

## IMPACT OF GENOTYPES AND PARITY ON REPRODUCTIVE AND PRODUCTIVE ATTRIBUTES IN DAIRY CATTLE OF NATORE DISTRICT, BANGLADESH

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**Abstract:** Impact of genotypes and parity on some vital reproductive and productive attributes in the local (L×L, n = 100) and four crossbred cows (L×F, L×SL, L×JR and L×S; n = 318) raised in randomly selected smallholder dairy farms scattered all over Natore District and adjacent areas have been assessed during a period from September 2007 to June 2010. With regard to reproductive attributes, significant differences existed among the cattle genotypes (P<0.05) except for gestation length (GL) and age at weaning (AW). The lowest age at puberty (AP) was found for L×F (21.42±0.37 months), while the highest for L×L (31.67±0.74 months). In terms of productivity, L×F cows produced the highest daily milk yield (DMY; 6.22±0.13 L), coupled with the highest total lactation yield (TLY; 2163.43±47.77 L), while L×L produced the lowest values (1.49±0.04 L and 416.40±12.3 L, respectively) for the traits. The effect of parity on both reproductive and productive attributes showed that the middle-aged dairy cows of the 3<sup>rd</sup> and 4<sup>th</sup> parities performed better than the younger (1<sup>st</sup> and 2<sup>nd</sup> parities) or the older (5<sup>th</sup> and beyond) ones. Considering the overall performance, the L×F cows could be ranked as the best genotype followed by their L×SL, L×JR, L×S and L×L counterparts in the study area.

**Key words:** Genotypes, parity, reproductive and productive attributes, dairy cattle, Natore.

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### Introduction

Dairy has nearly always been part of a mixed farming system in Bangladesh, where majority of the rural households have 2-3 dairy cows that are used as dual purposes for milk and draft power (Saadullah 2001). According to an earlier estimate, about 92% of our dairy cattle belong to local (L×L) or indigenous and non-descriptive, Zebu type *Bos indicus*, whereas the remaining 2% are of crossbred type (BSS 2006). The majority of the crossbred ones include Friesian (F), Jersey (JR), Sindhi (S) and Sahiwal (SL), which had been introgressed with the local cattle (Majid *et al.* 1995; Khan 2009; Kabir and Islam 2009).

Productive and reproductive attributes of cows affect the profitability of the dairy enterprise of a country (Islam *et al.* 2004; Khan *et al.* 2005) which also

influence the selection of the breeds of cattle (Al-Amin and Nahar 2007; Kabir and Islam 2009; Khan 2009; Das *et al.* 2011). A number of studies evaluating the productive and reproductive performances of the dairy cattle in various regions of Bangladesh include the Central Cattle Breeding Station (CCBS) at Savar, Dhaka (Hossain *et al.* 2002; Khan *et al.* 2005; Islam *et al.* 2006), Baghabarighat, Pabna (Das *et al.* 2003), Bogra (Islam *et al.* 2004; Alam and Sarder 2010), Mymensingh (Mondal *et al.* 2005), Barishal (Al-Amin and Nahar 2007), Comilla (Miazi *et al.* 2007), Chittagong (Azizunnesa *et al.* 2008; Das *et al.* 2011), Khulna (Kabir and Islam 2009) and Jessore (Rokonuzzaman *et al.* 2009).

Parity refers to the number of times a female animal has given birth. This is an important attribute in the life of a cow, because parity has been reported to have impacts

on a number of reproductive (Sattar *et al.* 2005; Bwire 2006; Balendran *et al.* 2008; Alam and Sarder 2010; Tadesse *et al.* 2010; Das *et al.* 2011) and productive (Islam *et al.* 2006; Azizunnesa *et al.* 2008) traits in both local and crossbred dairy cows.

A number of researchers abroad have worked on various aspects of productive performance in dairy cattle. Muller *et al.* (2000) reported milk yield in Holstein and Jersey dairy herds from France; Kahi *et al.* (2004) in purebred *B. taurus*, Bwire (2006) in Boran cattle and Muia *et al.* (2011) in smallholder native dairy cattle from Kenya; Sattar *et al.* (2005) in Holstein×L cows from Pakistan; Mureda and Zeleke (2007) in Holstein-Friesian×Zebu dairy cows from Ethiopia; and Swai *et al.* (2007) from Tanzania. In addition, recent studies carried out on lactation yield include: Brahman cows and their crosses in tropical Mexico (Osorio-Arcey and Segura-Correa 2010), Holstein-Friesian (Tedesse *et al.* 2010) and Zebu and crossbred dairy cows in Ethiopia (Kebede *et al.* 2011), and various genetic groups of dairy cows in tropical Colombia (Martinez *et al.* 2011). Keeping the array of work cited above in view, here we report the impact of various genetic groups of dairy cows raised in Natore District and adjacent areas and effect of their parities on some selected reproductive and productive attributes in the respective animals.

