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FACTORS INFLUENCING BODY WEIGHTS AT DIFFERENT AGES IN THALLI SHEEP

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ABSTRACT

Thalli is native sheep breed of Thall area of the Punjab, Pakistan. Data on 17030 birth records of 5421 Thalli sheep maintained at Livestock Experiment Station, Rakh Ghulaman, district Bhakkar during 1975-2004 were utilized in the present study with the aim to evaluate the performance of Thalli sheep in Pakistan. The genetic parameter estimation was performed using REML procedure by fitting an Individual Animal Model. Birth weight with an average of 4.11±0.82 kg, was significantly affected by year, type of birth, sex and age of the dam but season of birth was an in significant effect on the birth weight. Weight at 60 and 90-days of age averaged 11.58±3.57 and 14.92±4.56 kg, respectively. These weights were affected by year and season of birth, birth weight. Type of birth and sex had significant effect on weight at 60 days of age where as age of the dam had non-significant effect on weight at 60 days of age. Age of the dam significantly affected 90-day weight. Sex and type of birth had non-significant effect on 90 days weight. The weaning weight was 18.95±4.12 kg and was affected by year and season of birth, sex of lamb. No significant effects of type of birth, birth weight and age of dam on weaning weight were observed. The direct heritability estimate of birth weight was 0.067±0.01. The heritability estimates for 60- and 90-day weight were 0.116±0.01 and 0.18±0.01, respectively. The heritability estimate for weaning weight was 0.03±0.11. Genetic correlation between birth weight and weaning weight was negatively low with an estimate of 0.045±0.003. The low estimates of heritability for various performance traits indicated the presence of less additive genetic variance and large environmental variances. Hence improvement in the traits through selection may be limited.

Ker word: Thalli sheep, Pre-weaning body weights, Genetic factors, Pakistan.

INTRODUCTION

Genetic progress programs applied for livestock are conducted on the basis of two main approaches: selection and breeding systems (Ceyhan *et al*. 2011). The potential for genetic progress is largely dependent on the genetic variation in the traits and its relationship with other economic traits. The concept of heritability is essential for planning sufficient breeding programs and to predict the response to selection. High estimates of heritability indicate that additive gene affects are more important for a quantitative trait and the mating of the best to the best would produce more desirable offspring. When heritability of a trait is low, non additive gene action such as over-dominance, dominance and epistasis may be important. The genetic correlation is very important not only in predicting indirect response to selection but also in determining the optimum weightage and expected response to multiple trait selection.

Growth potential of the lambs is one of the most important traits in a genetic improvement scheme for meat sheep. A number of non-genetic factors affect these growth traits and directly obscure recognition of the genetic potential. Adjustment of data for non-genetic factors and estimation of genetic parameters for the various traits are necessary to obtain reliable estimates for important economic traits and to increase the accuracy of selection of breeding animals. An effective breeding plan can only be devised after thorough knowledge has been obtained about the inheritance of economically important traits (Thiruvenkadan *et al.,* 2011**)**. To determine optimal breeding strategies to increase the efficiency of sheep production, knowledge of genetic parameters for weight traits at various ages is needed. Various environmental effects on lamb growth have previously been studied in several investigations on other breeds (Yazdi *et al.* 1997; Akhtar 2001; Bahreini Behzadi *et al.*, 2007, Akhtar *et al*., 2012). Performance traits of farm animals are determined not only by an animal's genetic potential for growth but also by maternal genetic and permanent and temporary environmental effects (Tariq *et al*., 2010).

Very less information on the genetic aspects of productive and reproductive performance of Thalli sheep in Pakistan was available. Hence, the objectives of this study were to evaluate the influence of different environmental factors and to estimate genetic parameters of weight traits of Thalli sheep in Pakistan. The collected information will be useful for formulating effective breeding programme for the genetic improvement of this important breed of sheep.

MATERIALS AND METHODS

Source of Data: Pedigree and performance records of Thalli sheep maintained at Livestock Experiment Station (LES), Rakh Ghulaman, district Bhakkar during 1975-2004 were utilized for the present study.

