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Comparison of Reproductive Performance of Brahman Crossbred Females with other Available Cattle Genotypes in Mymensingh District

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Abstract

The study was conducted to evaluate the reproductive performance of Brahman crossbred females and compare them with other available cattle genotypes found in Mymensingh district. Reproductive performance data on 35 Brahman crossbreds, 32 Indigenous, 12 Sahiwal crossbreds and 21 Friesian crossbreds were collected from three different villages (Baera, Bhabkhali and Dowhakhola) adjacent to Bangladesh Agricultural University, Mymensingh. Statistical analyses were performed using Statistical Analysis System (SAS) computer program. Reproductive performance of Brahman crossbred was recorded as age at first service: 32.29 ± 1.46 months, age at first calving: 42.00 ± 1.49 months, service per conception: 1.7 ± 0.17, overall conception rate: 0.76 ± 0.05 (76.11%), conception at first service: 0.63 ± 0.08 (62.85%) and gestation length: 282.97 ± 0.78 days. Highly significant ($p<0.001$) effect of genotype was observed for age at first service and age at first calving; conception rate at first service differs significantly ($p<0.05$) among genotypes while service per conception, overall conception rate and gestation length were not significantly affected by genotype. Reproductive performance of Brahman crossbred heifer is within the moderate range and better for some traits (i.e. age at first service) than the other genetic groups studied (i.e. Indigenous, Sahiwal × Indigenous, Friesian × Indigenous).

Introduction

Bangladesh is a densely populated country, but the production of animal protein is immensely low to meet the demand for huge population and on the other hand demand of animal protein is increasing day by day. It is projected that demand for meat will continue to grow especially in the emerging developing countries like Bangladesh and prices will remain at a high level (Papry *et al*., 2020). The production of meat by indigenous cattle in Bangladesh is low because of their poor genetic makeup. Brahman is a promising beef cattle breed getting popularity day by day in Bangladesh (Mahbubul *et al*., 2020). Brahman or Brahman-based cows have lower reproductive rates compared with European breeds (Plasse, 1973). Brahman (*Bos indicus*) and their composite breeds mature later than Bos taurus breeds (Plasse *et al*., 1968a), have gestation lengths longer than *Bos taurus* breeds (Plasse *et al*., 1968b). The main indicators that would be considered in assessing reproductive performance are age at puberty, age at first calving, calving interval and number of services per conception (Aynalem *et al*., 2011; Demissu *et al*., 2013).

The reproductive performances of the crossbred cows may differ from that of the indigenous ones living in different geographical areas where the harsh environmental condition exists (Alam *et al*., 2001). As Brahman breed is a newly introduced breed in Bangladesh, there is a scarcity of information on reproductive traits of Brahman crossbred calves in Bangladesh. Evaluation of the reproductive performance of Brahman cross-bred female is necessary to disseminate Brahman breed in Bangladesh for the improvement of beef cattle by the up-grading program. In beef cattle, comparison across breeds is more important as crossbreeding at the commercial and farmer levels is common in our country. Considering the above facts and circumstances, the present study was designed under a farmer-participatory cattle up-grading program to evaluate and compare the reproductive performance of Brahman crossbred female generated at the community level in Mymensingh district.

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Materials and Methods

Feeding and management

Feeding system of calves from birth up to first calving at the rural condition were categorized depending on availability of dam milk and concentrate feed fed to the calves up to the age of first calving (i.e. Type 1- milk feeding + grazing, Type 2- milk feeding + grazing + concentrate, Type 3- only grazing and Type 4- grazing + concentrate).

Population size and data structure

Indigenous cows were inseminated with the crossbred Brahman (50% Brahman bull - 50% indigenous) bull semen in the selected areas of Mymensingh, Bangladesh. The population sizes are presented in Table 1.

Traits understudy

Age at first service

Age at puberty or first heat was assessed through behavioral estrus, and by the identification via rectal palpitation. The age at first service was recorded in month. The age was estimated and recorded by using dentition formulae and interviewing with owners.

Age at first calving

The age at first calving was estimated by using dentition formulae interviewing with owners and recorded as a month.

