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Heterosis on Productive and Reproductive Performance of Crossbreds from Jamunapuri and Black Bengal Goat Crosses

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Abstract: The experiment was carried out by crossing Jamunapuri male with Black Bengal female goat to assess the heterosis of productive and reproductive traits of F_1 and F_2. F_1 and F_2 for birth weight, live weight at 3, 6, 9 and 12 months of age, pre and post- weaning body weight gain, and litter size was significantly better than that of Black Bengal goat. However, F_1 was found to be higher than that of F_2. But pre-weaning survival rate was higher in Black Bengal goat than that of F_1 and F_2 crossbreds. Pre-weaning gain was higher than post-weaning gain in all populations. Heterosis of birth weight, live weight at 3,6,9 and 12 months of age, pre and post weaning gain, litter size and pre-weaning survival rates were 17.19, 23.35, 12.93, 7.44 and 5.71, 36.34, 31.87,15.38 and -4.82% for F_1 and 8.60, 11.67, 6.46, 3.72, 2.86 and 18.17, 15.94, 7.69 and -2.41% for F_2 respectively at location 1. But at location -2, heterosis of birth weight and pre-weaning survival rate were 24.79 and 16.54% for F_1 and 12.40 and 8.27% for F_2 respectively.

Key words: Black Bengal and Jamunapuri goat, locations, F_1 and F_2 crossbreds, productive and reproductive traits, heterosis

Introduction

Goats are numerically and economically very important and promising genetic resources in developing countries of Asia and Africa. There are about 703.39 million goats in the world, and 95% of them are found in developing countries. Asia have, 446.26 million goats, which is almost 66.3% of the world's population (FAO, 1997). Bangladesh is in 2nd highest position of Asiatic countries for goat population (FAO, 1997). Meat, milk and skin production are about 27.0,23.0 and 28.0 % respectively to the total production of Livestock Sector. Goat contributes Significantly to the GDP in Bangladesh (FAO, 1991). Though Black Bengal goat is dwarf but it is World famous for its adaptability, fecundity, delicious meat and superior skin quality (Devendra and Burns, 1983; Devendra, 1985; Saadullah, 1991 and Husain, 1993). Jamunapuri goat originated from India, is an excellent breed for Milch and meat production. Approximate milk production is 235 kg over a lactation period of 261 days (Devendra and Burns, 1970). The economic value of goats depends upon their productive and reproductive efficiency (Malik *et al.*, 1986). Introduction of high yielding specialized breed may bring drastic changes for increasing overall productivity like birth weight, growth rate and kid survivability (Keeping, 1951). Birth weight of goat is correlated with its adult size and with kids survivability (McGregor, 1984). The quantity of meat depends on growth rate, live weight at slaughter and total number of goats available for slaughter (Devendra, 1985). A work revealed that growth rate of Black Bengal is very low (Husain *et al.*, 1996). Lower birth weight and growth rate and insufficient milk production of dam are responsible for higher kid mortality (Husain *et al.*, 1995). Some reports indicate that crossbreeding between Jamunapuri buck and local small type goat might increase the birth weight, subsequent growth rate, adult size and carcass weight due to heterosis or non-additive gene effects (Peters and Horst, 1981 and Mukherjee, 1991). So, the present study was undertaken to evaluate heterosis (hybrid vigour) of productive and reproductive traits of crossbreds (F_1 and F_2) of Jamunapuri and Black Bengal goat in Bangladesh.

Materials and Methods

The experiment was carried out at following two locations:

Location 1: The research unit located in some areas around the Bangladesh Agricultural University campus, where 100 farmers were selected having 176 Black Bengal goats. Four Jamunapuri bucks were used for crossing with all Black Bengal goats. The F_1 bucks and does were used to produce F_2 progeny. A total of 215 F_1 and 79 F_2 goats were used in this study. Each animal was ear tagged to maintain individual identity pedigree and just after birth. Bucks were selected individually on the basis of their phenotypic performance. Animals were fed grass, herbs, tree leaves avoiding extra concentrated feeds.

Location 2: Here data were collected from the goat farm of Bangladesh Mission Ganakbari, Savar, Dhaka, where two bucks of Jamunapuri mated naturally with 37 Black Bengal goats for F_1 progeny. The F_1 bucks and does were mated for F_2 progeny. Here 51 F_1 and 50 F_2 goats were used for study. Animals were ear tagged for individual identity. Buck and does were fed green grass, herbs and tree leaves. Only the pregnant does and breeding bucks were provided supplementary feed for their productive purpose.

