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Effect of sire and environment on growth performance of grade-2 Brahman calves

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ABSTRACT

The present study was carried out to evaluate the effect of sire and environment on growth performance of grade-2 Brahman calves. A total of 70 grade-2 Brahman calves produced from 6 sires (14BR0043, 7BR-524, 14BR0040, 7BR-527, 14BR0041,7BR-522) were included in this study to know the effect of different sires on calves growth performances those located on 8 different areas (Barisal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, Sylhet). Analyses were performed by using Statistical Analysis System (SAS) version 9.1.3. Analyses revealed that sires had significant effect ($p<0.05$) on 1-month, 6-month, 24-month weights and average daily gain. In contrast, non-significant effect ($p>0.05$) was observed on birth weight, 3-month, 9-month and 12-month weights of progeny. The highest mean birth weight (32.27±0.59 kg) and 1-month weight (57.58±2.11 kg) of calves was found from the sire 14BR0040 and 14BR0041, respectively. The highest mean of 3-month (81.57±3.13 kg), 6-month (186.71±6.20 kg), 9-month (332.43±8.07 kg), 12-month (463.57±13.61 kg) and 24-month (903.33±16.71 kg) weights were found by sire 7BR-524, 14BR0043, 14BR0043, 7BR-524 and 14BR0040, respectively. The area significantly ($p<0.01$) affected on 3-month and 6-month weight of calves. The highest 3-month weight (90.00±7.52 kg) and 6-month weight (184.06±3.79 kg) of calves were recorded in Barisal and Rangpur, respectively. The average daily gain (ADG) of progeny from birth to 6-months had been significantly ($p<0.01$) influenced by different areas. The strong positive correlation between ADG from 12 to 24 months and ADG from 0 to 24 months was 0.91. This result showed that the sire and environment had significant effect on above growth traits at different ages of Brahman progeny, which indicated that best sire in best environment can produce superior progeny. As Brahman breed are good meat producer and the average daily gain is quite satisfactory in the specific location so it is concluded that Brahman breed can be a valuable alternative approach for increasing meat production. However, further study with large sample size of grade-2 Brahman should be taken to increase beef production.

Introduction

Sire and environment effect on early progeny growth are important indicators for superior beef breed production. Limited research related to growth and performance of Brahman cattle has been done as compared to *Bos taurus* breeds. Brahman crossbred cows expressed hot adaptive nature, harsh environments and high heterosis for reproductive and maternal traits due to widespread use of the breed in cow-calf production (Riley *et al*., 2004). Recently, the Brahman bull is a popular choice for farmers because of his superior characteristics and better performance. Although livestock is an integral component of agricultural production system in Bangladesh, but the production of animal protein is comparatively lagging behind to meet the demand for huge population, and this demand is incrementally increasing day by day. Now, yearly approximate meat production is 7.26 million MT but the total meat requirement is 12.1 million MT (DLS, 2018). So, still there is a need to produce 4.84 million MT more meat yearly to reach the target of fulfilment of meat requirement for human consumption. The reason of this deficiency of meat is the insufficient beef cattle production in Bangladesh. Nowadays, there has a great contribution of poultry population to fulfil the demand of meat in Bangladesh. If we want to get beef meat availability as like as poultry meat, we have to increase beef cattle production. Through increasing well adapted beef cattle production this contribution can also be improved.

Beef is the most promising and desirable meat in Bangladesh and all over the world. But Bangladesh has no planned beef cattle production practices. Due to lack of appropriate beef fattening program in Bangladesh for sufficient production, the price of beef has been increased gradually. To fulfil the requirement of meat, a well-adapted beef cattle genotype having higher growth

