Research

Effect of Non-Genetic Factors on Growth Traits of Kashmir-Merino Sheep

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ABSTRACT

The study investigates the influence of non-genetic factors viz. period and season of birth, sex, parity and birth type, on growth traits of Kashmir-Merino sheep reared under the temperate agro-climatic conditions of Kashmir. Growth performance records collected over a nine year period (2016 - 2024) at the Mountain Research Centre for Sheep & Goat (MRCSG), SKUAST-K, were analyzed using a fixed linear model in R package. Traits included birth weight (BW), weaning weight (WW), six-month weight (6M) and twelve-month weight (12M). The average BW, WW, 6M and 12M weights were estimated as 3.71±0.06 kg, 13.13±0.29 kg, 22.97±0.41 and 30.28±0.89 kg with coefficients of variation of 21.29 %, 18.74%, 17.94% and 21.33%, respectively. The overall least-squares means were 3.5 ± 0.129 kg, 14.6 ± 0.667 kg, 22.1 ± 0.916 kg, and 33.9 ± 2.38 kg for BW, WW, 6M and 12M, respectively. Period of birth, Season of birth, parity, sex and birth type significantly influenced the growth traits in Kashmir-Merino Sheep. The study highlights the importance of accounting for these non-genetic factors in growth performance evaluation in Kashmir-Merino sheep.

Keywords: Kashmir-Merino, Growth traits, Non-genetic factors, Least-squares means

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INTRODUCTION

Kashmir-Merino plays a crucial role in rural livelihoods, especially in pastoral and semi-nomadic systems, due to its fine quality wool and faster growth rate. It was developed by crossing Gaddi, Bhakarwal, and Poonchi sheep with 50 to 75% exotic inheritance from Rambouillet, Tasmanian and Delain Merino breeds (Tomar, 2004). Traits including birth weight, pre weaning and post weaning weight etc. are highly heritable and critical components in sheep industry for meat production. These traits are the main indices of selection and are influenced by both genetic as well as feeding and management. Non-genetic factors such as period, sex, season, parity and birth type are economically important to effectively implement farm-level management practices to enhance lamb growth. It is essential to adjust for environmental and physiological sources of variation, including age, gender, birth type or litter size, year, season, and other valuable environmental factors (Babar *et al.,* 2004). Adjusting data for these key non-genetic factors is crucial to obtain unbiased estimates of genetic merit and increase the accuracy of selection programs. The present study was conducted to investigate the effect of various non-genetic factors on growth traits in Kashmir-Merino sheep at Mountain Research Centre for Sheep and Goat (MRCS&G).

MATERIALS AND METHODS

The study was conducted on 184 records of Kashmir-Merino sheep maintained at MRCS&G, SKUAST-Kashmir, under organized conditions. The farm is located in the Ganderbal District of J&K, India, with longitude and latitude coordinates of 74.47 °E and 34.14 °N, respectively, and an altitude of 5300 ft above the mean sea level. The farm experiences a temperate climate with cool winters (average daytime temperature of 2.5 °C with night temperatures below freezing point) and warm summers (average temperature of 24 °C). The spring season is wet with regular rainfall while the autumn season mostly remains dry. The animals are reared under a semi-migratory and semi-intensive production system. During the daytime, animals are let out for grazing and maintained in closed paddocks at night. The animals migrate to highland pastures (Laderwas, Sonamarg, with an altitude of 11,800–

14,000 ft above mean sea level) from mid-June to mid-September for summer grazing. The breeding season commences in September and lasts till November and flushing is undertaken before the commencement of mating season. Ewes are put into the breeding plan after 18 months of age. The rams are separated from ewes during grazing, and tupping is allowed inside paddocks during night time only. Mating is followed by brisket painting of rams with different wool colours and a follow-up of rump stamps on ewes every morning. Close inbreeding is discouraged by planned and controlled mating via housing of ewes with particular rams only; male and female flocks are reared separately during the daytime.

The growth data was classified into two periods according to the generation interval in sheep. The data recorded were divided into two seasons of lambing (Jan-Feb and Mar-Apr), sex of lamb (male and female) and litter size (single, twin). The traits under study were i.e. Birth Weight (BW), Weaning Weight (WW), Six Month Weight (6M) and Yearling Weight (12M). The effect of non-genetic factors on growth traits were studied by emmeans package in R software for non-orthogonal data. To account for significant non-genetic factors below mentioned fixed linear model was used.

$$Y_{ijklmn} = \mu + P_i + S_j + (Sex)_k + Pa_l + B_m + e_{ijklmn}$$

Where,

Y_{ijklmn} = Observation on the nth animal in i_{th} period of birth, j_{th} season of birth and k_{th} sex, l_{th} parity and m_{th} birth type.

