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HERITABILITY ESTIMATES OF BIRTH AND WEANING WEIGHT IN LOHI SHEEP

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The data regarding birth weight performance of 3984 Lohi lambs progeny of 90 rams and weaning weight records of 3976 Lohi lambs progeny of 89 rams were used for the heritability estimation of birth and weaning weights, respectively. The lambs had halfsib relation among themselves. The flock was raised at Livestock Production Research Institute, Bahadurnagar, Okara and the collected data presents the flock performance for the period I960-90. The estimate of heritability was worked out by the method of paternal halfsib analysis by using Harvey's Mixed Model Least Squares and Maximum Likelihood Computer Program (LSMLMW, 1990). The heritabilities of birth and weaning weights estimated were as 0.108 ± 0.027 and 0.147 ± 0.034 in Lohi sheep, respectively.
Key words: Heritability, birth-weight, weaning-weight, Lohi sheep.

INTRODUCTION

Pakistan supports over 64 million small ruminants, which are in fact the major source of livelihood for over a million farmers. At present, there are 23.54 million sheep in the country and their population is increasing at the rate of 3.5 percent per annum (Anon, 2003). The Lohi breed is the biggest and most productive of all the breeds in the country. It comprises some 40 percent of the Punjab and 15 percent of the national population (Anon, 1996). The Lohi breed belongs to the irrigated areas of the central Punjab but is wide-spread in other regions of the Province. There is a wide diversity in various production traits of this breed which suggests that there is a great scope for improvement of performance. This diversity in performance could be due to several genetic and environmental influences.

Thus, any attempt to improve economic prospects of sheep for mutton and wool production would require the estimation of the extent of genetic and environmental sources of variation in these traits. The estimates of genetic and phenotypic parameters are essential in determining the methods of selection to be employed and in assessing the genetic gains in performance traits. Knowledge of the heritability of an economic character is necessary for devising an efficient selection and breeding plan. A study is thus planned on Lohi sheep to estimate the heritabilities of birth and weaning weight.

MATERIALS AND METHODS

The data regarding performance of 90 rams having a progeny of 3984, was used for birth weight heritability estimate and 89 rams having a progeny of 3976 lambs were used for the estimation of weaning weight heritability estimate. The lambs under study had the common sire and thus had halfsib relation among themselves in the flock. These animals were kept at Livestock Production Research Institute, Bahadurnagar, Okara and the performance data for the period I960-90 was utilized for the study. The estimate of heritability was worked out by the method of paternal halfsib analysis. The method is based on phenotypic resemblance between relatives. The mathematical model for the analysis was:

$Y_{ijk} = \mu + S_i + F_j + \varepsilon_{ijk}$

Where S_i represents the set of random cross classified effects of sires and F_j represents all fixed sets of significant effects other than μ. Interactions of S_i with all fixed sets of effects are assumed to be negligible.

In accordance with the above model, the analysis of variance and covariance was run by using Harvey's computer program (LSMLMW, 1990). The model analysis of variance for estimating heritability is given in table below:

Model analysis of variance for heritability estimation

Source of Variation	d.f	Sum of squares	Expected mean Squares
Between sires	s – 1	R (U,D,F) – R (U,F)	$\sigma^2_w + k_1 \sigma^2_s$
Fixed effects	$\Sigma (f_l - 1)$	$B'Z^{-1} B$ (adjusted for sires)	$\sigma^2_w + k_k{}^2_F$
Remainder	$N - [(s-1) + \Sigma(f_l - 1)]$	Y'Y – R(U,D,F)	σ^2_w

where,
S = total number of sires;
F_i = number of subclasses in each fixed variable;
K_i = average number of progeny per sire group
N = total number of progeny records used
σ^2_s = cross-classified sire variance component;
σ^2_w = within sire variance component;

In this analysis mean squares within sires (σ^2_w) contain ($3/4\ \sigma^2_g + \sigma^2_e$), whereas mean squares between sires contain ($3/4\ \sigma^2_g + \sigma^2_e$) + k($1/4\ \sigma^2_g$). The term ($1/4\ \sigma^2_g$),

called the sire component (σ^2_s) can be separated and it measures the covariance between halfsibs. In fact it is an estimate of 1/4 σ^2_g + 1/16 σ^2_{gg} + 1/64 σ^2_{ggg} + etc., where, σ^2_g is the additive genetic or genic variance, σ^2_{gg} is additive x additive and σ^2_{ggg} + etc. is the additive x additive x additive genic variance (epistatic variance). The heritability (h^2) can be estimated by multiplying the intra-class correlation (t) by four.