## Materials and Methods

*Sources and genotypes of the cattle:* The study was based on an intensive field survey to investigate the reproductive and productive performances of indigenous and crossbred dairy cows raised at 10 Upazilas of Natore District that included: Natore Sadar, Singra, Gurudaspur, Boraigram, Bagatipara, Lalpur, Puthia, Durgapur, Bagmara and Atrai. The data were collected from randomly selected dairy farmers using a specifically designed questionnaire from September 2007 to June 2010. A total of 418 dairy cows, consisting of 100 local (L×L) and 318 crossbred varieties such as local×Friesian (L×F, n = 118); local×Jersey (L×JR, n = 50), local×Sindhi (L×S, n = 50) and local×Sahiwal (L×SL, n = 100), were used for the study. Up to seven parities of the cows were considered for recording some selected reproductive and productive attributes.

*Reproductive attributes:* Eight reproductive attributes *viz.* age at puberty (AP, age in months of a heifer showing the first signs of estrous or 'heat'), age at first conception (AFC, age of the heifer at first conception), services per conception (SPC, number of services or inseminations required for each successful conception),

age at first calving (AFCL, age of the heifer at delivering the first calf), postpartum heat period (PPHP, interval between the date of calving and the date of next insemination), calving interval (CI, the number of days between two successive calving of a cow), gestation length (GL, interval in days between conception and parturition) and age at weaning (AW, age at which a calf ceases suckling the mother) were considered.

*Productive attributes:* Five productive attributes *viz.* daily milk yield (DMY, the amount of milk in litres yielded by a cow per day), lactation length (LL, the number of days from first milking to the end of milking of a cow), total lactation yield (TLY, total quantity of milk produced by a cow throughout her LL), peak milk yield (PMY, the highest amount of milk yielded by a cow during her LL) and the birth weight of calves (BWC, the weight of a new born calf in kg) have been analyzed.

*Parities:* The order of calving by the dairy cows under study was considered because the higher the number of parity completed by a cow, the greater is the profit from it. Cows from both local and crossbred genotypes belonging to parity 1 (*i.e.* a single parturition) up to parity 7 (*i.e.* seven parturitions) were included in the survey for recording their two reproductive features such as CI and GL; and four productive attributes *viz.* DMY, TLY, LL and BWC.

*Statistical analyses:* To determine any significant differences among the dairy cow genotypes against their reproductive and productive performances, a statistical package (SPSS version 11.0 for Windows) was used to calculate mean, standard deviation (SD), analysis of variance (ANOVA) and the least significant differences (LSD) for various parameters. All statements of significance were based at least on 95% confidence limits (*i.e.* P<0.05).

## Results and Discussion

*Reproductive attributes:* Apart from GL and AW, all the reproductive attributes varied significantly due to genotypes of the dairy cows (Table 1). The shortest values for AP and AFCL were shown by the L×F crossbreds, the longest ones by the local (Fig. 1; P<0.001 for both); the same were also true for PPHP and CI (Fig. 2; P<0.01 for both). The SPC value, however, was the lowest for L×F and the highest for L×S (P<0.05). Although GL and AW exhibited insignificant differences among the cattle genotypes, the longest GL was found in L×JR and the shortest in

L×SL; whereas the local cows had the longest AW and L×F the shortest (Table 1). Hence, taking all these reproductive attributes in consideration, the L×F crossbred cows could be ranked as the superior genotype followed by L×SL, L×JR, L×S and L×L, respectively.

**Table 1.** Effect of genotypes on some reproductive attributes in dairy cows in Natore District.

Genotypes (n)	AFC (months)	SPC (number)	GL (days)	AW (days)
L×L (100)	32.72±0.75 <sup>a</sup>	1.40±0.07 <sup>cd</sup>	280.64±0.36 <sup>a</sup>	205.47±2.94 <sup>a</sup>
L×F (118)	22.45±0.38 <sup>d</sup>	1.26±0.04 <sup>cd</sup>	280.42±0.31 <sup>a</sup>	200.12±2.25 <sup>a</sup>
L×JR (50)	27.66±0.83 <sup>bc</sup>	1.64±0.10 <sup>ab</sup>	281.20±0.43 <sup>a</sup>	201.32±3.53 <sup>a</sup>
L×S (50)	29.50±0.58 <sup>b</sup>	1.69±0.08 <sup>a</sup>	280.81±0.47 <sup>a</sup>	205.24±3.49 <sup>a</sup>
L×SL (100)	28.01±0.50 <sup>bc</sup>	1.33±0.05 <sup>cd</sup>	280.40±0.37 <sup>a</sup>	202.58±2.09 <sup>a</sup>
Levels of significance	P<0.001	P<0.05	ns	ns

Values are mean±SE; AFC= age at first conception; SPC= service per conception; GL= gestation length; AW= age at weaning; Dissimilar superscripts in columns differed significantly by LSD (P<0.05); ns=not significant; n= number of cattle used.

