



Factors affecting performance traits in Rambouillet sheep

AAKRITI SUDAN¹, R K TAGGAR², D CHAKRABORTY³, D KUMAR⁴ and N KUMAR⁵

Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu, R S Pura,
Jammu and Kashmir 181 102 India

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Sheep population (65.06 million) contributes around 12.71% to the total livestock population of the country (19th Livestock Census 2012). Performance of genetically superior sheep is affected by non-genetic factors such as year/period, season, sex and lambing type etc. which subsequently influence in knowing the exact breeding values. Therefore, identification of significant non-genetic factors and their correction helps in estimation of breeding values and genetic parameters of population. Rambouillet sheep breed was intensively used for crossbreeding programme in India especially in Jammu and Kashmir for improving the productivity of native sheep. Therefore, the present investigation was planned to study the different non-genetic factors affecting performance traits in Rambouillet sheep.

Performance data on 8,872 animals were collected from history sheets of Rambouillet sheep maintained at Government Sheep Breeding and Research Farm, Reasi, Jammu, Jammu and Kashmir, India. Performance traits included in the study were birth weight (BW), weaning weight (WW), nine-month body weight (9BW), twelve-month body weight or yearling weight (YW) and average wool production (AWP). All the traits under present study were normalized. The effects of non-genetic factors such as period, season, birth type and sex on various normalized traits were analyzed by least-squares analysis using the technique developed by Harvey (1990) as follows:

$$Y_{ijklm} = \mu + P_i + S_j + C_k + B_l + e_{ijklm}$$

where Y_{ijklm} , m^{th} record of individual lambed in i^{th} period, j^{th} season of k^{th} sex and of l^{th} birth type; μ , overall population mean; P_i , fixed effect of i^{th} period of lambing; S_j , fixed effect of j^{th} season of lambing; C_k , fixed effect of k^{th} sex; B_l , fixed effect of l^{th} birth type; e_{ijklm} , random error associated with each observation and assume to be normally and independently distributed with mean zero and variance

(0, σ^2). For significant effects, the differences between pairs of levels of effects were tested by Duncan's multiple range test as modified by Kramer (1957).

Significant effect ($P < 0.01$) of period of lambing was observed for all the traits under study (Table 1). There was an increasing trend of birth weight over the period of lambing. The highest BW was observed during P5 (2012–2015). There was no definite trend over the period of lambing for WW. The lowest WW, 9BW and YW were observed during P5 which is not desirable one. It may be due to the fact that during last period there was flood or natural calamities which led to wash out of green pastures and other feed resources that subsequently resulted into lower growth rate and simultaneously low weaning weight. Ganesan *et al.* (2013) in Madras Red sheep reported significant effect on BWT, 9BW and YW. Khan *et al.* (2013) reported significant effect of period on BWT and WWT in Rambouillet sheep. Zaffer *et al.* (2015a) reported significant effect of period on BWT, WWT, YW and AWP in Dorper crossbred sheep. Gupta *et al.* (2015) reported significant effect on BWT, WWT and GFW in crossbred sheep. Khan *et al.* (2015) reported significant effect of year on GFW in Rambouillet crossbred sheep. Zaffer *et al.* (2015b) reported significant effect of period on WWT, YW and AWP in Dorper · Rambouillet crossbred sheep. Chakraborty *et al.* (2015) reported non-significant effect on BWT but significant effect on WWT and YW in Dorper crossbred sheep. Reddy *et al.* (2017) reported significant effect on BW, 9BW and YW in Nellore brown sheep. On the contrary, Das *et al.* (2014) reported non-significant effect of year of lambing on BW, WW and GFW in Kashmir Merino sheep.

Season of lambing had significant effect only on WW (Table 1). However, lambs born during other seasons were superior for BW, WW, 9BW, whereas, lambs born during winter were superior for YW and AWP. This may be due to fact that ewes got lustrous fodder or green grasses at highland pastures which increased the body weight of lambs born during other seasons. Besides, lambs born during winter lost more body energy for preventing the cold whereas lambs born during other seasons needed less energy to prevent from environmental temperature (cold) and hence conserved more energy. Similar to present findings, Zaffer

Present address: ¹MVSc Scholar (aakriti.sudan01@gmail.com), ²Professor (ramantaggar@gmail.com), ^{3,4,5}Assistant Professor (dibyednu_vet40@yahoo.co.in, dr.dhirendrakumar@yahoo.com, drnishant9@gmail.com), Division of Animal Genetics and Breeding, Faculty of Veterinary Science and Animal Husbandry.

