



Estimation of genetic parameters for production and reproduction traits in Kashmir Merino sheep

MUBASHIR ALI RATHER¹, S SHANAZ², N A GANAI³, NUSRAT NABI⁴, AMBREEN HAMADANI⁵, SAFEER ALAM⁶, SABA BUKHARI⁷, ASHRAF BABA⁸ and TARIQ A RAJA⁹

Sher-e-Kashmir University of Agriculture Sciences and Technology of Kashmir, Srinagar, Jammu and Kashmir 190 006 India

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The Kashmir Merino breed was developed through crossing Gaddi, Bhakarwal and Poonchi with 50 to 75% exotic inheritance of Rambouillet and Merino sheep (Tomar, 2004) for apparel wool. However, due to the easy availability of fine and good quality synthetic fibers, wool has lost its market value and there is a shift in objective of sheep farming from wool to mutton traits. Therefore, all breeds of region and in particular Kashmir Merino owing to its population, adoption and performance need improvement with respective traits. As the breed improvement programs are based on genetic variation and its effective utilization by selecting breeding stock on the basis of genetic worth. Therefore, present study was undertaken to have an insight in genetic variation and association between economically decisive traits of this breed to improve its mutton traits and simultaneously conserving the improvement achieved in wool traits.

The performance data spread over 21 years (1997–2017) for Kashmir Merino Sheep for birth weight (BWT), 6 months body weight (6-MWT), yearling body weight (12 MWT), greasy fleece yield of first clip (GFY-1), greasy fleece yield of second clip (GFY-2), fiber diameter (FD), staple length (SL), age at first lambing (AFL) and inter-lambing period (ILP) maintained at Sheep Breeding Farm, Kralapathri; Sheep Breeding Farm, Gowbal and Fleece Testing Laboratory, Srinagar were used for present study.

Sheep breeding farm Kralapathri is located at 33° 53' latitude N and 74° 37' longitude E about 45 km from Srinagar. Sheep breeding farm Gowbal is located at 34° 16' latitude N and 53° 49' longitude E.

Present address: ^{1,5}PG Scholar (mubashir.70011@gmail.com, escritor005@gmail.com), ²Senior Scientist (sshanaz2007@gmail.com), ^{4,7}PhD Scholar (khannusratnabi@gmail.com, drsababukhari2010@gmail.com), ⁶Professor and Head (safeeralam1@gmail.com), ⁹Chief Scientist (tariqaraja@rediffmail.com), Division of Animal Genetics and Breeding. ³Director (drnazirahmad@gmail.com), Strategic Planning and Monitoring, SKUAST-K. ⁸Deputy Director (aaybee777@gmail.com), Department of Sheep Husbandry, Government of J&K, India.

The farms under study follow same management guidelines. The sheep are stall-fed during winter from 15th November to 1st April, grazed in the adjoining forest areas from 15th May to 15th August and taken to highland pastures for the rest the year. The fodder was fed to animals @ 1.5 kg, 1.6 kg and 1.6 kg per day per adult ewe, ram and hogget respectively. The concentrate ration is fed @ 600 g/day/adult male and @ 500 g/day/ewe and @ 300 g/lamb. Common salt @10 g/head/week was given to these animals.

Ewes, in late summer and early autumn were divided into groups based on body weight, wool yield wool and quality traits, each group consisting of about 100 ewes. Rams were similarly selected. Close breeding was avoided. Paint was applied on the brisket region of selected rams and put into the pens with allotted group of ewes for day and night. Lambs were weaned at an age of 4–5 months. The male and female weaners were reared in together.

Heritability estimates for different traits were obtained from sire component of variances using paternal half-sib correlation method (Becker 1975). Only the sires with three or more than three progeny were included for the estimation of heritability.

The sires with three or more than three progeny were included for the estimation of heritability. The model used to estimate the heritability was:

$$Y_{ij} = m + s_i + e_{ij}$$

where, Y_{ij} , observation of the j^{th} progeny of the i^{th} sire; m overall mean; s_i , effect of the i^{th} sire; NID (0, σ_s^2) and e_{ij} denotes random error NID (0, σ_e^2). The s_i and e_{ij} were assumed to be independent of each other.

