype x parity. The highest lactation length was observed for the genotype Jersey x Friesian x Local (JxFxL) and the lowest for Local (L) and Jersey x Local (JxL) in the first and second lactation. The highest milk yield was observed for the genotype JxF and JxFxL and lowest for L and JxL. The highest length of dry period was observed in L and lowest for JxL and JxFxL.
Maximum services were required for L and JxFxL and lowest for JxL and Sahiwal x Local (SLxL.) The highest gestation length was observed for genotype SLxL and L, while the lowest for JxF and JxL. The highest post-partum heat period was observed for genotype JxL and JxFxL and lowest for L in pooled lactation. The milk yield of all the crossbred cows showed 16 to 58 per cent higher milk yield than indigenous cows (541.26 kg/lactation). The overall reproductive performance of different genotypes so far included in this study were not very different.

Key words: Genotype, reproduction, crossbred, indigenous lactation.

Introduction

Livestock plays an indispensable role in the traditional agrarian and largely subsistant economy of Bangladesh. The landless and marginal farmers largely depend on livestock for their survival (Ahmed, 1992). Cattle of Bangladesh is an inseparable and integrated part of the agricultural operation and it ranks twelfth in cattle population in the world and in the Asian countries its position is third but it yields only 21 % of the world's milk production and 34 % of the beef production (Alam *et al.*, 1994; Rahman, 1992).

In Bangladesh the livestock population consisted of 23.6 million cattle (FAO, 1997). Despite this large cattle population in the country, the output of milk falls short of requirement. The average milk of indigenous dairy cows are only 137 liters per lactation (DLS, 1991). This low productivity of the native cows is mainly due to poor genetic potentials. But on the other hand, it is important to note that prevailing environmental condition is not suitable for raising high productive exotic breeds. It is estimated that daily per capita requirement of milk is 250 ml and thus annual requirement stands at about 9.86 million metric tones for the country (DLS, 1991), But it is alarming that the present daily per capita availability of milk is only 33.95 ml and total annual production is estimated to be 1.34 million metric tones. Hence, annual deficit of milk in the country is about 8.52 million metric tones.

In Bangladesh about 87 per cent of its population are undernourished and the country has been suffering from an acute shortage of milk and milk products. To meet the deficit the country has to import milk and milk products from abroad every year spending huge amount of foreign currency which is about Tk. 2901 million (BBS, 1994). Not only, that milk and milk products of some countries may still contain radioactive substances, which have hazardous impact on public health especially for children.

Livestock development depends mainly on genetic potential of the animal. Optimum nutrition, disease control and managemental practices permit full expression of this genetic potential. Climatic stress in the form of high ambient temperature, high humidity and erratic or inadequate rainfall affects the productivity of dairy cattle in the tropics (Cunninghum, 1980; Ansell, 1985).

It is an important factor to maintain right genotype in the right environment for the expression of full genetic potentiality. Any deviation in the genetic environment interaction will cause serious consequence on productivity. Reproductive pattern and ability are directly involved in overall productivity of animals. The reproductive adaptability in the given environment must be considered as one of the major tasks for any improvement attribute. It is reported from other parts of the developing countries as well as the experience gathered already from home country, that production performance of crossbred cows is not promising to a certain extent. This might be due to lack of adaptability in unfavourable environmental conditions, lack of availability and cost maintenance for such type of high yielding variety in the existing socio-economic condition.

Whatever the avenue of genetic improvement is used, the identification of best genotype within and among the breeding stock is the most important.

Considering the above facts and circumstances, the present study was undertaken with the objectives to study the milk production and reproductive potentials of different crossbred cows under farm conditions, as well as to recommend a suitable genotype under local nutritional and managemental condition.

