Direct Selection Response to Growth and Correlated Response to Lactation Traits in Black Bengal Goats

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ABSTRACT : A field trial on selection for increased live weight in Black Bengal (BB) goat was conducted over two generations. Parents of both sexes were selected (mass selection) based on mature body weight criteria set against age. A parallel randomly mated line was maintained to compare the response (R) of selection at birth, 3, 6, 9 and 12 months of age in both generations. Lactation yield (LY), average per day yield (APDY) and lactation length (LL) were evaluated in the selected line in comparison to randombreds as a result of correlated response. Live weights were significantly improved at onward birth in first generation and only at birth in second generation. Improvements (%) in live weight at 3, 6, 9 and 12 months in first generation were 17.6, 18.4, 16.6, and 12.0 at birth in second generation. Significant correlated R were found in LY and APDY. Results suggest that there may be a positive relationship between live weight and lactational traits in BB goats of Bangladesh. It was also concluded that such a field scheme can be effectively used for genetic improvement of goats in subsistence farming, at least for short term gain. *(Asian-Aust. J. Anim. Sci. 2001. Vol 14, No. 7 : 899-904)*

Key Words : Selection, Live Weight, Lactational Traits, Black Bengal Goat

INTRODUCTION

In Asia, Bangladesh has the third highest population of goats, about 34 million heads representing 57% of total ruminant livestock (Amin et al., 2000a). In each year 116,000 MT meat, 1,328,000 MT milk and 39,000 MT raw skin are provided by the goat alone. Goat meat contributed 37.91% of total meat in 1997 while it was only 12% during the period from 1979 to 1981 in Bangladesh (FAO, 1997). About 90% of the goats in Bangladesh are of Black Bengal (BB) which is a very promising dwarf meat type breed noted for its high reproductive rate, superb adaptability and excellent grade chevon and skin. Goats, as it is found in all developing countries, are chiefly reared by subsistence farmers beside their primary occupation. Despite its magnificent contribution in the rural economy, there has been little work on its genetic improvement or on conservation (Husain et al., 1998; Amin et al., 2000b). Although BB goats have manifold merits still they are reported to be slower in growth and produce little milk. Lower birth weight and inadequate milk in BB goats are responsible, to a great extent, for higher kid mortality (Husain et al, 1994; Husain et al. 1995; Husain et al., 1998). Husain (1993), on the other hand, observed large within breed variation among individuals for these traits in BB goats of Bangladesh. Considering these impediments, possibilities for genetic improvement of growth and milk production in BB goats have been proposed by many authors (Devendra and Burns, 1983; Husain et al., 1996a, 1996b, 1998). Our in-field experiment was pertinent to a situation lacking in organized recording and breeding system. It was, therefore, aimed at a trial of how best a genetic program can be adapted in such a situation. The objectives of the experiment were to measure selection response directly on body weight and correlatedly on lactational traits since both are of equal importance. In addition, estimation of heritability on live weights at various ages using field data was a co-objective of the study.

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MATERIALS AND METHODS

This field experiment was carried out at the villages around Bangladesh Agricultural University, Mymensingh over the period from 1995 to 1999.

Breeding and management

Table 1 and figure 1 depict the mating layout and breeding group of goats of the experiment. Bucks for breeding were kept at breeding station while the remaining animals of this experiment remained in farmers' ownership.

Breeder does and bucks of foundation generation were selected for live weight from farmers' flocks. As they were taken from different age groups, an age-weight chart (table 2) was used to take selection decision. To embody a sizable number of goats in the breeding groups and to minimize time frame, the age of foundation parents was kept flexible within the range of 6-18 months in male and 6-24 (or above) months in female. The breeding and management of the experimental goats may also be seen from Amin et al. (2000a, b). The aid to and method of selection were 'mass selection' and 'independent culling level' respectively (Willis, 1996).