μ = Overall mean

P_i = Effect of i_{th} period of birth (1 to 2)

S_j = Effect of j_{th} season of birth (1 to 2)

$(Sex)_k$ = Effect of k_{th} sex (1 to 2)

Pa_l = Effect of l_{th} parity (1 to 5)

B_m = Effect of m_{th} birth type (1 to 2)

e_{ijklmn} = Random error ~ NID (0, $\sigma^2 e$)

The difference of means between subclasses of periods, seasons, sex, parity and birth type were tested for significance using Duncan's Multiple Range Test using agricolae package in R software.

RESULTS AND DISCUSSION

Average of the Traits and Coefficient of Variation

The descriptive statistics are presented in Table 1. The coefficient of variations (CV%) of all the traits under study were low to moderate indicating that the traits had low to medium variability. Among all traits 12M body weight had the highest coefficient of variation (21.33%). Das *et al.,* (2014) reported lower value of CV for BW (18.75%) and WW (6.07%) in Kashmir-Merino sheep. Mallick *et al.,* (2017) reported lower value of CV for BW (17.49%), 6M (15.32%) and 12M (15.61%) respectively in Bharat Merino. Rather *et al.,* (2022) reported higher average birth weight with lower CV (17.70%) in Kashmir-Merino sheep.

Table 1. Descriptive statistics of growth traits in Kashmir-Merino Sheep

Trait	N	Mean ± SE	Std. Deviation	CV%
BW	184	3.71±0.06	0.79	21.29
WW	71	13.13±0.29	2.46	18.74
6M	103	22.97±0.41	4.12	17.94
12M	53	30.28±0.89	6.46	21.33

Least-Square Means of the Traits

The least-squares means, test of significance and trends in growth traits of Kashmir-Merino sheep are presented in Table 2, Table 3 and Fig 1-5 respectively. The overall least-squares means were 3.5 ± 0.129 kg, 14.6 ± 0.667 kg, 22.1 ± 0.916 kg, and 33.9 ± 2.38 kg for BW, WW, 6M and 12M respectively. The observed LSM's for birth weight (BW), Weaning Weight (WW), six months body weight (6M) and yearling body weight (12M) are more than those reported by Das *et al.,* (2014) (2.82 ±0.05 kg and 13.31± 0.07 kg for BW and WW); Rather *et al.,* (2019) (3.27±0.03 kg, 11.38±0.16 kg, 16.30±0.45 kg, 19.54±0.23 kg, 24.23±0.27 kg and 32.43±0.41 kg for BW, 3M, 6M, 9M, 12M and 18M respectively; Rather *et al.,* (2020) (3.34± 0.05, 19.33± 0.45 and 22.44 ±0.46 for BW, 6M and 12M and Rather *et al.,* (2022) (2.65±0.13 for BW) weight in Kashmir-Merino sheep.

Effect of Period

The effect of period was significant (P<0.01) on WW, whereas it was non-significant on other traits. The trends in the period showed improved early performance for BW and WW thereafter, with a decline in 6M and 12M suggesting a need to balance selection pressure and management strategies to ensure consistent growth beyond weaning. Year of birth had no significant effect on BW and WW (Das *et al.,* 2014), whereas it had a significant effect on BW, 6M, 9M, 12M and 18M (Rather *et al.,*2019) in Kashmir-Merino sheep. In a subsequent study, Rather *et al.,* (2020) observed a significant effect of period of birth on BW, 6M and 12M in Kashmir-Merino sheep.