**Table 2.** Effect of genotypes on some productive attributes in dairy cows in Natore District.

Genotypes (n)	DMY (L)	PMY (L)	LL (days)	BWC (kg)
L×L (100)	1.49±0.04 <sup>d</sup>	2.31±0.06 <sup>d</sup>	278.18±3.25 <sup>d</sup>	14.45±0.16 <sup>c</sup>
L×F (118)	6.22±0.13 <sup>a</sup>	10.14±0.21 <sup>a</sup>	346.62±1.82 <sup>a</sup>	23.87±0.04 <sup>a</sup>
L×JR (50)	4.62±0.13 <sup>bc</sup>	7.11±0.24 <sup>c</sup>	337.73±4.12 <sup>ab</sup>	19.86±0.37 <sup>d</sup>
L×S (50)	4.78±0.14 <sup>bc</sup>	7.26±0.28 <sup>bc</sup>	317.14±3.74 <sup>c</sup>	21.38±0.32 <sup>c</sup>
L×SL (100)	5.00±0.13 <sup>b</sup>	7.93±0.21 <sup>b</sup>	327.30±1.99 <sup>c</sup>	22.70±0.20 <sup>b</sup>
Levels of significance	P<0.001	P<0.001	P<0.001	P<0.001

Values are mean±SE; DMY= daily milk yield; PMY= peak milk yield; LL= lactation length and BWC= birth weight of calves. Dissimilar superscripts in columns differed significantly by LSD (P<0.05); n= number of cattle used.

**Table 3.** Effect of parities on some reproductive and productive attributes in the dairy cows in Natore District (pooled data).

Parities (n)	CI (days)	GL (days)	DMY (L)	LL (days)	BWC (kg)
1 <sup>st</sup> (47)	--	281.30±3.33 <sup>a</sup>	3.50±1.94 <sup>b</sup>	293.89±38.61 <sup>c</sup>	18.28±4.06 <sup>b</sup>
2 <sup>nd</sup> (77)	450.44±54.42 <sup>a</sup>	280.58±2.68 <sup>a</sup>	4.96±1.90 <sup>a</sup>	313.61±34.83 <sup>b</sup>	21.47±3.64 <sup>a</sup>
3 <sup>rd</sup> (81)	432.92±56.81 <sup>b</sup>	280.25±3.41 <sup>a</sup>	4.91±2.17 <sup>a</sup>	327.71±34.68 <sup>a</sup>	21.13±4.18 <sup>a</sup>
4 <sup>th</sup> (65)	420.89±47.76 <sup>b</sup>	280.57±3.83 <sup>a</sup>	4.60±2.12 <sup>a</sup>	335.36±28.30 <sup>a</sup>	21.18±4.32 <sup>a</sup>
5 <sup>th</sup> (57)	467.84±60.03 <sup>a</sup>	281.27±3.08 <sup>a</sup>	3.45±1.38 <sup>b</sup>	318.24±32.62 <sup>b</sup>	19.00±3.79 <sup>b</sup>
6 <sup>th</sup> (48)	459.70±54.2 <sup>a</sup>	281.04±3.34 <sup>a</sup>	3.28±1.18 <sup>b</sup>	312.80±36.16 <sup>b</sup>	18.86±3.63 <sup>b</sup>
7 <sup>th</sup> (43)	445.00±35.36 <sup>ab</sup>	281.51±3.54 <sup>a</sup>	1.20±0.57 <sup>c</sup>	270.00±4.25 <sup>d</sup>	14.50±0.71 <sup>c</sup>
Levels of significance	P<0.05	ns	P<0.01	P<0.01	P<0.05

Values are mean±SD; CI= calving interval; GL= gestation length; DMY= daily milk yield; LL= lactation length and BWC= birth weight of calves; Dissimilar superscripts in columns differed significantly by LSD (P<0.05), n= number of cattle used.

