Research Journal of Animal, Veterinary and Fishery Sciences E-ISSN 2320 – 6535
Vol. **4(8),** 1-3, September **(2016)** *Res. J. Animal, Veterinary and Fishery Sci.*

Short Communication

Association of Linear Body Measurements with Age at First Lambing in Sheep

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Available online at: www.isca.in, www.isca.me
Received 29th August 2016, revised 11th September 2016, accepted 20th September 2016

Abstract

Age at first lambing and growth rate are important economic traits in sheep production. Harnali is a new synthetic strain of sheep developed for superior carpet wool, better growth and adaptability. Data recorded on 349 Harnali animals for Body length (BL), Body height (BH), Heart girth (HG), Paunch girth (PG), Tail length (TL), Head circumference (HC), Ear length (EL), Ear width (EW), Face length (FL) and Age at first lambing (AFL) were analysed to study the association of body measurements with age at first lambing. The mixed linear model methodology with dam's weight at lambing as covariate was used to study the effect of non-genetic factors on body measurements and age at first lambing. Genetic parameters were estimated by paternal half sib correlation method using sire components of variance and covariance and backward stepwise regression procedure was utilized to develop prediction equations. High heritability estimates were obtained for BL, BH, HG, TL, HC, EL, EW and FL while moderate estimate was obtained for PG and AFL. The phenotypic correlations of various linear body measurements with AFL were quite varying in magnitude ranging from -0.01±0.01 to 0.13±0.02. BL was found to have the highest phenotypic correlation with AFL (0.13±0.02). The genetic correlations of BL, TL, EL and EW with AFL were estimated as 0.39±0.14, 0.16±0.15, 0.19±0.16 and 0.17±0.16, respectively. The various combinations of linear type traits to predict AFL were found to have coefficient of determination as high as 0.085. The phenotypic and genetic correlations of AFL with body measurements indicated that body length of animal is directly related to its age at first lambing and ear length which can be used as a tool for selection of early lambing animals.

Keywords: Harnali sheep, Linear body measurements, Age at first lambing, Genetic parameters.

Introduction

Sheep in India are raised mainly for lamb, mutton and carpet wool production. Regular reproduction and faster growth are important components of flock productivity and also serious limiting factor in improving productivity in indigenous breeds of sheep. The attainment of sexual maturity and age at first lambing at an early age reduces the generation interval, which improve the overall productivity of the flock by reducing the management cost.

Ages at first lambing and growth rate are the important economic traits in sheep production. In recent years, there have been a great number of studies on the association of body weight with various body measurements taken at different growth periods of sheep[1-3]. But little is known about the association of age at first lambing and linear body measurements.

Harnali sheep is a new synthetic dual purpose strain evolved for superior carpet wool and better growth. The crossbreds having 62.5 per cent exotic inheritance from Russian Merino and Corriedale and 37.5 per cent from local Nali breed were mated inter-se for several generations for stable performance. Harnali population has now become stable[4] and stability is one of the most desirable properties of a genotype to be released as a breed for wider utilization.

The value of sheep depends mainly on body weight and early attainment of sexual maturity. Body measurements, an indicator of breed standards provides great convenience for prediction of body weight without weighbridges[2,5,6]. However, attainment of sexual maturity and age at first lambing is also an important economic trait in sheep. Studies on association between linear body measurements and age at first lambing will be helpful in planning breeding strategies for improvement in growth. Negligible work has been reported in literature about association of linear body measurements and age at first lambing in sheep. Hence, the present investigation was undertaken to study association of linear body measurements with age at first lambing.

Materials and Methods

The data were recorded on 349 Harnali sheep maintained in the Department of Animal Genetics and Breeding, Lala Lajpat Rai University of Veterinary and Animal sciences, Hisar over a period of 18 years from 1998 to 2015. The adult animals above

2 years of age were recorded for nine linear body measurements viz: Body Length (BL), Body Height (BH), Heart girth (HG), Paunch girth (PG), Tail length (TL), Head circumference (HC), Ear length (EL), Ear width (EW), Face length (FL) and Age at first lambing (AFL). Least-squares and maximum likelihood computer programme[7] using mixed linear model with dam's weight at lambing as covariate for estimation of various tangible factors on body measurements and age at first lambing was used. The following mathematical model was used:

$$Y_{ijklm} = \mu + S_i + P_j + B_k + A_l + b\,(X_D - \overline{X}) + e_{ijklm}$$

Where: Y_{ijklm} is the observation on m^{th} animal belonging to l^{th} age group of dam, of k^{th} sex born in j^{th} period of birth, of i^{th} sire; μ is the overall mean; S_i is the random effect of i^{th} sire; P_j is the fixed effect of j^{th} period of birth ($j = 1,2,3,\ldots.6$); B_k is the fixed effect of k^{th} sex ($k = 1, 2$); A_l is the fixed effect of l^{th} age group of dam ($l = 1,2,\ldots.7$); b is the linear regression coefficient of trait on dam's weight at lambing; X_D is the dam's weight at lambing; $\overline{X}$ is the mean dam's weight at lambing and e_{ijklm} is the random error component. Genetic and phenotypic correlations and heritability were estimated by paternal half sib correlations method using sire component of variance and covariance. Backward stepwise regression procedure[8] was utilized to predict AFL from linear body measurements.

