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Evaluation of growth performance and litter size of four different crossbred sheep in Bangladesh Livestock Research Institute

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Abstract

The purpose of the experiment was to investigate the litter size and growth performance of four distinct crossbred sheep at Bangladesh Livestock Research Institute (BLRI). Data were obtained on 160 crossbred sheep of Dorper, Perendale, Suffolk, and Damara raised on BLRI sheep research farm, Savar, Dhaka, from January 2021 to June 2022. The effects of genotype, sex, and season on birth weight (Bwt), 3 months body weight (Bwt3m), 6 months body weight (Bwt6m), 12 months body weight (Bwt12m), average daily gain from birth to 3 month (ADG3m), 3 to 6 month (ADG6m), and 6 to 12 month (ADG12m) of ages and litter size (LS) of doe were investigated. All the data in this study were analyzed by the Statistical Package for the Social Sciences (SPSS) version 20.0 computer program and the significance differences among the mean values were ascertained using Duncan's multiple range test (DMRT). The effect of genotype on Bwt6m was found highly significant $p<0.01$). Genotype had also a significant ($p<0.05$) effect on Bwt3m, ADG3m, and ADG6m. The effect of season was found to be insignificant ($p>0.05$) except for Bwt3m and ADG3m (($p<0.05$). Among the four crossbred genotypes, the highest litter size was found in Damara crossbreds (1.44±0.07) while, the highest birth weight was found in Dorper crossbreds (2.09±0.05 kg), and the highest body weight at 12 months of ages was found in Suffolk crossbreds (20.58±1.33 kg). The growth performance and litter size of BLRI developed four different crossbred sheep may be improved by proper breeding, nutrition, health, and other management.

Key words: Body weight, average daily gain, litter size, crossbred sheep

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Introduction

In Bangladesh, the contribution of livestock farming to total household income was recorded at 11.0%, with sheep making up the largest portion at 11%, followed by goats at 3.58% and cattle at 2.62% (Rahman *et al.*, 2014). In addition to cattle, buffalo, and goats, fast-growing sheep can be a main source for increasing meat production, which can be extremely beneficial, particularly for the underprivileged in rural areas. As the productivity of the indigenous sheep breeds is very low, crossbreeding can be an effective tool to increase their growth

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rate and productivity. Breed complementarity and heterosis effects make crossbreeding a viable breed improvement technique because of its immediate advantages (Leymaster, 2002; Hayes *et al.,* 2009). A high growth rate influences the meat production by increasing the body weight of animals. To improve the ability of native sheep to reproduce and be productive, Bangladesh Livestock Research Institute (BLRI) imported 42 pure exotic breeds of sheep from Australia, namely Perendale (n=14), Suffolk (n=13) and Dorper (n=15); and Damara (n=5) from Bengal meat, Bangladesh which were originated from Singapore. Later, research was taken to develop a crossbred sheep by using the exotic genotype. Evaluation of the adaptability, productivity, and reproductive performance of different crossbred genotypes is important so that, which crossbred is more suitable in Bangladesh could be determined. Therefore, the objective of the study was to assess the growth performance and litter size of different crossbred sheep in BLRI sheep research farm.

Materials and Methods

Experimental site and duration

Data were obtained on a total of 160 crossbred sheep (Dorper crossbred, Perendale crossbred, Suffolk crossbred, and Damara crossbred) raised on BLRI sheep research farm, Savar, Dhaka (situated roughly 28 kilometers northwest of Dhaka, with latitude and longitude measurements of 23.8583º North and 90.2667º East, respectively) from January 2021 to June 2022.

Management procedure housing and feeding

All the animal were housed in permanent slated- floor houses raised above the ground level according to the sex and age groups with sufficient space to keep them comfortable. A concentrate feed containing 17% CP and 11MJ/kg DM was given to the animals twice a day (in the morning and evening) at a rate of 1.5% of their body weight, along with green grasses that were supplied at ad-libitum basis (100kg concentrate mixture contained 30 kg crushed maize, 30 kg wheat bran, 16 kg khesari bran, 20 kg soybean meal, 1.5 kg protein concentrate, 1 kg DCP, vitamin mineral premix 0.5 kg and 1 kg salt per animal per day). Adequate fresh water was supplied all the time.