Conception rate

The pregnancy was diagnosed between 60 and 90 days after insemination by rectal palpation at the farmer's house with the help of artificial insemination (AI) technician. The overall conception rate was calculated as mean with standard error. First service conception rate (FSCR) for a particular group was determined by the number of heifers conceived to the first service divided by the number of heifers given the first service multiplied by 100.

$$\mathrm{FSCR}(\%) = \frac{\text{No. of heifers became pregnant at 1st service}}{\text{Total number of first service provided}} \times 100$$

Service per conception

This was defined as the average number of services or inseminations required for each successful conception. It is used as a measure of reproductive efficiency of female. It was calculated by dividing the total number of animal inseminated by the number of animal conceived.

Gestation length (GL)

Gestation length was calculated by the time of conceives to parturition. Gestation length of different crossbred heifers was recorded as days.

Data entry, reliability test and sorting

After completing the pre-tabulation task of the collected data, records of Brahman and other crossbred heifers were entered in Excel sheets of Microsoft office computer program. The collected data were tested for their normal distribution using the Statistical Analysis System (SAS) method and abnormal data were omitted from the data sheets.

Statistical analysis

The sorted data were analyzed by using the Statistical Analysis System (SAS) computer package (SAS, version, 9.1.3) according to the following linear model. DUNCAN test was performed to separate mean values in case of significant factors. A factorial design was used as an experimental design to calculate the effect of area, breed and feeding practices on each trait studied.
Statistical model for reproductive traits is as follows:

$Y = \mu + S_i + B_j + A_k + e_{ijk}$

Where, Y is a dependent variable (individual animal records for the animal); μ is the overall mean; S_i is the effect of area; B_j is the effect of type of feeding practices or the effect of genotype; A_{ij} is the interaction effect of area and type of feeding practice or genotype; e_{ij} is the residual error.

Results

Age at first service and age at first calving

The mean value with a standard error of age at first service and age at first calving of Brahman crossbred and other heifers are summarized in Table 2. High differences ($p<0.001$) were found among different genetic group for these traits. Lowest age at first service of 32.28±1.46 months and age at first calving of 42.00±1.49 months were found for Brahman crossbred among the four cattle group studied.

Service per conception, conception rate and conception rate at first service

While comparing these three traits a significant difference ($p<0.05$) was observed for conception rate at first service but genotype effect was non-significant for service per conception and conception rate (Table 3). Indigenous heifer showed the best performance with the lowest 1.41±0.41 service per conception, highest 0.86±0.05 overall conception rate and highest 0.84±0.06 conception at first service compared to Friesian crossbred, Sahiwal crossbred and Brahman crossbred respectively.

Gestation length

Brahman crossbred gestation length was found 282.97±0.77 days while the shortest gestation length was found 281.08±1.41 days for Indigenous heifers. The average value of gestation length of the different genetic groups studied is presented in Table 4.

Effect of different factors on reproductive performance of Brahman crossbred female

Area effect ($p<0.05$) were found for all considered traits except gestation length where area effect was non-significant. Feed shows significance ($p<0.05$) for service per conception, age at first service, conception rate at first service, overall conception rate with high significant ($p<0.01$) effect for age at first calving but did not affect gestation length. Area*feed interaction effect did not show significance among studied cattle genetic group. Effect of Area, genotype and area by genotype interaction effect on the performance of Brahman crossbred female are showed in Table 5.

Table 1. Number of cattle studied in the experiment

Area	Brahman× Indigenous	Indigenous	Shahiwal × Indigenous	Friesian × Indigenous	Total
Bhabkhali	11	11	7	7	36
Baera	8	10	2	10	30
Dowhakhola	16	11	3	4	34
Total	35	32	12	21	100

Table 2. Age at first service and age at first calving of different genetic group.