For example, if a parent is to be selected at 9 month it

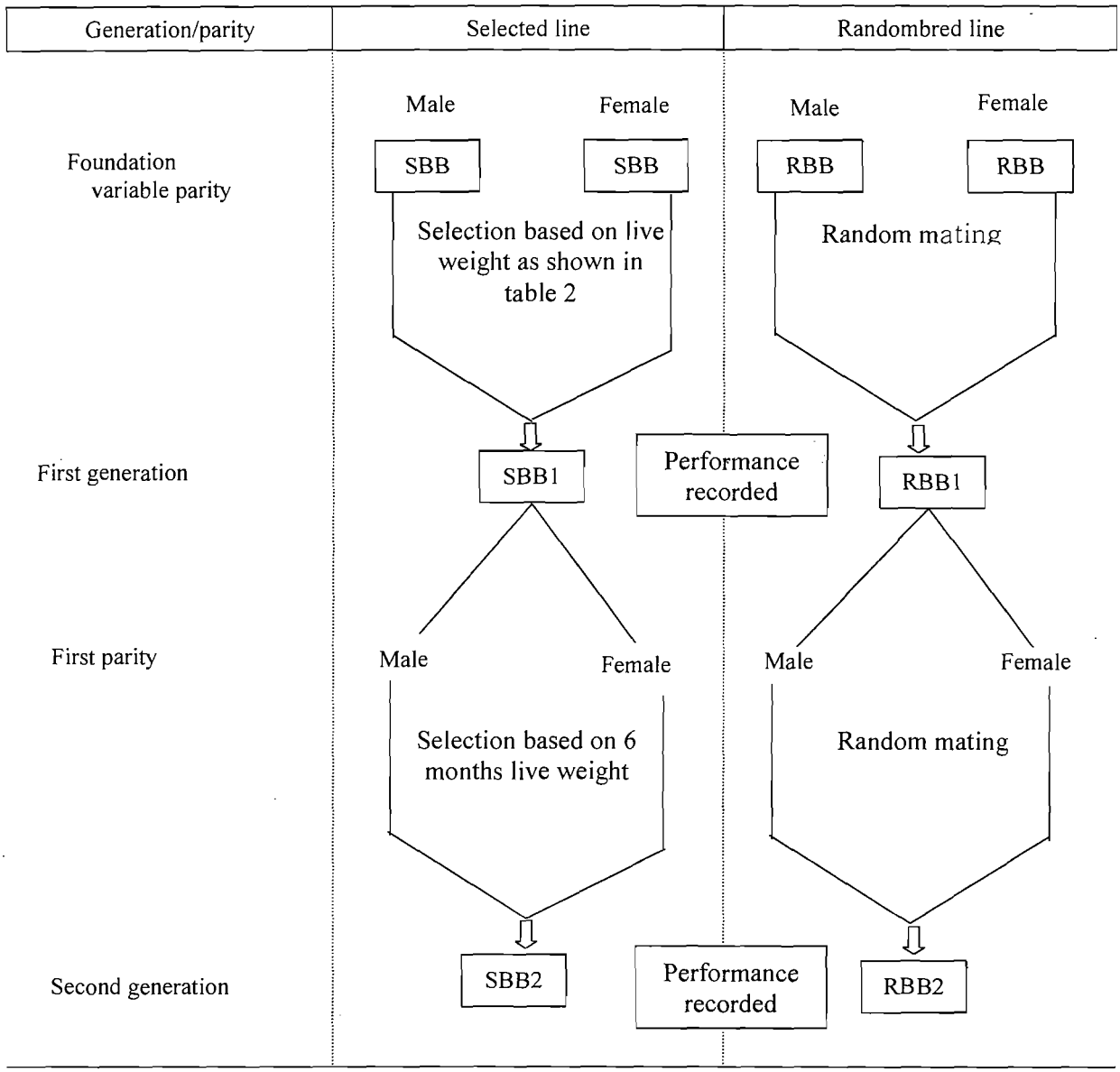

Figure 1. Experimental layout

should be 12 kg live weight (for buck) or 10 kg (for doe) as the minimum. The age-weight chart was built upon the experience gathered from a pre-experiment survey conducted in the locality concerned. It was found that more or less 20% animals had live weight above the figures given in the chart. Amongst first generation selected line (SBB1), parents were selected at 6 months of age only based on the same criterion (minimum 8 kg live weight for both sex) in order to produce second generation goats. Randombred animals were randomly chosen as parents without imposing such consideration. Their generations were continued in parallel with that of the selected line. A total of 10 and 9 selected and random bucks respectively was used in the breeding programme in the foundation generation and those for first generation were 2 and 3 respectively (table 1). Breeding with foundation parents was accomplished in 4 separate locations. But first generation parents were bred only in one location and, to avoid possible inbreeding, bucks produced in a particular location were not used in that location for breeding. Does given service were followed up for kidding and lactation. All the animals under research were kept in a typical goat husbandry system (Amin et al., 2000b) and fed only on grazing. All animals under experimentation were ear tagged and records on individual cards for each of the animals were maintained. Responses to selection were measured from the difference between selected and randombred goats within the same generation.

Recording live weight

Birth weights of first and second generation kids were recorded within 6 hours of kidding. Subsequent live weights

Table 1. Breeding design

Generation of parents	Sire		Dam line	Progeny					
	Line	Number used		Line	Number of individuals at*				
					1	2	3	4	5
Foundation	SBB	10	SBB	SBB1	323	273	234	154	94
