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

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

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 of 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 \( (0, \sigma_s^2) \) and \( e_{ij} \) denotes random error NID \( (0, \sigma_e^2) \). 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
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 environmental 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) Hernali 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

| Trait | BWT | 6-MWT | 12-MWT | GFY-1 | GFY-2 | FD | SL | AFL | ILP |
|-------|-----|-------|--------|-------|-------|----|----|-----|-----|
|       | 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** | 0.50±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** | −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** | −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 | −62±1.43** |
| ILP | 0.01±0.02NS | 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.
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 Harnali 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 Harnali 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.

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