Data on different performance traits were statistically analyzed to estimate the magnitude of various genetic and non-genetic sources of variation for weight at birth, 60, 90 days of age and weaning weight. Before data analyses several edits were performed to remove the outliers. In addition to the basic edits of consistency checks for dates and animal identities, records of ewes which had aborted, missed a period due to sickness or other reasons were eliminated. Less than two percent records were eliminated during these edits. The following edits were performed to remove the outliers.

2.0 kg ≥ Birth weight ≤ 5.5kg;
10kg ≥ Weaning weight ≤ 30 kg;
75 days ≥ weaning age ≤ 150 days;

The selected ranges were similar to those for other local breeds viz. Lohi (Babar, 1994), Hissardale (Akhtar, 1996) and Kajli (Qureshi, 1996). Only normal and complete records were considered for analyses. The records from stillbirth or premature births were excluded from the study.

Statistical Analysis: Data on various performance traits were statistically analyzed to estimate the magnitude of various genetic and non-genetic sources of variation in these traits. Only normal and complete records were considered for analyses. The standard weaning age was assumed as 120 days. Since the lambs varied in their ages at weaning, weaning weight (w. wt) was adjusted to 120 days by the following formula:

$$\text{Adjusted 120-day w. wt} = \frac{\text{Actual w. wt} - \text{B.wt}}{\text{Actual w. age in days}} * 120 + \text{B.wt}$$

The records from stillbirth or premature were excluded from the study. For data entry MS Excel spread sheet were used. For each quantitative trait, the following linear model was adopted:

$Y_{ijklm} = \mu + P_i + S_j + \$(\text{Age, covariable})_k + T_l + S_m + (SOB^*Sex)_{jm} + (SOB^*TOB)_{jl} + (Sex^*TOB)_{ml} + \varepsilon_{ijklmn}$

Where, Y_{ijklm} = observed body weight at different ages, μ = Population mean, P_i = effect of i^{th} year of birth (i = 1 to 30), S_j = effect of j^{th} season (j = 1 to 2), A_k = effect of age dam group (A_k, k=1, \$ = covariable), T_l = effect of l^{th} type of birth (l= 1 to 3), S_m = effect of m^{th} sex (m = 1 and 2), $(SOB^*Sex)_{jm}$ = interaction between j^{th} season and m^{th} sex, $(SOB^*TOB)_{jl}$ = interaction between j^{th} season and l^{th} type of birth, $(Sex^*TOB)_{ml}$ = interaction between m^{th} sex and l^{th} type of birth and ε_{ijklmn} = random error.

The data were subjected to analysis of variance for estimation of the magnitude of environmental factors. For this purpose, least squares analysis of variance from General Linear Model (GLM) procedure of SAS 9.1 was employed.

Estimation of Genetic Parameters: The heritability for each trait was estimated by using Restricted Maximum Likelihood Procedure after Patterson and Thompson (1971) fitting an individual animal model. All these analyses were carried out by using Derivative Free Restricted Maximum Likelihood (DFREML) set of computer programmes (Meyer, 2000). Only fixed effects found significant in initial model were included in model.

RESULTS AND DISCUSSION

The average values for different weights at different ages are presented in Table 1.

Table 1. Descriptive statistics for some performance traits in Thalli Sheep

Trait	No. of records	Mean ±S.E.
Birth weight (kg)	17030	4.11±0.82
60-day weight (kg)	10377	11.58±3.57
90-day weight (kg)	10377	14.92±4.56
Weaning weight (kg)	11674	18.95±4.12