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rate and more meat producing ability is necessary to increase the beef production in Bangladesh. According to Bondoc *et al*. (1989), the highly commercial and specialized beef cattle improvement systems practiced in developed countries may not be biologically and economically suitable in developing situations. So, the selective breeding within superior local stock can be cultivated for increasing the genetic potential of our beef cattle widely to meet up the future challenge of animal product. Superior bull selection is very much essential to get superior progeny having higher growth rate which may help to increase meat production and also increase the productivity of existing stock. As Brahman is a fast growing and high yielding meat producing cattle suitable under tropical environments, so Brahman is thought to be the most suitable beef breed for increasing meat production in Bangladesh. According to Antonio *et al.* (2006), Brahman breed is the most suitable and compatible beef breed in tropical and sub-tropical region. The present study was commenced to evaluate the effect of sire and environment on growth performance of grade-2 Brahman calves which will be helpful to make decision for beef breeding. In considering the above facts and circumstances, it is clear that in present context beef production might be the positive initiative for diminishing the gap between demand and supply of meat. Thus, the present study was undertaken to evaluate the effect of Brahman breeding bulls on progeny early growth performance and phenotypic correlations among the growth traits at different ages of Brahman crossbred calves.

Materials and Methods

The present study was conducted with grade-2 Brahman calves cherished in different farmers' level of 12 different upazilas of 11 different districts of 8 divisions of the country under the control of Department of Livestock Services (DLS) and Department of Animal Breeding and Genetics, Bangladesh Agricultural University, Mymensingh.

Site of the experiment and period

This study was conducted at Central Cattle Breeding and Dairy Farm and 12 different upazilas (Barisal Sadar, Chhagalnaiya, Tungipara, Jashore Sadar, Dewangonj, Belkuchi, Sariakandi, Chowhali, Pirganj, Chirirbandar, Takurgaon Sadar, Moulovibazar Sadar) those were in 8 divisions (Barisal, Chattogram, Dhaka, Khulna, Mymensingh, Rajshahi, Rangpur, Sylhet) during the periods of January 2018 to March 2019. The entire activities of this experiment were performed with the collaboration of DLS and Department of Animal Breeding and Genetics of Bangladesh Agricultural University, Mymensingh through execution of a project entitled "Genetic improvement of indigenous cattle for beef production through crossing with Brahman cattle by farmers' participatory breeding approach in Bangladesh" under the financial support from NATP.

Source of data on 75% Brahman calves

In this experiment, the grade-1 Brahman heifers were taken which were produced from indigenous cows inseminating by Brahman (100%) frozen semen and then grade-1 Brahman cows were inseminated by 100% Brahman frozen semen to produce the grade-2 Brahman calves. Performance of those grade-2 calves were evaluated at different farmers' level. A total of 70 grade-2 Brahman (75%) calves were included in this experiment of which 39 males and 31 females' calves. All data such as date of artificial insemination, date of calving, weight of different growth stages was collected from the herd book recorded in Upazila Livestock Office with the help of community research assistants in the respective selected research areas of DLS with its ongoing project.

Mating plan

In this experiment, the Local and G_1 heifers (Brahman×Local) were inseminated by imported frozen semen of 6 different proven sires of Brahman breed for producing grade-2 Brahman progeny and measuring their growth performance at early stage. The mating plan of this experiment is showed in Fig. 1.

Measurement of weights

Birth weight, one-month and three-month weights were measured with a balance and six-month, nine-month, twelve-month and twenty-four month weights were calculated according to Shaeffer's formula as described by Hossain and Akhter (1999).

Statistical analysis

The growth traits studied in this experiment for measuring the progeny performance were- birth weight, one-month, three-month, six–month, nine–month, twelve–month and twenty four–month weight as well as average daily gain at different stages. The significance of fixed effects was tested by least-squares analyses of variance using generalized linear model (GLM) procedure of the Statistical Analysis System (SAS, 2009). Mean comparisons were estimated by Duncan's multiple range test (DMRT) method. The following generalized linear model was used for analyses:

$$Y_{ijkl}=\mu + S_i+ Aj+ X_k+ S_i*A_j+ e_{ijkl}$$

Where, Y_{ijkl}= Observation on traits; μ = Overall mean; S_i= Effect of Sire; A_j= Effect of area; X_k= Effect of sex; S_i*A_j= Interaction effect of sire by area and e_{ijkl}= Residual error.