Materials and Methods

The study was conducted at Beltoli Private Dairy Farm under the District of Mymensingh. The data were collected from the farm records maintained during the period of 1995-97. Collection and comparison of data were performed at the Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh. Data entry into the microcomputer and analyses were done under the existing computer facilities of the Department. The information on the productive and reproductive performances of 111 cows of different genotypes were collected from the records maintained at Beltoli Private Dairy Farm in Mymensingh. The experimental animals were divided into five genetic groups according to their genetic composition, such as Local (L), Jersey x Local (JxL), Jersey x Friesian (JxF), Jersey x Friesian x Local (JxFxL), and Sahiwal x Local (SLxL). Feeding and management system in the Beltoli private dairy farm were almost uniform throughout the year. Stall feeding was practiced through out the year. Concentrate feeds were given two times a day, at morning, before milking and evening. Concentrate feeds include wheat bran, till oil cake, rice bran, kheshai and common salt. Green grasses were supplied after milking. Different types of green grasses such as Para, Napier etc. are cultivated in field near the farm. Road side grasses were also collected from the cowboys and fed to cows. Six traits mostly relating to production and reproduction were considered in this analysis such as: lactation length, milk yield, length of dry period, service per conception, gestation length and post-partum heat period. There were sufficient hierarchies in the data structure. The number of observations varied from class to class. So, the statistical design of the study was non orthogonal factorial in nature, (Snedecor and Cochran, 1980). The Least-Squares procedure was used to analyze the fixed main effects such as gestation length, number of service per conception, lactation length, length of dry period, post-partum heat period and milk yield. For all traits linear fixed model (model 1) was used. For the Least-Squares analysis the computer program Harvey (1990) was used. The best fitting model for the analyzed trait is given below :

$$Y_{ijk} = \mu + G_i + L_j + (G^*L)_{ij} + e_{ijk}$$

Where,

Y_{ijk} = Kth record on a trait of cow in the ith genetic group and jth lactation number.

μ = The overall population mean

G_i = Effect of ith genetic group (1-5)

L_j = Effect of jth lactation number (1-2)

$(G^*L)_{ij}$ = Genotype x Lactation interaction effects

e_{ijk} = Random error associated with individual observation.

For mean comparisons LSD was calculated by computer, using MSTAT programme.

Results and Discussion

Lactation length: The Least-Square means of lactation length along with standard error for different genetic groups are presented in Table 1. The highest lactation length was observed in JxFxL (352.50±43.43 days for first lactation and 302.50±61.42 days for second lactation). The lowest lactation length was found in L (249.00±18.11 days) for first lactation and in JxL (144.00±38.85 days) for second lactation. The Least-Squares analysis of variance showed that lactation length was significantly affected by parity ($P<0.01$) and genotype x parity interaction ($P<0.01$). LSD test indicates no significant difference between the genotypes JxF and SLxL; JxL and L but the mean of JxFxL differ significantly from JxF, JxL, SLxL and SLxL differ from L (Table 1). The analysis of variance for lactation length data indicated that R^2 of the model was 27.9%. It means that of the total variation available in the lactation length data, the included factor in the model contributed only 27.9%. The rest of the variation left unexplained or in the error term. The results of this study agree with the findings of Sultana (1995), who also observed almost similar lactation length for different genotypes.

Chaudhury *et al.* (1994) analyzed full lactation length in four different types of Sahiwal x Holstein Friesian (Fi, Fz, Fs and F4) along with pure Sahiwal cross and they found the largest value in F4 (383.8 days) and the shortest in pure Sahiwal (262 days). Nahar *et al.* (1989) observed that the genetic group had a significant effect ($P<0.01$) on lactation length and they found the average value for Sahiwal x Local (Fi) to be 295.54 days.