	RBB	9	RBB	RBB1	270	232	198	124	88
1st	SBB1	2	SBB1	SBB2	67	56	44	34	15
	RBB1	3	RBB1	RBB2	66	57	51	38	21

SBB=Selected Black Bengal, RBB=Randombred Black Bengal.
* 1 = birth, 2=3 months, 3=6 months, 4=9 months, 5=12 months

Table 2. Age-weight chart used for selection of breeding animals in foundation generation

Live weight (kg) of	Age of the animal to be selected (months)				
	6	9	12	18	≥24
Buck	8	12	14	18	-
Doe	8	10	12	14	16

were taken trimonthly up to 12 months in wethers and up to conception in does. Then live weights were corrected for sex.

Recording and estimation of lactation performance

Since it was a field experiment and the goats were owned by the farmers, it was not possible to milk every nanny goat daily. Therefore, 10 random nannies from each group were hand milked every 7th day up to 13th week (or earlier) assuming test day represented the whole week (Metz 1990; Zygoyiannis, 1994). If a nanny dried naturally before reaching the 13th week of lactation the subsequent milk yield was recorded to be zero. Lactation yield was estimated as

$$LY = 7 \sum_{i=1}^{13} Ti$$

where Ti represent test day yield (i = 1, 2, ... 13). Actual lactation length (LL), estimated lactation yield (LY) and calculated average per day yield (APDY) were the parameters for evaluating milk potential.

Heritability (h^2) estimation

Values of h^2 were estimated for live weights at birth, 3, 6, 9 and 12 months of age using sex-pooled data from RBB1 goats. Estimations were made based on paternal half sib analysis method (Becker, 1975) involving 9 sire groups. Total number of RBB1 progenies are shown in table 1.

Statistical analyses

Data on live weights and lactation records were analysed by General Linear Model (GLM) using SAS statistical package (SAS, 1991). Least Squares Means (LSM) were calculated and separated with the same computer programme. Paired t-test was performed according to Snedecor and Cochran (1980) to test the significance of selection response.

