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Adaptation and Growth Performance of F1 Progeny of Crossbred Sheep in Bangladesh

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ABSTRACT

The research was conducted to assess the growth performance of different crossbred sheep at Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka. In the crossbreeding program, Perendale, Dorper and Damara breed were considered as sire and BLRI improved native sheep (BNS) was used as dam. The production performance of assorted F_1 progeny were evaluated and compared with BLRI improved native sheep. Data analysis was carried out using Generalized Linear Model (GLM) procedure of Statistical Package for the Social Sciences (SPSS) version 25.0. Each crossbred genotype outperformed native sheep in terms of live weights and Average Daily gain (ADG). The live weights ($p<0.001$ and $p<0.01$) and ADG ($p<0.001$) significantly influenced by genotype except the 6 months live weight. Seasonal effects were found non-significant on live weights and ADG except birth weight ($p<0.05$). Among the crossbreds, the highest birth weight was found in Dorper crossbred (2.37±0.13 kg) while 12 months live weight was found higher in Perendale crossbred (22.33±0.99 kg), respectively. In case of cumulative growth performance of male, the highest value was found in Damara crossbred while, Perendale crossbred female was found better compared to other crossbred. Major disease frequently occurred in crossbred sheep was diarrhea. The survivability rate (%) of crossbred sheep at lamb (0-3 months of age) and grower (3-8 months of age) stage were 92.55 and 90.8, respectively indicates positive influence on the crossbreeding program. Though, this is very first work regarding crossbred sheep, further research is needed in corporation with other economic trait associated with growth and reproduction to evaluate all the crossbred genotype as well as select a suitable crossbred for the production of commercial market lamb in Bangladesh.

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Introduction

Sheep is one of the promising livestock species after cattle and goat which have great potentiality for profitable lamb production in the revolution in livestock industry of Bangladesh (Sun et al., 2020; Hashem et al., 2020; Hossain et al., 2021). Present sheep population of the country is 3.90 million, which has increased 6 times during the last ten years with average annual growth rate of 1.99% (DLS, 2024). Sheep farming might be a sustainable tool to produce animal protein, eradicate poverty, women empowerment and socio-economic development of Bangladesh (Kendall and Telfer, 2000; Haque et al., 2020; Amin et al., 2020).

There is no established sheep breed in Bangladesh, but only the native sheep which have slow growth rate. In addition to conventional sheep, crossbred sheep are a potential resource to accomplish the increasing demand of animal protein in Bangladesh. Crossbreeding is generally considered as an effective tool to improve the production potentiality of native livestock species in the developing countries. Genetic improvement of the productive and reproductive traits of small ruminant is the results of selective breeding within breeds, development of new breeds or genotypes and crossbreeding. Heterosis is the primary benefit of an organized crossbreeding program that rapidly improves the productivity of crossbred animals

compare to the average performance of a pure breed (Fathala et al., 2014).

Different research work incorporating crossbreeding or synthetic breed development program revealed that crossbred performance using exotic sires were superior as compared to the native sheep stock (Sanna et al., 2001; Boujenane, 2002; Tibbo, 2006; Tsegay et al., 2013; Lakew et al., 2014; Tilahun et al., 2014; Lalit et al., 2016).

On the other hand, no research has been conducted on the development of synthetic sheep breeds in Bangladesh. Numbers of crossbreeding program were undertaken in our country to improve the indigenous sheep with high performing exotic sheep viz. Lohi, Romney Marsh, Suffolk and Perendale but the attempts did not succeed (Bhuiyan, 2013; Hamid, 2019). Latterly, Bangladesh Livestock Research Institute (BLRI) had started research work with some exotic sheep breed originated from Australia named Suffolk, Perendale, Dorper (Giasuddin et al., 2018) and Damara which is originated from South Africa with the aim to develop a suitable crossbred sheep for meat production. The program has begun using Perendale, Dorper and Damara as sire line and BLRI improved native sheep as dam line for crossbreeding. To augment the genetic superiority as well as diminish the degenerating performance of crossbred animals in subsequent generation, it is cardinal to integrate crossbreeding program with selective breeding (Gizaw et al., 2012). Therefore, to utilize the breeding program effectively, the current work was conducted to evaluate the relative performance of various crossbred sheep genotypes.