Genotype	N	Age at first service (month)	Age at first calving (month)
		Mean± SE	Mean± SE
Brahman × Indigenous	35	32.28^{a}±1.46	42.00^{a}±1.49
Indigenous	32	43.50^{b}±1.88	53.21^{b}±1.84
Sahiwal × Indigenous	12	41.66^{b}±1.88	51.33^{b}±1.95
Friesian × Indigenous	21	39.14^{ab}±1.63	47.80^{ab}±1.73
Significance level		***	***

N = number of observations; SE = standard error; means with different superscripts within a column differed significantly ($p<0.001$)

Table 3. Service per conception and conception rate of different genotype

Genotype	N	Service per Conception (Number)	Overall Conception rate (Per heifer)	Conception rate at first service (Per heifer)
		Mean ± SE	Mean ± SE	Mean ± SE
Brahman × Indigenous	35	1.71±0.17	0.76±0.05	0.63^{b}±0.08
Indigenous	32	1.41±0.14	0.86±0.05	0.84^{a}±0.06
Sahiwal × Indigenous	12	1.50±0.23	0.81±0.08	0.67^{b}±0.14
Friesian × Indigenous	21	1.43±0.18	0.85±0.06	0.81^{a}±0.09
Significance level		NS	NS	*

N = number of observations; SE = standard error; means with different superscripts within a column differed significantly ($p<0.001$)

Table 4. Mean value (±SE) of gestation length (day) for each genetic group

Genotype	Gestation length (day)	
	N	Mean ± SE
Brahman × Indigenous	35	282.97±0.77
Indigenous	32	283.34±0.77
Sahiwal × Indigenous	12	281.08±1.41
Friesian × Indigenous	21	282.71±1.19

N = number of observations

Table 5. Effect of different factors on different traits of Brahman crossbred

	Service per conception	Age at first service	Age at first calving	Conception rate at first service	Overall conception rate	Gestation length
Area	*	*	*	*	*	NS
Feed	*	*	**	*	*	NS
Area*Feed	NS	NS	NS	NS	NS	NS

NS = non-significant; *** = $p<0.001$; ** = $p<0.01$; * = $p<0.05$

Discussion

Age at first service and age at first calving

The overall mean value for age at first service of Brahman crossbred heifer was 32.29±1.46 months and genotype had strong significant ($p<0.001$) effect on age at first service (Table 2). Present findings are much higher than the report of 15.93 months (Chase *et al*., 1997) in Brahman × Angus crossbred heifer and 18.01±0.28 months (Rahman, 2020) for grade-1 Brahman crossbred heifer. In case of indigenous, Sahiwal crossbred and Friesian crossbred age at service were 43.50±1.88, 41.66±1.88 and 39.14±1.63 months, respectively. Brahman crossbred showed better performance among the four genotypes considered in the study. Fluctuation in age at first service may be due to heredity, feeding practices, management and environment.

In this study, it was found that age at first calving for Brahman crossbred heifer was 42.00±1.49 months. The present result was longer than the report of 25.08±7.7 months (Chase *et al*., 2004) for Brahman × Angus cows in Florida, United States of America, 31.3±4.12 months (Motta-Delgado *et al*., 2015) for F_1 Holstein × Brahman cows in Colombia and 1038±13.7 days (Magna and Segura-Correa, 2001) in Brahman cows in south-eastern Mexico. In contrary to this study, Tumwasorn *et al*. (1982) found 48 months for age at first calving in Brahman-Native crossbred in Thailand. Age at first calving found 47.80±1.73 months for Friesian crossbred, 51.33±1.95 months for Sahiwal crossbred and 53.21±1.84 months for Indigenous cow in this study and differ significantly ($p<0.001$) among various genotypes (Table 2). Brahman crossbred performance for age at first service was best among the four genotypes studied in this experiment. Lower the age at first calving better the reproductive performance of milch animals and vice-versa.

Service per conception, conception rate and conception rate at first service

Lesser number of services per conception, better the reproductive performance of milch animals and vice-versa. Service per conception for Brahman crossbred heifer in this study was 1.71±0.17 (Table 3). This estimate agrees with Tumwasorn *et al*. (1982) who found 1.7 services per conception for Brahman-Native cow in Thailand. This result was higher than the report of 1.10±0.03 (Rahman, 2020) for grade-1 Brahman crossbred in Bangladesh, 1.48 (Khotimah *et al*., 2018) for Brahman crossbred in Indonesia. Brahman crossbred required the highest number of (1.71±0.17) service for each conception whereas Indigenous required lowest (1.41±0.14) number of service and Friesian crossbred and Sahiwal crossbred are intermediate (1.43±0.18, 1.50±0.23) to them. Service per conception of heifers varies due to the effect of different factors such as genotype, nutrition and other managerial factors related to insemination.

