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GENETIC ANALYSIS OF FITNESS TRAITS OF CORRIEDALE SHEEP UNDER TEMPERATE CONDITIONS OF KASHMIR

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ABSTRACT

Pedigree information data for 49 years (1969-2017) for fitness traits maintained at Mountain Research Centre for Sheep and Goat (MRCSG), SKUAST-K Shuhama Kashmir was analyzed to evaluate the performance of Corriedale sheep under the temperate agro-climatic conditions of Jammu & Kashmir state. The effects of non-genetic factors such as period of birth and sex on various normalized fitness traits such as age at first lambing (AFL), litter size (LS), total lambs born per ewe (TLB) and survival rate (SR) were analyzed by least squares analysis. The period of birth was found to have highly significant ($p < 0.01$) effect on all the traits studied. The least square means revealed that lambs born in period 1969-1975 had higher values of TLB, higher percentage of SR and lowest value of ALF. Sex of lamb had significant ($p < 0.05$) effect on SR. The heritability estimates were 0.09 ± 0.01, 0.40 ± 0.04, 0.29 ± 0.07 and 0.23 ± 0.03 for AFL, LS, TLB and SR, respectively. The study revealed that AFL and fitness traits are influenced by both genetic and non-genetic factors. Therefore, improvement in these traits in the flock can be achieved through selection and management.

Keywords: Age at first lambing, Corriedale sheep, litter size, heritability, survival rate

INTRODUCTION

Sheep are a class of livestock reared from the time immemorial by mankind. With an estimated area of 0.3 million ha under alpine & subalpine pastures, the state of Jammu and Kashmir (J&K) is ideally suited for sheep and goat farming. Despite all this a large population of sheep in the State is low yielding. Given the predominantly non-vegetarian food habits, the cold climatic conditions in the Northern Himalayan state of J&K and the poor growth potential of local breeds of sheep with pigmented and rough fiber, the policymakers since pre-independence have opted for the introduction of promising exotic breeds ('Tasmanian Merino' in 1942, 'Rambouillet' in 1952, 'Corriedale' and 'Poll Dorset' in 1962) for cross breeding with local sheep in order to boost mutton and wool production in the State. Corriedale sheep is known for its good mutton conformation, excellent wool characteristics, relatively early maturity and has good range characteristics. This sheep breed was imported in Jammu & Kashmir state during early sixties for use in the improvement of local sheep at the Mountain Research Centre for Sheep and Goat (MRCSG), Shuhama, Kashmir which is one of the organized sheep farms in Kashmir valley.

At any organized farm, reproductive characteristics have been recognized as the main factors affecting the profitability of sheep breeding systems (Matos *et al.*, 1997). These traits can be described as a group of traits that enable animals to adapt well to any environment and include several reproduction and survival traits (Goddard, 2009). Therefore, improvement in ewe reproductive and productivity traits are the key targets in sheep breeding and could be attained by enhancing the number of lambs weaned and weight of lambs weaned per ewe within a specific year. The major part of the income in any sheep production system is supplied through lamb production (Ekiz *et al*., 2005). Despite the importance of fitness traits in the maintenance of elite germplasm, scanty research could be traced about this breed under the Kashmir agroclimatic conditions. Keeping in view the importance of fitness traits in genetic improvement of any flock, this study was taken up to assess the impact of various non-genetic factors on fitness traits so that the subsequent breeding interventions could be done while taking these factors into consideration.

MATERIALS AND METHODS

The data sets were collected from the birth registers and pedigree sheets maintained at Mountain Research Centre for Sheep and Goat (MRCSG**),** F.V. Sc & A.H**,** SKUAST-K Shuhama Kashmir for a period of 49 years from 1969 to 2017. The traits studied were: age at first lambing (AFL), total lambs born per ewe (TLB), litter size (LS) and survival rate SR). The ALF (days), TLB (No.) and SR (%) were calculated separately from data set. Litter size (No.) was recorded at the time of lambing. The data were suitably classified according to different periods and sex to record the impact of non-genetic factors on different traits under study. Assuming that each year had specific environmental conditions and sex of each animal influenced the traits under study, the data was classified into seven periods according to the year of birth (each period consisting of 6 years) and based on the sex as depicted below. The data could not be subdivided into the seasons of birth as all the animals recorded had born from February to April of each year.