Materials and Method

The breeding program was carried out at Sheep Research Farm, Bangladesh Livestock Research Institute (BLRI), Savar, Dhaka. The data were collected from January, 2018 to January, 2020.

Animal Selection and Breeding

The crossbreeding program was conducted with exotic sheep viz. Dorper, Perendale and Damara as sire line while BLRI improved native sheep (BNS) was used as dam line. The average birth weight, live weight at 3 and 6 months of age and mature live weight of BNS were 1.46, 6.96, 11.16 and 25.83 kg, respectively (Pervage et al., 2009; Mowsume et al., 2023). BNS that attained a birth weight and mature weight of at least 1.5 and 25 kg and achieved at least one parity was selected as dam. Natural service was performed for mating the animals. The breeding plan is given in Table 1.

Three crossbred sheep (Dorper, Perendale and Damara crossbred) were considered as treatment group and BNS was regarded as the control group to compare the production performance of their offspring. A total number of 40 native sheep was considered as control group.

Feeding and Overall Management

All the research animal were housed in a permanent slated floor raised above the ground level with enough space for giving them more comfort. Crossbred sheep were given 8 hours to graze (from 8 AM to 4 PM) with one hour as resting period (12:00 PM to 01:00 PM). Animals were given a concentrate combination comprising 17% CP, 11 MJ ME/kg DM supplied for ewes, rams, and lambs twice daily in the morning and evening at rates of 200, 250, and 100 g/d/head, respectively. Adequate fresh water was supplied for all the time. The ingredients of concentrate mixture is given in Table 2.

The PPR (Peste Des Petits Ruminants) vaccine was administered to each animal regularly. Deworming and dipping with 0.5% melatheon solution was practiced at a regular interval to control the internal and external parasites. Animals with severe skin disorders, stunted growth, unthriftiness, repeat breeding and unhealthy conditions were removed from the flock.

Record Keeping

Data on birth weight, live weight at 3, 6, 9 and 12 months, average daily weight gain at 0-3, 3-6, 6-9 and 9-12 months of age, disease incidence and lamb mortality were observed and recorded. Genotype and season were considered as fixed effects. The year round seasonal effect were recorded as summer season (March-June), rainy season (July-October) and winter season (November-February).

Statistical Analysis

Sample size of the experiment was unbalanced due to the result of natural service. All the recorded data were compiled in Microsoft Excel Worksheet, organized and analyzed by General Linear Model (GLM) procedure of Statistical Package for the Social Sciences (SPSS) version 25.0. For mean comparisons, the Duncan's Multiple Range Test (DMRT) was applied.

Table 1. The breeding plan

	Perendale (♂)	Dorper (♂)	Damara (♂)
BNS (♀)	Perendale (♂) × BNS (♀)		
BNS (♀)		Dorper (♂) × BNS (♀)	
BNS (♀)			Damara (♂) × BNS (♀)

*BNS= BLRI Improved Native Sheep

Table 2. The ingredients of concentrate mixture

Feed ingredients	Quantity in the concentrate mixture (%)
Crushed maize	21
Wheat bran	50
Soybean meal	14
Grass pea meal	12
Protein concentrate	1
Di-calcium phosphate (DCP)	0.5
Vitamin-mineral premix	0.5
Salt	1
Total	100

Results and discussion:

Live weight gain

All crossbred genotypes outperformed native sheep in terms of live weight gain at various ages. (Table 3). The genotype has significant effects ($p<0.001$ and $p<0.01$) on the live weights except the 6 months live weight. Dorper crossbred had the highest birth weight (2.37±0.13 kg) among the crossbreds followed by Perendale (2.33±0.12