Breeding

This crossbreeding program was executed with Suffolk, Dorper, Perendale, and Damara as male lines and native sheep (Coastal and Jamuna River Besin) as female lines. A ram was utilized to detect the heat of the ewe in the morning. In accordance with the prearranged mating chart, a female in estrous naturally mated with the ram. Ram was kept separately from ‘ewe’ to avoid unplanned mating.

Health care and disease management

Each and every animal received a PPR (Peste Des Petits Ruminants) vaccination at the age of 3 months. Deworming was performed regularly in every 3 months interval and dipping with 0.5% melatheon solution was practiced monthly. Sick animals, animals with poor health, repeat breeding, severe skin diseases, kids with stunted growth were culled from the flock.

Season

The year was divided into three seasons viz. summer (March-June), rainy (July-October) and winter (November-February).

Parameters studied

In this research, productive traits such as birth weight (Bwt), three months body weight (Bwt3m), six months body weight (Bwt6m), twelve months body weight (Bwt12m), average daily gain from birth to 3-month (AGD3m), 3-month to 6-month (ADG6m) and 6-month to 12-month of ages (ADG12m) were taken into consideration. Data were collected from a total of 160 crossbred sheep viz. 69 Dorper crossbred, 30 Perendale crossbred, 16 Suffolk crossbred and 45 Damara crossbred. All the body weights were measured in kilogram (kg) and the growth rate was measured in gram per day (g/d). The litter size was considered as reproductive trait only.

Statistical analysis

The data gathered from this research was first entered into a Microsoft Excel worksheet, organized, and processed for further analysis. Collected data on body weight and litter size were designed by 3×4 factorial experiment and analyzed by the General Linear Model (GLM) procedure of Statistical Package for the Social Sciences (SPSS) version 20.0 computer program. The significance differences among the mean values were ascertained using Duncan's multiple range test (DMRT).

Results and Discussion

Effect of genotype on growth performance and litter size of different crossbred sheep

The effect of genotype on Bwt, Bwt3m, Bwt6m, Bwt12m, ADG3m, ADG6m, and ADG12m, and litter size of dam of crossbred sheep are presented in Table 1. There was no significant ($p>0.05$) effect of genotype on birth weight. In case of Dorper, Perendale, Suffolk, and Damara crossbred sheep, the average birth weight were 2.09±0.05, 1.86±0.07, 2.07±1.10, and 1.93±0.06 kg, respectively. Giorgis *et al.*'s (2017) findings, which are marginally higher than those of the current study, revealed that the birth weights of Dorper crossbred sheep (Dorper x doygena, Dorper X Bonga, and Dorper X Dawro) were 2.58±0.59, 2.62±0.19, and 2.42±0.25 kg, respectively. The differences may be due to the different blood levels of crossbred sheep, environmental effects, management practices, age and the nutritional status of the dam.

The average Bwt3m, Bwt6m, and Bwt12m were 8.87±0.23, 12.61±0.36, and 20.31±1.09 kg for Dorper crossbred; 8.26±0.33, 12.90±0.4, and 18.73±0.9 kg for Perendale crossbred; 9.69±0.54, 15.49 ± 0.71, and 20.58±1.33 kg for Suffolk crossbred and 9.48±0.28, 13.69±0.36, and 20.11±1.09 kg for Damara crossbred, respectively.

Bwt3m (9.69±0.54) and Bwt6m (15.49±0.71) of Suffolk crossbreds were higher followed by Dorper crossbreds, Perendale crossbreds, and Damara crossbreds. The effect of genotype on Bwt6m was highly significant ($p<0.01$) under this study. The result is in agreement with the findings of Momani Shaker et al. (2010) who worked with Awassi crossbreds and Abebe et al. (2015) worked with (Dorper × Afar, Dorper × Menz). This result is almost similar to the outcome of Abebe et al. (2015) who reported that 3-month, 6-month, and 12-month body weight (kg) of crossbred sheep (Dorper × Afar) were 9.45+0.87, 13.18+0.97, and 24.96+3.77, respectively. According to Ayichew (2019), the average daily gain for sheep raised from 25% Dorper x 75% CH and 50% Dorper x

50% CH was 130.79 and 125.84 g/d, respectively, which is higher than the findings of the current investigation. Highest litter size was found in Damara crossbred (1.44) followed by Suffolk (1.38), Perendale (1.27) and Dorper (1.25) crossbred, respectively.