The genetic and phenotypic correlations between various combinations of two-trait were calculated by paternal half-sib correlation method utilizing sire components of variance and covariance among sire groups as given by Becker (1975).

The heritability estimates and correlations (genetic and phenotypic) between different traits are presented in Table 1. The heritability estimates were low for reproduction traits (AFL and ILP) and fibre diameter, moderate for birth weight

Table 1. Heritability, Genetic and Phenotypic correlation among different traits

Trait	BWT	6-MWT	12-MWT	GFY-1	GFY-2	FD	SL	AFL	ILP
BWT	0.49±0.07	0.10±0.09**	0.50±0.08**	0.29±0.09**	0.35±0.13**	0.58±0.09**	-0.04±0.09**	-0.73±0.10**	0.13±0.30 ^{NS}
6-MWT	0.06±0.02**	0.57±0.07	0.68±0.06**	0.68±0.06**	0.26±0.12**	-0.15±0.18**	0.16±0.21**	-0.42±0.25**	0.60±0.97**
12-MWT	0.14±0.02**	0.54±0.01**	0.58±0.07	-0.21±0.10**	0.87±0.04**	-0.07±0.19**	0.06±0.08**	-0.25±0.38**	0.3±0.40**
GFY-1	0.02±0.01**	0.54±0.01**	0.05±0.02**	0.61±0.08	0.21±0.12**	0.05±0.82	-0.29±0.08**	0.28±0.25**	0.67±0.41**
GFY-2	0.06±0.02**	0.13±0.01**	0.38±0.01**	0.03±0.01**	0.52±0.04	0.73±0.73**	-0.02±0.10**	0.47±0.29**	0.53±0.45**
FD	0.04±0.02**	-0.03±0.01**	0.02±0.03**	-0.04±0.02**	0.03±0.02**	0.23±0.04	0.05±0.13**	0.23±1.07**	-0.23±1.07**
SL	-0.01±0.03**	-0.05±0.03**	-0.06±0.03**	-0.08±0.02**	0.01±0.02**	-0.10±0.02**	0.66±0.10	0.30±0.60**	-0.20±0.26**
AFL	-0.03±0.03**	-0.07±0.03**	-0.09±0.03	0.17±0.02**	0.08±0.03**	-0.01±0.04**	0.01±0.03*	0.06±0.06	-0.62±1.43**
ILP	0.01±0.02 ^{NS}	0.04±0.04**	0.09±0.03**	0.05±0.04**	0.07±0.04**	0.05±0.04**	-0.66±0.07**	0.03±0.04*	0.15±0.09

The heritability values lie on the diagonal, while genetic and phenotypic correlations are placed above and below the diagonal. NS, non-significant; *significant at 5% level; **significant at 1% level.

and high for six months body weight, yearling body weight, wool production traits and staple length. The lower estimates for reproductive traits indicates the presence of lower additive genetic variance as they are largely influenced by environment factors and higher heritability estimates for growth traits indicates existence of considerable additive genetic variance to be utilized through mass selection for improvement of this breed. Umeel *et al.* (2018) in Munjal sheep reported similar estimates of heritability for BWT, 6-MWT and 12-MWT. The estimates of heritability for GFY-1, GFY-2 and SL in the present study were higher than those reported by Dixit *et al.* (2009) in 3/4 crossbred Bharat Merino. The heritability estimate for SL in the present study was lower than 0.76±0.15 reported by Dixit *et al.* (2009) in 3/4 crossbred Bharat Merino and higher than 0.38±0.05 reported by Lalit *et al.* (2017) in Harnali sheep. The heritability estimates for AFL and ILP in the present study were higher than 0.02±0.05 and 0.01±0.05 respectively, reported by Lalit *et al.* (2017) in Harnali sheep. The genetic correlations among body weight traits were positive and significant in the present study. The positive genetic correlations among body weight traits in the present study indicated that the body weights at different ages are governed by same set of gene combination and there is no inherent antagonism in expression of these traits. Sharma *et al.* (2016) in Marwari and Karakul, Lalit *et al.* (2017) in Harnali sheep and Umeel *et al.* (2018) in Munjal sheep also reported positive genetic and phenotypic correlations among different growth traits.