Birth Weight: The analysis of variance for the birth weight (Table 2) reflected that year of birth (YOB), sex and type of birth (TOB) and age of the dam at lambing significantly influenced the trait (P<0.01). However, season of birth (SOB), SOB*Sex, SOB*TOB and Sex*TOB were non-significant factors for birth weight. The least squares means for birth weight (Table 3) showed wide variation during different years with a range of 3.13±0.07 kg (in 1984) to 4.77±0.07 kg (in 1995). Significant differences between years of birth on the birth weight reflected the variability of environmental conditions. Variation in birth weight across years indicated that the feeding, management and environmental conditions could affect the ewes during pregnancy. This variation also indicated the managerial ability of the management in terms of staff supervision, availability of financial resources and culling strategies adopted at this farm. In order to improve the birth weight in future, it is recommended to adopt better management practices and select those ewes as future dams with heavier body weights. Availability of feed and fodder resources over the 30 years period varied due to rains and ambient temperature also led to considerable variation in birth weight.

Type of birth and sex had highly significant effects on weight at birth. The birth weight was significantly affected by type of birth (single vs. multiple) in Fars Karakul breed of sheep (Alipour and Edriss; 1997). Male single born lambs showed higher birth weight compared to single born female lambs. Older ewes produced heavier lambs at birth than two-year old ewes, but this effect declined when the ewe reached 8 years of age (Amores *et al.* 1998). In earlier studies similar results have been reported in different breeds of the globe (Akhtar *et al.,* 2001; Abegaz *et al.* 2002; Esenbuga *et al*., 2002; Matika *et al.,* 2003; Babar *et al.,* 2004; Akhtar et al., 2012). The heavier lambs born as single had better opportunities in the dam's uterus than the multiple births. Male lambs are heavier than female this is due to the reason the gestation period for male lambs was slightly longer (1-2 days) when compared to female ones (Babar, 1994). This wide variation in birth weight indicated that selection for obtaining higher birth weight could improve the birth weight of lambs so that early lamb mortality may be reduced.

Table 2. Significance levels of the examined factors in the Analysis of Variance

Trait	YOB	SOB	Sex	TOB	Age	SOB*TOB	Sex*SOB	Sex*TOB
Birth weight	**	N.S.	**	**	**	N.S.	N.S.	N.S.
60-day weight	**	**	*	**	N.S.	**	**	N.S.
90-day weight	**	**	N.S.	N.S.	**	**	**	N.S.
Weaning weight	**	**	**	N.S.	N.S.	**	**	N.S.

YOB= year of birth; SOB= season of birth; TOB= type of birth and ** = Significant (P<0.01); * = Significant (P<0.05) and NS = Non Significant.

Table 3. Least Square Means and Standard Errors of Birth, 60-Days, 90- Days and weaning Weight