The overall mean for conception rate of Brahman crossbred was 0.76±0.05 (Table 3). This estimate is better than the normal standard of 65% (Phillips, 2010) and higher than the report of Fatematuzzohora *et al*. (2016) who stated 63.11% for Brahman crossbred heifer, 55.3% (Islam *et al*., 2019) for Brahman crossbred, 88.33% (Rahman, 2020) for grade-1 Brahman crossbred cattle and 69.3% (Khotimah *et al*., 2018) for Brahman crossbred in Indonesia. Highest conception rate (0.86±0.05) was found for indigenous and lowest for Brahman crossbred while Friesian crossbred and Sahiwal crossbred were intermediate. Difference in the breed of cow, age of cow, parity number, insemination time, quality of semen, skill of the AI worker and health status of the animal may influence the conception rate.

In the present study, the overall mean of first service conception rate was 0.63±0.08 for Brahman crossbred which was in the range of ideal values (50% or higher) for this trait (Hutchinson, 1984). This result is higher than the findings of 47.5% conception rate at first service for *Bos indicus* (Zebu) cows reported by Mukasa-Mugerwa *et al*. (1991) in Ethiopia. On the other hand, our findings were lower than the report of Abe *et al*. (2009) who found 69.0% first service conception rate for Holstein heifer and cows in Japan. Highest first service conception rate was found for Indigenous cows (0.84±0.06) followed by Friesian crossbred cows (0.81±0.09), Sahiwal crossbred cows (0.67±0.14) and Brahman crossbred cows (0.63±0.08). The first service conception rate was significantly ($p<0.05$) affected by genotype.

Gestation length

The overall mean for gestation length for Brahman × Indigenous cattle was 282.97±0.77 days and this trait was not affected by genotype (Table 4). The gestation length of Brahman crossbred in this study found was shorter than the report of 286±1.1 days (Rae, 2002) for Angus-Brahman crossbred, 290±1 days for Red Brahman × Hereford and 291±1 days for Gray Brahman× Hereford (Sanders *et al.*, 2005). Among four genotypes studied in this experiment, Brahman crossbred gestation length was comparatively longer than Sahiwal crossbred (281.08±1.41 days) and almost similar to Friesian crossbred (282.71±1.19 days) but better than indigenous cows (283.34±0.77 days). The variation in gestation length is genetically determined. A little variation in gestation length within individual may be contributed mainly by age of dam, nutritional body condition of dam and sex of the foetus, formation of twin and hormonal functions of the foetus. Environmental factors such as season, temperature, feeding and management may also contribute to some extent (Mostari *et al*., 2007).

Effect of different factors on reproductive performance of Brahman crossbred female

Area had significant ($p<0.05$) effect on service per conception, age at first service, age at first calving, conception rate at first service and overall conception rate while gestation length was not affected by area. In the support of this result, Kabir (2000) also found that location had significant ($p<0.05$) effect on conception rate on cows and Bahmnai *et al*. (2011) found that region had no significant influence on gestation length of crossbred female. Feed had strong significant ($p<0.01$) effect on age at first calving and significant ($p<0.05$) effect on service per conception, age at first service, conception rate at first service and overall conception rate. These results agree with the findings of Mollah *et al*. (2015) who also found that conception rate was significantly ($p<0.05$) influenced by feeding practices in Zebu cattle. Feed effect was non-significant on gestation length. Interaction effect of area by feeding had no significant effect on any one of the reproductive traits considered in this study.

Conclusion

According to our data, we can conclude that the reproductive performance of Brahman crossbred heifers maintained under the rural condition was comparatively satisfactory and improvable through improved management. However, further research with large sample size is suggested for a better conclusion.

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Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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