RESULTS AND DISCUSSION

Direct response to live weight

Figure2(a) and 2(b) show live weights of selected and randombred group of BB goats respectively at birth, 3, 6, 9

Table 3. Actual and % improvement in live weight in goats resulting from selection

Live weight at	First generation $(a_1 - b_1)^{\#}$	Second generation $(a_2 - b_2)^{\#}$	Per generation (pooled) $(a_2 - b_1)/_{2b1}{}^{\#}$
Actual (kg)			
Birth	0.07 ±0.04	0.11***±0.03	0.09***±0.01
3-month	0.70***±0.17	0.34 ±0.27	0.52** ±0.13
6-month	1.19***±0.29	0.26 ±0.43	0.73 ±0.33
9-month	1.48** ±0.48	0.62 ±0.46	1.05**±0.30
12-month	2.73*** ±0.53	0.64 ±0.79	1.69 ±0.74
% improvement			
Birth	8.4	12.0	12.1
3-month	17.6	7.9	8.3
6-month	18.4	3.5	9.0
9-month	16.6	6.3	17.5
12-month	24.1	5.2	7.1

** p<0.01; *** p<0.001. #a = Mean of selected group; b = Mean of randombred group. 1 = first generation; 2 = second generation.

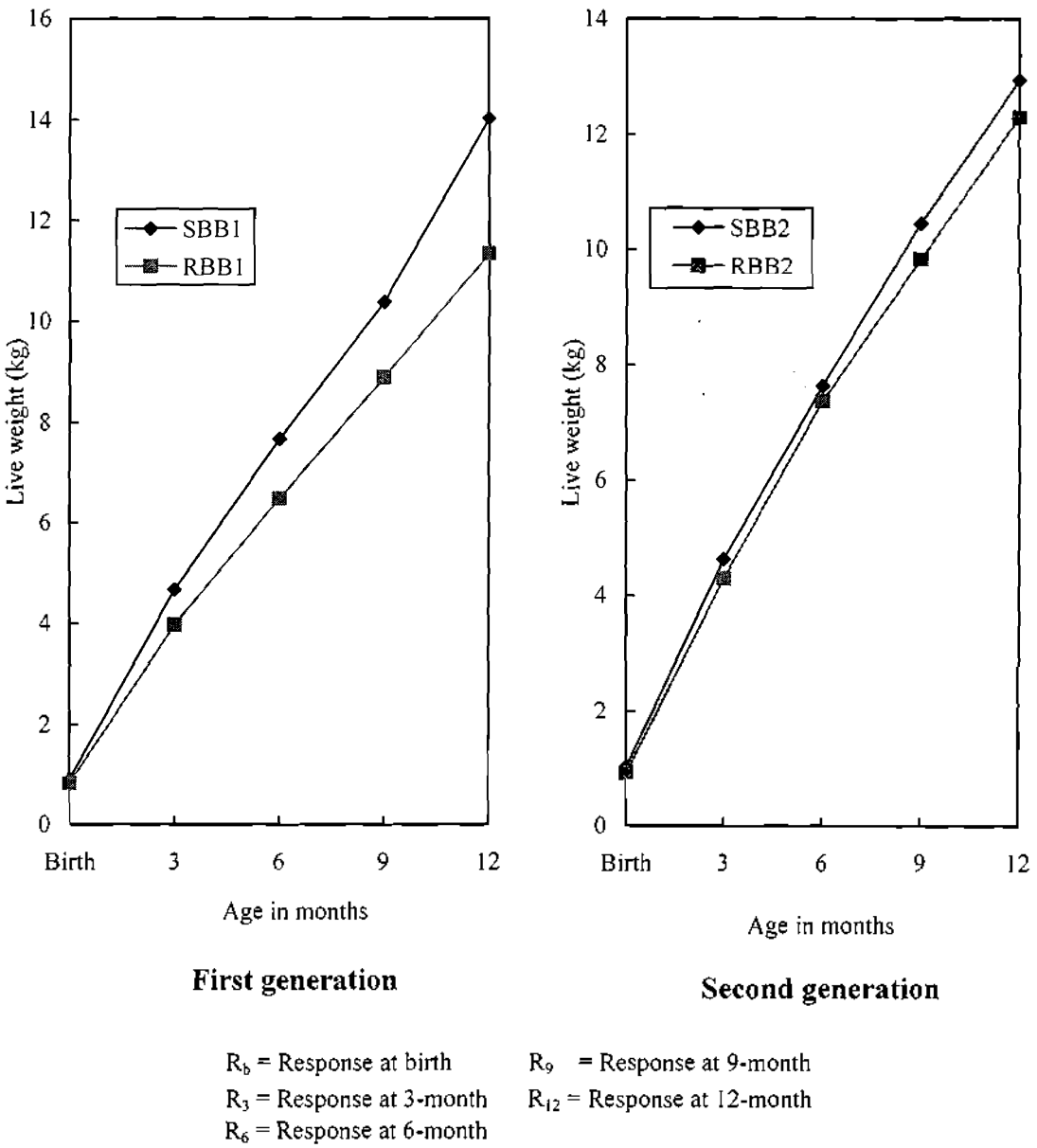

Figure 2. Selection response (R) in first and second generation goats

and 12 months of age for first and second generation.

They also show the magnitude of selection responses (R) at the aid stages. R was found to be increased with the increase of age in either generation but the magnitudes were more pronounced in first than in second generation. Table 3 demonstrates the actual magnitude of R and improvement in percentage in first, second and pooled generation. From t-test, responses in live weight were significant at 3 months and onward in first generation and only at birth in second generation. When generations were pooled responses in live weight at birth, 3 and 9 months were significant. Improvements expressed as percentages were higher in first generation than in second except at birth. Pooled improvement (%) ranged from 7.10 (12 months) to 17.53 (9 months). Selection did not improve ($p>0.05$) birth weight in SBB1. This might be due to effect of varying parity of SBB dams as they were incorporated in the programme regardless of parity. Litter size and dam's body weight varied with variation of parity which might, because of variation in birth weight of kids, have resulted in lower response. In SBB2 kids, R was found to be significant ($p<0.001$) at birth, possibly because of the uniformity of kids in size that resulted from SBB1 dams which all were of first parity. Selection responses onward birth in second generation were

