



## INFLUENCE OF GASTRO-INTESTINAL PARASITES ON PRODUCTIVE AND REPRODUCTIVE PERFORMANCES OF BLACK BENGAL GOAT UNDER FIELD CONDITION

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Part of PhD work of first author

### ABSTRACT

A study was conducted taking 118 Black Bengal does with age of 3 months and above with the aim for assessing the influence of parasitic infestation as well as variability of productive and reproductive performances before recommendation of selection and breeding in farmers' flock. A total of 252 progenies were available for estimation of physical characteristics and productive performance (body weight) up to 1.5 years despite of certain amount of mortality and forced selling by the goat owners in different ages. The present study revealed that gastrointestinal parasites caused significant weight loss from one year age onward in case of the progenies born from the does having more than 1200 EPG count under field condition. The average body weight of the progenies of the does having less than 1200 EPG count was improved in comparison to their dam while the progenies of does having more than 1200 EPG count showed body weight lower than their dams under field condition. There was no significant variation observed in body height and body length of the progenies of different groups. Significant effect of maternal gastrointestinal nematode load was observed on heart girth of progenies from one year of age which indicated that the progenies of Group 3 was lean in comparison to the progenies of other two groups from one year of age under field condition. The result revealed that age at first service, average body weight at first service, age at first kidding, number of services required per conception and gestation period of the progenies of Group 3 did not show any variation with the lower EPG groups (Group 1 and 2). Significant difference was observed only in case of average weight at first kidding, service period and kidding interval among the progenies of higher and lower nematode infected groups. The progenies from the does having less than 1200 EPG count (Group 1 and 2) did not showed any degradation in reproductive performance while significant decrease in body weight at first kidding of the progenies of Group 3 than other two groups. The service period and kidding interval of the progenies of the does having high EPG level were significantly longer than the groups having lighter infection. It has been observed that the progenies of does having EPG count more than 1200 have no effect on body weight and physical characteristics only up to six months of age indicating the existence of maternal immunity up to six months and give poor productive and reproductive performance at their adulthood. Hence selection based on EPG count (<1200 EPG) lead to about 8 to 10% improvement in production per generation in Black Bengal Goat under field condition.

### INTRODUCTION

Among the livestock of India, goats have fulfilled agricultural, economic, cultural and even religious roles from very early times in human civilization. They are the most adaptable and geographically widespread livestock species ranging from the high altitude to desert and humid coastal areas of India and contribute to the rural economy where all other means of agriculture is a failure. Goats make an important contribution to the sustenance of small and marginal landholders and landless rural people by their contribution towards marketable commodities such as meat, milk, fibre and skin. It also plays a leading role in eradication of poverty in small farmers and landless labourers by self-employment. Improvement of goat production is necessary to benefit the rural community and smallholder farmers through research and policy-making on the physical characteristics, reproductive ability, feeding systems, productivity and health aspects of goats because increased animal production should be achieved rather than by increasing animal numbers, but enhanced disease control, integration of fodder production,

improved husbandry and controlled breeding are essential steps to intensify animal production. (Dhollander *et al.*, 2005) Though most of the Indian breeds of goats are welladapted to the harsh environment, low nutrition, tropical disease and poor water quality, gastrointestinal parasites are considered to one of the top ten ranked disease in goats (Rout and Chauhan, 2004). In the world when goat producers are facing increasing problems due to the rapid spread of antihelmintic resistance, the battle against gastrointestinal nematodes is a difficult one. Widespread infection with internal parasites in grazing animals, associated production losses, antihelmintic costs and death of infected animals are some of the major concerns. India is paradise of many parasites due to its hot and humid climatic condition. The climatic factor may favour the development of gastro-intestinal parasites during the period of nutritional stress and wet season in the tropical area (Hawladar *et al.*, 2002) like India and could negatively contribute to the reproductive and productive performance of goat and slows down the genetic progress (Preston and Allonby, 1979). The most

important helminthes infections of livestock are infections of grazing ruminants by nematodes residing within the gastrointestinal (GI) tract of the vertebrate host. Strongyle infestation significantly affects the body weight gain of sheep and goat and lead to economic loss (Tinar *et al.*, 2005). Among strongyle group of nematodes, *Haemonchus* sp. reduces productivity through reduced efficiency of nutrient utilization and growth rate, in addition to mortalities which occur at severe infestation levels. In small ruminants, GI nematodes are often one of the most important impediments to the successful raising of the animals. Along with GI nematodes, liver flukes and trematodes also aggravate the condition of the animal. The present study was conducted with the aim for assessing the influence of parasitic infestation as well as variability of productive and reproductive performances of Black Bengal goat before recommendation of selection and breeding in farmers' flock.