Effect of Sex

The sex of lamb had significant (P<0.001) effect on BW and 12M. Male lambs were heavier than female lambs at all ages, attributed to hormonal differences and higher muscle accretion potential. Mallick *et al.,* (2017) reported significant effect of sex at birth, six and twelve

Table 2. Least-Square means of Growth Traits in Kashmir-Merino Sheep

Particular	N	BW (kg)	N	WW (kg)	N	6M(kg)	N	12M(kg)
Overall Mean	184	3.5 ± 0.129	71	14.6± 0.667	103	22.1 ± 0.916	53	33.9 ± 2.38
Sex		***						***
Male	89	3.66^{a}±0.13	36	14.8±0.70	49	22.4±0.94	13	36.7^{a}±2.94
Female	95	3.34^{b}±0.14	35	14.4±0.73	54	21.8±1.05	40	31.1^{b}±2.16
Period				***				
2016-2021	78	3.45±0.15	61	13.5^{b}±0.61	48	22.9±1.06	10	35.4±3.33
2022-2024	106	3.55±0.13	10	15.7^{a}±0.71	55	21.3±0.96	43	32.3±2.00
Parity		***		***		***		
1	83	3.09^{c}±0.12	39	15.8^{a}±0.69	44	20.1^{a}±0.87	14	28.9±2.45
2	50	3.40^{bc}±0.13	21	13.9^{b}±0.77	31	23.6^{a}±0.92	18	36.2±2.67
3	30	3.51^{ab}±0.17	11	14.0^{b}±0.91	13	22.1^{a}±1.29	09	35.4±3.25
4	16	3.66^{ab}±0.20			13	22.6^{a}±1.24	09	34.7±2.78
5	5	3.84^{a}±0.33			2	22.1^{a}±2.89	03	34.3±4.28
Season								***
1	75	3.41±0.14	20	14.8±0.76	43	21.6±0.99	22	35.9^{a}±2.64
2	109	3.59±0.14	51	14.3±0.73	60	22.6±1.01	31	31.9^{b}±2.92
Birth Type		***						
1	173	3.93^{a}±0.08	67	13.5±0.48	95	23.5±0.71	50	33.0±1.61
2	11	3.07^{b}±0.22	04	15.6±1.20	08	20.7±1.52	03	34.7±3.95

N- No. of Observations, BW- Birth Weight, WW- Weaning Weight, 6M- 6 Months Weight, 12M- 12 Months Weight, **P < 0.05, ***P < 0.01

Table 3. Analysis of variance (M.S. values) of growth traits in Kashmir-Merino sheep

Sources of variation	Mean sum of squares			
	BW	**WW**	**6M**	**12M**
Period	0.35 (1)	36.54*** (1)	52.51 (1)	41.3 (1)
Season	1.23 (1)	2.25(1)	21.9 (1)	170.19 ** (1)
Sex	4.40*** (1)	2.54 (1)	6.5 (1)	226.1*** (1)
Parity	7.48***(4)	52.18***(2)	229.14 (4)***	288.9(4)
Birth type	7.10***(1)	13.64(1)	52.14(1)	6.8(1)
Residual	85.71 (175)	307.54 (64)	1389.7 (94)	1470.6 (44)

Figures in parentheses indicate respective degrees of freedom. **P < 0.05, ***P < 0.01

months of age in Bharat Merino, whereas Rather *et al.,* (2019) observed a significant (p<0.01) effect on BW, 9M, 12M and 18M weight in Kashmir-Merino sheep.

Effect of Season

The effect of season was significant (P<0.01) on 12M weight. 12M weight was much better in lambs born in Jan-Feb, possibly due to better post-weaning forage quality or reduced stress. Lambs born in spring season showed better growth performance compared to those born in winter due to favorable grazing and temperature conditions. Das *et al.,* (2014) reported significant effect on WW in Kashmir-Merino sheep.

Effect of Parity

The effect of parity was significant (P<0.01) on BW, WW and 6M weight. Birth weight consistently improved with increasing order of parity whereas, WW and 6M weight fluctuated slightly, possibly due to environmental/maternal factors. Lambs born to pluriparous dams were consistently heavier at all ages compared to those born to primiparous dams due to better maternal development, experience, and body condition at optimal parity. Rather *et al.,* (2020) reported significant effect of parity on BW, WW, and 6M in Kashmir-Merino sheep.