**Productive attributes:** The genotypes of the dairy cows were found to have highly significant effects on all the productive attributes under study (Table 2; P<0.001 for all). Both the highest DMY and PMY were recorded in L×F while the corresponding lowest values were observed in the local cows. The same trend was noticed for TLY (Fig. 3; P<0.001), where L×F cows had the highest lactation yield and the locals had the lowest. The longest LL was also shown by L×F whereas the shortest by the locals. The heaviest BWC values were observed in L×F and the lightest ones in L×L cows. As in

reproductive attributes, the overall ranking for the productive attributes in the experimental animals stands as follows: L×F > L×SL > L×JR > L×S > L×L.

**Parities:** Parity-wise reproductive and productive attributes are presented in Table 3. Results revealed that CI differed significantly among the parities (P<0.05) where the shortest and the longest values were recorded in the 4<sup>th</sup> and the 5<sup>th</sup> parity cows, respectively. The remaining parities were in the sequence of 3<sup>rd</sup> < 7<sup>th</sup> < 2<sup>nd</sup> < 6<sup>th</sup> for the trait. However, there was no appreciable

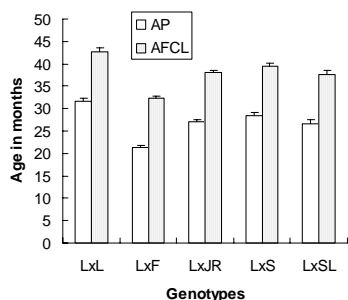
effect of parity on the GL of the cows under study. As regards the productive attributes, the highest DMY, TLY, LL and BWC values were found in the 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup> and 2<sup>nd</sup> parity cows, respectively, and the lowest values for each were observed in the 7<sup>th</sup>. Reviewing the overall data on the lactation yield, it became obvious that the mid-parity dairy cows performed significantly better than their early and late parity counterparts (Fig. 4;  $P < 0.5$ ).

There have been a number of studies on reproductive performance of the indigenous as well as existing crossbred dairy cattle in the country. Das *et al.* (2003) worked on Baghabarihat milk pocket area and found 1.29 and 104.82 days for SPC and PPHP, respectively in Pabna local cows. Both these values are different from the present ones, although GL of 280.59 days is similar to the present work. Poor fertility of the local dairy cows at the Milk and Cattle Improvement Farm, Bogra was evident by late maturing, long CI and higher PPHP values (Islam *et al.* (2004). The local and crossbred cows at the Central Cattle Breeding Station at Savar, Dhaka (Khan *et al.* 2005; Islam *et al.* 2006) also had higher CI and SPC, but the GL was similar to the present result. The Red Chittagong cows and several crossbreds maintained at Bangladesh Agricultural University, Mymensingh (Mondal *et al.* 2005) showed higher SPS, lower CI but equivalent GL values. Al-Amin and Nahar (2007) reported that the local and L×F cows in the costal areas of Barishal Division had significantly lower AFC and SPC but higher CI. Although in agreement with the present results Miazhi *et al.* (2007) found significantly lower AP in crossbreds in Comilla, PPHP and GL of the cows were higher from those of ours. The L×F cows in Hathazari, Chittagong were reported to have higher AP, SPC and CI but relatively lower GL (Azizunnesa *et al.* 2008). The local and crossbred dairy cattle from Daulatpur, Khulna (Kabir and Islam 2009), however, had almost similar reproductive attributes as those of the present study area. Reviewing the co-operative dairy condition of the country, Khan (2009) observed that the Pabna local and L×F crossbreds had much higher AP, CI and SPC, but GL of the cows was similar to the present result. A detailed study of the dairy cows under smallholder farming system in eight Thanas of Jessore District by Rokonuzzaman *et al.* (2009) revealed that SPC and CI of L×L were significantly higher than those of L×F, L×S and L×SL, which are similar to the present cows. But in contrast to this study, PPHP in the present L×F was much lower. The recent observations by Islam (2010) on the dairy cows of the greater Rajshahi conform to the present ones in that genotypes were

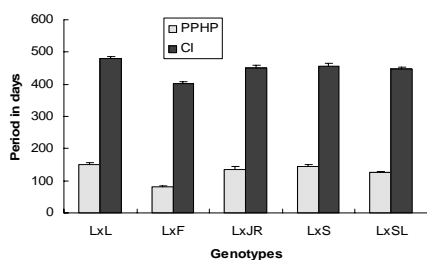
found to have significant effects on AP, AFC, SPC and PPHP traits in both the local and crossbreds. However, in contrast to the present findings, Alam and Sarder (2010) did not find any significant effect of cattle breeds on reproductive traits in Bogra; and Das *et al.* (2011) reported higher AFC but much lower PPHP and CI in the crossbred and local cows from 15 dairy farms in Chittagong metropolis. The aforesaid similarities and disagreements in reproductive performance in dairy cattle in various parts of the country are explainable in terms of genotypic, geographical, management and nutritional status of the experimental animals.