Results

Effect of bull on progeny growth traits

Table 1 imparted that there had significant effect ($p<0.05$) of sires on progeny one-month and six-month weights and non-significant effect on birth weight and three-month weight. Highest average for one-month

weight's (57.58±2.11 kg) was found in the calves of sire 14BR0041 and the lowest mean (46.67±4.21 kg) of that trait was found from the sire 7BR-527. The highest mean of six-month weight (186.71±6.20 kg) was found in the calves of sire 14BR0043 and the lowest mean (157.71±6.20 kg) was found in the calves of sire 7BR-524. Table 1 also depicted sire had non-significant effect ($p>0.05$) on progeny's nine months weight and twelve months weight and had significant effect ($p<0.05$) on progeny's twenty four months weight. The highest mean of twenty four month weight (903.33±16.71 kg) of calves was observed for the sire 14BR0040 and the lowest average (824.29±24.46 kg) of calves was recorded from 7BR-524 sire. Average daily gain (ADG) at different stages of calves were significantly ($p<0.01$) affected by different sires (Table 2). The sire had significant effect on ADG from birth to six-month, six to twelve-month, twelve to twenty four-month and birth to twenty four-month respectively and each sire influenced on ADG of their progeny performances severally. The highest mean of ADG from birth to six-month was found 872.29±35.38g which was recorded from the progeny of sire 14BR0043 and the lowest mean of that one was 700.00±35.38g from the progeny of sire 7BR-524. The highest mean of ADG from 6-12 months age was found 1699.29±82.89g for the progenies of sire 7BR-524 and the lowest mean of that trait was 1433.33±126.61g for the progeny of sire 7BR-527. In case of ADG from 12-24 months age, the maximum value of calves' body weight gain (1266.67±128.14g) was recorded from sire 7BR-527 and the minimum daily gain of calves' body weight (988.14±83.89g) was found from sire 7BR-524. The highest mean ADG from birth to twenty four-months of calves (1193.20±22.81g) had been recorded from sire 14BR0040 and the lowest mean (1085.71±33.40g) of calves observed from the sire 7BR-524.

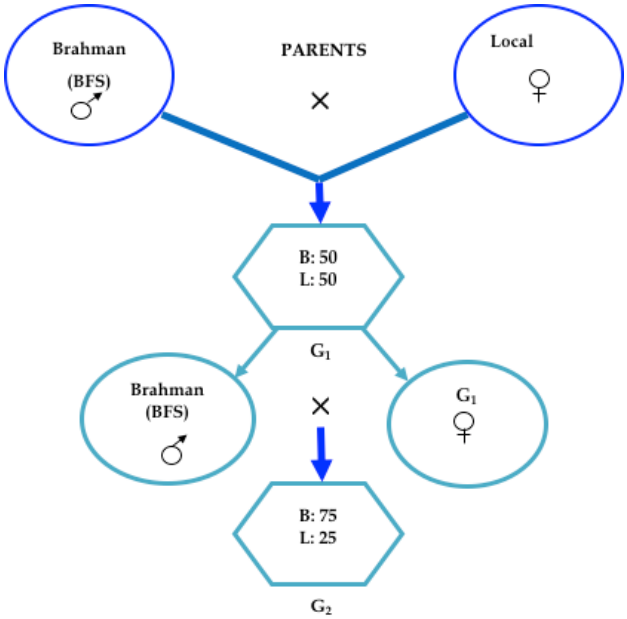

Fig. 1. Mating plan of the experiment (BFS, Brahman Frozen Semen; B, Brahman Crossbred; L, Local; G_1, Grade-1; G_2, Grade-2)

Table 1. Effect of breeding bull on progeny birth weight to twenty four-month weight

