



Selective breeding of Black Bengal goats for improving productivity

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The All India meat production for the year 2009–10 is 4.02 million tonnes as against 2.21 million tonnes in 2004–05. The goat population in India is 122.7 million in the year 1997, which increased to 140.5 million in the year 2007 (Department of Animal Husbandry Dairying and Fisheries 2010). The study was undertaken to improve the productivity of Black Bengal goats using selective breeding methodology especially under field conditions.

A survey was undertaken in 35 villages in Patna district of Bihar and 127 flocks were visited to evaluate the production performance of Black Bengal goats under farmers' conditions. The morphometric characteristics such as height at withers, body length and chest girth, and the body weight were studied in 654 kids at 0, 3, 6, 9 and 12 months of age. From the survey, 4 superior bucks were selected based on phenotypic characteristics, body condition, litter size and ancestral history of productive and reproductive performance of goats of farm ICAR Research Complex for Eastern Region, Patna. The bucks were trained for semen collection; the semen was collected twice in a week and the quality characteristics of the semen was assessed. The semen samples, which have the progressive motility of more than 90% were extended with sodium citrate-fructose-egg yolk diluent and finally stored at 4°C refrigeration temperature. Six villages in the periphery of Patna city, in Beur block of Patna district, were selected for transferring the germplasm of superior bucks to the village herds. Does (10) from each village were inseminated with the semen collected from the superior bucks. After insemination, the farmers were advised not to breed the goats with other bucks. Kids (132) were produced over the span of 18 months from 60 does in 2 kiddings. These kids were evaluated and compared for their superiority over their dams. The data were analyzed statistically as per Snedecor and Cochran (1968).

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Flock size and composition: Flocks are generally smaller in size and most of the flocks possess less than 5 does with a maximum of 10 kids of both the sexes. Flock size of 7–9 was highest followed by the flock size of 4–6.

The size of flocks was little bigger than Gohilwadi goats (Singh *et al.* 2009), which may be due to higher fecundity rates in Black Bengal goats. Majority of the flocks does not possess breeding bucks and none of the flocks had accompanying sheep with them. Breeding is carried out by bucks which are collectively owned by many farmers. Almost all the flocks had 25–30% adult does of more than 3 years, 15–20% of does of more than 1 year 50–60% of kids of both the sexes less than 1-year old.

Physical characteristics: The breed exists in various coat colours as the study revealed in 7 recognizable varieties in the breed. The overall ratio of different varieties in males and females in the surveyed area is given in Table 1. Among them, complete black coat colour is predominant followed by complete white colour. However, there is neither preferential selection nor preferential mating is being carried out for coat colour in the breeding tract. Acharya (1982) described 4 predominant coat colours with mixture of black patches sometimes with predominant colours. The slight changes in the coat colour observed in this study may be due to natural selection in the breeding tract over the years.

Characteristics of bucks used in selective breeding: Among the morphometric characteristics, the chest girth was higher at adult stage followed by body length and height at withers. The body measurements and body weight observed

Table 1. Varieties of Black Bengal goats in the native tract

Coat colour	Percentage
Complete black	28.3
Complete white	24.7
Predominantly brown with white patches	18.8
Predominantly black with white patches	12.6
Predominantly white with black patches	8.6
Predominantly white with brown patches	4.2
Complete brown	2.8

Table 2. Evaluation of semen of Black Bengal bucks earmarked for selective breeding

Attribute	Findings (n=56)
Ejaculate colour	Creamy white
Ejaculate volume (ml)	0.48±0.06
Wave motion (0–5)	4.3
Progressive motility (%)	90.12±2.17
Sperm concentration (×10 ⁹ /ml)	2.92±0.15
Live sperm (%)	84.2±2.14

in this study for Black Bengal bucks were in close agreement with the similar traits of the same breed and lesser than that of other Indian goat breeds at the similar age as reported by Acharya (1982). Generally most of the Indian goats are medium size breeds whereas Black Bengal is a small sized goat in its genetic architecture.

Seminal characteristics: The average semen volume and the semen concentration obtained in this study were higher (Table 2) than the one reported by Oyeyemi *et al.* (2001) for African Dwarf goats and lesser than that of Black Bengal

Table 3. Principal morphometric traits and body weight of Black Bengal kids in the random bred population and in the kids after selective breeding