All genetic and phenotypic associations between body weight and wool yield traits were observed to be positive except between greasy fleece yield of first clip and yearling body weight and it can be more surface area for wool growth. Dixit *et al.* (2009) in 3/4 × bred Bharat Merino also found positive genetic correlation of six months body weight and staple length. Lalit *et al.* (2017) in Harnali also found positive genetic association between birth weight and staple length and between six months body weight and staple length. The phenotypic correlation of fibre diameter with six months body weight was low and negative (-0.03±0.01) and with birth weight and yearling body weight was low and positive (0.04±0.02 and 0.02±0.03).

The phenotypic association of staple length with all the three growth traits was negative and low. Gupta (2000) in Rambouillet, Merino and their crosses also found negative genetic relationship between staple length with birth weight and six months body weight. Dixit *et al.* (2009) in 3/4 × bred Bharat Merino also found negative phenotypic relationships of six months body weight with staple length. The genetic correlation of body weight traits (BWT, 6-MWT and 12-MWT) with age at first lambing was negative and with inter-lambing period was positive. Similarly, the phenotypic association of body weight traits with age at first lambing was negative and with inter-lambing period was positive and low. Gupta (2000) in Rambouillet, Merino and their crosses with indigenous sheep breeds of Northwestern Himalayan region also observed negative genetic and phenotypic relationship between 6-MWT and AFL. The negative genetic correlations between body weight traits (BWT, 6-MWT and 12-MWT) and AFL were also observed by Baba (2016) in Corriedale sheep and Kumar *et al.* (2017) in Harnali sheep.

The genetic and phenotypic correlations greasy fleece yield of first clip with greasy fleece yield of second clip was positive. This may imply that fleece yield at first and subsequent shearings, is controlled by similar gene combinations. Similar estimates of genetic correlations have been reported in Kashmir Merino (Sheikh and Dhillon, 1992), Dixit *et al.* (2009) in 3/4 × bred Bharat Merino. The genetic correlation of wool yield traits (GFY-1 and GFY-2) with FD was positive (0.05±0.82 and 0.73±0.73) and with SL was negative (-0.29±0.08 and -0.02±0.10). Positive and significant genetic correlation between greasy fleece yield and fibre diameter has been observed in Corriedale by Cardellino *et al.* (1987). Gupta (2000) in different breeds of sheep, Dixit *et al.* (2009) in 3/4 × bred Bharat Merino and Lalit *et al.* (2016) Harnali also reported positive genetic association between two traits. The positive genetic correlation of greasy fleece yield of first clip with fiber diameter was undesirable. The negative genetic and phenotypic associations of staple length with greasy fleece yield of first clip were in agreement with Gupta (2000) in Rambouillet and Merino breeds and Cardellino *et al.* (1995) in Polwarth sheep. Wool yield was observed to be positively

correlated with AFL and ILP in the present study. Similar findings were obtained by Lalit *et al.* (2016) in Hernali and Gupta (2000) in Rambouillet & Merino. The positive and significant genetic correlation (0.05 ± 0.13) of fiber diameter with staple length was in consonance with findings of Gupta (2000) in different genetic groups and Lalit *et al.* (2017) in Hernali. The negative phenotypic correlation between these traits was also observed by Khan *et al.* (2015) and Mahajan *et al.* (2018) in Rambouillet. The negative phenotypic correlation of fiber diameter with inter-lambing period was in consonance with findings of Gupta (2000). However, Lalit *et al.* (2017) in Hernali found low and positive genetic correlation between two traits. The negative genetic and positive phenotypic correlation of FD with ILP was in agreement with observation of Gupta (2000) in exotic and indigenous breeds of sheep. The positive genetic and phenotypic correlation of the age at first lambing with the staple length in the present study advocated results obtained by Lalit *et al.* (2017) in Hernali sheep. The genetic and phenotypic correlations of staple length with inter-lambing period were negative as was also reported by Gupta (2000) in different breeds of sheep and Lalit *et al.* (2017) in Hernali. The high and negative genetic correlations of age at first lambing with inter-lambing period was in consonance with report of Gupta (2000) in Rambouillet and Merino sheep and Malik *et al.* (2018) in Munjal. However, Lalit *et al.* (2017) in Hernali and Khan *et al.* (2017) in Rambouillet observed positive genetic correlation between the two traits. The positive and low phenotypic association of age at first lambing with inter-lambing period in consonance with findings of Lalit *et al.* (2017) in Hernali and Malik *et al.* (2018) in Munjal. However, Khan *et al.* (2017) in Rambouillet reported negative phenotypic correlation between these traits.