## **MATERIALS AND METHOD**

The field study was conducted on Black Bengal goat (*Capra hircus*) during the period from July, 2004 to June, 2007.

### **Site of field study**

The research work was carried out at Mohanpur village under Haringhata block in the Nadia district of West Bengal state which is under New Alluvial zone of Lower Gangetic Plain region of India. The village was selected nearer to the University and having good Black Bengal goat population.

### **Geographical location**

The field area is situated at latitude of 23.5°N and longitude of 89°E and an altitude of 9.75 metre above the mean sea level located close to the tropic of cancer.

### **Season and climate**

A year divided in three seasons namely,

Monsoon (S1) : July to October.

Winter (S2) : November to February

Summer (S3) : March to June.

Average temperature, relative humidity and rainfall of the three seasons were recorded.

### **Selection of animal**

#### **Genetic group**

The study was conducted with a total of 118 Black Bengal does with age of three months and above. The goats were mated randomly for one year from July, 2004 to June, 2005. All the one hundred eighteen does were divided into three groups depending upon the mean annual egg per gram of faeces (EPG) count of gastrointestinal nematode, *Strongyle* sp. from July 2004 to June 2005 and they were considered as base stock. The groups were - Group 1 (Low EPG < 600), Group 2 (Moderate EPG >600 < 1200) and Group 3 (High EPG > 1200).

From July 2005 the remaining one hundred does were mated with selected superior bucks at the ratio of 20:1. The selection of buck was made on the basis of their physical characters (growth, biometry, reproductive performance of ancestors and semen characteristics) and low egg per gram of faeces (EPG) output. A member of the twin family was preferred over singlet or triplet. Replacement of bucks whenever necessary, were made by selecting new buck on the basis of the above mentioned

criteria. This genetic programme was started from July, 2005 and was continued till June, 2007.

### **Management**

All the animals utilized for the present study were maintained in the farmers' house. The animals were fed mainly on grazing and allowing tree leaves during the rainy days. Little amount of concentrate (within the range of 50gm) comprising of Maize (crushed)- 70%, Mustard oil cake- 15%, Mung churni- 14% and Mineral mixtures, Vitamins along with salts- 1% were offered at the last stage of pregnancy and continued till few days after parturition. All the does were kept on the floor made of soil or mud. The goat houses were shedded with paddy straw or corrugate sheet.

### **Health care**

All the animals were dewormed four times in a year. Deworming was performed on the basis of faecal examination. Vaccination against PPR, Goat pox and FMD was done in every year. Regular grooming of the animals had been practiced by the goat farmers. Other health care and treatment had been given whenever needed.

### **Recording of body weight and body measurement**

The body weight was taken in a platform weighing balance for Black Bengal goat prior to feeding of concentrate and collection of blood. The body measurements were recorded as per the methods outlined by Singh *et al.* (1979). The body weight and body measurement at zero day was taken within twenty four hours after birth. The correlation between body weight and linear body measurements were estimated by standard method.

### **Reproductive performances**

The Age at first service (AFS), Weight at first service (WFS), Service per conception (SPC), Age at first kidding (AFK), Weight at first kidding (WFK), Gestation period (GP), Service period (SP) and Kidding interval (KI) of does were studied as described by Ahmed (1992).

### **Coprological examination**

A total of one thousand four hundred sixteen faecal samples from one hundred eighteen apparently healthy Black Bengal does were collected in each month during the study period from July, 2004 to June, 2005. Freshly voided faecal pellets when available or the per-rectal samples from individual animals were collected in a 30 ml wide mouth plastic vials. All the details regarding age and animal number in respect of each sample were recorded. The samples were brought to the laboratory and stored at 4°C in a refrigerator till further processing. Based on the age during collection of samples, the animals were divided as young (below six months of age), growing (within six months to nine months) and adult (nine months and above). Faecal examination was done by direct microscopic examination as well as floatation and sedimentation methods (Soulsby, 1982) for prevalence study of gastrointestinal parasites. All the positive samples were subjected to eggs per gram of faeces (EPG) count for strongyle group of gastrointestinal nematodes, by employing modified McMaster technique (Coles *et al.*, 1992)..

### **Statistical methodology**

The effect of the intensity of GI nematode infection (EPG) of the base stock on the variability of different important

productive and reproductive traits of the progenies was estimated by analysis of variance. (Snedecor and Cochran, 1994)

## RESULT

### Productive performance of base stock

#### Body weight

Body weight of one hundred eighteen Black Bengal does in different age was estimated as 5.03 kg at three months, 7.27 kg at six months, 10.01 kg at nine months, 11.35 kg at one year and 13.02 kg at one and half year of age.

