RESEARCH ARTICLE
JIVA 20 (3) December 2022
https://doi.org/10.55296/JIVA/20.3.2022.79-84

Received: 22-07-2022
Accepted: 15-09-2022

ESTIMATION OF GENETIC PARAMETERS FOR GROWTH TRAITS OF BLACK BENGAL GOATS (*Capra hircus bengalensis*) UNDER FIELD CONDITION

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ABSTRACT

Goat being low maintenance, resilient livestock for tough times plays a significant role for small and marginal farmers and landless labourers particularly in the rainfed areas where crop production is uncertain and rearing large animals is restricted due to acute scarcity of feed and fodder. Goat husbandry has to be addressed with priority not only for rural development but also for its contribution towards the rural economic upliftment. The data of 10148 kids born during the period 2008 to 2019 maintained at farmers' fields at the different districts of West Bengal were analyzed. The heritability, phenotypic and genotypic correlation were evaluated for the body weight at birth, 3, 6, 9 and 12 months of age. The heritability estimates of birth weight, 3, 6, 9 and 12 months body weight in the present study were 0.515 ± 0.507, 0.247 ± 0.169, 0.325 ± 0.548, 0.511 ± 0.322 and 0.311 ± 0.209, respectively. The genetic and phenotypic correlations between body weights at different ages were positive except at birth. Positive genetic correlations among the body weight traits suggested that the kids at 3 months age and 6 months age can be used to bring about improvement at 12 months age.

Keywords: Black Bengal goat, Genetic parameter, Genetic correlation, Growth traits, heritability, Phenotypic correlation

INTRODUCTION

The state of West Bengal is the breeding ground of the Black Bengal goat, a dwarf breed renowned for its adaptability, fertility, prolificacy, meat delicacy and superior skin quality (Akhtar *et al*., 2006). Despite the popularity of goat meat, goat rearing has not been conducted either as a large or a small-scale industry in the state of West Bengal or India as a whole (Biswas, 2010). Birth weight and weaning weight are important when considering growth potential and muscle development in meat goats. The profitability of goat production for meat largely depends on kid weight as the growth performance

of kids determines the meat-producing ability at a marketable age. One way to achieve heavy market weight is to enhance the growth performance of the kids by improving their growth potential and survival rate. The potential of genetic improvement of a trait of interest is largely dependent on its heritability and genetic relationship with other traits of economic importance (Faruque *et al.,* 2010). Genetic parameters including genetic correlations and heritability are required to plan breeding strategies and genetic evaluation programs in livestock (Hill, 2014). Birth weight and body weight of goat at different ages are considered as important traits because there is a positive correlation between birth weight and growth rate, age at maturity and mature body weight (Banerjee, 1991) which influences the future productive and reproductive performance of the animal. It is now well documented that the selection of good quality bucks and their widespread use could be able to improve birth weight, body weight gain of goat. Keeping in view the importance of Black Bengal goat, the present study has been taken to study genetic parameters of growth traits of Black Bengal goat.

MATERIALS AND METHODS

The research work was conducted on 10148 numbers of kids born during the period 2008 to 2019 maintained at farmer's herd under the project All India Coordinated Research Project on Goat Improvement in four agro-climatic zones namely Nadia, Sundarban, Murshidabad and Jhargram of West Bengal. Mixed Model Least-square and Maximum Likelihood (LSMLMW MIXMDL) Computer Program PC-2 version was used for least-squares analysis and estimating genetic parameters. Heritability estimates were obtained by the paternal half-sib correlation method (Becker, 1984) from the various components obtained through the analysis of variance. The genetic and phenotypic correlations between different traits were estimated from the analysis of variance and covariance using half-sib data as suggested by Becker (1984).

The following mathematical model was used for statistical analysis of traits under study.

$$Y_{ijklmn} = \mu + A_i + B_j + C_k + D_l + E_m + e_{ijklmn}$$

Whereas, Y_{ijklmn} is the observation of n^{th} kid born in i^{th} cluster, j^{th} period, k^{th} season, l^{th} sex and m^{th} parity. μis the overall mean, A_i is the fixed effect of i^{th} cluster, B_j is the fixed effect of i^{th} period, C_k is the fixed effect of i^{th} season, D_l is the fixed effect of i^{th} sex, E_m is the fixed effect of i^{th} parity and e_{ijklmn} is the residual random error with Y_{ijklmn} observation, assumed to be NID (0, σ 2 e)

RESULTS AND DISCUSSION

Estimation of heritability

All the heritability (h^2) obtained for body weight at different ages was medium. The heritability of birth weight, 3, 6, 9 and 12 month body weight in the present study was estimated as 0.515 ± 0.507, 0.247 ± 0.169, 0.325 ± 0.548, 0.511 ± 0.322 and 0.311 ± 0.209, respectively (Table 1). The weight at birth was of high heritability and the heritability of body weight tended to increase with increasing age from 3 months to 9 months and then decreased in 12 months of age. These differences in heritability estimates obtained in the present study may be attributed to the size of data set and environmental factors (feeding and management).