SUMMARY

Data pertaining to 6,300 birth records spread over 21 years of Kashmir Merino sheep maintained at Government Sheep Breeding Farm Kralapathri and Government Sheep Breeding Farm Goabal Kashmir and Fleece Testing Laboratory were used to estimate the genetic parameters. The genetic parameters for birth weight (BWT), 6 months body weight (6-MWT), yearling body weight (12 MWT), greasy fleece yield of first clip (GFY-1), greasy fleece yield of second clip (GFY-2), fiber diameter (FD), staple length (SL), age at first lambing (AFL) and inter-lambing period (ILP) were estimated by paternal half-sib correlation method using sire components of variance and covariance. The heritability estimates for BWT, 6-MWT, 12-MWT, SL, GFY-1, GFY-2 were moderately high whereas the estimates of heritability for FD, SL, AFL and ILP were low respectively. The genetic correlation between different traits ranged from -0.73 ± 0.10 to 0.87 ± 0.04 while as phenotypic correlation different traits ranged from -0.66 ± 0.07 to 0.54 ± 0.01 . Keeping in view its high heritability of SMW and favorable correlations with birth weight, yearling body weight, wool traits and age at first lambing, it is concluded

that selection on basis of 6-MWT would be effective to improve growth, quality wool production and age at first lambing in Kashmir Merino sheep.

REFERENCES

- Akhtar P, Ali S, Hussain A, Mirza M A, Mustafa M I and Sultan J I. 2008. Heritability estimates of post weaning performance traits of Hissardale sheep in Pakistan. *Turkish Journal of Veterinary and Animal Sciences* **32**(4): 275–79.
- Baba M A. 2016. 'Genetic evaluation and trends of growth and age at first lambing in Corriedale flock of sheep in Kashmir.' M.V.Sc. thesis. Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir. Thesis submitted to Division of Animal Genetics and Breeding.
- Becker W A. 1975. *Manual of Quantitative Genetics*. 3rd Edition, Washington State University, Washington, USA.
- Cardellino R A, Cardellino R C and Siewerdt F. 1995. Genetic parameters of wool production traits in Polwarth sheep. *Production – Ovina* **8**: 7–16.
- Das A K, Chakraborty D, Kumar N, Gupta P, Khan N N and Bukhari S. 2014. Effects of non-genetic factors on performance traits of Kashmir Merino sheep. *Indian Journal of Animal Research* **48**(2): 106–108.
- Dixit S P, Dhillon J S and Singh G. 2001. Genetic and non-genetic parameter estimates for growth traits of Bharat Merino lambs. *Small Ruminant Research* **42**(2): 101–104.
- Dixit S P, Singh G, Kant N and Dhillon J S. 2009. Contribution of genetic and phenotypic parameters affecting fleece traits in 3/4th bred Bharat Merino Sheep. *Indian Journal of Animal Research* **43**(1): 1–6.
- Gupta N. 2000. 'Genetic evaluations of exotic fine wool breeds (Rambouillet and Merino) and their crosses with indigenous sheep breeds of Northwestern Himalayan region.' M.V.Sc. thesis, Department of Animal Breeding, Genetics and Biostatistics College of Veterinary and Animal Sciences Himachal Pradesh Krishi Vishwavidyalaya Palampur, Himachal Pradesh, India.
- Hanford K J, Van Vleck L D and Snower G D. 2003. Estimates of genetic parameters and genetic change for reproduction, weight, and wool characteristics of Targhee sheep. *Journal of Animal Science* **81**(3): 630–640.
- Khan G M and Singh B P. 1974. Comparative performance of Kashmir Merino, Russian Merino and Stavropol breeds of sheep maintained in Kashmir. *Indian Veterinary Journal* **51**: 186–89.
- Khan N N, Assad N, Kumar N, Chakraborty D, Ayaz A, Dar M A. 2017b. Genetic parameters of reproduction traits in Rambouillet sheep. *International Journal of Current Microbiology and Applied Sciences* **6**(8): 2090–94.
- Khan N N, Kumar N, Das A K, Chakraborty D, Taggar R K and Gupta P. 2015. Genetic studies on wool production traits in Rambouillet crossbred sheep in J & K State, India. *Indian Journal of Animal Research* **49**(1).
- Kushwaha B P, Jain A and Singh G. 1995. Estimates of genetic and phenotypic parameters of body weights and fleece weight in Avivastra sheep. *Indian Journal Animal Sciences* **65**(7): 812–13.
- Lalit Z S, Dalal D S, Dahiya S P, Patil C S and Dahiya R. 2016b. Genetic analysis of growth traits in Hernali sheep. *Veterinary World* **9**(2): 128.
- Lalit Z S, Malik Z S, Dalal D S, Patil C S and Dahiya S P. 2017. Genetic studies on growth, reproduction and wool production