#### Physical characteristics

The physical characteristics like average body height, heart girth and body length of base stock of Black Bengal goat at different age was recorded as 35.60 cm at three months of age, 40.26 cm at six months of age, 44.38 cm at nine months of age, 49.43 cm at one year of age and 53.87 cm at one and half year of age. The heart girth at three months of age was 38.16 cm while body length was 35.61 cm at the same age. At six months of age the heart girth and body weight was 44.72 cm and 40.54 cm respectively. The goats of nine months of age had 48.81 cm heart girth and 44.68 cm body length. The heart girth and body length at one year and one and half year age were 54.26 cm, 49.78 cm and 58.91 cm, 54.87 cm respectively. It was also observed that there was positive correlation between body height and body weight (0.79, 0.79, 0.80, 0.80 and 0.80),

heart girth and body weight (0.69, 0.77, 0.78, 0.84 and 0.82) and body length and body weight (0.77, 0.78, 0.80, 0.80 and 0.83) at three months, six months, nine months, one year and one and half year age respectively.

### Reproductive performance of base stock

As per available information of reproductive performance of one hundred eighteen Black Bengal does, the average values of different reproductive traits was ascertained and revealed that the result that Black Bengal does have received first service at an average age of 238 days with an average body weight of 8.5 kg. The average age at first kidding was 388 days with an average body weight of 13.4 kg. The result revealed that the number of services required per conception was 1.21. The Black Bengal does of the present study had average gestation period of 144 days, service period of 61 days and the does gave birth to another kid at 205 days after parturition.

### Effects of gastrointestinal parasites

The present study was carried out to assess the effect of gastrointestinal parasites on productive and reproductive performances of the progenies of selected Black Bengal goats at the farmers' house.

A total of two hundred fifty two progenies were available for estimation of physical characteristics and productive performance (body weight) up to one and half years (18 months) despite of certain amount of mortality and forced selling by the goat owners in different ages.

**TABLE 1.** Body weight (Mean  $\pm$  SEM) of the progenies of Black Bengal goat in different EPG level under field condition

Age group	Group 1	Group 2	Group 3	Overall
Birth	1.25 $\pm$ 0.05 (112)	1.21 $\pm$ 0.05 (128)	1.20 $\pm$ 0.10 (12)	1.22 $\pm$ 0.06 (252)
3 months	5.47 $\pm$ 0.16 (112)	5.07 $\pm$ 0.17 (128)	4.72 $\pm$ 0.25 (12)	5.20 $\pm$ 0.11 (252)
6 months	7.55 $\pm$ 0.16 (112)	7.35 $\pm$ 0.20 (128)	7.07 $\pm$ 0.31 (12)	7.35 $\pm$ 0.12 (252)
9 months	10.52 $\pm$ 0.28 (112)	9.89 $\pm$ 0.27 (128)	8.83 $\pm$ 0.49 (12)	10.05 $\pm$ 0.18 (252)
12 months	12.57 $\pm$ 0.35 <sup>a</sup> (112)	11.80 $\pm$ 0.29 <sup>a</sup> (128)	9.67 $\pm$ 0.53 <sup>b</sup> (12)	11.43 $\pm$ 0.23 (252)
18 months	14.02 $\pm$ 0.41 <sup>a</sup> (112)	12.89 $\pm$ 0.33 <sup>a</sup> (128)	10.64 $\pm$ 0.58 <sup>b</sup> (12)	13.06 $\pm$ 0.26 (252)

*Values bearing same or no superscript within a row do not differ significantly.*

*Data in parentheses are the number of progenies in each sub-class.*

### Productive performance

The productive performance (growth) of the two hundred fifty two kids of the does of different groups (divided based on overall mean EPG counted during the year July, 2004 to June, 2005) were recorded from July, 2005 to June, 2007 and the result is presented in Table 1. The statistical analysis is presented in Table 2. The result revealed that birth weight of Group 1 (1.25 kg) was slightly higher than Group 2 (1.21 kg) and Group 3 (1.20 kg) but the effect was not significant. The body weight at three months age of Group 1 (5.47 kg), Group 2 (5.27 kg) and Group 3 (4.72 kg) was almost with in the same range without any significant variation. Similarly, body weight at six months' age and nine months' age of Group 1, 2 and 3 was not significantly varied. The body weight of the progenies of Group 1 (12.57 kg) and Group 2 (11.80 kg) at one year was significantly ( $P < 0.05$ ) higher than that of

Group 3 (9.67 kg). Similar result was also recorded in the age of one and half year where mean body weight of the progenies of Group 1 (14.02 kg) and Group 2 (12.89 kg) was significantly ( $P < 0.05$ ) higher than Group 3 (10.64 kg). The variation in body weight at one year and one and half year between Group 1 and Group 2 was statistically non-significant.