Sire ID	Mean±SE (kg)						
	Birth weight	WT1	WT3	WT6	WT9	WT12	WT24
14BR0043	29.71^{a}±0.86 (7)	52.43^{ab}±2.76 (7)	80.86^{a}±3.13 (7)	186.71^{a}±6.20 (7)	332.43^{a}±8.07 (7)	459.29^{a}±13.61 (7)	852.57^{ab}±24.46 (7)
7BR-524	31.71^{a}±0.86 (7)	55.14^{ab}±2.76 (7)	81.57^{a}±3.13 (7)	157.71^{c}±6.20 (7)	323.43^{a}±8.07 (7)	463.57^{a}±13.61 (7)	824.29^{b}±24.46 (7)
14BR0040	32.27^{a}±0.59 (15)	53.40^{ab}±1.88 (15)	78.27^{a}±2.14 (15)	180.27^{ab}±4.24 (15)	318.47^{a}±5.52 (15)	454.53^{a}±9.30 (15)	903.33^{a}±16.71 (15)
7BR-527	31.33^{a}±1.31 (13)	46.67^{b}±4.21 (13)	76.33^{a}±4.78 (13)	179.67^{ab}±9.48 (13)	330.67^{a}±2.33 (13)	437.67^{a}±20.79 (13)	900.00^{ab}±37.36 (13)
14BR0041	31.50^{a}±0.66 (14)	57.58^{a}±2.11 (14)	79.83^{a}±2.39 (14)	172.17^{abc}±4.74 (14)	327.42^{a}±6.17 (14)	456.75^{a}±10.40 (14)	845.17^{ab}±18.68 (14)
7BR-522	32.00^{a}±0.61 (14)	49.79^{ab}±1.95 (14)	79.64^{a}±2.21 (14)	163.43^{bc}±4.39 (14)	329.21^{a}±5.71 (14)	455.00^{a}±9.62 (14)	859.64^{ab}±17.29 (14)

Means with different superscript within same column differed significantly ($p<0.05$); SE, standard error; WT1, one-month weight; WT3, three-month weight; WT6, six-month weight; WT9, nine-month weight; WT12, twelve-month weight; WT24, twenty four-month weight, respectively. The parentheses indicate the number of observations

Table 2. Effect of breeding bull on average daily gain at different stages of progeny

Sire ID	Mean±SE (g)			
	$ADG_{(0-6)}$	$ADG_{(6-12)}$	$ADG_{(12-24)}$	$ADG_{(0-24)}$
14BR0043	872.29^{a}±35.38 (7)	1514.29^{ab}±82.89 (7)	1077.57 ^{ab}±83.89 (7)	1127.29^{ab}±33.40 (7)
7BR-524	700.00^{c}±35.38 (7)	1699.29^{a}±82.89 (7)	988.14^{b}±83.89 (7)	1085.71^{b}±33.40 (7)
14BR0040	822.20^{ab}±24.17 (15)	1523.80^{ab}±56.62 (15)	1229.60^{ab}±57.30 (15)	1193.20^{a}±22.81 (15)
7BR-527	824.00^{ab}±54.04 (13)	1433.33^{b}±126.61 (13)	1266.67 ^{a}±128.14 (13)	1190.00^{a}±51.01 (13)
14BR0041	781.50^{abc}±27.02 (14)	1581.08^{ab}±63.30 (14)	1064.08 ^{ab}±64.07 (14)	1114.67^{ab}±25.51 (14)
7BR-522	730.29^{bc}± 25.01 (14)	1619.93^{ab}±58.61 (14)	1108.64 ^{ab}±59.32 (14)	1133.86^{ab}±23.61 (14)

Means with different superscript within same column differed significantly ($p<0.01$); SE, standard error; $ADG_{(0-6)}$,Average daily gain from birth to six-month weight; $ADG_{(6-12)}$, Average daily gain from six-month to twelve-month weight; $ADG_{(12-24)}$, Average daily gain from twelve-month to twenty four-month weight; $ADG_{(0-24)}$, Average daily gain from birth to twenty four-month weight respectively. The parentheses indicate the number of observations

Effect of sex on progeny growth traits

Table 3 imparts that there was no significant effect ($p>0.05$) of calf sex on birth weight, one-month weight, three-month weight and six-month weight, nine-month weight, twelve-month weight and twenty four-month weight.