Traits		At birth	3 months	6 months	9 months	12 months
Height (cm)						
Male	RP	22.18±0.34 (38)	36.83±0.22 (128)	40.94±0.56 (55)	43.58±1.0 (18) (15)	47.53±1.12 (19)
	SB	23.05±0.29 (69)	37.21±0.31 (56)	42.03±0.53 (38)	44.39±0.46 (21)	48.80±0.89 (60)
Female	RP	21.87±0.38 (46)	32.21±0.32 (143)	37.12±0.27 (84)	39.81±0.33 (67)	43.65±0.49 (38)
	SB	22.68±0.32 (63)	33.15±0.32 (55)	38.31±0.35 (52)	40.76±0.42 (43)	44.72±0.63 (38)
Body length (cm)						
Male	RP	19.68±0.39 (38)	32.15±0.21 (128)	39.36±0.47 (55)	42.59±0.94 (18)	46.82±1.33 (15)
	SB	20.87±0.25 (69)	33.23±0.31 (56)	40.56±0.48 (38)	43.58±0.61 (21)	48.07±0.80 (19)
Female	RP	18.85±0.42 (46)	29.97±0.27 (143)	36.49±0.40 (84)	39.75±0.28 (67)	43.11±0.55 (60)
	SB	19.35±0.26 (63)	30.35±0.38 (55)	37.71±0.41 (52)	40.85±0.46 (43)	44.35±0.51 (38)
Chest girth (cm)						
Male	RP	24.26±0.35 (38)	40.25±0.18 (128)	47.53±0.49 (55)	52.68±0.89 (18)	56.46±1.14 (15)
	SB	25.14±0.31 (69)	41.38±0.38 (56)	48.17±0.46 (38)	53.89±0.52 (21)	58.09±0.71 (19)
Female	RP	23.33±0.37 (46)	36.40±0.21 (143)	44.12±0.33 (84)	48.31±0.35 (67)	53.87±0.39 (60)
	SB	23.93±0.30 (63)	37.10±0.35 (55)	45.19±0.44 (52)	49.57±0.39 (43)	54.61±0.68 (38)
Body weight (kg)						
Male	RP	1.32±0.44 (38)	5.06±0.22 (128)	8.61±0.39 (55)	12.11±0.87 (18)	14.41±0.90 (15)
	SB	1.40±0.28 (69)	5.57±0.35 (56)	9.02±0.45 (38)	12.94±0.73 (21)	15.2±0.71 (19)
Female	RP	1.26±0.38 (46)	4.61±0.21 (143)	7.53±0.42 (84)	9.68±0.32 (67)	12.98±0.46 (60)
	SB	1.31±0.29 (63)	4.85±0.37 (55)	7.92±0.38 (52)	10.13±0.40 (43)	13.58±0.54 (38)

RP, Kids from random bred population; SB, kids born from selective breeding. Figures in parenthesis are number of observations.

bucks reported by Kabiraj *et al.* (2011). The variation in volume and concentration of semen may be attributed to breed, nutrition and other environmental circumstances.

Effect of selective breeding on economic traits: The height at withers and body length of Black Bengal goats are almost similar for all the age groups since birth (Table 3). The same trend was also observed by Chowdhury and Faruque (2004) and Hoque *et al.* (2011). This may be due to the short stature of Black Bengal goats.

The biometrical characteristics and body weight of Black Bengal goats found in the random bred population were in close agreement with Acharya (1982) and Hoque *et al.* (2011). However, Chowdhury and Faruque (2004) reported higher values for the same breed. The average height at withers, body length and chest girth of Black Bengal goats were lesser than Marwari (Barhat 2005), Kanni Adu (Thiruvankadan *et al.* 2005), Sangamneri (Verma *et al.* 2010) and Surti (Deshpande *et al.* 2010) breed of goats.

The kids born from selective breeding had higher height, body length, chest girth and body weight than the kids found in the random-bred population but the difference was not significant at any stage. This may be due to the factors that the experiment was carried out under field conditions and the 2 populations were reared in different environmental conditions. Moreover, the genetic distance between the 2 populations is not higher as they belong to the same breed. Hence, continuous breeding of progenies with the selected bucks repeated many times would be the option for continuous improvement of the breed.

Phenotypic correlation: The phenotypic association of body weight (Table 4) with different morphometric characteristics was highly significant ($P < 0.01$) and positive which is in close agreement with Hoque *et al.* (2011) for the same breed.

Strategies for improvement of the breed: Chaotic breeding system under field conditions in small ruminants hampers the progress of genetic improvement. Though many successful breed improvement programmes have been completed in our country, most of them are under institutional level. To convert the success under field conditions, there is a need for coordinated implementation of breed improvement

programmes through various agencies. Implementation of selective breeding in large scale need establishment of large nucleus farm and standardized estrous synchronization protocols applicable under Indian conditions. So that, the elite germplasm from the nucleus herd could be transferred into a large number of village herds.

The present study revealed that the Black Bengal goats are reared in small flocks in their native tract. The breed exists in 7 different recognizable varieties with complete black dominates in frequency followed by complete white. Though the body weight of Black Bengal kids are comparatively smaller on comparison to the body weights of kids from other breeds of India, the faster vertical expansion of Black Bengal flocks in terms of superior fecundity could offset smaller body weights to a greater extent. The selective breeding methodology adopted in the present study improved the morphometry and body weight of Black Bengal goats though the differences were not significant. Continuous selection of bucks from village flocks and repeated breeding of random-bred population with the selected bucks might significantly improve the morphometry and the body weight of Black Bengal goats on long-term basis.

SUMMARY

The selective breeding methodology was followed for improving the productivity of Black Bengal goats under field conditions. Superior bucks were procured from the field and were trained for semen collection. The germplasm was transferred to the nearby village herds through AI. The height, length and girth of Black Bengal female goats at 3 months of age in the random bred population increased in the kids born from selective breeding. The body weight of Black Bengal goats in the random bred population at 3 and 12 months of age in the kids parented by selected bucks, the body weight was higher. Significant difference was not noticed between the random bred population and the population descended from selected bucks, but improvement in performance of the later was noticed for all the age groups. Phenotypic correlation between the body weight and morphometric traits was highly significant for both males and females. Strategy for long-term improvement of productivity through selective breeding was discussed.

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Table 4. Phenotypic correlation of body weight with morphometric characteristics at 3 months of age

Traits	Body weight	Height at withers	Body length	Chest girth
Body weight		0.83±0.04	0.74±0.06	0.91±0.04
Height at withers	0.81±0.05		0.78±0.02	0.88±0.07
Body length	0.75±0.02	0.74±0.06		0.83±0.06
Chest girth	0.89±0.02	0.92±0.05	0.81±0.04	

Values above and below diagonal are males and females respectively.

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