### Physical characteristics

The body height, heart girth and body length of the two hundred fifty two progenies of does of three groups recorded. The variations in the body height in different ages were not significant among the three groups. Average height at birth of Group 1 (23.16 cm), Group 2 (22.78 cm) and Group 3 (22.19 cm) was almost in the same range. Height at the age of three months (36.65 cm 36.14 cm and 35.45 cm respectively), six months (41.05 cm, 40.80 cm and 39.73 cm respectively), nine months (46.04 cm, 44.91

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cm and 43.82 cm respectively), one year (50.82 cm, 48.83 cm and 48.09 cm respectively) and one and half year (55.67 cm, 54.66 cm and 53.27 cm respectively) of Group 1, Group 2 and Group 3 was also not varied significantly. The heart girth at birth (24.77 cm, 24.39 cm and 24.28 cm respectively), three months of age (40.03 cm, 38.94 cm and 38.25 cm respectively), six months of age (46.23 cm, 44.36 cm and 43.04 cm respectively) and nine months of age (51.02 cm, 49.87 cm and 48.30 cm respectively) of Group 1, Group 2 and Group 3 was not significantly varied among the groups. The heart girth at one year's age of Group 1 (56.40 cm) and Group 2 (55.28 cm) was significantly ( $P < 0.05$ ) higher than Group 3 (52.39 cm). Similarly, heart girth at one and half year's of age of Group 1 (61.82 cm) and Group 2 (59.54 cm) was

significantly ( $P < 0.05$ ) higher than Group 3 (52.28 cm). No significant variation in heart girth at one year and one and half year of age was observed between Group 1 and Group 2.

The body length among different ages was not significantly varied among the three groups. Average body length at birth of Group 1 (22.72 cm), Group 2 (22.07 cm) and Group 3 (21.17 cm) were not varied significantly. Similarly the body length in three months age (36.98 cm, 35.43 cm and 34.81 cm), six months age (42.07 cm, 40.36 cm and 39.16 cm), nine months age (46.42 cm, 45.29 cm and 44.25 cm), one year age (51.33 cm, 49.31 cm and 48.54 cm) and one and half year age (56.25 cm, 55.27 cm and 53.91 cm) of Group 1, Group 2 and Group 3 respectively were also in the same range.

**TABLE 2.** Analysis of variance of body weight of the progenies of Black Bengal goat in different EPG level under field condition

Age group	Source	df	Sum of Squares	Mean Square	F
Birth	Between groups	2	0.37	0.19	1.87
	Within groups	249	24.67	0.10	
	Total	251	25.04		
3 months	Between groups	2	6.97	3.49	1.96
	Within groups	249	442.14	1.78	
	Total	251	449.11		
6 months	Between groups	2	4.11	2.06	1.82
	Within groups	249	281.75	1.13	
	Total	251	285.86		
9 months	Between groups	2	22.54	11.27	2.05
	Within groups	249	1368.44	5.50	
	Total	251	1390.98		
12 months	Between groups	2	58.93	29.47	3.36*
	Within groups	249	2182.49	8.77	
	Total	251	2241.42		
18 months	Between groups	2	101.02	50.51	4.03*
	Within groups	249	3120.36	12.53	
	Total	251	3221.38		

\*  $P < 0.05$

\*\*  $P < 0.01$

**TABLE 3** Reproductive performance (Mean  $\pm$  SEM) of the progenies of Black Bengal goat in different EPG level under field condition

Reproductive traits	Group 1	Group 2	Group 3	Overall
AFS	228.62 $\pm$ 4.39 (50)	236.84 $\pm$ 5.31 (51)	244.59 $\pm$ 7.32 (8)	235.31 $\pm$ 3.19 (109)
WFS	8.85 $\pm$ 0.16 (50)	8.37 $\pm$ 0.22 (51)	8.12 $\pm$ 0.22 (8)	8.50 $\pm$ 0.12 (109)
AFK	388.60 $\pm$ 6.09 (50)	390.31 $\pm$ 5.27 (51)	407.42 $\pm$ 8.54 (8)	393.03 $\pm$ 3.70 (109)
SPC	1.21 $\pm$ 0.08 (50)	1.22 $\pm$ 0.07 (51)	1.24 $\pm$ 0.09 (8)	1.22 $\pm$ 0.05 (109)
WFK	14.32 $\pm$ 0.31 <sup>a</sup> (50)	14.10 $\pm$ 0.32 <sup>a</sup> (51)	12.45 $\pm$ 0.42 <sup>b</sup> (8)	13.73 $\pm$ 0.21 (109)
GP	143.73 $\pm$ 2.36 (50)	144.17 $\pm$ 2.02 (51)	144.21 $\pm$ 0.41 (8)	144.01 $\pm$ 1.24 (109)
SP	59.38 $\pm$ 1.51 <sup>a</sup> (50)	61.11 $\pm$ 1.26 <sup>a</sup> (51)	66.21 $\pm$ 0.56 <sup>b</sup> (8)	61.27 $\pm$ 0.83 (109)
KI	203.11 $\pm$ 2.95 <sup>a</sup> (50)	205.28 $\pm$ 2.22 <sup>a</sup> (51)	210.41 $\pm$ 0.75 <sup>b</sup> (8)	205.48 $\pm$ 1.49 (109)

Values bearing same or no superscript within a row do not differ significantly.