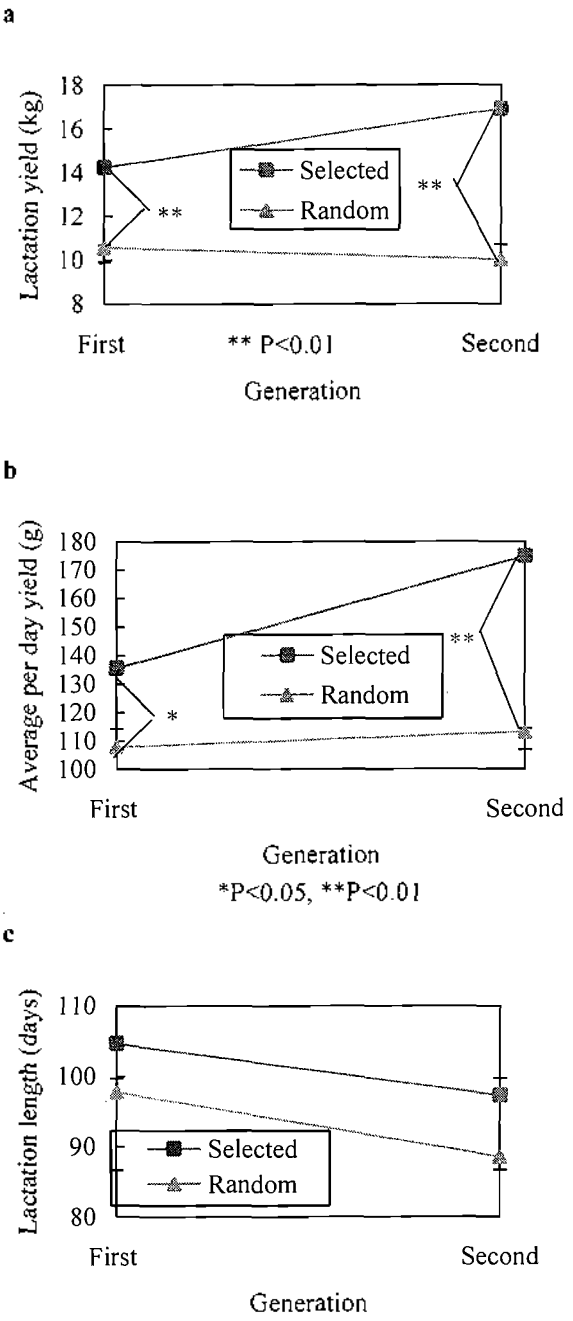

Figure 3. (a) Lactation yield. (b) Average per day yield. (c) Lactation length.

insignificant (p>0.05) which might be due to exhaustion of variabilities for one generation selection already done. Mean live weights of SBB1 were close to, but of RBB1 were lower than, values reported by Mia et al. (1993) and Husain et al. (1996a, b) for BB goats up to 9 months. Literature concerning genetic gain in live weight of goats especially of this kind is seriously meagre. However, Husain et al. (1996b) found 21.5, 23.8 and 18.8 percent improvement in birth, 3 and 6 months live weight resulted from an experiment involving one generation of similar phenotypic selection in a BB population. This agrees to a great extent with the present results. Results suggest that selective breeding of this nature may be more fruitful when practiced in an unselected population than in one already selected in BB goats of Bangladesh.

Correlated responses to lactation performance

Parents of both sexes were selected for heavier live weight. Live weight increased (significantly or insignificantly) in all stages in both generations. Figure 3(a), 3(b) and 3(c) represent the LY, APDY and LL of the two lines for first and second generation. It was evident that LY, APDY and LL in the selected line were increased in each generation compared to its counterpart. But the differences between selected and randombred lines were significant (p<0.05) only in LY and APDY. Selection resulted in an increase in LY and APDY not only within generation; SBB2 were found to yield more milk than SBB1 in terms of LY and APDY. An insignificant (p>0.05) decline in LL from first to second generation might be due to small sample size, sampling error or differences in the kidding season. Reports on milk production performance in the literature are very few. Agrawal and Bhattacharyya (1978) reported, however, higher APDY (344 g) in BB goats between 7th and 9th day. The results suggest that there may be a positive genetic correlation between live weight and milk potential in BB goats at least upto a certain level.

Heritability (h^2)

Estimate of h^2±SE for live weight at birth, 3, 6, 9 and 12 months of age were 0.30±0.16, 0.57±0.27, 0.27± 0.17, 0.27±0.19 and 0.35±0.24 respectively. All the estimates were medium in magnitude except that at 3 months. Season of kidding, maternal factors and litter size might inflate the value at 3 months of age (weaning age). Many estimates appeared to be very close with present estimates for 6, 9 and 12 months live weight (Acharya, 1988; Singh, 1994 and Mehta et al., 1997) in different goat breeds of India. A good number of estimates for birth weight have been reported of which lowest (0.01) and highest (0.75) values were given by Moulick and Syrstad (1970) and Ali and Hasnath (1977) respectively for BB goats. The values obtained dictate that mass selection for live weight may be useful in improving live weight in BB goats in field conditions.

CONCLUSION

Genetic improvement both in growth and lactation traits in BB goats may be achieved through simple phenotypic selection for heavier live weight. Estimates of heritability for live weights were medium at birth, 6, 9 and 12 months but high at 3 months. Heavy involvement and expenditure can be avoided by running the selection programme in-field rather

than on-station. In order to obtain discernible progress a wider context cost-effective and sustainable breeding scheme may be launched with the model adopted herein.

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REFERENCES

Acharya, R. M. 1988. Goat breeding and meat production. In: Goat Meat Production in Asia. Proc. workshop held in Tando Jam, Pakistan, 13-18 Mar. pp. 14-19.