Fixed Effects	Traits			
	BW (kg)	60 DW (kg)	90 DW (kg)	WW (kg)
Overall means ±SE	4.11±0.82 (17030)	11.58±3.57 (10377)	14.92±4.56 (10377)	18.95±4.12 (11674)
Year of birth	**	**	**	**
1975	3.64±0.09 (140)	-	-	
1976	3.55±0.07 (467)	-	-	
1977	3.80±0.08 (280)	-	18.43±0.50 (166)	20.07±0.47 (280)
1978	3.95±0.08 (270)	-	-	18.01±0.47 (269)
1979	3.90±0.08 (317)	-	-	17.96±0.46 (313)
1980	3.84±0.08 (286)	-	22.73±3.76 (1)	19.97±0.47 (281)
1981	3.82±0.07 (805)	14.21±0.32 (340)	13.55±0.45 (400)	19.73±0.43 (774)
1982	3.84±0.07 (827)	12.64±0.33 (817)	16.70±0.43 (770)	19.93±0.43 (800)
1983	3.46±0.07 (843)	9.58±0.32 (575)	14.39±0.45 (424)	18.16±0.48 (236)
1984	3.13±0.07 (1016)	10.01±0.32 (962)	11.49±0.43 (924)	17.86±0.44 (749)
1985	3.62±0.07 (1141)	10.27±0.33 (1125)	13.43±0.43 (1048)	18.51±0.43 (1002)
1986	3.67±0.07 (470)	9.92±0.32 (427)	11.30±0.45 (412)	16.76±0.46 (356)
1987	4.24±0.07 (581)	8.68±0.33 (577)	14.14±0.43 (573)	17.45±0.43 (567)
1988	3.90±0.07 (459)	13.40±0.32 (455)	9.31±0.44 (448)	10.90±0.45 (391)
1989	3.54±0.07 (600)	11.92±0.34 (595)	17.98±0.43 (554)	21.52±0.43 (533)
1990	3.64±0.07 (406)	12.14±0.32 (373)	15.39±0.45 (373)	18.12±0.46 (351)
1991	4.44±0.07 (659)	11.72±0.35 (565)	13.31±0.43 (643)	15.18±0.44 (632)
1992	4.72±0.08 (404)	13.33±0.37 (309)	14.10±0.51 (160)	15.91±0.66 (52)
1993	4.45±0.07 (667)	15.45±0.32 (174)	16.86±0.48 (208)	20.30±0.44 (478)
1994	4.58±0.07 (886)	13.10±0.33 (881)	18.23±0.43 (853)	20.80±0.43 (870)
1995	4.77±0.07 (644)	13.34±0.32 (642)	14.67±0.44 (641)	16.83±0.44 (941)
1996	4.54±0.07 (691)	14.24±0.32 (690)	15.91±0.43 (686)	18.49±0.43 (683)
1997	4.05±0.07 (751)	12.71±0.34 (746)	17.20±0.43 (743)	19.70±0.43 (741)
1998	4.17±0.07 (612)	12.83±0.33 (315)	14.48±0.47 (292)	16.29±0.44 (534)
1999	4.16±0.07 (552)	18.17±1.65 (547)	14.31±0.44 (520)	17.39±0.44 (533)
2000	4.27±0.07 (446)	-	-	11.27±3.77 (1)

2001	4.30±0.07 (505)	14.72±0.71 (3)	-	22.20±0.53 (125)
2002	4.36±0.07 (458)	-	-	25.70±3.77 (1)
2003	4.28±0.07 (541)	8.60±2.00 (19)	18.33±0.95 (19)	21.9±0.74 (37)
2004	4.29±0.07 (525)	12.3±3.00 (2)	11.17±2.68 (2)	20.51±3.77 (1)
Season of birth	NS	**	**	**
Autumn	4.01±0.06 (12232)	13.96±0.32 (7625)		19.63±0.43 (8300)
Spring	4.05±0.12 (5017)	10.88±0.57 (3606)		17.33±0.77 (3931)
Sex	**	**	NS	**
Female	3.85±0.08 (9044)	11.89±0.39 (5743)		17.57±0.53 (6648)
Male	4.21±0.10 (8205)	12.95±0.46 (5488)		19.39±0.62 (5583)
Birth Type	**	**	NS	NS
Single	4.24±0.00 (14321)	11.66±0.17 (9152)		18.89±0.23 (10056)
Twin	3.68±0.01 (2913)	11.56±0.18 (2064)		18.76±0.25 (2160)
Triplet	3.62±0.21 (15)	11.49±0.94 (15)		17.79±1.26 (15)
Regression				
Age of Dam	**	NS	**	**
Birth Weight		**	**	**

LSM = Least Square Means; SE = Standard Error; figure in parenthesis indicate the No. of Obs.: ** = Significant (P<0.01); * = Significant (P<0.05) and NS = Non Significant.

Weight at 60 Days of Age: The influence of different factors on weight at 60 days of age is given in Table 2. ANOVA results indicated that year (YOB) and season of birth (SOB), type of birth (TOB), interaction between season of birth into sex, interaction between season of birth into type of birth and linear effect (covariable) of birth weight on 60 days weight was significant (P<0.01), whereas sex of the lamb affected the trait significantly (P<0.05) in the present study.

