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

Livestock Development Program, Proshika, Dhaka, Bangladesh
Poultry Production Research Division, BLRI, Savar, Dhaka, Bangladesh
Department of Genetic & Animal Breeding, BAU, Mymensing, Bangladesh

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 F1, F2, F3, and F4 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, F2 was found to be higher than that of F1. But pre-weaning survival rate was higher in Black Bengal goat than that of F1 and F2 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 F1 and 8.60, 11.67, 6.46, 3.72, 2.86 and 18.17, 15.94, 7.69 and 2.41% for F2 respectively at location 1. But at location 2, heterosis of birth weight and pre-weaning survival rate were 24.79 and 16.54% for F1, and 12.40 and 8.27% for F2 respectively.

Key words: Black Bengal and Jamunapuri goat, locations, F1 and F2 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 700 million goats in the world, and 95% of them are found in developing countries. Asia have, 446.26 million goats, which is almost 65.3% of the world's population (FAO, 1997). Bangladesh is in 2nd highest position of Asian countries for goat population (FAO, 1997). Meat, milk, and skin production are about 27.6, 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 Burrell, 1987; Devendra, 1995). Jamunapuri goat originated from India, is an excellent breed for Milk and meat production. Approximate milk production is 235 kg over a lactation period of 261 days (Devendra and Burrell, 1970). The economic value of goats depends upon its productive and reproductive efficiency (Malik et al., 1984). Introduction of high yielding specialized breed may bring drastic changes for increasing overall productivity like birth weight, growth rate and kid survivability (Kepping, 1981). 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 kids available for slaughter (Devendra, 1987). 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 dams are responsible for higher kid mortality (Husain et al., 1996). Some reports indicate that crossbreeding between Jamunapuri 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 effect (Peters and Horst, 1981 and Mulukhajj, 1991). So, the present study was undertaken to evaluate heterosis (hybrid vigour) of productive and reproductive traits of crossbreds (F1 and F2) 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 F1, bucks and does were used to produce F2 progeny. A total of 215 F1 and 79 F2 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 foods.

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 F1 progeny. The F1 bucks and does were mated for F2 progeny. Here 51 F1 and 50 F2 goats were used for study. Animals were ear tagged for individual identity. Bucks and does were fed grass, herbs, tree leaves. Only the pregnant does and breeding bucks were provided supplementary food for their productive purposes. The following traits of F1 and F2 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:
   \[ \text{Pre-weaning body weight} = \left( \frac{3 \text{ months body weight} - \text{birth weight}}{90} \right) \]
   \[ \text{Post weaning body weight} = \left( \frac{12 \text{ months body weight} - 3 \text{ months body weight}}{270} \right) \]
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), F1, and F2 progeny were investigated and for unknown parent Jamunapuri (P) goat was calculated by Bowman (1984) formula:
Zaman et al.: Heterosis of crossbred goat

\[ MP_F = 2(MF_{\text{F}} - HF_{\text{F}} + MF_{\text{F}}) \]

Where
- \( MF_{\text{F}} \) = Mean of \( F_1 \) progeny
- \( HF_{\text{F}} \) = absolute heterosis of \( F_1 \)
- \( MF_{\text{F}} \) = Mean of \( F_2 \) progeny
- \( MP_{\text{F}} \) = Mean of parent \( F_1 \)
- \( MP_{\text{F}} \) = Mean of parent \( F_2 \)

Heterosis for each trait was estimated using the following formula:

Percent of heterosis in \( F_1 \) = \( \frac{100 \times (\text{Mean of } F_1 - \text{Mean of parents})}{\text{Mean of parents}} \)

Percent of heterosis in \( F_2 \) = \( \frac{100 \times (\text{Mean of } F_2 \text{ progeny} - \text{Mean of parents})}{\text{Mean of parents}} \)

Statistical analysis: Data were analyzed using computer MSTAT package programme.

The following statistical model was used for data analysis:

\[ Y_{ij} = \mu + \delta_i + e_{ij} \]

Where, \( Y_{ij} \) is the observations of \( j \)th population in \( i \)th genetic group.
- \( \mu \) is the overall mean
- \( \delta_i \) is the fixed effect of \( i \)th genetic Groups (\( i = 1-3 \))
- \( e_{ij} \) is the random error.

Table 1: Least mean \( \pm SE \) of different traits of different goat populations at different locations

<table>
<thead>
<tr>
<th>Traits</th>
<th>Location 1 (BAU)</th>
<th>Location 2 (Ganakbari Savar)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( \overline{P}_1 )</td>
<td>( \overline{P}_2 )</td>
</tr>
<tr>
<td></td>
<td>( \overline{L}_{\text{SE}} )</td>
<td>( \overline{L}_{\text{SE}} )</td>
</tr>
<tr>
<td>Live weight (kg)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birth weight</td>
<td>0.67 ( \pm ) 0.021</td>
<td>1.58 ( \pm ) 0.018</td>
</tr>
<tr>
<td>3 months weight</td>
<td>4.30 ( \pm ) 0.049</td>
<td>5.03 ( \pm ) 0.051</td>
</tr>
<tr>
<td>6 months weight</td>
<td>5.10 ( \pm ) 0.077</td>
<td>6.08 ( \pm ) 0.081</td>
</tr>
<tr>
<td>9 months weight</td>
<td>9.30 ( \pm ) 0.101</td>
<td>11.56 ( \pm ) 0.056</td>
</tr>
<tr>
<td>12 months weight</td>
<td>11.54 ( \pm ) 0.153</td>
<td>14.43 ( \pm ) 0.110</td>
</tr>
</tbody>
</table>