Agrawal and Bhattacharyya. 1978. Yield and composition of milk in Black Bengal, Barbari and Black Bengal × Barbari nannies. Ind. J. Anim. Sci. 48(12):882-886.

Ali, S. Z. and M. A. Hasnath. 1977. Heritability estimates of birth weight of Black Bengal kids at the Bangladesh Agricultural University Goat Breeding Project. Ind. Vet. J. 54:632-637.

Amin, M. R., S. S. Husain and A. B. M. M. Islam 2000a. Evaluation of Black Bengal goats and their cross with the Jamunapari breed for carcass characteristics. Small Rumin. Res. 38:211-215.

Amin, M. R., S. S. Husain and A. B. M. M. Islam. 2000b. Reproductive peculiarities and litter weight in different genetic groups of Black Bengal does. Asian-Aust. J. Anim. Sci. 14(3):297-301.

Becker, A. W. 1975. Manual of Quantitative Genetics (3rd ed.). Washington State University, USA.

Devendra, C. and M. Burns 1983. Breeds. In: Goat Production in the Tropics. Commonwealth Agricultural Bureaux, U.K. pp. 7-48.

FAO. 1997. FAO Production Year Book. vol. 51. Food and Agriculture Organization of the United Nations, Rome, Italy.

Husain, S. S., A. B. M. M. Islam and M. M. Huq 1994. Comparative study on the survivability of Black Bengal kids in selected and random groups. Bang. J. Anim. Sci. 23(1-2):81-87.

Husain, S.S.; P. Horst and A. B. M. M. Islam 1995. Effect of different factors on pre-weaning survivability of Black Bengal kids. Small Rumin. Res. 18:1-5.

Husain, S. S., M. R. Amin and A. B. M. M. Islam. 1998. Goat production and its breeding strategy in Bangladesh. Proc. 1st National Workshop on Animal Breeding held on 26 Nov. 1998, BAU, Mym., Bangladesh pp. 17-36.

Husain, S. S., P. Horst and A. B. M. M. Islam. 1996a. Study on the growth performance of Black Bengal goats in different periods. Small Rumin. Res. 21:165-171.

Husain, S. S., P. Horst and A. B. M. M. Islam 1996b. Phenotypic selection on the improvement of growth performance of Black Bengal kids. Asia-Aus. J. Amin. Sci. 9:149-153.

Metz, T. 1990. Milk production of Malaysian Katjang and German Fawn x Katjang goats estimated by the kid suckling method. Ph.D. thesis. Technische Universität, Berlin and University of Malaysia.

Mehta, B. S., D. K. Singh and B. U. Khan. 1997. Genetic studies on growth in Sirohi goats. Ind. J. Anim. Sc. 67:723-725.

Mia, M. M., A. Ali and M. A. R. Howlider. 1993. Growth performance of Black Bengal Bengal, Barbari, Anglo-Nubian and Barbari×Black Bengal goats. Ind. J. Anim. Sc. 63:1214-1215.

Moulick, S. K. and O. Syrstad 1970. Genetic and environmental causes of variation in birth weight of Black Bengal goats. J. Agric. Sc. 74:409.

SAS 1991. Statistical Analysis System. SAS Institute, SAS Inc. Cary, USA.

Singh, D. K. 1994. Improvement of Goat Production in India. World Agriculture. Sterling publication Ltd. London. pp. 78-81.

Snedecor, G. W. and W. G. Cochran 1980. Statistical Methods (7th edition). The Iowa State University Press, Ames, Iowa, USA.

Willis, M. B. 1991. Aids to selection. Selection for multiple objectives. In: Dalton's Introduction to Practical Animal Breeding (3rd edition). Blackwell Science. pp 61-86.

Zygoyiannis, D. 1994. A study of genetic and phenotypic parameters for milk yield and milk characteristics in indigenous and crossbred goats in Greece. Word Rev. Anim. Prod. 29(2): 20-28.