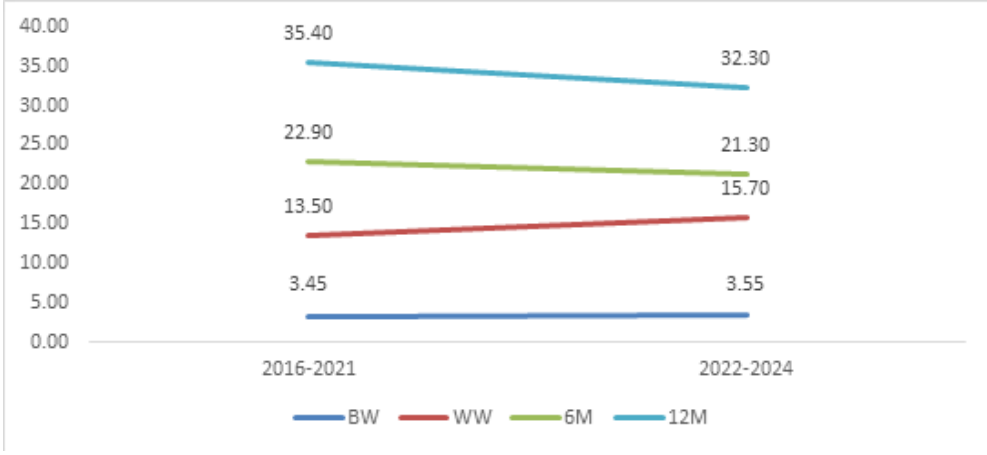

Fig. 1: *Body weight variation across periods in Kashmir-Merino Sheep.*

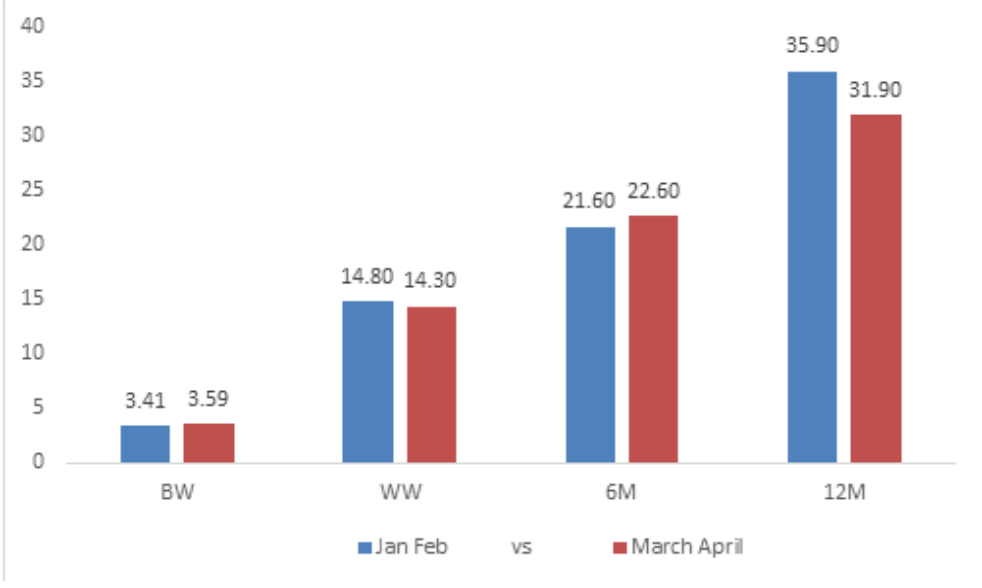

Fig. 2: *Body weight variation across Season in Kashmir-Merino sheep*

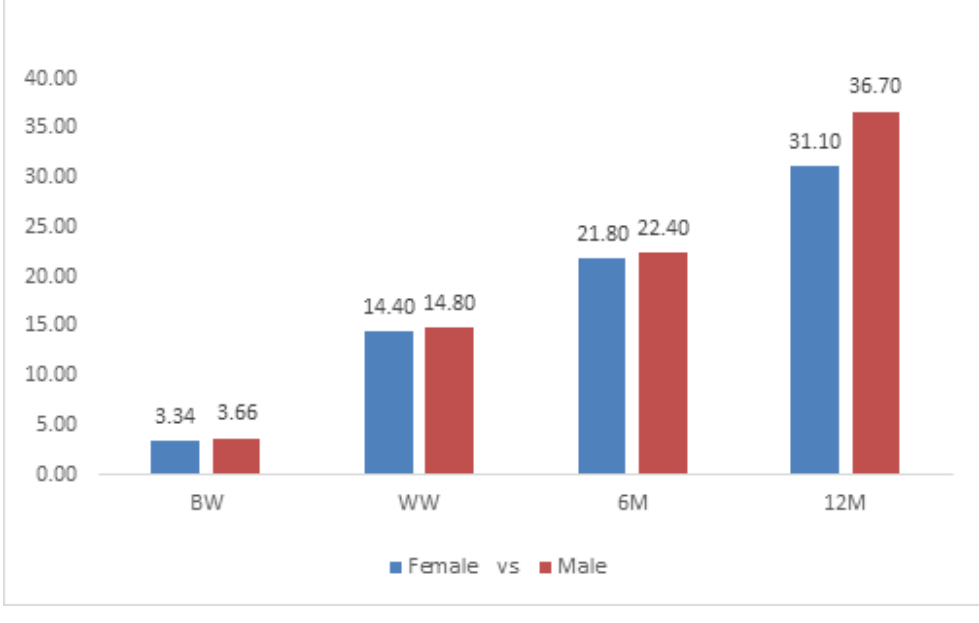

Fig. 3: *Body weight variation across Sex in Kashmir-Merino Sheep*

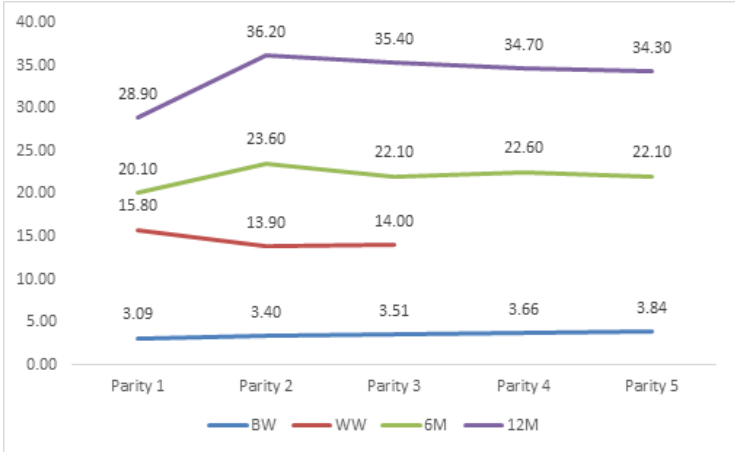

Fig. 4: *Body weight variation across parity in Kashmir-Merino Sheep*

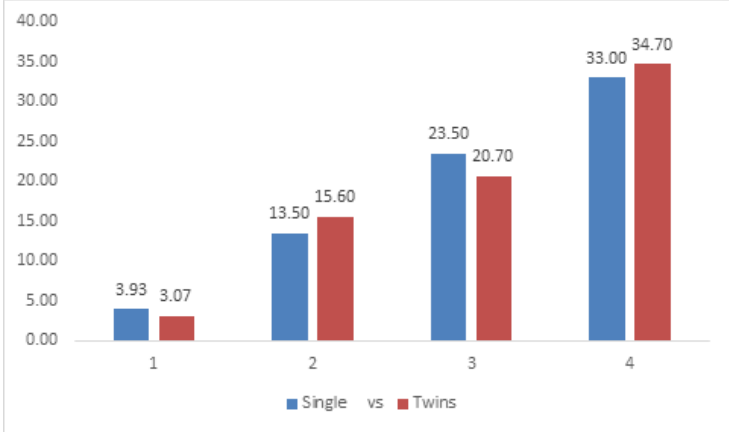

Fig. 5: *Body weight variation across birth type in Kashmir-Merino Sheep*

Effect of Birth Type

The effect of birth type was significant (P<0.01) on BW only. Lambs born as singles had higher birth weights than twins primarily due to less intrauterine competition and greater availability of dam's milk. Mallick *et al.,* (2017) observed significant effect of birth type on BW and 12M weight in Bharat Merino, whereas Rather *et al.,* (2020) reported no significant effect on growth traits in Kashmir-Merino sheep.

CONCLUSION

The overall least-squares means were 3.5 ± 0.129 kg, 14.6 ± 0.667 kg, 22.1 ± 0.916 kg, and 33.9 ± 2.38 kg for BW, WW, 6M and 12M respectively. The non-genetic factors exert a significant influence on the growth traits in Kashmir-Merino sheep. Males, later parities, and single-born lambs showed superior growth, while seasonal variations affected post-weaning performance. These findings highlight the necessity of accounting for environmental and physiological variations in genetic evaluation to ensure unbiased breeding values and improved flock productivity.

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DISCLOSURE STATEMENT

The authors declare that no actual or potential conflict of interest could inappropriately influence the work.

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