Data in parentheses are the number of observations in each sub-class

**TABLE 4.** Analysis of variance of reproductive performance of the progenies of Black Bengal goat in different EPG level under field condition

Reproductive traits	Source	df	Sum of Squares	Mean Square	F Value
AFS	Between groups	2	76.43	38.22	1.89
	Within groups	106	2143.50	20.22	
	Total	108	2219.93		
WFS	Between groups	2	15.34	7.67	1.34
	Within groups	106	606.10	5.72	
	Total	108	321.45		
AFK	Between groups	2	61.38	30.69	1.16
	Within groups	106	2811.84	26.53	
	Total	108	2873.22		
SPC	Between groups	2	0.49	0.24	0.29
	Within groups	106	87.59	0.83	
	Total	108	88.08		
WFK	Between groups	2	49.36	24.68	3.31*
	Within groups	106	790.14	7.45	
	Total	108	839.50		
GP	Between groups	2	6.90	3.45	1.11
	Within groups	106	330.68	3.12	
	Total	108	337.58		
SP	Between groups	2	58.55	29.28	3.30*
	Within groups	106	941.37	8.88	
	Total	108	999.92		
KI	Between groups	2	205.24	102.62	3.38*
	Within groups	106	3213.75	30.32	
	Total	108	3418.99		

\* P &lt; 0.05 \*\* P &lt; 0.01

**Reproductive performance**

To know the reproductive performances of the progenies of three groups, one hundred nine does were examined throughout the study period from July, 2005 to June, 2007 despite of mortality as well as selling by the goat owners. The average values of different reproductive traits are presented in Table 3 and the analysis of variance is presented in Table 4. The age at first service of Group 1 (228.62 days), Group 2 (236.64 days) and Group 3 (244.59 days) was not significantly varied. The average weight at first service (8.85 kg, 8.37 kg and 8.12 kg), average age at first kidding (388.60 days, 390.31 days and 407.42 days) and number of services required per conception (1.21, 1.22 and 1.24) of Group 1, Group 2 and Group 3 respectively were also not significantly varied among the groups. The result revealed that the weight at first kidding was significantly ( $P < 0.05$ ) varied between the groups. Average weight at first kidding of the progenies of Group 3 (12.45 kg) were significantly ( $P < 0.05$ ) lower than the progenies of group 2 (14.10 kg) and Group 1 (14.32 kg). Average weight at first kidding of Group 2 was not statistically varied from Group 1. There was non significant difference in the average gestation period (143.73 days, 144.17 days and 144.21 days respectively) of three groups. The service period of Group 3 (66.21 days) was significantly ( $P < 0.05$ ) higher than Group 2 (61.11 days) and Group 1 (59.38 days). The variation of service period between Group 1 and Group 2 was non significant. Similarly, average kidding interval of Group 3 (210.41 days) was also significantly ( $P < 0.05$ ) higher than Group 2 (205.28 days) and Group 1 (203.11 days). There

was non significant difference between Group 1 and Group 2.

**DISCUSSION****Productive performances of base stock****Body weight**

The body weight is considered as main component towards estimation of productive performance since Black Bengal goat is an established meat breed. The body weight from three months of age of the base stock was showed uniformity with the advancement of age. The body weight observed by Singh and Singh (2000) at three months, six months, nine months and twelve months of age was higher than present findings as they had considered both male and female for estimation of average body weight. Literature suggested that body weight of male goat was significantly higher than female goat so comparison on body weight of does under present study could not be compared with the results of previous workers. However, the present study was almost in uniformity with the findings of Rao and Patro (2004) for female goat under village condition. Body weight at three months of age (4.85 kg) as recorded by Akhtar *et al.* (2006) in Bangladesh was slightly lower than present result but body weight at six months (8.11 kg), nine months (10.68 kg) and twelve months of age (15.49 kg) was quite higher than the present finding which might be associated with the effect of selection employed by them apart from consideration of both male and female.