Weight at 90 Days of Age: ANOVA results (Table 2) showed that the significant influence of year and season of birth, interaction between season of birth with sex and season of birth with type of birth on weight at 90 days of age were observed (P<0.01). The effect of birth weight and age of dam (covariables) on 90 days of age was also found to be significant (P<0.01). The effect of sex of lamb born, type of birth (TOB) and interaction of sex with type of birth was detected to be non significant. Autumn born lambs were heavier (16.85±0.42 kg) as compared to spring born lambs (14.06±0.76 kg). Male lambs were numerically also heavier (15.88±0.61kg) than female lambs (15.03±0.52 kg).

Weaning Weight (120 Days): The significant effects of year, sex and season of birth and interactions between season of birth into sex of lamb and season of birth into type of birth were found significant on weaning weight (P<0.01). However, the differences in weaning weight of the lambs due to type of birth and sex into type of birth interaction and linear effects of birth weight and age of the dam (covariables) on weaning weight were non significant (Table 2). The least squares means for weaning weight (Table 3) fluctuated from year to year. The data revealed that the autumn born lambs were heavier (19.63±0.43kg) compared to spring born lambs (17.33±0.77 kg). Single born lambs were slightly heaviest at weaning (18.89±0.23 kg) than twins (18.76±0.25 kg) and triplets (17.79±1.26 kg). Similarly, the male lambs were also heavier than the females (19.63±0.43 vs.17.33±0.77 kg).

The findings of the present study were in agreement with those reported by Babar *et al*. (2003) who reported that weaning weight was significantly (P<0.01) influenced by the year and season of birth in Lohi sheep. Similar findings have been reported in Buchi sheep of Pakistan (Akhtar *et al*., 2012) The interaction betwee

GENETIC PARAMETERS

The genetic composition of a population must be focused on considering the relative importance of hereditary and environmental factors influencing the performance of individuals in that population. The most popular genetic parameters are repeatability, heritability and genetic correlations.

Birth Weight: The data on birth weight of 17040 animals sired by 134 rams were evaluated to estimate heritability of birth weight (Table 4). The direct heritability estimate was 0.07±0.02 (low estimates). Heritability estimates for birth weight was 0.16±0.04 for Pelibuey (PB) breed and corresponding figures for Barbados Blackbelly (BB) breed was 0.04±0.07, respectively for 4754 lambs born from Pelibuey (PB) and Barbados Blackbelly (BB) ewes (Carrillo and Segura, 1993). Heritability estimate was 0.06±0.039 for Black Karkul sheep (Eskandary and Kashan, 1998). Boujenane and Kansari (2002) estimated a heritability of 0.05 for Timahdite breed of sheep. The heritability estimates for birth weight of Lohi sheep in Pakistan by using paternal half-sib analysis ranged from 0.048 to 0.14 (Shah and Khan, 2004). The low estimates of heritability for birth weight suggested that genetic improvement in birth weight through selection may be limited.

Table 4. Heritability estimates of various performance traits of Thalli sheep by REML

Traits	Sires	Estimates
Birth weight	134	0.07±0.02
60-day weight	91	0.12±0.01
90-day weight	91	0.18±0.02
Weaning weight	117	0.04±0.11

Weights at 60 and 90-Days: The heritability estimates of 60 and 90-day weights calculated from 11475 ewes sired by 91 rams were 0.12±0.01 and 0.18±0.02, respectively (Table 4). The low heritability estimates as obtained in the present investigation mean that environment has played more significant role for the expression of weight at 60 and 90 days of age (feeding and availability of feed and forages). The low estimates of heritability indicated the presence of less additive genetic variance and large environmental variances. Hence, improvement in the traits through selection may be limited.

Weaning Weight: The heritability estimate of weaning weight was 0.04±0.11. This estimate was based on 12984 animals from 117 rams (Table 4). However, somewhat higher (0.177 & 0.147) estimates had been reported by Simm *et al*., 2002 and Babar *et al*., 2003). Heritability estimates for pre-weaning body weights were low which indicates the presence of low additive genetic variance. It is concluded that in order to improve the pre-weaning traits in future better management practices and selective breeding programme may be adopted.

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