Milk yield: The Least-Squares means±SE for total milk yield are presented in Table 3. The highest milk yield observed in JxF (858.53±54.81 kg) for first lactation and JxFxL (971.50±211.42 kg) for second lactation. The lowest milk yield was observed in L (541.26±62.34 kg) for first lactation and in JxL (361.00±82.65 kg) for second lactation. The Least-Squares analyses of variance showed that the genotype had a significant ($P<0.01$) effect on milk production. LSD test indicated that JxF and JxFxL differ significantly from JxL, SLxL and L but no significant difference were observed between the genotypes JxF and JxFxL; JxL and SLxL; JxL and L (Table 1). The analysis of variance for total milk yield data indicated that R^2 of the model was 22.7%. It means that of the total variation available in total milk yield data, the included factor in the model contributed only 22.7%. The rest of the variation remains unexplained or in the error term. The results of this study agrees with the findings of Nahar *et al.* (1992), who observed similar results. Chaudhury *et al.* (1994) reported that lactation production of Sahiwal was significantly lowest as compared to other crossbred groups. Nahar *et al.* (1989) observed the highest lactation production in Holstein x Local (1992.39±1957 kg) lowest in Sindhi x Local (997.97±19.10 kg). They reported that different genotypes had a significant ($P<0.01$) effect on lactation yield. Rahman *et al.* (1987) observed the highest lactation yield in Local x Friesian cows (1765.48 lit). Local x Sindhi cows gave the poorest milk yield (1108.6±96.62) among crossbred groups. Hossain and Routledge (1982) reported that the lactation yield of ½ Local - ½ Jersey and Local cows were 1858.5 and 213.00 kg respectively. Total milk yield in all lactations were adjusted into 305 days of standard lactation period. The Least-Squares means of adjusted milk yield along with standard error for different genetic groups are presented in Table 3. The highest adjusted milk yield is observed in JxF (859.10±42.38 kg) for first lactation and 1196.08±69.21 kg for second lactation. The lowest adjusted milk yield is observed in L (660.35±50.00 kg) for first lactation and 661.92±691.21 kg for second lactation. The Least-Squares analyses of variance showed that genotype had a significant effect ($P<0.01$) on adjusted milk yield. LSD test indicated that no significant differences were observed among genotypes JxL, JxFxL and SLxL but the mean of JxF differ significantly from JxL, JxFxL, SLxL and L. Again JxFxL differ significantly from L (Table 1). The analysis of variance for adjusted milk yield data indicated that R^2 of the model was 34%. It means that of the total variation available in the adjusted milk yield data, the included factor in the model contributed only 34%. The rest of the variation remains unexplained or in the error term. Investigations were made to observe the pattern of monthly average milk yield of different genotypes. The genotypic effect in milk yield has been given in Fig. 1. The highest milk yield was found in SLXL and the lowest in L at 3 months of lactation and thereafter milk yield was declined. The milk yield of JxF was higher at 4 to 9 months of lactation than that of other genotypes. On the other hand, the milk yield of local cows was lower than that of all genotypes at all stages of lactation.

Length of dry period: The Least-Squares means of length of dry period along with standard error for different genetic groups are presented in Tables 1 and 2. The highest length of dry period is observed in L (131.93±10.09 days for first lactation and 133.00±14.77 days for second lactation). The lowest length of dry period is observed in JxL (80.00± 19.54 days) for first lactation and in JxFxL (74.50±27.63 days) for second lactation. The Least-Squares analysis of variance showed that the dry period was significantly affected ($P<0.01$) by genotype. LSD test indicates that L differ significantly from JxF, JxL, JxFxL and SLxL. It also indicates that no significant differences were observed between JxF and SLxL; JxL and JxFxL but JxF and SLxL differ significantly from JxL and JxFxL (Table 2). The analysis of variance for length of dry period data indicated that R^2 of the model was 22.8%,

Table 1: Least-Squares means with standard error for productive and reproductive traits of different genetic groups of cows in first parity.

Genetic group	Trait				
	Lactation length (days)	Length of dry period (days)	Service per conception (No)	Gestation length days (days)	Post-partum heat period (days)
Overall	291.49'29.30	103.18'14.83 (55)	1.04'0.57 (72)	275.80'13.12 (72)	99.60'13.50 (55)
Jersey x Friesian	300.94'15.36b (72)	103.00'7.52b (27)	1.09'0.06ab (32)	261.06'6.87 (32)	95.59'7.00b (27)
Jersey x Local	27.00'38.85cd (32)	80.00'19.54c (4)	1.00'0.15b (5)	279.60'17.39 (5)	120.75'18.21a (4)
Jersey x Friesian x local	352.50'43.43a (5)	87.00'19.54c (4)	1.00'0.17b (4)	277.50'19.44 (4)	12.00'18.21a (4)
Sahiwal x local	285.00'30.71bc (4)	114.00'17.47b (5)	1.00'0.12b (8)	280.63'13.75 (8)	85.00'14.87bc (6)
Local	249.00'18.11d (23)	131.93'10.09a (15)	1.13'0.07a (23)	280.17'8.11 (23)	76.67'9.40c (15)

Means with different superscript within the same column differ significantly, (P<0.05) or (P<0.0).
Number in the parentheses indicate replication within each treatment.