**Physical characteristics**

The body measurements have been used to predict body weight by several authors in many breeds of Indian goats

(Das *et al.* 1990; Prasad *et al.* 1990; Singh and Mishra, 2004). The physical characteristics mainly body biometry from three months to eighteen months of age of the base stock has showed a consistency. The body measurement viz. body height, heart girth and body length have positive correlation with body weight as observed in the present study which might be used as a parameter for selection of Black Bengal goat to improve the meat production (Khan *et al.* 2006). The result of heart girth and body length observed by Verma *et al.* (2000) on Barbari goats was much higher than the present result as Black Bengal is a smaller breed than Barbari. The body height, heart girth and body length of Black Bengal goat at six months of age in the present study was in agreement with the findings of Singh (2002) and Kumar and Singh (1983). Manna (2002) had observed slightly lower values of physical characteristics of Black Bengal goat up to one year of age because they had conducted their study during July to November, which is being the peak period for gastrointestinal nematode load.

#### **Reproductive performance of the base stock**

Better reproductive performance directly and indirectly improve the production ability of the animal. The reproductive performance like age at first service, body weight at first service, age at first kidding, body weight at first kidding, number of service(s) required per conception, gestation period, service period and kidding interval in the present study gave a clear picture of these traits for Black Bengal goats maintained absolutely in the farmers' house. The age at first service was in agreement with the previous observation made by Misra and Sinha (2001) and Dhara *et al.* (2008) under field condition in India. In farm condition with semi-intensive system of management, Black Bengal does showed early maturity as reported by Hossain *et al.* (2004) in Bangladesh and Zeshmarani *et al.* (2007) in Manipur, India.

The average body weight at first service was corroborated with the observation of Ray *et al.* (1990). On the contrary, Akhtar *et al.* (2006) reported slightly higher body weight as they observed higher age at first service. Age at first kidding was substantiated with the earlier reports on Black Bengal goat in India (Singh *et al.* 1998 and Zeshmarani *et al.* 2007) and Bangladesh (Faruque *et al.*, 2002 and Hossain *et al.* 2004) which established that irrespective of location the age at first kidding of Black Bengal doe had uniformity. It was evident from the reports (Myenuddin and Wahab, 1989; Husain *et al.* 1990 and Mia *et al.* 1996) that before 90s the Black Bengal does kidded earlier under field condition but they had started to give birth at an older age in late 90s onward which may be associated with indiscriminate breeding practice in field level. The result on average weight at first kidding was in close agreement with Dhara *et al.* (2008) at the beginning of their study which became higher at the later period of their study due to the effect of selection process employed by them. Average weight at first kidding was depended upon the number of kids born and thus the reports of previous workers varied (Singh *et al.* 1987 and Ray *et al.* 1990). Number of services required per conception as revealed in the present study was in uniformity with the previous workers (Manna, 2002; Faruque *et al.* 2002; Hossain *et al.* 2004; Akhtar *et al.* 2006 and Dhara *et al.* 2008) irrespective of their study area.

The average gestation period of the base stock was substantiated with the findings of Faruque *et al.* (2002), Chowdhury *et al.* (2002), Zeshmarani *et al.* (2007) and Dhara *et al.* (2008) irrespective of location or system of management. Ahmed (1992) observed higher value of gestation period as 150 days while Singh and Singh (1999) observed lower value as 140.85 days which might be due to the effect of parity, season or different agro-climatic condition. The service period as evident from the result was in accordance with the reports of Misra and Sinha (2001) and Dhara *et al.* (2008). Ghosh *et al.* (1994) observed higher service period (78 days) for Black Bengal doe maintained under deep litter system of management which might affect the natural performance of Black Bengal goat. Hussain *et al.* (1990) reported shorter service period which might be associated with the purity of the breed which is extincting due to indiscriminate breeding practice adopted by the farmers. The observation on kidding interval of Black Bengal goat by different workers of India and Bangladesh showed different result. The present study was corroborated with Ray *et al.* (1990), Rao *et al.* (2002) and Dhara *et al.* (2008) under field condition. Lower kidding interval found by Hossain *et al.* (2004) and Hassan *et al.* (2007) might be due to proper health care management taken along with additional feed and mineral supplementation during pregnancy resulting in early involution of uterus and thus early onset of oestrous.

#### **Effects of gastrointestinal parasites**

##### **Productive performance**

The effect of GI parasites on the productive performance of the progenies of Black Bengal goat has been studied. It is evident that GI parasites are responsible for marked loss in the production.