Effect of area on progeny growth traits

The effect of area on different growth traits are shown in Table 4 and Table 5. The area had no significant ($p>0.05$) effect on birth weight and one-month, nine-month weight, twelve-month and twenty four-month weight of calves. But in terms of three and six-month weight of calves, the area affected significantly ($p<0.01$) on those traits. The highest three-month weight (90.00±7.52 kg), six-month weight (184.06±3.79 kg) of calves had been found in Barisal, Rangpur and the corresponding lowest three-month (63.00±5.32 kg) and, six-month weight (150.00±16.06 kg) of calves had been found in Mymensingh, Chattogram, respectively. The ADG of progeny from birth to six-month weight had been significantly ($p<0.01$) affected by different areas and the ADG of progeny from six-month to twelve-month, from twelve-month to twenty four-month weight and from birth to twenty four-month weight found from different areas were non-significant (Table 5). The highest ADG from 0-6 months (850.67±21.54g) of calves was found in Rangpur and the lowest ADG from 0-6 months (644.00±91.39g) of calves was observed in Chattogram.

Phenotypic correlation of progeny growth traits

Both positive and negative phenotypic correlation among the growth traits of grade-2 Brahman progeny were found in this study (Table 6 and Table 7). There was strong positive correlation (0.91) was found between ADG from twelve to twenty four-month and ADG from birth to twenty four-month. Moderate to high and negative correlations were observed between ADG from birth to six-month and six to twelve-month (-0.49), between ADG from six to twelve-month and twelve to twenty four-month (-0.64). The estimated negative phenotypic correlation might be due to small number of animals were considered in analysis. On the contrary, the weak positive correlations were found between ADG from birth to six-month and twelve to twenty four-month (0.20), between ADG from birth to six-month and birth to twenty four-month (0.24).

Discussion

Effect of bull on growth traits of calves

From the observation of present study, highest mean of one-month, six-month and twenty four-month weight was found in the calves of sire 14BR0041 and 14BR0043 and 14BR0040 respectively. However, the present study indicated that every sire had effects on above growth traits severally i.e. sire had effects on the age of progeny. There had high significant effects among the mean of calves from one sire to another sires. Haque *et al.* (2016) showed bull had no significant effect ($p>0.05$) on birth weight and three-month weight but significant ($p<0.05$) effect on six-month, nine-month and twelve-month weight which were slightly related to this study. Beside this, the present study showed the birth weights of grade-2 Brahman progeny which were higher than those of the previous study, Rashid *et al* .(2016), Khatun (2012), and Tahira (2018). This result might be owing to cumulative effects of better growth potential genes of pure Brahman cattle (Haque *et al.,* 2016). These highest birth weights proves that bulls with better genotype produce better progeny because birth weight is an important growth trait indicator for selection a good beef breed. Salim *et al.* (2015) stated for Dhofari breed calves that had high birth weight class sire produced heavier ($p<0.05$) calves at birth, weaning, yearling, pre-weaning and post weaning daily gain than medium and low birth weight class sire.

Effect of bull on average daily gain

Many researchers showed that ADG affected by many factors. Sire is one of the factors which effects on the ADG of its progeny. From the results, it is evident that ADG of calves at different stages had high significant ($p<0.01$) effect from one sire to another. So, there had high significant ($p<0.01$) effect on ADG from one sire to another.

Table 3. Effect of calf sex on progeny birth weight to twenty four-month weight

Calf sex	Mean±SE (kg)						
	Birth Weight	WT1	WT3	WT6	WT9	WT12	WT24
Male	31.60^{a}±0.39 (39)	53.29^{a}±1.30 (39)	79.94^{a}±1.37 (39)	174.34^{a}±3.10 (39)	326.20^{a}±3.58 (39)	452.06^{a}±5.88 (39)	871.11^{a}±11.47 (39)
Female	31.65^{a}±0.49 (31)	52.91^{a}±1.61 (31)	78.91^{a}±1.68 (31)	169.83^{a}±3.83 (31)	325.26^{a}±4.42 (31)	461.74^{a}±7.25 (31)	855.48^{a}±14.15 (31)