All the traits under study were normalized using the mean and standard deviation of the traits. The effects of non-genetic factors such as period and sex on various normalized fitness traits were analyzed by least squares analysis using the technique developed by Harvey (1990). The following model was used for present investigation with assumptions that the different components being fitted into the model were linear, independent and additive.

$$Y_{ijk} = \mu + P_i + S_j + e_{ijk}$$

Where, Y_{ijk}, k^{th} record of individual lambed in i^{th} period and k^{th} sex, μ is the overall population mean, P_i is the fixed effect of i^{th} period, S_j is the fixed effect of j^{th} sex and e_{ijk} is the error associated with each observation and assumed to be normally and independently distributed with mean zero and variance $\sigma^2 e$

The statistical significance of various fixed effects (period and sexes) in the least squares model was determined by 'F' test. For significant effects, the differences between pairs of levels of effects were tested by Duncan's multiple range test as suggested by Kramer (1957). The genetic parameters for different traits were obtained from the sire component of variances using the paternal half-sib correlation method (Becker, 1975).

RESULTS AND DISCUSSION

The least squares mean along with standard errors to identify the effect of period of birth on AFL, LS and TLB; and the effect of period of birth and sex of animal on SR is presented in Table 1. The least

Table 1: Least squares means of fitness traits in Corriedale sheep

Particulars	N	AFL (days)	N	LS (No.)	N	TLB (No.)	N	SR (%)
Overall mean	2648	792.76 ± 11.03	6874	1.07 ± 0.01	6874	4.80 ± 0.11	6874	80.90 ± 1.91
Period of birth		**		**		**		**
P1 (1969-1975)	301	514.44 ± 13.4^{a}	505	1.21 ± 0.01^{e}	505	5.66 ± 0.16^{d}	505	82.90 ± 9.03^{d}
P2 (1976-1982)	436	582.90 ± 12.3^{b}	834	1.07 ± 0.01^{c}	834	5.55 ± 0.14^{c}	834	81.78 ± 1.35^{c}
P3 (1983-1989)	496	729.30 ± 12.5^{c}	1004	1.13 ± 0.01^{d}	1004	4.90 ± 0.13^{b}	1004	81.36 ± 1.66^{c}
P4 (1990-1996)	653	886.12 ± 12.7^{cd}	1738	1.02 ± 0.01^{ab}	1738	4.41 ± 0.13^{ab}	1738	80.61 ± 1.73^{b}
P5 (1997-2003)	347	915.47 ± 17.4^{d}	986	1.04 ± 0.01^{b}	986	4.53 ± 0.13^{ab}	986	80.30 ± 1.85^{ab}
P6 (2004-2010)	311	931.96 ± 13.2^{d}	1089	1.01 ± 0.01^{a}	1089	4.32 ± 0.14^{ab}	1089	80.20 ± 1.98^{ab}
P7 (2011-2017)	104	989.12 ± 12.1^{e}	718	1.02 ± 0.01^{ab}	718	4.26 ± 0.14^{a}	718	80.01 ± 1.10^{a}
Sex								*
Females							3591	82.90 ± 0.02^{a}
Males							3283	80.14 ± 0.04^{b}

**indicate the significance at 1% level. Means with same superscript do not differ significantly
N indicates the number of animals observed, ALF = Age at first lambing in days, LS = Litter size (No.), TLB = Total lambs born (No.), SR (%) survival rate and P1 (1st period of birth) to P7 (7th period of birth).

