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Research Article

GENETIC AND NON GENETIC FACTORS AFFECTING WOOL TRAITS IN HARNALI SHEEP

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ABSTRACT

Twenty two years data (1992-2013) pertaining to wool traits of a synthetic population of Harnali sheep developed by inter-se mating of Corriedale and Russian Merino with Nali maintained at Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, were utilized for the present study. The overall least squares means for greasy fleece weight (GFW), staple length (SL), fibre diameter (FD), medullation percentage (MP) were found to be 1.62±0.02kg, 5.65±0.03cm, 25.85±0.07μ and 26.98±0.36%, respectively. The effect of year of birth and dam's weight at lambing was significant on GFW but was non-significant on SL, FD and MP. No definite trend was observed over the years on wool traits. Heritability estimates for various wool traits were moderate and obtained as 0.24±0.05, 0.28±0.20 and 0.32±0.18 for SL, FD and MP, respectively. High estimate of heritability for GFW (0.54±0.07) was obtained. The genetic and phenotypic correlations among all the wool traits were positive, significant and low to moderate.

Key words: Genetic, non genetic factors, sheep, wool traits

Sheep is one of the important species of livestock in India with 65.07 million population (BAHS, 2014) ranking second in the world. There are 40 descript breeds of sheep distributed in various agro-climatic zones of the country (National Bureau of Animal Genetic Resources, 2015). Harnali sheep is a three breed cross by 37.5% Nali and 62.5% exotic inheritance (Merino and Corriedale with equal inheritance, i.e., 31.25%) developed at the Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar for superior wool production. At present about 300 animals of Harnali sheep are maintained at university farm besides several animals have been disseminated to farmers around Hisar. Inter-se mating of these crossbreds has been in progress for several generations at LUVAS, Hisar.

Wool quality and quantity traits are very important because they are the first indicators of wool production potential of the animal. Greasy fleece weight (GFW) is very important for evaluating the quantity of clean wool. Staple length (SL) is important because the staple length of the fiber indicates quality of wool. Fibre diameter (FD) is the most important trait for the evaluation of wool quality as it is the major factor for the fineness of the wool. Medullation is an inherent property of wool and it imparts resiliency and is an important criterion for selection of sheep for fine wool. There are many genetic and non-genetic factors which influence the phenotypic expression of the production of sheep. Therefore, the present investigation was undertaken to study the factors affecting the wool traits of Harnali sheep and also to estimate the genetic parameters for making future breeding plan for the improvement of this breed.

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MATERIALS AND METHODS

This study was conducted on the data collected over a period of 22-years (1992-2013) pertaining to 862 Harnali sheep maintained at the LUVAS, Hisar. Hisar is located at 29°092 N, 75°422 E, altitude 215 m with average rainfall 490.6 mm and average temperature ranges between 17.6 and 32.5^{0}C. The traits included GFW, SL, FD and medullation percentage (MP). The lambs were allowed to suckle up to 90 days. They were also provided with concentrate feed after 2 months of age. The effect of non-genetic factors *viz*. year of birth, sex and dam's weight at lambing on various traits were studied by least square analysis technique using the following mixed model:

$$Y_{ijk} = \mu + S_i + Y_j + b(X_{ijk} - \bar{x}) + e_{ijk}$$

Where, Y_{ijk}=observation on l^{th} lamb belonging to i^{th} sire (i=175) born in j^{th} year; μ=overall mean; S_i=random effect of i^{th} sire, Y_j=fixed effect of j^{th} year (j=1-22); b=partial regression of traits on dam's weight at lambing; X_{ijk}=dam's weight corresponding to Y_{ijk}; $\bar{X}$ =mean dam's weight at lambing; e_{ijk}=random error associated with each observation and assumed to be normality and independently distributed which follows normal distribution with mean zero and variance.

The least squares and maximum likelihood computer program (Harvey, 1990) was used to estimate the effect of various factors on different wool traits. Modified Duncan's multiple range test (Kramer, 1957) was used for comparing sub group means. Heritability estimates for different growth traits were obtained from sire component of variances by using paternal half-sib correlation method (Becker, 1975). The standard errors of heritability estimates were obtained by using formula given by Swiger *et al.* (1964). Genetic correlations among different traits were calculated from sire components of variances and co-variances.

RESULTS AND DISCUSSION

The least squares means along with standard errors of different non genetic factors affecting the wool traits in Harnali sheep are given in Table 1. The overall mean for GFW, SL, FD and MP was found to be 1.62±0.02 kg, 5.65±0.03 cm, 25.85±0.07µ and 26.98±0.36%, respectively.

The highest GFW (2.02±0.10 kg) and SL (6.24±0.33) were obtained in the years 1992 and 1996, respectively. On the other hand the lowest value for fibre diameter (24.48±1.26µ) was obtained in the year 1994. Year of lambing showed a highly significant (P<0.01) source of variation for GFW in this study. No definite trend was observed over the year of lambing on all the traits under study. The variability in GFW, SL and FD due to years may be due to variations in physical environmental conditions, feeding, forage availability prevailing in different years for grazing and selection of rams as also opined by Khan *et al.* (2015). Mir *et al.* (2000) reported significant effect of year of birth on GFW in Corriedale sheep. Tomar *et al.* (2000) reported a significant effect of year of birth on GFW in Bharat Merino sheep. Dam's weight at lambing was statistically significant for GFW (Table 2) which was also reported by Dey (2004), Sehrawat (2005), Lalit (2016).