The following traits of F_1 and F_2 crossbred were recorded:

1. Birth weight, 6 hours after birth at location 1 and 3 hours after birth at location 2
2. Live weight at 3, 6, 9 and 12 months of age. Individual body weight of kid was recorded in the morning before feeding.
3. Daily body weight gain:
   Pre-weaning body weight = (3 months body weight - birth weight)/90
   Post weaning body weight = (12 months body weight - 3 months body weight)/270
4. Liter size = No.Kids/ birth/ doe.
5. Pre-weaning kid survival rate, calculated as percentage up to 3 months of age.
6. Survivability: Calculated as percentage.

Performance of percent Black Bengal goat (P_1), F_1 and F_2 progeny were investigated but for unknown parent Jamunapuri (P_2) goat was calculated by Bowman (1984) formula:

$MP_2 = 2(MF_1-HF_1)-MP_1$
Where
MF_1= Mean of F_1 progeny, HF_1= absolute heterosis of F_1,
HF= $2(MF_1- MF_2)$,
MF_2 = Mean of F_2 progeny,
MP_1= Mean of parent P_1
MP_2 = Mean of parent P_2

Heterosis for each trait was estimated using the following formula:
Percent of heterosis in F_1 = 100(Mean of F_1- Mean of parents) /Mean of parents
Percent of heterosis in F_2 = 100(Mean of F_2 progeny - Mean of parents)/Mean of parents

Statistical analysis: Data were analyzed using computer MSTAT package programme.
The following statistical model was used for data analysis:
Yij = μ + ßi+ eij
Where, Yij is the observations of jth population in ith genetic group.
μ is the overall mean
ßi is the fixed effect of ith genetic Groups (I = 1-3)
eij is the random error.

Results and Discussion

Birth weight of F_1 progeny was significantly higher than that of Black Bengal goat (P_1) but not F_2 progeny at both locations. Estimated value of Jamunapuri (P_2) at location 1 was much higher (1.69kg) than that of P_1, F_1 and F_2 (Table 1). The heterosis of F_1 and F_2 for birth weight at location 1 was 17.19 and 8.60%, and at location 2 was 24.79 and 12.40% respectively (Table 2). Live weight at 3, 6, 9 and 12 months of age, pre and post weaning body weight gain differed significantly among P_1, F_1 and F_2 ($P < 0.001$). The highest live weight at different age, pre and post weaning body weight gain were found on F_1, intermediate on F_2 and lowest on P_1 (Black Bengal goat) at location 1 only. The estimated live weight of Jamunapuri (P_2) at 3, 6, 9 and 12 months of age was 4.72, 8.25,12.2 and 15.77 kg respectively, its pre and post weaning body weight gain was 35.98 and 33.97 kg respectively (Table 1). The heterosis of these traits was almost double in F_1 than that of F_2 (Table 2).
The highest litter size was found on F_1, intermediate on F_2 and the lowest on P_1 at location 1($P < 0.01$) and location 2 ($P < 0.05$). The estimated litter size of Jamunapuri was 1.47 for location 1 and 1.16 for location 2 (Table 1). Heterosis of F_1 and F_2 was 15.38 and 7.69 at location 1 and 16.54 and 8.27 at location 2 respectively. Pre-weaning survival rate was

Table 1: Least mean ± SE of different traits of different goat populations at different locations

Traits	Location 1 (BAU)					Location 2 (Ganakbari, Savar)				
	Black Bengal (P_1) LSM± SE	F_1 LSM± SE	F_2 LSM± SE	Level of significance (Estimated values)	Jamunapuri (P_2)	Black Bengal (P_2) (P_1) LSM± SE	F_1	F_2 LSM± SE	Level of LSM± SE	Jamunapuri significance (Estimated values)
Live weight (Kg)										
Birth weight	0.87[b]± 0.012 (176)	1.50a± 0.018 (215)	1.39a± 0.031 (79)	***	1.68	1.00b± 0.015 (37)	1.51a± 0.034 (51)	1.36a± 0.014 (50)	***	1.42 (kg)
3 months weight	4.36± 0.048 (151)	5.60a± 0.051 (177)	5.07b± 0.055 (71)	***	4.72	-	-	-		-
6 months weight	6.91c± 0.067 (127)	8.56a± 0.081 (146)	8.07b± 0.078 (62)	***	8.25	-	-	-		-
9 months weight	9.30± 0.101 (88)	11.55a± 0.093 (115)	11.15b± 0.097 (57)	***	12.2	-	-	-		-
12 months weight	11.54± 0.158 (58)	14.43a± 0.110 (99)	14.04b± 0.10 (46)	***	15.77	-	-	-		-
Daily weight gain (g)										
Pre-weaning gain	32.82b± 0.26 (140)	46.90a± 0.31 (180)	40.65a± 0.42 (68)	***	35.98	-	-	-		-
Post-weaning gain	27.15b± 0.44 (116)	40.30a± 0.24 (101)	35.43ab± 0.45 (47)	***	33.97	-	-	-		-
Litter size	1.13b± 0.158 (116)	1.50a± 0.053 (120)	1.40a± 0.084 (47)	**	1.47 (20)	1.15b± 0.08 (22)	1.50a± 0.128 (18)	1.4a± 0.146	*	1.16
Pre-weaning survival rate(%)	89.20a± 0.02 (176)	79.02b± 0.03 (205)	81.16b± 0.04 (69)	*	77.00(%)	-	-	-	-	-