Means with different superscript within same column differed significantly ($p<0.05$); SE, standard error; WT1, one-month weight; WT3, three-month weight; WT6, six-month weight; WT9, nine-month weight; WT12, twelve-month weight; WT24, twenty four-month weight, respectively. The parentheses indicate the number of observations

Table 4. Effect of area on progeny birth weight to twenty four-month weight

Study area	Mean±SE (kg)						
	Birth Weight	WT1	WT3	WT6	WT9	WT12	WT24
Barisal	33.00^{a}±2.39 (5)	60.00^{a}±7.62 (5)	90.00^{a}±7.52 (5)	155.00^{ab}±16.06 (5)	300.00^{a}±21.47 (5)	485.00^{a}±36.37 (5)	899.00^{a}±67.47 (5)
Chattogram	34.00^{a}±2.39 (5)	61.00^{a}±7.62 (5)	87.00^{a}±7.52 (5)	150.00^{b}±16.06 (5)	298.00^{a}±21.47 (5)	465.00^{a}±36.37 (5)	880.00^{a}±67.47 (5)
Dhaka	31.71^{a}±0.90 (7)	55.14^{a}±2.88 (7)	81.57^{a}±2.84 (7)	157.71^{ab}±6.07 (7)	323.43^{a}±8.12 (7)	463.57^{a}±13.75 (7)	824.29^{a}±25.50 (7)
Khulna	31.50^{a}±1.19 (4)	53.00^{a}±3.81 (4)	77.50^{a}±3.76 (4)	177.00^{ab}±8.03 (4)	317.75^{a}±10.74 (4)	468.50^{a}±18.19 (4)	907.75^{a}±33.74 (4)
Mymensingh	32.00^{a}±1.6 (6)	50.50^{a}±5.39 (6)	63.00^{b}±5.32 (6)	157.50^{ab}±11.36 (6)	330.00^{a}±15.18 (6)	439.50^{a}±25.72 (6)	818.50^{a}±47.71 (6)
Rajshahi	31.88^{a}±0.60 (16)	49.50^{a}±1.91 (16)	80.25^{a}±1.88 (16)	166.06^{ab}±4.016 (16)	330.06^{a}±5.37 (16)	453.31^{a}±9.09 (16)	865.94^{a}±16.87 (16)
Rangpur	30.94^{a}±0.56 (18)	54.83^{a}±1.80 (18)	80.61^{a}±1.77 (18)	184.06^{a}±3.79 (18)	326.89^{a}±5.06 (18)	452.61^{a}±8.57 (18)	857.72^{a}±15.90 (18)
Sylhet	32.00^{a}±0.80 (9)	53.67^{a}±2.54 (9)	77.11^{a}±2.51 (9)	178.44^{ab}±5.35 (9)	326.67^{a}±7.16 (9)	454.89^{a}±12.12 (9)	894.89^{a}±22.49 (9)

Means with different superscript within same column differed significantly ($p<0.01$); SE, standard error; WT1, one-month weight; WT3, three-month weight; WT6, six-month weight; WT9, nine-month weight; WT12, twelve-month weight; WT24, twenty four-month weight, respectively. The parentheses indicate the number of observations