Table 1. Effect of genotype on growth performance and litter size of different crossbred sheep (Mean ± SE)

Parameter	Crossbred Genotype				Level of significance
	Dorper crossbred	Perendale crossbred	Suffolk crossbred	Damara crossbred	
Birth weight (kg)	2.09^{a}±0.05 (69)	1.86^{a}±0.07 (30)	2.07^{a}±1.10 (16)	1.93^{a}±0.06 (45)	NS
3-month body weight (kg)	8.87^{ab}±0.23 (64)	8.26^{b}±0.33 (29)	9.69^{a}±0.54 (11)	9.48^{a}±0.28 (41)	*
6-month body weight (kg)	12.61^{b}±0.36 (36)	12.90^{b}±0.47 (21)	15.49^{a}±0.71 (09)	13.69^{b}±0.36 (35)	**
12-month body weight (kg)	20.31^{a}±1.09 (09)	18.73^{a}±0.91 (13)	20.58^{a}±1.33 (06)	20.11^{a}±1.09 (09)	NS
Average daily gain from birth to 3-month (g)	75.25^{ab}±2.35 (64)	71.40^{b}±3.50 (29)	84.04^{a}±5.68 (11)	83.51^{a}±2.94 (41)	*
Average daily gain from 3 to 6-month (g)	46.93^{b}±2.40 (36)	48.70^{b}±3.13 (21)	62.22^{a}±4.79 (09)	47.52^{b}±2.43 (35)	*
Average daily gain from 6 to 12-month (g)	37.22^{a}±3.98 (09)	31.15^{a}±3.31 (13)	29.91^{a}±4.87 (06)	31.11^{a}±3.98 (09)	NS
Litter size of Dam	1.25^{a}±0.06 (69)	1.27^{a}±0.09 (30)	1.38^{a}±0.12 (16)	1.44^{a}±0.07 (45)	NS

Figure in the parenthesis indicates the number of observations. *= significant ($p<0.05$), **= significant ($p<0.01$), NS= Non significant ($p>0.05$). Means with different superscripts within each column differed significantly ($p<0.05$).

Table 2. Effect of sex on growth performance of different crossbred sheep (Mean ± SE)

Parameter	Sex		Level of significance
	male	female	
Birth weight (kg)	2.01[a]±0.04 (93)	1.98[a]±0.05 (67)	NS
3-month body weight (kg)	9.18[a]±0.20 (84)	8.71[a]±0.24 (61)	NS
6-month body weight (kg)	13.77[a]±0.29 (57)	12.69[b]±0.33 (44)	*
12-month body weight (kg)	21.50[a]±0.65 (18)	18.09[b]±0.63 (19)	***
Average daily gain from birth to 3-month (g)	79.56[a]±2.09 (84)	74.63[a]±2.45 (61)	NS
Average daily gain from 3 to 6-month (g)	52.91$_a$±1.87 (57)	43.62$_b$±2.13 (44)	***
Average daily gain from 6 to 12-month (g)	38.83[a]±2.37 (18)	26.34[b]±2.31 (19)	***

Figure in the parenthesis indicates the number of observations. *= significant (p<0.05), **= significant (p<0.01), ***= significant (p<0.001), NS= Non significant (p<0.05). Means with different superscripts within each column differed significantly (p<0.05).

Effect of sex on growth performance of different crossbred sheep

The effect of sex on growth performance of different crossbred sheep, regarding the average of all breeds is presented in Table 2. There was a significant effect of sex on Bwt6m (p<0.05), Bwt12m, ADG6m, and ADG12m (p<0.001). Whereas the effect of sex on Bwt, Bwt3m and ADG3m was not significant (p>0.05). This is fairly comparable to the results of Belete *et al.* (2015) and Gebreyowhens *et al.* (2017), who discovered that the average daily body weight gain for male crossbreds was 162.5 ± 12.5, 137.0 ± 24.1, 88.9 ± 0.0, and 83.3 ± 0.0 g for the age groups of 0-4, 5-9, 10-12, and >12 months, respectively. In contrast, the average daily body weight gain for the female crossbreds was 111.1 ± 5.6 g/day and 158.2 ± 9.7 g/day for the age groups of 0–4 months and >12 months, respectively. Rams' greater body weight than ewes' could be caused by the way their endocrine systems differ.