kg) and Damara (2.12±0.09 kg), respectively. Damara crossbred performed better in case of 3 and 9 months live weight (10.30±0.39 and 18.39±0.66 kg), on the other hand, Perendale crossbred was found superior at the age of 6 and 12 months live weight (14.37±0.69 and 22.33±0.99 kg). Season did not significantly affect live weight except birth weight ($p<0.05$). In case of genotype- season interaction, there was no significant difference in live weight at different ages except birth weight ($p<0.05$). Zaffer et al. (2015) found the birth weight, weaning weight, 6 and 12 months live weight of crossbred sheep as 2.86 ± 0.06 kg, 15.27 ± 0.29 kg, 17.03 ± 0.26 kg, 22.32 ± 0.29 kg, respectively, which is nearly identical to the current findings but lambing season significantly affected only weaning weight and 12 months live weight which contradicts the findings. Higher live weight compare to the present findings were found by Belete et al. (2015) which were 2.20 ± 0.47, 19.00 ± 0.27 and 31.85 ± 0.89 kg, respectively for birth weight, weaning weight, and 12 months live weight, respectively for Dorper crossbred sheep. Tarekegn et al. (2014) also found higher performance compare to the present findings as 3.24 kg, 20.51 kg and 64.69 g/d for the birth weight, 6 months body weight and 3 months growth rate, respectively. Similarly, relatively higher live weight than this result was also found by Tesema et al. (2022) for Dorper crossbred sheep and the values were and 3.03 ± 0.02, 14.5 ± 0.18, 20.4 ± 0.26, 24.8 ± 0.31, and 28.3 ± 0.40 kg, respectively for birth weight, weaning weight, 6, 9 and 12 months live weight, respectively. In another study conducted in Ethiopia, the average birth weight, 3, 6, 9 and 12 months live weight of Dorper crossbred were found as 2.55, 13.78, 20.78, 19.45 and 26.16 kg, respectively which are much higher than the current findings (Gebreyowhens et al., 2017). Giorgis et al., (2017) also found higher birth weight of Dorper F_1 crossbred (2.54 kg) compare to the present findings. However, the variations might be originated from the differences in management, environment and genotype-environment interactions.

Among the male of different genotypes, cumulative growth performance was better in Damara crossbred followed by Dorper, Perendale and native sheep genotype and the average live weight at 12 months of age were 24.19, 22.52, 21.77 and 19.14 kg, respectively (Figure 1). But in case of female, Perendale crossbred was superior in cumulative growth performance followed by Dorper, Damara and native sheep genotype and the values were 22.23, 22.16, 19.66 and 16.9 kg, respectively at 12 months age (Figure 2).

Table 3. Effect of genotype and season on live weights of crossbred sheep at different ages-

Factors	N	Least Squares Means (LSM)±SE for different Live weight (kg)				
		Birth weight	3 months	6 months	9 months	12 months
Overall	144	2.12±0.05	9.63±0.23	13.57±0.32	17.35±0.39	20.93±0.45
Minimum		1.00	5.45	8.30	10.10	11.65
Maximum		3.80	18.10	26.80	35.00	42.20
Genotype						
Perendale crossbred	31	2.33^{a}±0.12	10.14^{a}±0.51	14.37±0.69	18.28^{a}±0.85	22.33^{a}±0.99
Dorper crossbred	26	2.37^{a}±0.13	10.24^{a}±0.56	13.63±0.78	17.45^{a}±0.93	21.36^{a}±1.08
Damara crossbred	47	2.12^{a}±0.09	10.30^{a}±0.39	13.76±0.54	18.39^{a}±0.66	22.12^{a}±0.77
BNS	40	1.68^{b}±0.84	7.83^{b}±0.37	12.51±0.50	15.25^{b}±0.62	17.92^{b}±0.72
Significance level		***	***	NS	**	***
Season						
Winter (November-February)	63	2.18^{a}±0.09	10.15±0.39	14.40±0.53	18.01±0.66	21.66±0.76
Summer (March- June)	43	2.29^{a}±0.08	9.89±0.35	13.50±0.47	17.52±0.58	20.98±0.68
Rainy (July-October)	38	1.90^{b}±0.10	8.85±0.46	12.80±0.63	16.50±0.77	20.16±0.89
Significance level		*	NS	NS	NS	NS
Genotype×Season Significance level		*	NS	NS	NS	NS

BNS: BLRI improved native sheep; ***: Highly significant ($p<0.001$); **: moderately significant ($p<0.01$); *: significant ($p<0.05$); NS: non-significant ($p>0.05$); SE: standard error mean; N: number of observations.