##### **Body weight**

The present study revealed that gastrointestinal parasites caused significant weight loss from one year age onward in case of the progenies born from the does having more than 1200 EPG count under field condition. Similar observation was also reported by Faye *et al.* (2003) and Das *et al.* (2005). The reduced body weight in the adult goats indicates negative impact on the weight gain. It was evident from the result that the does of the base stock having EPG count more than 1200 developed anaemia and hypoproteinaemia which obviously had affected the health status as decreased protein level of the dam hampered the body building activities of their kids. Spedding *et al.* (1958) recorded upto 30% reduction in growth rate of sheep due to normal burden of nematode infection. However, in the present study faecal egg count indicated that a moderate burden of nematodes caused lower body weight in the dam (Githigia *et al.* 2001). The result further revealed that in higher EPG group, the growing goats (from 0 to 6 months) had lower growth rate in comparison to lower EPG group though the growth rate was non-significant. The progenies born from heavily infected does allowed to graze in the same pasture with their dam and thus received greater larval challenge after six months as maternal resistance exists in the progenies upto six months only (Mandonnet *et al.* 2001) and thus resulted in weight loss which has reflected significantly in their adulthood.

The average body weight of the progenies of the does having less than 1200 EPG count was improved in comparison to their dam while the progenies of does

having more than 1200 EPG count showed body weight lower than their dams under field condition. This indicated that apart from other criteria, the selection of does on the basis of EPG level less than 1200 may consistently improve the body weight of their progenies.

#### **Physical characteristics**

The measurements of various body conformations are of value in judging the body weight and also helpful in developing suitable selection criteria (Bose and Basu 1984 and Islam *et al.* 1991). The result of physical characteristics like body height, heart girth and body length of the progenies from birth to one year and six months of age in different EPG groups could not be corroborated. There was no significant variation observed in body height and body length of the progenies of different groups.

Significant effect of maternal gastrointestinal nematode load was observed on heart girth of progenies from one year of age which indicated that the progenies of Group 3 (>1200 EPG) was lean in comparison to the progenies of other two groups from one year of age under field condition. Thiruvankadan (2005) reported that body weight had higher association with heart girth than with length or height which was also reflected in the present study since there was significant weight loss from one year of age onward in case of the progenies born from the does having more than 1200 EPG count. The body measurements has positive correlation with body weight as observed in the present study which was also reported by previous workers (Majid *et al.* 1999 and Khan *et al.* 2006). The negative impact of GI nematode load towards body weight (Githigia *et al.* 2001; Faye *et al.* 2003 and Das *et al.*, 2005) was directly affected the body measurements. It may be assumed that hypoproteinaemia and anaemia of the does with higher EPG count (Group 3) affected the growth rate of the progenies. Steel (1974) and Symons and Steel (1978) opined that helminth diseases cause a series of metabolic changes in the animal, the primary impact of which is on protein metabolism and the effect carry through to the metabolism of other nutrients resulting in a syndrome analogous to malnutrition. It was obvious that the progenies from the does with high EPG and low body condition have got less milk from the dam than the healthier groups and thus deprived of essential proteins, minerals and micro nutrients which affected their muscle building activities though to a lesser extent. These progenies also took the infection after elimination of maternal immunity (Mandonnet, 2001) after six months of age. Again they had run down their pool of plasma protein, minerals and micro-nutrients by direct infection. Consequently, they had reduced the capacity to accumulate muscle (Sykes *et al.* 1977) which ultimately reflected in their body configuration by making them lean as evident by reduced heart girth.

No change was observed in the productive performance of the progenies born from the does having EPG count less than 1200.

#### **Reproductive performance**

The reproductive performance has always given less importance in production than live weight of meat breeds of animals. But some of the reproductive traits have a significant importance while considering productive performance of meat breed.

The result revealed that age at first service, average body weight at first service, age at first kidding, number of services required per conception and gestation period of the progenies of Group 3 (> 1200 EPG) did not show any variation with the lower EPG groups (Group 1 and 2). Significant difference was observed only in case of average weight at first kidding, service period and kidding interval among the progenies of higher (>1200 EPG) and lower (<1200 EPG) nematode infected groups. The progenies from the does having less than 1200 EPG count (Group 1 and 2) did not showed any degradation in reproductive performance.

The result showed that there was significant decrease in body weight at first kidding of the progenies of Group 3 than other two groups. It was evident from the earlier reports that the maternal resistance exists in the progeny for upto six months (Robinson, 1996 and Mandonnet *et al.* 2001) and in peri-parturient animal due to maternal stress relaxation in immunity take place (Mandonnet *et al.* 2005). As the progenies in field condition has reared in the same pasture field it can be assumed that after six months they also became more susceptible to infection and highest susceptibility occurred during pregnancy. Along with these factors the condition was more aggravated with lower body weight and nutritional stress during pregnancy. The animal showed significantly lower body weight at first kidding than those groups which received lighter GI nematode infection.

The result revealed that the service period and kidding interval of the progenies of the does having high EPG level were significantly longer than the groups having lighter infection. However, Chiezey *et al.* (2008) reported that ewes having higher EPG count of nematode revealed longer lambing interval which might be due to delayed resumption of ovarian activity post partum.