$h^2 = 4t$

$$t = \frac{\frac{1}{4}\sigma^2_g}{(\frac{3}{4}\sigma^2_g + \sigma^2_e) + (\frac{1}{4}\sigma^2_g)} = \frac{\sigma^2_s}{\sigma^2_s + \sigma^2_e}$$

The standard error (S.E.) of heritability based on intra-class correlation (t) was worked out using the under mentioned formula described by Swiger *et al.*. (1964):

$V(h^2) = 16\ V(t)$

$$V(t) = \sqrt{\frac{2(N-1)(1-t)^2\left[1+(k-1)t\right]^2}{k^2(N-s)(s-1)}}$$

S.E. $(h^2) = V(h^2)$

RESULTS AND DISCUSSION

a) Birth Weight: The data on birth weight of 3984 half sibs from 90 sires was analyzed for the estimation of heritability of birth weight. Analysis of variance for heritability estimation is given in Table-1 which yielded heritability estimate of 0.108 ± 0.027 for birth weight. The heritability estimate of birth weight obtained in the present investigation was close to those reported by Chaudhry and Shah (1985), Maui and Rodricks (1987), Bromley *et al.* (2000) and Sarti *et al.* (2001). Chaudhry and Shah (1985) reported that heritability of birth weight was 0.14 in Lohi and 0.10 in Kachhi breeds of sheep. Maui and Rodricks (1987) studied production data of Merino-Nilagiri crossbred sheep and reported heritability of birth weight as 0.10 ± 0.07. Sarti *et al.* (2001) reported the heritability estimation as low (<0.20) calculated on the basis of analyzing 393 weight records, collected from birth till weaning. Bromley *et al.*. (2000) reported the heritability estimate of birth weight as 0.09 in Columbia, polypay, Rambouillet and Targhee breeds of sheep which has a close coincidence with the findings of the current study.

The present estimate was, however, lower than the estimate reported by Aziz and Schaeffer (1986) who analyzed records of 32502 Suffolk and 17893 Dorset lambs and reported that heritability estimates for birth weight were 0.33 and 0.27 in the two breeds, respectively.

Table 1. Analysis of variance of birth weight for heritability estimation

Source of variation	df	Mean Squares	E.M.S
Between sires	89	0.75	$\sigma^2_w + 36.16\ \sigma^2_s$
Fixed effects			$\sigma^2_w + k_k{}^2_F$
Years	29	1.92	
Seasons	1	18.78	
Birth Type	1	176.75	
Sex	1	39.28	
Age of dam	2	10.73	
Years x Type	29	0.78	
Season x Type	1	6.73	
Type x Sex	1	1.03	
Type x Age	2	0.98	
Remainder	3826	0.38	σ^2_w

The heritability estimates for birth weight as obtained by Stobart (1983) and Sheikh *et al.* (1986) were much lower than the present estimate. Stobart (1983) made genetic analysis of Columbia, Rambouillet and Targhee sheep and reported that heritability of birth weight was 0.06 + 0.01. Sheikh *et al.* (1986) made genetic evaluation of a flock of Kashmir Merino sheep and reported that heritability of birth weight was 0.03 ± 0.02.

b) Weaning Weight: The data on weaning weights of 3976 lambs, the progeny of 89 rams were analysed for the estimation of heritability of weaning weight. Analysis of variance for heritability estimation is given in Table-2 which gave the heritability estimate of 0.147±0.034. The heritability estimate of weaning weight obtained in the present investigation was close to those reported by Shrestha and Heanly (1985), Aziz and Schaeffer (1986) and Davis (1987). Davis (1987) reported the heritability of weaning weight in Merino breed as 0.18 ± 0.05. Buisset *et al.* (1994) reported the weaning weight heritability for sheep as 0.05 to 0.14 which is low but in close conformity to the findings of the current study.

Table-2. Analysis of variance of weaning weight for heritability estimation

Source of variation	df	Mean Squares	E.M.S
Between sires	88	54.23	$\sigma^2_w + 39.92\ \sigma^2_s$
Fixed effects			$\sigma^2_w + k_k{}^2_F$
Years	29	273.77	
Seasons	1	2843.29	
Birth Type	1	4719.45	
Sex	1	1763.52	
Years x Sex	29	11.98	
Season x Type	1	258.51	
Season x Sex	1	128.73	
Type x Sex	1	41.42	
Remainder	3823	21.45	σ^2_w

The heritability estimate of weaning weight reported by Reddy *et al.*. (1983), Singh *et al.* (1984), Subandriyo *et al.*. (1985), Shrestha *et al.* (1985), Wyk *et al.* (1985), Chaudhry and Shah (1985) and El-Karim and Owen (1988) were higher than the heritability estimate of weaning weight obtained in the present investigation. These workers reported the heritability of weaning weight ranging from 0.41 to 0.93 in various breeds of sheep. The greater variation among the heritability estimates among the breeds has been reported by Martin *et al.* (2000). For sixty days weight Columbia, Dorset, Hampshire and Rambouillet which were 0.04, 0.27, 0.26 and 0.07, respectively.

The differences of present study and those of other investigators might be due to breed and environmental conditions under which various flocks were maintained. This difference might also be due to the method of calculating the heritability. The estimate of heritabilities of birth and weaning weight of present study is low. It means expression of the traits are mainly under the influence of environmental factors like feeding and other managemental factors and improvement in these traits can be obtained by improving the environmental factors influencing the birth and weaning weight.

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