A huge literature is available on the productive performance of the local and exotic and/or crossbred dairy cows in the country. A comparison of milk yield among L×L and L×F, L×JR and L×SL cows raised at Savar, Dhaka was presented by Hossain *et al.* (2002), where DMY (3.24 kg), TMY (877 kg) and LL (254 days) had the highest values in L×F that are all much smaller than the present results. The LL (260.38 days) of the crossbreds (Das *et al.* 2003) was much shorter but the BWC (22.18 kg) of the local cows (Islam *et al.* 2004) was much higher than those of ours. Values of these important traits in both local and crossbred cattle reported by Khan *et al.* (2005), Mondal *et al.* (2005), Islam *et al.* (2006) and Al-Amin and Nahar (2007) differed considerably from those of the present ones. The productive performance of the L×F cows in Comilla (Miazhi *et al.* 2007) and Chittagong (Azizunnesa *et al.* 2008) was inferior to that of the greater Rajshahi (Islam 2010), which corroborates with the present results. In contrast, data on productivity of dairy cows including BWC from Khulna (Kabir and Islam 2009) were much higher than those of Rajshahi and Natore. The above studies, however, conform to the present findings in that genotypes of the dairy cattle were the obvious prime factor for such variations in the productive traits.

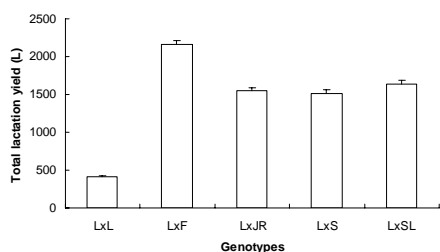
Effects of parity in dairy cows on such attributes as CI (Sattar *et al.* 2005; Tadesse *et al.* 2010), DMY (Islam *et al.* 2006) TMY (Azizunnesa *et al.* 2008), LL (Rokonuzzaman *et al.* 2009), BWC (Bwire 2006) and pregnancy rate (Balendran *et al.* 2008; Alam and Sarder 2010) were much similar to the present data, suggesting that mid-parity cows performed better than the early or late parity ones. However, this was not the case for the Holstein-Friesian×Zebu dairy cows in the Eastern lowland of Ethiopia (Mureda and Zeleke 2007) in which calving to first service intervals and calving to conception were significantly longest for the first and beyond 6<sup>th</sup> parities as compared to the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> parities.



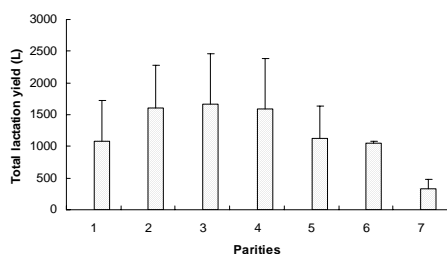
**Fig. 1.** Effect of genotypes on the age at puberty (AP) and age at first calving (AFCL) in the dairy cows in Natore District; LxL= local, LxF = localxFriesian; LxJR= localxJersey; LxS= localxSindhi and LxSL= localxSahiwal.



**Fig. 2.** Effect of genotypes on the postpartum heat period (PPHP) and calving interval (CI) in the dairy cows in Natore District; LxL= local, LxF = localxFriesian; LxJR= localxJersey; LxS= localxSindhi and LxSL= localxSahiwal.



**Fig. 3.** Effect of genotypes on the total lactation yield (TLY) in the dairy cows in Natore District; LxL= local, LxF = localxFriesian; LxJR= localxJersey; LxS= localxSindhi and LxSL= localxSahiwal.



**Fig. 4.** Effect of parities on the total lactation yield (TLY) in the dairy cows in Natore District.

## Conclusion

The present results clearly demonstrate that various reproductive and productive attributes of the local and crossbred cows in the smallholder dairy farms in Natore and adjacent areas are affected by both the genotypes and parities of the cows. The best genotype was the LxF, which had such desirable traits as AP, AFC, SPC, CI, DMY, TMV and LL compared to those in the local and the other crossbred counterparts. The experimental cows of the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> parities showed much better performance than the 1<sup>st</sup> and late (*i.e.* 5<sup>th</sup> and beyond) parities under the prevailing non-genetic conditions of the study area.

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