- traits in Harnali sheep. *Indian Journal of Animal Research* **51**(5): 813–16.
- Mahajan V, Das A K, Taggar R K, Kumar D and Khan N. 2018. Non-genetic factors influencing the wool traits of Rambouillet sheep in Jammu. *International Journal of Current Microbiology and Applied Sciences* **7**(3966–3973)
- Malik Z S, Dalal D S, Dahiya S P and Patil C S. 2018. Estimation of genetic parameters for production traits in Munjal sheep. *Indian Journal of Small Ruminants* **24**(1): 31–34.
- Sharma M K, Sharma N K, Singh V K and Beniwal B K. 2003. Genetic evaluation of Nali and Marwari sheep in arid zone of Rajasthan: Body weights. *Indian Journal of Small Ruminants* **9** (1): 65–68.
- Sharma N K, Nehra K S and Gahlot G C. 2016. Genetic evaluation of Karakul and Marwari sheep in arid zone of Rajasthan: body weights. *Veterinary Practitioner* **17**(2): 265–67.
- Sheikh N A and Dhillon J S. 1992. Genetic studies on quantitative wool traits in Kashmir Merino sheep. Wool and Woollen of India 21–23.
- Sheikh N A, Dhillon J S and Parmar O S. 1986. Genetic evaluation of a flock of Kashmir Merino Sheep. *Indian Journal of Animal Science* **56**(2): 244–247.
- Sheikh N A. 1984. 'Genetic evaluation of closed flock of Kashmir Merino sheep'. M.V.Sc. Thesis, Punjab Agricultural University, Ludhiana.
- Shiekh N A and Dhillon J S. 1985. Effect of crossbreeding Kashmir Merino with Australian Merino on various economic traits. *Indian Journal of Animal Sciences* **55**(7): 608–610.
- Tomar A K S, Mehta B S, Kaishan J and Singh G. 2000. Genetic studies on growth and greasy fleece yield in Bharat Merino sheep. *Indian Journal of Animal Sciences* **70**(5): 537–539.
- Tomar S S. 2004. *Textbook of Animal Breeding*. Kalyani Publishers, Ludhiana.
- Umeel, Malik Z S, Dalal D S, Dahiya S P and Patil C S. 2018. Estimation of genetic parameters for production traits in Munjal sheep. *Indian Journal of Small Ruminants* **24**(1): 31–34.
- Zaffer V, Taggar R K and Chakraborty D. 2015. Non-genetic factors affecting growth and production traits in Dorper crossbred sheep. *Journal of Animal Research* **5**(2): 227.