Table 1
Least squares mean along with standard errors for wool traits in Harnali sheep

Effects	No. of observations	GFW (kg)	SL (cm)	FD (µ)	MP (%)
Overall (µ)	862	1.62±0.02	5.65±0.03	25.85±0.07	26.98±0.36
Year		**			
1992	35	2.02^{a}±0.10	5.73±0.52	25.39±1.29	30.59±5.62
1993	42	1.99^{a}±0.10	5.26±0.50	24.97±1.23	30.40±5.42
1994	21	1.83^{ab}±0.10	5.04±0.51	24.48±1.26	32.71±5.56
1995	41	1.51^{bc}±0.08	5.49±0.38	24.95±0.94	26.33±4.15
1996	50	1.59^{bc}±0.07	6.24±0.33	26.20±0.82	26.74±3.61
1997	48	1.69^{b}±0.07	5.28±0.37	25.15±0.90	22.94±3.97
1998	25	1.70^{b}±0.07	5.30±0.35	26.02±0.86	29.73±3.80
1999	39	1.65^{b}±0.07	5.39±0.32	25.43±0.80	29.94±3.51
2000	49	1.68^{b}±0.06	5.69±0.29	26.00±0.71	27.04±3.13
2001	33	1.53^{bc}±0.06	5.19±0.30	26.34±0.75	28.82±3.31
2002	32	1.65^{b}±0.06	5.14±0.29	25.93±0.71	26.39±3.12
2003	56	1.42^{bc}±0.05	5.87±0.26	25.14±0.64	24.21±2.84
2004	48	1.64^{b}±0.05	6.05±0.27	25.77±0.68	28.09±2.98
2005	24	1.81^{ab}±0.06	5.77±0.30	26.36±0.73	23.58±3.22
2006	41	1.34^{c}±0.05	5.84±0.28	25.64±0.70	27.36±3.08
2007	52	1.52^{bc}±0.06	5.83±0.29	26.64±0.71	26.91±3.14
2008	58	1.54^{bc}±0.06	5.67±0.30	26.22±0.74	25.52±3.23
2009	40	1.40^{c}±0.09	5.76±0.41	26.22±0.74	25.75±4.52
2010	46	1.51^{bc}±0.08	5.75±0.43	25.39±1.02	26.13±4.41
2011	31	1.39^{c}±0.08	5.75±0.49	25.85±1.06	26.09±4.67
2012	40	1.60^{bc}±0.10	5.73±0.49	25.48±1.22	25.80±5.35
2013	11	1.74^{ab}±0.17	5.89±0.84	25.16±2.08	25.15±9.15
Regression of dam's weight at lambing		0.007±0.002	0.008±0.007	0.03±0.019	0.08±0.83

Means with different superscripts for an effect differed significantly (P<0.05). GFW=Greasy fleece weight; SL=Staple length; FD=Fibre diameter; MP=Medullation percentage

Table 2
Analysis of variance for wool traits

Source of variation	D.F.	Mean sum of squares GFW	SL	FD	MP
Sire	148	0.12	1.02	5.46	140.95
Year	21	0.35**	1.47	4.79	163.66
Dam's weight at lambing (linear regression)	1	0.26**	0.51	9.28	0.15
Error	691	0.09	1.03	5.83	113.21

**Significant at P<0.01. GFW=Greasy fleece weight; SL=Staple length; FD=Fibre diameter; MP=Medullation percentage; DF=Degree of Freedom

The estimates of heritability along with standard errors for GFW, SL, FD and MD were 0.54±0.07, 0.24±0.05, 0.28±0.20 and 0.32±0.18, respectively (Table 3). The heritability estimates for wool traits were moderate to high in the present study. Lee *et al.* (2000) and Khan *et al.* (2015) reported similar estimates for GFW. Moderate to high heritability estimates suggested the presence of sufficient additive genetic variance for these traits which could be utilized for improvement.

The genetic correlations among all the wool traits were positive, significant and low to moderate ranging from 0.16±0.15 to 0.34±0.11 (Table 3). Positive genetic correlation was reported by Snowder *et al.* (2005) in Rambouillet between GFW and SL. The phenotypic correlations among all the wool traits were positive, low

Table 3
Estimates of heritability (diagonal), genetic (above diagonal) and phenotypic (below diagonal) correlations along with standard errors among wool traits

Traits	GFW	SL	FD	MP
GFW	**0.54±0.07**	0.28±0.13	0.21±0.12	0.34±0.11
SL	0.30**±0.03	**0.24±0.05**	0.16±0.15	0.23±0.11
FD	0.19**±0.34	0.27**±0.03	**0.28±0.20**	0.31±0.12
MP	0.22**±0.03	0.14**±0.03	0.37**±0.03	**0.32±0.18**

**Significant at P<0.01. GFW=Greasy fleece weight; SL=Staple length; FD=Fibre diameter; MP=Medullation percentage to moderate and significant ranging from 0.14±0.03 to 0.37±0.03. Similar results were reported by Dey (2004), Sehrawat (2005) and Dixit *et al.* (2009). Keeping in view the direction and magnitude of correlation, efficient selection may be devised for optimum correlated response.

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