Estimation of genetic and phenotypic correlation

The genetic correlations of birth weight with body weight at 3, 6, 9 and 12 months of ages were estimated as -0.248 ± 0.550, -0.644 ± 0.341, -0.633 ± 0.351 and -0.882 ± 0.136, respectively (Table 1). The genetic correlations of birth weight with body weight at different ages were negative and low. Whereas the phenotypic correlations of birth weight with body weights at different ages were 0.152 ± 0.550, -0.047 ± 0.341, -0.046 ± 0.351 and -0.054 ± 0.136, respectively. The phenotypic correlations of birth weight with body weight at three month of age was positive and high with body weights at other ages were negative and low.

The genetic correlations of body weight at the age of three months with weights at six, nine and 12 months of ages were estimated as 0.896 ± 0.118, 0.912 ± 0.104 and 0.407 ± 0.493, respectively. They were positive and high till nine months of age but low at 12 months of age. The phenotypic correlation of body weight at the age of three months with weights at six, nine and 12 months of age were estimated as 0.593 ± 0.118, 0.355 ± 0.104 and 0.165 ± 0.493, respectively and were positive and low till 12 months of age. The genetic correlations of body weight at the age of six months with weights at nine and 12 months of ages were observed as 0.303 ± 0.003 and 0.769 ± 0.241, respectively. The phenotypic correlation of body weight at the age of six months with weights at nine and 12 months of age were 0.601 ± 0.003 and 0.355 ± 0.241, respectively The estimate of genetic and phenotypic correlation of body weight at the age of nine months with 12 months body weights was 0.743 ± 0.264 and 0.543 ± 0.264, respectively.

In the present study, the heritability estimates of growth traits are medium to high. High heritability estimate indicates that body weight could be easily improved

Table 1: Heritability (diagonals), Genetic (below diagonals) and Phenotypic (above diagonal) Correlation for Growth Traits in Black Bengal goats

Weight at	Birth	3 Month	6 Month	9 Month	12 Month
Birth	**0.515±0.507**	0.152 ± 0.550	-0.047 ± 0.341	-0.046 ± 0.351	-0.054 ± 0.136
3 Month	-0.248 ± 0.550	**0.247 ± 0.169**	0.593 ± 0.118	0.355 ± 0.104	0.165 ± 0.493
6 Month	-0.644 ± 0.341	0.896 ± 0.118	**0.325 ± 0.548**	0.601 ± 0.003	0.355 ± 0.241
9 Month	-0.633 ± 0.351	0.912 ± 0.104	0.303 ± 0.003	**0.511 ± 0.322**	0.548 ± 0.264
12 Month	-0.882 ± 0.136	0.407 ± 0.493	0.769 ± 0.241	0.743 ± 0.264	**0.311 ± 0.209**

through selection. Similar medium to high heritability estimates for Black Bengal goat was reported by Amin *et al.* (2001) and Haque *et al.* (2012). This is contrary to the findings by Nahardeka *et al.* (2001) and Yadav and Khada (2009) for different body weights and growth in Assam local and Kutchi goats, respectively. The values obtained dictate that mass selection for live weight may be useful in improving live weight in Black Bengal goats in field conditions.

Results show that genetic and phenotypic correlations between body weights at different ages are positive except with birth weight. Positive genetic correlations amongst the body weight traits indicate good association amongst the body weight at the different ages. This suggests that the selection of kids at the age of three months and six months can be used to bring about improvement at 12 months age. The result agreed with the findings of Mahal *et al*. (2012) and Mia *et al*. (2013) for black Bengal goats.

CONCLUSION

The positive and moderate genetic correlations and positive but low phenotypic correlations indicate that kids with heavier birth weight might gain more weight at subsequent ages and the environment causes variation on growth. Genetic correlations are mainly attributed to the pleiotropic effects of genes and the linkage of genes governing different traits. This helps to predict correlated response to selection. In the case of positive correlation between traits, response to selection is more because selection for one trait automatically improves others depending upon the degree of correlation. High genetic correlations between body weights suggest that many of the genetic factors that influence body weight from weaning to the adult stage were the same. The positive and high correlation indicated that kids with heavier weaning weights might be heavier at subsequent ages. Mass selection of individuals at 3 months can be a good criterion for genetic gain in the future, if maternal effects are taken into consideration effectively.

ACKNOWLEDGEMENT

The authors are thankful to All India Co-ordinated Research Project on Goat Improvement for giving permission to perform the research work.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare that are relevant to the content of this article**.**

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