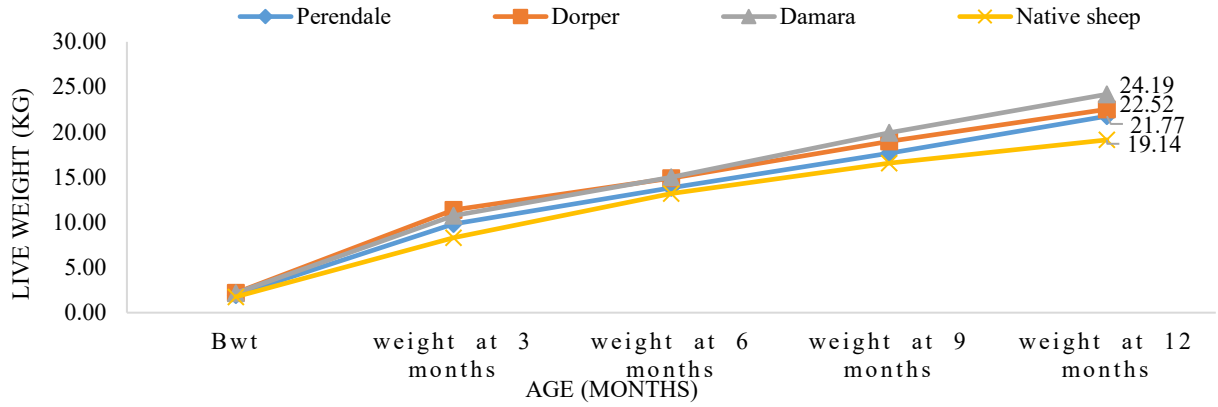

Figure 1. Cumulative growth performance of different crossbred male

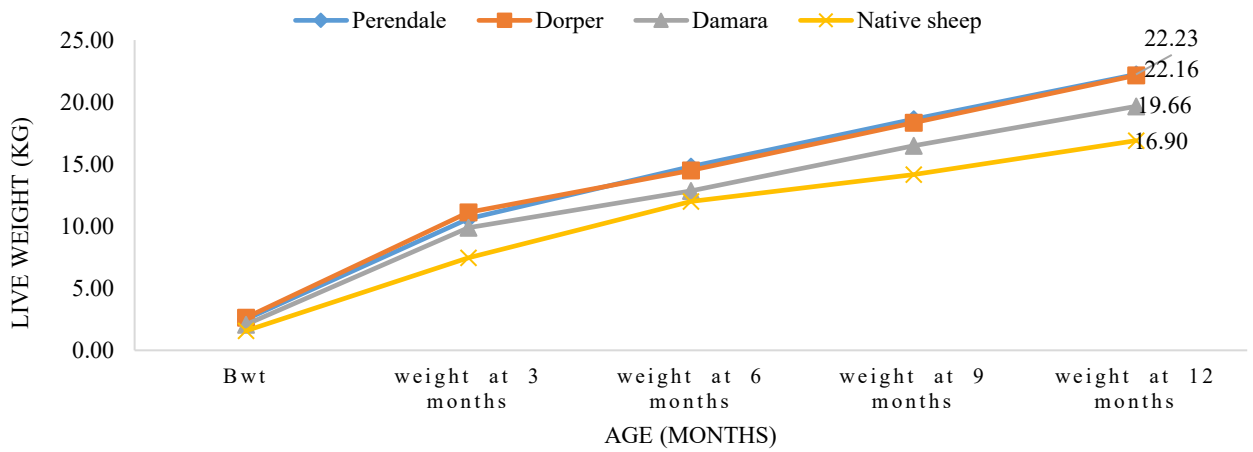

Figure 2. Cumulative growth performance of different crossbred female

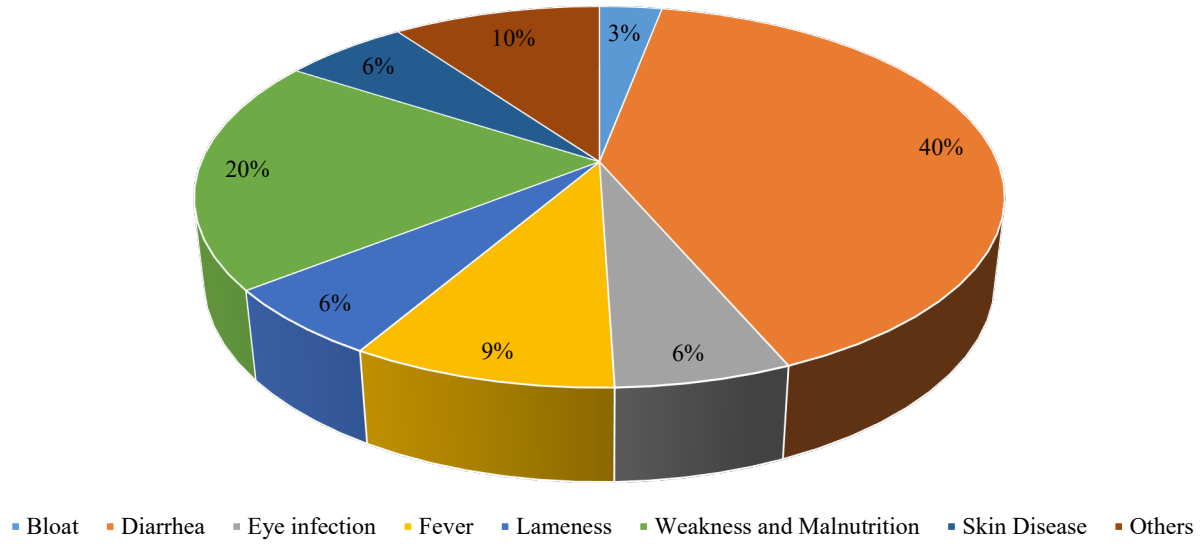

Figure 3. Disease incidence of crossbred sheep
Figures in the parenthesis represent the number of observations.

Average Daily Weight gain (ADG)

There was significant impact of genotype on ADG ($p<0.001$) at different ages of sheep (Table 4). All the crossbred genotype were superior in ADG than BNS except in case of daily weight gain at 3-6 months of age. Highest ADG at 0-3 months and 6-9 months were found in Damara crossbred (89.89±3.92 and 50.94±2.54 g/d), respectively. In case of 3-6 months ADG, native sheep were found to be superior (51.39±2.54 g/d) than all the crossbred genotypes. Perendale crossbred performed better in case of 9-12 months ADG (45.04±3.21 g/d). However, season had no significant effect on ADG. In case of genotype- season interaction, no significant effect was found in ADG at different ages except at birth to 3 months ADG ($p<0.05$). Relatively lower ADG of Dorper crossbred sheep at 0-3 months of age (69.4 g/day) than the present findings was found by Tsegay et al. (2013). In another study, ADG of and 50% Dorper crossbred at 3-6 months of age were found as 132 and 126 g/d, respectively (Tilahun et al., 2014) which are much higher than the current findings. Ayichew (2019) reported 125.84 g/day ADG of Dorper F_1 crossbred at 3-6 months of age in Ethiopia, which is also much higher than the present findings. Relatively much higher result was found for Dorper crossbred (199.6 g/d ADG at 0-3 months of age) than the current findings reported by Gavojdian et al. (2013). This could be due to the differences in management practices or environment of the study area.

Disease Incidence and Lamb Survivability

Major disease occurred in crossbred sheep was diarrhea (40%) followed by weakness and malnutrition (20%), fever (9%), eye infection (6%), lameness (6%), skin disease (6%) and bloat (3%). Other health problem was 10% including mechanical injury and fighting etc.

Most of the crossbred sheep affected with fever as a result of exposer with sunlight during grazing. It might be due to the consequences of heat stress. Tesema et al. (2020) found GI (gastrointestinal) parasites, pneumonia and septicemia as important diseases of crossbred animals. Internal parasites and pneumonia could have occurred as a result of grazing habit and a lack of suitable post-lambing management of crossbreds.