Effect of season on growth performance and litter size of different crossbred sheep

Table 3 presents the season's impact on crossbred sheep growth performance and litter size. There was no significant (p>0.05) effect of season on Bwt, Bwt6m, Bwt12m, ADG6m, ADG12m, and litter size of the dam in the present study. The effect of season on Bwt3m and ADG3m was significant (p<0.05) which, is in agreement with the findings of Abebe et al. (2015) and Belete *et al*. (2015). The rainy season had significantly (p<0.001) higher birth and

Table 3. Effect of season on growth performance and litter size of different crossbred sheep (Mean ± SE)

Parameter	Season			Level of significance
	Summer	Rainy	Winter	
Birth weight (kg)	1.98^{a}±0.06 (55)	1.98^{a}±0.07 (37)	1.27^{a}±0.06 (68)	NS
3-month body weight (kg)	8.71^{ab}±0.28 (41)	8.51^{b}±0.30 (37)	9.41^{a}±0.22 (67)	*
6-month body weight (kg)	12.76^{a}±0.44 (26)	13.18^{a}±0.38 (35)	13.76^{a}±0.36 (40)	NS
12-month body weight (kg)	18.50^{a}±0.95 (11)	21.12^{a}±1.05 (09)	19.84^{a}±0.77 (17)	NS
Average daily gain from birth to 3-month (g)	74.39^{ab}±2.95 (41)	72.54^{b}±3.10 (37)	82.11^{a}±2.31 (67)	*
Average daily gain from 3 to 6-month (g)	44.65^{a}±2.88 (26)	50.44^{a}±2.49 (35)	50.22^{a}±2.39 (40)	NS
Average daily gain from 6 to 12-month (g)	30.61^{a}±3.58 (11)	36.30^{a}±3.96 (09)	31.54^{a}±2.88 (17)	NS
Litter size of Dam	1.35^{a}±0.06 (55)	1.38^{a}±0.08 (37)	1.27^{a}±0.06 (68)	NS

Figure in the parenthesis indicates the number of observations. *= significant ($p<0.05$), NS= Non significant ($p>0.05$). Means with different superscripts within each column differed significantly ($p<0.05$).

weaning weights than other seasons, according to Abebe *et al.* (2015). The result is also similar to that of Mellado et al. (2016) who found that the weaning weight of Dorper sheep was significantly ($p<0.01$) heavier in spring season. This finding is consistent with Tesema *et al.'s* (2020) findings that the season had no discernible impact on the dam's litter size.

Effect of litter size on birth weight of different crossbred sheep

The effect of litter size on birth weight of four different crossbred sheep is presented in Table 4. It shows that the effect of litter size on Bwt was highly significant ($p<0.01$). The Bwt at single and twin litter size were 2.05 ± 0.04 and 1.88 ± 0.06 kg, respectively. Single lambs were heavier than twin lambs

Table 4. Effect of litter size on birth weight of different crossbred sheep (Mean ± SE)

Litter size	Birth weight (kg)	Level of sig.
Single	2.05^{a}±0.04 (109)	**
Twin	1.88^{b}±0.06 (51)	

Figure in the parenthesis indicates the number of observations. **= significant (p<0.01). Means with different superscripts within each column differed significantly (p<0.01).

at birth. The result is slightly consistent with that of Abebe *et al.* (2015) who found that the weights of single-born and twin-born lambs of Dorper crossbred sheep were 3.28+0.04 and 2.54+0.07 kg. On the contrary, the result of the current study is dissimilar to the findings of Momani Shaker *et al.* (2010) who reported that single born and twin born lamb weights of Awassi crossbred sheep were 4.56 ± 0.16 and 3.35 ± 0.18 kg, respectively. The maternal uterine space and nutrient availability have a limited capacity to gestate offspring, as litter size grows, the weight of each individual born decreases.

Conclusion

These findings revealed that among the crossbred genotypes, Suffolk crossbreds were better in terms of body weight at 3 and 6-month and average daily gain, while Dorper and Damara crossbreds were also found better in terms of birth weight and body weight at 12 months. Eventually, it could be concluded that further studies with a larger sample size including more reproductive parameters, will develop the native sheep of Bangladesh.

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