Table 5. Effect of area on average daily gain at different stages of progeny

Study area	Mean±SE (g)			
	$ADG_{(0-6)}$	$ADG_{(6-12)}$	$ADG_{(12-24)}$	$ADG_{(0-24)}$
Barisal	678.00^{ab}±91.39 (5)	1833.00^{a}±219.31 (5)	1134.00^{a}±234.40 (5)	1186.00^{a}±92.03 (5)
Chattogram	644.00^{b}±91.39 (5)	1750.00^{a}±219.31 (5)	1137.00^{a}±234.40 (5)	1159.00^{a}±92.03 (5)
Dhaka	700.00^{ab}±34.54 (7)	1699.29^{a}±82.89 (7)	988.14^{a}±88.59 (7)	1085.71^{a}±34.78 (7)
Khulna	808.50^{ab}±45.69 (4)	1619.50^{a}±109.65 (4)	1203.50^{a}±117.20 (4)	1200.25^{a}±46.02 (4)
Mymensingh	697.50^{ab}±64.62 (6)	1566.50^{a}±155.07 (6)	1038.50^{a}±165.74 (6)	1077.50^{a}±65.08 (6)
Rajshahi	745.56^{ab}±22.85 (16)	1595.94^{a}±54.83 (16)	1130.50^{a}±58.60 (16)	1142.63^{a}±23.01 (16)
Rangpur	850.67^{a}±21.54 (18)	1492.06^{a}±51.69 (18)	1109.89^{a}±55.25 (18)	1132.67^{a}±21.69 (18)
Sylhet	813.44^{ab}±30.46 (9)	1535.89^{a}±73.10 (9)	1205.44^{a}±78.13 (9)	1182.00^{a}±30.68 (9)

Means with different superscript within same column differed significantly ($p<0.01$); SE, standard error; $ADG_{(0-6)}$, Average daily gain from birth to six-month weight; $ADG_{(6-12)}$, Average daily gain from six-month to twelve-month weight; $ADG_{(12-24)}$, Average daily gain from twelve-month to twenty four-month weight; $ADG_{(0-24)}$, Average daily gain from birth to twenty four-month weight respectively. The parentheses indicate the number of observations

Table 6. Phenotypic correlation among the growth traits (from birth to twenty four-month weight) of Brahman progeny

Growth Trait	WT1	WT3	WT6	WT9	WT12	WT24
Birth Weight	0.08	0.09	-0.17	-0.19	0.11	0.14
WT1		0.22	0.05	-0.25	0.04	0.01
WT3	-		-0.06	-0.01	0.05	-0.05
WT6	-	-		-0.06	-0.02	0.25
WT9	-	-	-		-0.03	-0.22
WT12	-	-	-	-		-0.25

WT1, one-month weight; WT3, three-month weight; WT6, six-month weight; WT9, nine-month weight; WT12, twelve-month weight; WT24, twenty four-month weight, respectively

Table 7. Phenotypic correlation among the average daily gain of 75% Brahman progeny at different ages

Growth Trait	$ADG_{(6-12)}$	$ADG_{(12-24)}$	$ADG_{(0-24)}$
$ADG_{(0-6)}$	-0.49	0.20	0.24
$ADG_{(6-12)}$	-	-0.64	-0.32
$ADG_{(12-24)}$	-	-	0.91

$ADG_{(0-6)}$, Average daily gain from birth to six-month weight; $ADG_{(6-12)}$, Average daily gain from six-month to twelve-month weight; $ADG_{(12-24)}$, Average daily gain from twelve-month to twenty four-month weight; $ADG_{(0-24)}$, Average daily gain from birth to twenty four-month weight, respectively

As the higher daily gain of calves at 24-month age was found from sire 14BR0040, so this sire may be the best genotype then the others. This finding completely agrees with the studies of Taslim (2014), Haque *et al.* (2011), Saha (2016) and Khatun (2012) who stated that area, bull and sex had significant effects ($p<0.01$) on average daily gain of Brahman cross calves. Tahira (2018) found the highest average daily gain of Brahman crossbreds by bull 14BR-41 for male (783.89±47.26g) and by bull 7BR-527 for female (727.12±31.73g). According to Haque *et al.* (2016), ADG was significantly higher (570.52±5.19g) in 50% Brahman cross than 25% Brahman cross calves (529.98±4.54g). Bondoc and Forte (2007) showed that the ADG at pre-weaning was significantly affected by the sire ($p<0.05$) and Browning *et al.* (1995) showed that sire breed of calf affected ($p<0.05$) calf weaning weight and ADG which strongly supports to the present study. From above discussion, it is evident that average weights at different ages of 75% Brahman cross calves were higher than those of 50% Brahman cross calves and 25% Brahman cross calves. The reason of this variation may be the cumulative effects of better growth potential genes in 75% Brahman cattle than the lower genetic proportion of Brahman. But there is no available literature that helps to point out a better discussion and conclusion for 75% graded Brahman. Moreover, the findings of this study are comparable with the findings of Sarkar *et al*. (2010) who explained that the ADG of Red Chittagong and Holstein-Friesian bull calves was 270g and 360g, respectively. Similarly, Osei *et al.* (1991) found growth rates for Friesian calves bred in the humid forest zone of Ghana averaged 0.44 kg per day from birth to three months, 0.27 kg per day from three to six months and 0.23 kg per day from six to nine months which is lower than the present study. Comparison with Brahman bulls to bulls of other breeds in terms of growth performance indicates that Brahman is the best and suitable genotype for beef breed production in Bangladesh. So, this present study indicates that Brahman cattle can be bred and maintained for beef production in tropical and sub-tropical environments.