Table 2: Least-Squares means with standard error for productive and reproductive traits of different genetic groups of cows in second parity.

Genetic group	Trait				
	Lactation length (days)	Length of dry period (days)	Service per conception (No)	Gestation length days (days)	Post-partum heat period (days)
Overall	214.62'36.22 (39)	101.38'18.07 (28)	1.52'0.14 (39)	276.53'16.22 (39)	114.24'16.39 (31)
Jersey x Friesian	161.67'25.08c (12)	76.44'13.02b (9)	1.17'0.10c (12)	275.42'11.22 (12)	106.30'11.52b (10)
Jersey x Local	144.00'38.85c (5)	94.20'17.47b (5)	1.60'0.15b (5)	274.60'17.39 (5)	114.60'16.29b (5)
Jersey x Friesian x local	302.50'61.42a (2)	74.50'27.63b (2)	2.00'0.23a (2)	277.00'27.49 (2)	161.50'25.75a (2)
Sahiwal x local	223.13'30.71b (8)	128.80'17.47a (5)	1.00'0.12d (8)	277.38'13.75 (8)	113.60'16.29b (5)
Local	241.83'25.08b (12)	133.30'14.77a (7)	1.85'0.10b (12)	278.25'11.25 (12)	75.22'12.14c (9)

Means with different superscript within the same column differ significantly, (P<0.05) or (P<0.0).
Number in the parentheses indicate replication within each treatment.

Table 3: Least-Squares means with standard error for milk yield (kg) in cows of different genetic groups in pooled lactation.

Genetic group	Trait			
	Total milk yield		Adjusted milk yield	
	First lactation LSM ±SE	Second lactation LSM ±SE	First lactation LSM ±SE	Second lactation LSM ±SE
Overall	712.11'91.00 (72)	634.77'108.18 (39)	740.72'80.85 (72)	900.34'99.10 (39)
Jersey x Friesian	858.53'54.81a (32)	732.33'54.81b (12)	859.10'42.38a (32)	1196.08'69.21a (12)
Jersey x Local	629.00'82.65bc (5)	361.00'82.65d (5)	684.40'107.22bc (5)	741.20'107.22bc (5)
Jersey x Friesian x local	852.75'149.49a (4)	971.50'211.42a (2)	762.00'119.88b (4)	1114.00'169.55a (2)
Sahiwal x local	697.00'105.71b (8)	573.50'105.71c (8)	737.75'84.77bc (8)	788.50'84.77b (8)
Local	541.26'62.34c (23)	535.50'86.31c (12)	660.35'50.00c (23)	661.92'69.21c (12)

Means with different superscript within the same column differ significantly, (P<0.05) or (P<0.0).
Number in the parentheses indicate replication within each treatment.

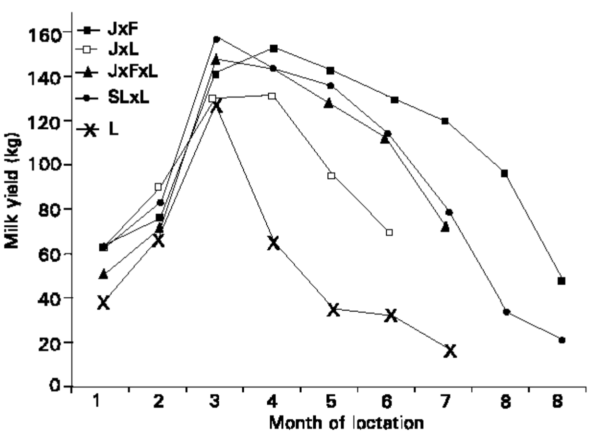

Fig. 1: Average monthly milk yield of different genotypes.

which means that of the total variation available in the length of dry period data, the included factor in the model contributed only 22.8% and the rest of the variation remained unexplained or in the error term. The results of this study are in agreement with the findings of Dalal *et al.* (1991) and Nahar *et al.* (1989). Maroof *et al.* (1987), reported that dry period was affected (P<0.01) by calving season and calving period. But breed, parity and farm had no significant effects on dry period. Hossain and Routledge (1982) observed that the dry period of Local cows was significantly higher than that of pure breed and their crosses. They found that the dry period of Local cows were 275±136 days and Jersey crosses were 57±29 days. In the present study it was observed that the length of dry period of Local cows were very long in comparison with other crossbred cows. This variation is mainly contributed by genetic constituent of animal and the environmental factor.