Daily weight gain (g)

Pre-weaning gain | 22.80 \( \pm \) 0.29 | 46.90 \( \pm \) 0.51 | 40.65 \( \pm \) 0.42 | *** | 36.06 | - | - | - | - | - |
| Post-weaning gain | 27.15 \( \pm \) 0.44 | 40.33 \( \pm \) 0.24 | 35.43 \( \pm \) 0.45 | *** | 37.22 | - | - | - | - | - |
| Litter size | 1.90 \( \pm \) 0.158 | 1.59 \( \pm \) 0.065 | 1.64 \( \pm \) 0.068 | *** | 1.47 | 1.16 \( \pm \) 0.08 | 1.50 \( \pm \) 0.08 | 1.35 \( \pm \) 0.14 | * | 1.10 |
| Pre-weaning survival rate(%) | 86.20 \( \pm \) 0.02 | 76.12 \( \pm \) 0.03 | 81.14 \( \pm \) 0.04 | * | 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).

Results and Discussion:

Birth weight of \( F_1 \) progeny was significantly higher than that of Black Bengal goat \( (P_{\text{F1}}) \) but not \( F_2 \) progeny at both locations. Estimated values of Jamnapuri \( (P_{\text{F2}}) \) at location 1 was much higher (1.69kg) than that of \( P_{\text{F1}} \) and \( P_{\text{F2}} \) at birth weight at location 1 was 17.19 and 8.60%, and at location 2 was 24.79 and 12.60% respectively (Table 2). Live weight at 3, 6, 9 and 12 months of age, pre and post weaning body weight gain differed significantly among \( P_{\text{F1}} \) and \( P_{\text{F2}} \) (P < 0.001). The highest live weight at different age, pre and post weaning body weight gain were found on \( P_{\text{F2}} \), intermediate on \( P_{\text{F1}} \) and lowest on \( P_{\text{F1}} \) (Black Bengal goat) at location 1 only. The estimated live weight of Jamnapuri \( (P_{\text{F2}}) \) 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 36.98 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 \( P_{\text{F1}} \) intermediate on \( P_{\text{F2}} \) and the lowest on \( P_{\text{F1}} \) at location 1 (P < 0.01) and location 2 (P < 0.05). The estimated litter size of Jamnapuri 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 7.89 at location 1 and 16.54 and 8.27 at location 2 respectively. Pre-weaning survival rate was

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

<table>
<thead>
<tr>
<th>Traits</th>
<th>Location 1 (BAU)</th>
<th>Location 2 (Ganakbari Savar)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( F_1 ) percent heterosis</td>
<td>( F_2 ) percent heterosis</td>
</tr>
<tr>
<td>Live weight (kg)</td>
<td>17.19</td>
<td>8.60</td>
</tr>
<tr>
<td>3 months weight</td>
<td>23.25</td>
<td>11.67</td>
</tr>
<tr>
<td>6 months weight</td>
<td>12.93</td>
<td>6.46</td>
</tr>
<tr>
<td>9 months weight</td>
<td>7.44</td>
<td>3.72</td>
</tr>
<tr>
<td>12 months weight</td>
<td>5.71</td>
<td>2.88</td>
</tr>
</tbody>
</table>

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 from F1 and F2 at location 2 were not available (except birth weight and litter size)
Zaman et al.: Heterosis of crossbred goat

89.20, 79.02 and 81.16 % in P1, F1, and F2 respectively and estimated value in Jamnapari was 77.00%. The heterosis was found to be - 4.82 and - 2.44 for F1, and F2 respectively. The highest productive and reproductive performance was found in F1 progeny compared with F2 or parents (P0) supported by Mishra et al. (1978), 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% (F1), 8.60% (F1) and 24.79% (F1), 12.40% (F1), respectively. Difference between two locations seemed to be caused by the variation in management and plane of nutrition, which was consistent with Kanauja and Pander (1987), who found 27.18% (F1) and 15.90% (F1) in Beetal and Black Bengal crosses. Heterosis for 3-months live weight was found to be 23.30% (F1) and 11.67% (F1) 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 Kanauja and Pander (1987), where they described as 37.44% heterosis in F1, for Beetal (G1) and Black Bengal (E) crosses. Heterosis for litter size was found to be 15.30% (F1) and 7.69% (F1) at location 1 and 16.54% (F1) and 8.27% (F1) at location 2. The results of the two locations were almost similar because of gene combination of Jamnapari and Black Bengal goat. In comparison, 17.6% heterosis for litter size in F1, was observed by Nitter (1987) in sheep and 10.1% in F1 of Cher Barrich (CB) 5 Romanov sheep was observed by Ricordeau et al. (1977), while 10% in F1, 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 Jamnapari and Black Bengal goat would be suitable for meat production. However, F crosses may get prime consideration for meat production, though it had higher mortality.

References


Abst., 40: 514.