Results and Discussion

Effect of non - genetic factors: The effect of non-genetic factors on linear body measurements and age at first lambing was studied to standardize the data for estimation of genetic parameters. The period of birth had significant ($P<0.01$) effect on BL, BH, HC, FL and AFL but was non-significant on other body measurements. The period effect on length, height and circumference of the animals might be due to variation in availability of feed and fodder in different periods. The period of birth had significant effect on AFL. The effect of sex was found significant ($P<0.01$) on all the body measurement traits except ear length and ear width. The males were having higher estimates for all body measurements than females. This variation might be due to hormonal influences and higher birth weight in males. The effect of dam's age at lambing was non-significant on all the body measurements and age at first lambing. However, dam's weight at lambing significantly ($P<0.05$) influenced all body measurements and age at first lambing indicating that body condition score of dam at the time of lambing is very important factor for body conformation of lambs in the adult age. Higher body condition score of dams at lambing reflect better nourishment of the lambs before and after birth.

Phenotypic and genetic correlations: The phenotypic and genetic correlations of linear body measurements with age at first lambing are presented in Table-1. Low to moderate correlations were found between linear body measurements and AFL. BL had the highest phenotypic correlation (0.13±0.02) with AFL following by BH (0.09±0.03). The significant and positive phenotypic correlations of BL and BH with AFL indicate the positive association of age at first lambing and body length with body height of the animal. A low to moderate and positive genetic correlation of AFL was estimated with BL (0.39±0.14), EL (0.19±0.11), EW (0.17±0.16) and TL (0.16±0.15). However, low and negative genetic correlations of AFL was found with HG (-0.13±0.19). However, medium to high correlations among various body measurements and performance traits were reported both at genetic and phenotypic level[2,9-11]. The phenotypic and genetic correlations of AFL with body measurements indicated that age at first lambing is directly related with body length of animal.

Table 1
Genetic (r_g) and phenotypic (r_p) correlations along with standard error among linear body measurements and age at first lambing

Traits	AFL	
	r_p	r_g
Body length	0.13*±0.02	0.39±0.14
Body height	0.09±0.03	-0.05±0.19
Heart girth	-0.04±0.01	-0.13±0.19
Posterior girth	-0.04±0.02	0.10±0.24
Tail length	-0.01±0.01	0.16±0.15
Head circumference	0.01±0.01	0.12±0.16
Ear length	-0.06±0.03	0.19±0.16
Ear width	-0.06±0.02	0.17±0.16
Face length	0.05±0.01	0.05±0.19
Age at first lambing	–	–

Prediction of GFW from different linear body measurements: Efforts were made to develop equations for prediction of AFL from body measurements of the animal and the results are presented in Table-2. When all the nine body measurements were included the prediction equation was $Y = 505.86 + 1.3L + 8.5H - 4.1HG + 0.66PG + 0.35TL + 5.91HC - 10.05EL + 3.29EW - 10.05FL$ with R^2=0.085. When four traits viz; height, heart girth, ear length and face length were considered together the equation was changed into $Y = 701.09 + 9.99H - 2.88HG - 9.77EL - 9.27FL$ with R^2=0.075 (Eq 6). Likewise, the regression equation was established as $Y = 511.509 + 9.44H - 9.32EL$ with R^2= 0.068 when height and ear length were considered. The result showed that coefficient of determination (R^2) was low with various combinations of the linear body measurements to predict AFL. When coefficient of determination (R^2) is below 0.50 to 0.60 than it is of no use to predict the trait. Hence it is not practically feasible to predict AFL on the basis of the linear body measurements in Harnali sheep; however, some idea can be obtained about AFL of the animal from linear body measurements.

Table 2
Prediction of AFL from different linear body measurements in Harnali sheep

Eq. No.	Prediction equations	R^2
1	Y = 505.86 + 1.3L + 8.5H -4.1HG + 0.66PG + 0.35TL + 5.91HC – 10.05EL + 3.29EW – 10.05FL	0.085
2	Y = 514.41 + 1.38L + 8.55H – 4.23HG + 0.71PG + 5.74HC – 9.89EL + 3.57EW – 10.37FL	0.085
3	Y = 517.27 + 1.37L + 8.37H - 4.17HG + 0.72HG + 6.12HC – 8.82EL – 10.25FL	0.084
4	Y = 535.05 + 9.01H – 4.17HG +0.74PG + 6.45HC – 8.50EL - 9.80FL	0.084
5	Y = 533.69 + 8.88H – 3.45HG + 6.85HC – 8.43EL – 10.14FL	0.083
6	Y = 701.09 + 9.99H – 2.88HG – 9.77EL – 9.27FL	0.075
7	Y = 511.509 + 9.44H -9.32EL	0.068

Conclusion

It was concluded that linear body measurements had low to moderate genetic correlations with age at first lambing in Harnali sheep. Body length of the animal had the highest association with age at first lambing which can be used as a selection tool for selecting early lambing sheep.

Acknowledgment

The authors are thankful to the Vice Chancellor, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, Haryana for providing the infrastructure facilities that enabled the successful completion of the research.

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