Service per conception: The Least-Squares means of service per conception along with standard error for different genetic groups are presented in Table 1 and 2. The highest service per conception was observed in L (1.13±0.07) for first lactation and in JxFxL (2.00±0.23) for second lactation. The lowest service per conception was observed in JxL (1.00±0.15), JxFxL (1.00±0.17) and SLxL (1.00±0.12) for first lactation and in SLxL (1.00±0.12) for second lactation. Analysis of variance showed that the number of services per conception was significantly (P<0.01) affected by genotype, parity and the interaction of genotype x parity. LSD test indicates no significant difference among the genotypes
JxF, JxL, JxFxL and SLxL but the mean of L differ significantly from JxL, JxFxL and SLxL. (Table 1). The analysis of variance for service per conception data indicated that R^2 of the model was 32.2%. It means that of the total variation available in the service per conception data, the included factor in the model contributed only 32.2%. The rest of the variation remain unexplained or in the error term. The results of this studies are in agreement with those found by Chaudhury *et al.* (1994), who observed almost similar services per conception for different genotypes. Sultana (1995) studied on the performance of exotic cattle breeds and their crosses in Bangladesh and observed both genetic and non-genetic factors had no significant effect on service per conception. A number of other factors which might have influenced the variation in service per conception are the quality and quantity of semen used in artificial insemination, improper detection of heat, failure to inseminate at appropriate time and skill of the inseminator. The other related factors are the level of fertility which may be influenced the age of bulls and cows, season of the year, age of semen, diseases, semen handling techniques

and other environmental factors.

Gestation length: The Least-Squares means of gestation length along with standard error for different genetic groups are presented in Table 1 and 2. The highest gestation length is observed in SLxL (280.63±13.75 days) for first lactation and in L (278.25±11.22 days) for second lactation. The lowest gestation length was found in JxF (261.06±6.87 days) for first lactation and in JxL (274.60±11.39 days) for second lactation. The gestation period was not significantly affected ($P<0.05$) by genetic groups. The results are in agreement with Majid *et al*. (1995), who reported a non-significant variation in gestation period among different genotypes. Similar results were also obtained by Sultana (1995) and Rahman *et al*. (1993). They found a range of gestation period of 270-285 days and no significant variations were observed in gestation length among different breeds and crossbreds. Nahar *et al*. (1992) also reported that the gestation period of different crosses varied little from 280 days.

Post-partum heat period: The Least-Squares means of post-partum heat period along with standard error for different genetic groups are presented in Table 1 and Table 2. The highest PPH is observed in JxL (120.75±18.21 days) for first lactation and in JxFxL (161.50±25.75 days) for second lactation. The lowest PPH is observed in L (76.67±9.40 days) for first lactation and 75.22±12.14 days for second lactation. The analysis of variance showed that the genotype had a significant ($P<0.01$) effect on post-partum heat period. LSD test indicated no significant differences between the genotype JxF and SLxL; JxL and JxFxL; SLxL and L but JxL and JxFxL differ significantly than JxF, SLxL and L (Table 1). The analysis of variance for post-partum heat period data indicated that R^2 of the model was 21.4%. It means that of the total variation available in the post- partum heat period data, the included factor in the model contributed only 21.4%. The rest of the variation left unexplained or in the error term. The results of this study agree with the findings of Nahar *et al*. (1992). Majid *et al*. (1995) found that a little variation in PPH among different genetic but statistically non-significant. Nahar *et al*. (1989) reported that different breeds had a significant effect on PPH. They found that PPH in different breed groups ranged from 113.93±5.45 to 150.71±4.42 days. Post-partum heat period is a very important reproductive trait in dairy herd. Hafez (1993) suggested that the post-partum breeding should be delayed up to 60-90 days after parturition, when the uterus undergoes recovery and preparation for the next pregnancy.

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