There was higher mortality found in crossbred sheep as compared to the native sheep (Table 5). In all the crossbred sheep, higher mortality was found in growing stage (9.2%) rather than lamb (7.45%). It might be due to the result of weaning stress. But in case of native sheep, lamb mortality was higher (5.00%) rather than growing stage (4.21%). Relatively much higher mortality were found by Tesema et al. (2020) than the present findings, which were 86.0, 76.6, and 67.9% for Dorper x native crossbred lambs at 3, 6 and 12 months of age, respectively. Getachew et al. (2015) reported the mortality rate of Menz sheep at weaning and one year of age as 16.7% and 36.3%, both of which are greater than the current finding. Gavojdian et al. (2013) reported 90.6% survivability rate of Dorper crossbred sheep at 0-3 months of age which is lower than the current result (92.55%). Relatively lower survival percentage of Dorper x Menz crossbred sheep (81%) up to 3 months of age was noted by Abebe et al. (2015) than the present findings. The current crossbreeding program found positive influence on the survivability rate of lamb compared to the reviewed research. This might be due to the good mothering ability of BNS to raise their lamb.

Table 4. Effect of genotype and season on Average Daily Gain of crossbred sheep at different ages-

Effect	N	Least Squares Means (LSM)±SE for different Average Daily Gain (g/d)			
		0-3 months	3-6 months	6-9 months	9-12 months
Overall	144	82.45±2.3	43.30±1.59	41.4±1.49	39.84±1.47
Minimum		44.51	11.54	10.99	12.22
Maximum		175.82	126.37	102.97	114.56
Genotype					
Perendale crossbred	31	85.80^{a}±5.04	46.54^{ab}±3.49	42.86^{a}±3.26	45.04^{a}±3.21
Dorper crossbred	26	86.43^{a}±5.51	37.27^{b}±3.83	42.03^{a}±3.57	43.35^{a}±3.51
Damara crossbred	47	89.89^{a}±3.92	38.02^{b}±2.72	50.94^{a}±2.54	41.28^{a}±2.50
BNS	40	67.67^{b}±3.66	51.39^{a}±2.54	30.08^{b}±2.37	29.70^{b}±2.33
Significance level		***	***	***	***
Season					
Winter (November-February)	63	87.60±3.88	46.75±2.69	39.64±2.52	40.52±2.48
Summer (March- June)	43	83.47±3.43	39.70±2.38	44.10±2.22	38.38±2.19
Rainy (July-October)	38	76.29±4.55	43.46±3.16	40.69±2.95	40.63±2.90
Significance level		NS	NS	NS	NS
Genotype×Season Significance level		*	NS	NS	NS

BNS: BLRI improved native sheep; ***: Highly significant ($p<0.001$); **: moderately significant ($p<0.01$); *: significant ($p<0.05$); NS: non-significant ($p>0.05$); SE: standard error mean; N: number of observations.

Table 5. Survivability (%) of different crossbred genotype

Genotype	Lamb (0-3 months of age)		Growing (3-8 months of age)	
	Mortality (%)	Survivability (%)	Mortality (%)	Survivability (%)
Perendale	6.67 (3)	93.33 (42)	7.14 (3)	92.86 (39)
Dorper	5.26 (2)	94.74 (36)	8.33 (3)	91.67 (33)
Damara	8.57 (9)	91.43 (96)	10.42 (10)	89.58 (86)
Total crossbred	7.45 (14)	92.55 (174)	9.2 (16)	90.8 (158)
Native sheep	5.00 (10)	95 (190)	4.21 (8)	95.79 (192)

Conclusion

It may be concluded that, the growth performance of Damara and Perendale crossbred were better. Crossbred sheep showed higher growth compare to native sheep. Though mortality rate was higher in crossbred sheep, it may decrease with each successive generation. Schematic and scientific breeding plan with proper nutrition and other managemental facilities may contribute to upgrade or improvement of native sheep by exotic sheep. Thus, the crossbreeding with exotic sheep should continue to develop a sustainable meat type sheep in Bangladesh.

Declarations

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