Lest square means obtained in the present study for fitness traits were in consonance with the estimates published in the literature for different sheep breeds ((Das *et al.*, 2000; Dixit *et al*., 2002; Rather, 2019; Rather *et al.*, 2020c).). The overall least square means were 792.76 ± 11.03 days, 1.07 ± 0.01, 4.80 ± 0.11 and 80.90 ± 1.91% for AFL, LS, TLB and SR, respectively. The effect of period was highly significant ($p < 0.01$) on all the traits studied; whereas the effect of sex was significant ($p < 0.01$) only on SR (%). The least square means revealed that lambs born in P1 (1969-1975) had higher values of total lambs born per ewe, higher percentage of survival rate and lowest value of age at first lambing. Higher litter size is an economically important trait and therefore the non-genetic influences may affect the productivity of the farm at large. (Marufa *et al*., 2017). A highly significant effect of the period is in agreement with Mandakmale *et al. (*2013) in Deccani breed and Gowane *et al*. (2014) in Malpura breed of sheep and Vatankhah *et al.* (2016) in Lori Bakhtiari breed of sheep. However, the non-significant effects were reported by Babar and Javed (2009) in Rambouillet breed of sheep. The variation in the performance due to periods may perhaps be due to the variation in management and availability of feed and fodder. This is based on the assumption that the period under study spans decades and this period is sufficiently large to assume that significant variations may be present. The significance ($p < 0.01$) of sex on survival is in line with Gowane *et al*. (2014) in Malpura breeds of sheep. The significantly ($p < 0.05$) higher survival rate of female lambs than male lambs is in agreement with Mandal *et al*. (2007) in Muzaffarnagari sheep, Sarkar *et al.* (2008) in crossbred and exotic sheep and Rather *et al.* (2020a) in Kashmir Merino lambs. However, Mustafa *et al.* (2014) in Karaku, Thalli and Kacchi breeds of sheep found non-significant effect of sex on survivability. The higher mortality in male lambs may be ascribed to fact that male lambs require more nutrition due to higher growth rate as compared to the females which is often unmet. This leads to high mortality among males (Rather *et al*., 2020b).

The heritability estimates for reproduction and fitness traits are presented in Table 2. The heritability (h^2) estimates were low for AFL and SR%, whereas moderate for LS and TLB. The low estimate of h^2 for AFL and SR% indicated the presence of lower additive genetic variance as the traits are largely influenced by environmental factors. The moderate h^2 for LS and TLB indicated ample

Table 2: Genetic parameters of fitness traits in Corriedale sheep

Traits	AFL	LS	TLB	SR (%)
AFL (days)	0.09 ± 0.01	0.02 ± 0.04	0.03 ± 0.4	0.09 ± 0.04
LS (No.)	0.05	0.40 ± 0.04	0.64 ± 0.06	-0.05 ± 0.09
TLB (No.)	0.07	0.15	0.29 ± 0.07	-0.32 ± 0.09
SR (%)	0.06	-0.04	-0.04	0.23 ± 0.03

scope of further improvement in these traits in the flock under study by direct selection. Similar estimates of h^2 were observed by Gowane *et al.* (2014) in Malpura sheep and Rather *et al*. (2020) in Kashmir Merino sheep. This is also in consonance with the fact that the fitness traits do not generally have high heritability. The genetic and phenotypic association of AFL with fitness traits was positive and low. The correlations (genetic and phenotypic) of LS with TLB were positive whereas negative with SR% similarly, the genetic and phenotypic associations of TLB with SR (%) were moderate negative and low negative, respectively.

Conclusion: All measures of fitness traits were significantly influenced by non-genetic factors *viz*., the period of birth and sex of lamb. The variation of performance of Corriedale sheep with respect to fitness traits indicated the environment has a significant role in the expression of the genetic worth of a genotype. The variable estimates heritability for reproduction and fitness traits indicated existence a considerable amount of genetic and environmental variance. Therefore, these traits can be improved through selection and management.

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Conflict of interest: The authors declare that there is no conflict of interest.

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