Effect of sex on progeny growth traits

The findings of the present study of effect of calf sex on growth traits of progeny are agreed to the findings of the study of Janus and Antoszek (1999), Rabeya *et al.*(2009) and Messine *et al.* (2007) and disagreed to that of the study of Afroz *et al.*(2011), Kabir and Islam (2009) and De Oliveira *et al.*(1982). In present study, the male calve weights were higher than the female calves weights which might be due to greater skeletal growth rate of male calves compared to female calves.

Effect of area on progeny growth traits

The outcome of the present study narrated in result section is related to the findings of Haque *et al.* (2011) who reported that area and sex had highly significant ($p<0.001$) effects on birth weight, yearling weight and average daily gain of Brahman × Local calves. As the highest six-month weight and ADG from 0-6 months of calves was found in Rangpur and the lowest six-month weight and ADG from 0-6 months of calves was observed in Chattogram, So, it indicates that the environment of Rangpur area may be the best for better growth of Brahman calves. As to be expected, farmers of Rangpur region were highly interested in producing beef cattle and provided good care and management condition that translates into a higher weight in Brahman calves. This could also be due to good environmental conditions and the availability of the quality and quantity of forage at Rangpur than other areas.

Phenotypic correlation of progeny growth traits

The results indicated that both positive (ranging from 0.05 to 0.25) and negative (ranging from -0.01 to -0.25) correlations among the growth traits from birth to twenty four-month weight of the Brahman progeny were found. The present study stated that the strong positive correlations between ADG from twelve to twenty four-month and ADG from birth to twenty four-month (0.91) which revealed that selection based on growth traits would help to improve the correlated traits in the upcoming generations. The strong positive correlation values indicate the constant weight gain of progeny. This findings are supported by Saha (2016) who explained that the genetic and phenotypic correlations between average daily gains at different stages of growth of 25% Brahman calves were positively and highly correlated among themselves (r_g ranged from 0.78±0.29 to 0.88±0.18 and r_p ranged from 0.52 to 0.71). On the contrary, Haque *et al*. (2016) observed strong positive correlation between birth weight and weight at three-month (0.65), between weights at six- and nine-month (0.65) as well as moderate phenotypic correlations between birth weight and weight at six-month (0.52) and nine-month weight (0.63), between three- and six-month weight (0.60) and nine-month weight (0.62), respectively which are not similar to the findings of present study.

Conclusion

The effect of sire and environment on progeny growth of grade-2 Brahman calves using the growth performance data of those calves will be helpful to find out the best genotype for beef production and to make decision for

beef breeding. The higher significant weight of growth traits observed from different sires indicate that Brahman cattle has the ability of higher growth rate and building up greater final body weight with excellent body conformation and size. The significant effects ($p<0.01$) of area on three-month and six-month weight of calves indicate that weight of grade-2 Brahman calves can vary due to change in different areas. The strong positive phenotypic correlation point out that selection for growth traits will help to increase growth yield at following generation. The findings of this study indicate that grade-2 Brahman crossbred can be a valuable stock to improve meat production and to produce a superior beef breed in Bangladesh. However, due to being a newly introduce breed in Bangladesh, Brahman cattle should be taken into consideration for further in depth study with large number of animals.

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