Means with uncommon superscripts (a,b,c) differ significantly, ***, p< 0.001; **, p< 0.01; *, p< 0.05.
Figures in parentheses indicate number of animals.
-Collected data from the location 2 were not available (except birth weight and litter size).

Table 2: Percent heterosis of F_1 and F_2 goats for different traits at different locations

Traits		Location 1 (BAU)		Location 2 (Ganakbrari Savar)	
		F_1 percent heterosis	F_2 percent heterosis	F_1 percent heterosis	F_2 percent heterosis
Live weight (kg)					
	Birth weight	17.19	8.60	24.79	12.40
	3 months weight	23.35	11.67	-	-
	6 months weight	12.93	6.46	-	-
	9 months weight	7.44	3.72	-	-
	12 months weight	5.71	2.86	-	-
Daily weight gain (g)					
	Pre-weaning gain	36.34	18.17	-	-
	Post-weaning gain	31.87	15.94	-	-
Litter size		15.38	7.69	16.54	8.27
Pre-weaning survival rate		-4.82	-2.41	-	-

* Collected data of F1 and F2 at location 2 were not available (except birth weight and litter size)

89.20, 79.02 and 81.16 % in P_1, F_1 and F_2 respectively and estimated value in Jamunapuri was 77.00%. The heterosis was found to be - 4.82 and - 2.41 for F_1 and F_2 respectively. The highest productive and reproductive performance was found in F_1 progeny compared with F_2 or parents (P_1) supported by Mishra *et al.* (1976), Castillo and Garcia (1971) and Verma *et al.* (1991). Pre weaning daily gain was higher than post weaning, which was advocated with the findings of Wahid *et al.* (1985). Birth was related with subsequent body weight, weight gain & litter size, supported by Gall (1981). Heterosis for birth weight at location 1 and 2 was found to be 17.19% (F_1), 8.60 % (F_2) and 24.79% (F_1), 12.40% (F_2) respectively. Difference between two locations seemed to be caused by the variation in management and plane of nutrition, which was consistent with Kanaujia and Pander (1987), who found 27.18% (F_1) and 15.90% (F_2) in Beetal and Black Bengal crosses. Heterosis for 3- months live weight was found to be 23.30% (F_1) and 11.67% (F_2) at BAU location. The heterosis for 3-months live weight was higher than that of birth, 6, 9 and 12 months of live weight. It might be due to maternal influence supported by Singh *et al.* (1990), but was inconsistent with Kanaujia and Pander (1987), where they described as 37.44% heterosis in F_1 for Beetal (G) and Black Bengal (E) crosses. Heterosis for litter size was found to be 15.38% (F_1) and 7.69% (F_2) at location 1 and 16.54% (F_1) and 8.27% (F_2) at location 2. The results of the two locations were almost similar because of gene combination of Jamunapuri and Black Bengal goat. In comparison, 17.8% heterosis for litter size in F_1 was observed by Nitter (1987) in sheep and 10.1% in F_1 of Cher Berrich (CB) 5 Romanov sheep was observed by Ricordeau *et al.* (1977), while 10% in F_1 for Collected data from location 2 were not available (except birth weight and litter size).

The results in this study were almost similar to those results.

The study showed the considerable heterosis for all traits, except pre-weaning kid survival rate. It revealed that under improved management, crossbred of Jamunapuri and Black Bengal goat would be suitable for meat production. However, F_1 crossbreds may get prime consideration for meat production, though it had higher mortality.

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