Emaciation and the consequent hypoglycaemia when they set in are thought to affect the ovulation rate by affecting energy needed for the release of gonadotrophic- induced LH release (Osburn and Kennedy, 1981). Energy balance and supply is increasingly being recognized as an important factor in the immune response (Lord, 2002) as well as in the reproduction. It was evident from the result that the progenies of the higher EPG group showed lower body weight at one year of age. So it may be assumed that the animal having lower body weight and higher susceptibility to infection took a longer time for resumption of ovarian activity post partum and thus longer time for next ovulation resulting in lengthy service period and kidding interval. It is obvious that lengthy service period and kidding interval resulted in less number of progeny born and thus hampered the production system in terms of number of animal in next generation and so on.

#### **CONCLUSION**

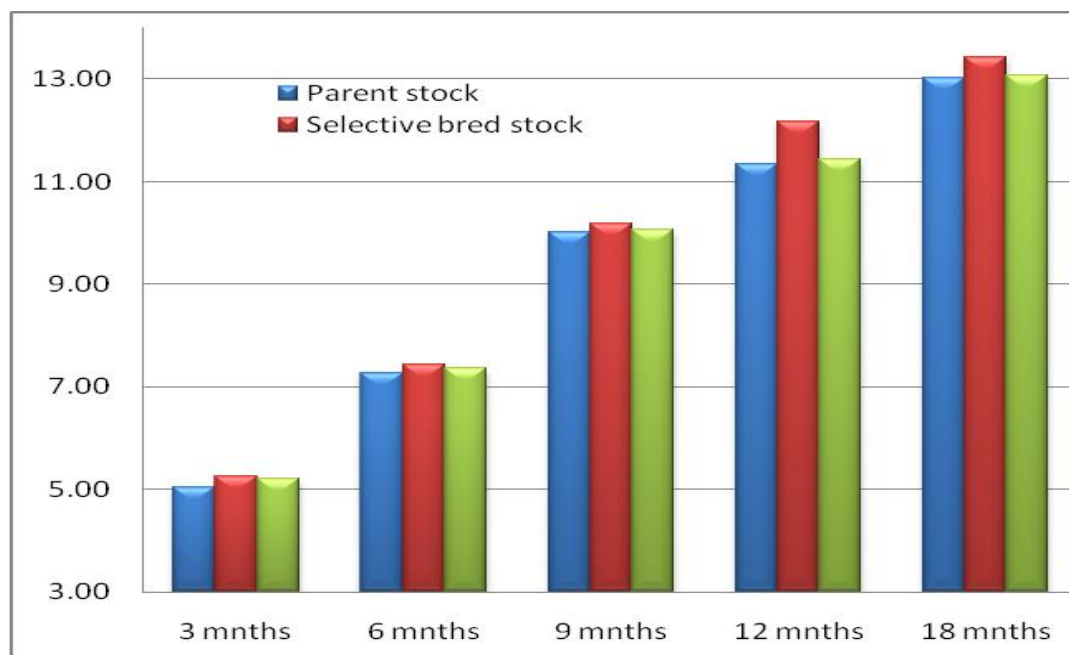
The Black Bengal does of the three groups have reared in the same pasture in field condition but it was observed that they harbored different level of nematode infection. It is clear that the does of Group 1 and Group 2 were resistant to GI nematode infection where as Group 3 was susceptible to infection. The groups having EPG count up to 1200 had remained healthier and the progenies born from them performed well in terms of productive and reproductive performances. But the does of base stock

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having EPG count more than 1200 (though this group includes a little of the population of base stock i.e. 8.5% only) showed internal illness and the progenies born from them also showed deterioration in performance in terms of production and reproduction and a considerable economic loss in goat rearing. So it may be suggested that apart from other selection criteria like growth, biometry, reproductive performance of ancestors, selection of GI nematode resistant Black Bengal goats on the basis of faecal egg

count of nematodes and its indicator trait i.e. PCV may be considered as an important selection tool for improvement of Black Bengal goat in the farmers' house towards economic goat rearing and hence this breeding practice has a potential for improving the livelihood of the poor farmers. Selection based on EPG count (<1200 EPG) lead to about 8 to 10% improvement in production per generation in Black Bengal Goat under field condition

**FIGURE 1.** Impact on production of black Bengal Goat selection based on GI nematode load



	Parent stock	Selective bred stock	Overall	Improvement	Improvement %
3 months	5.03	5.26	5.20	0.23	4.57
6 months	7.27	7.44	7.35	0.17	2.34
9 months	10.01	10.18	10.05	0.17	1.70
12 months	11.35	12.16	11.43	0.81	7.14
18 months	13.02	13.42	13.06	0.40	3.07

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