Table 1. Least-squares means and their standard errors for performance traits in Rambouillet sheep

Particular	BW (kg)	WW (kg)	9BW (kg)	YW (kg)	AWP (kg)
Overall mean	3.10±0.03 (7748)	21.49±0.20 (5704)	24.11±0.09 (4759)	28.20±0.11 (4379)	1.27±0.02 (5471)
<i>Period of lambing</i>					
P1 (1996–1999)	2.66 ^a ±0.04 (650)	25.02 ^d ±0.24 (513)	25.68 ^d ±0.10 (471)	29.92 ^d ±0.12 (423)	1.92 ^c ±0.05 (55)
P2 (2000–2003)	2.68 ^a ±0.04 (1558)	20.59 ^b ±0.25 (554)	23.83 ^b ±0.14 (530)	27.37 ^b ±0.18 (420)	0.86 ^a ±0.02 (1050)
P3 (2004–2007)	2.91 ^b ±0.04 (1552)	20.67 ^b ±0.22 (1304)	24.17 ^c ±0.11 (1288)	28.50 ^c ±0.13 (1173)	1.22 ^b ±0.02 (935)
P4 (2008–2011)	3.41 ^c ±0.04 (1751)	21.53 ^c ±0.22 (1329)	23.97 ^b ±0.12 (1167)	28.25 ^c ±0.14 (1155)	1.19 ^b ±0.02 (1487)
P5 (2012–2015)	3.80 ^d ±0.04 (2237)	19.63 ^a ±0.22 (2004)	22.89 ^a ±0.11 (1303)	26.99 ^a ±0.14 (1208)	1.13 ^b ±0.02 (1944)
<i>Season of lambing</i>					
Winter (Dec-Feb)	3.06±0.02 (7539)	20.53 ^a ±0.11 (5522)	24.09±0.05 (4597)	28.31±0.07 (4219)	1.28±0.01 (5404)
Others	3.13±0.05 (209)	22.45 ^b ±0.36 (182)	24.13±0.17 (162)	28.10±0.20 (160)	1.26±0.04 (67)
<i>Type of birth</i>					
Single	3.25 ^b ±0.03 (7476)	22.84 ^b ±0.18 (5452)	25.31 ^b ±0.09 (4522)	29.61 ^b ±0.10 (4226)	1.27±0.02 (5314)
Twin	2.94 ^a ±0.05 (272)	20.13 ^a ±0.26 (252)	22.90 ^a ±0.13 (237)	26.80 ^a ±0.16 (653)	1.27±0.03 (157)
<i>Sex of lambs</i>					
Male	3.16 ^b ±0.03 (3889)	21.75 ^b ±0.20 (2785)	24.20 ^b ±0.10 (2342)	28.37 ^b ±0.11 (2314)	1.26±0.02 (2622)
Female	3.02 ^a ±0.03 (3859)	21.22 ^a ±0.20 (2919)	24.01 ^a ±0.10 (2417)	28.03 ^a ±0.12 (2065)	1.28±0.02 (2849)

Figures in parentheses are number of observations. Means with different superscripts differ significantly among themselves

et al. (2015a) also reported non-significant effect of season on BWT, YW and AWP, and significant effect on WWT in Dorper crossbred sheep. Ganesan *et al.* (2013) reported non-significant effect on BWT, 9BW and YW in Madras Red sheep. Das *et al.* (2014) reported non-significant effect of season of lambing on BW and GFW, and significant effect on WW in Kashmir Merino sheep. Khan *et al.* (2013) reported non-significant effect of season on BWT and WWT in Rambouillet sheep. Gupta *et al.* (2015) reported non-significant effect on BWT, WWT and GFW in crossbred sheep. Khan *et al.* (2015) reported non-significant effect of season on GFW in Rambouillet crossbred sheep. Zaffer *et al.* (2015b) reported non-significant effect of period on WWT, YW and AWP in Dorper × Rambouillet crossbred sheep. Chakraborty *et al.* (2015) reported non-significant effect on BWT, WWT and YW in Dorper crossbred sheep. Reddy *et al.* (2017) reported significant effect on BW, 9BW and YW in Nellore brown sheep.

Type of birth carried highly significant effect on all the traits under study except for AWP (Table 1). This reflects that during twinning, there is intra-uterine competition between the foetus for space in uterus which is required for proper growth of foetus and also for placental nutrition, whereas, in single-born lambs, there is ample intra-uterine space for fetal growth and also the placental nutrition.

Sex had highly significant effect on all the traits under study except for AWP (Table 1). This establishes the role of sex hormones in male and female growth and also the physiological status of male and female lambs during growth. Ganesan *et al.* (2013) reported significant effect on BWT, 9BW and YW in Madras Red sheep. Khan *et al.* (2013) reported significant effect of sex on BWT and WWT in Rambouillet sheep. Zaffer *et al.* (2015a) reported significant effect of period on BWT, WWT and AWP in Dorper crossbred sheep. Gupta *et al.* (2015) reported significant effect of sex on BWT, WWT and GFW in crossbred sheep. Khan *et al.* (2015) reported significant

effect of sex on GFW in Rambouillet crossbred sheep. Zaffer *et al.* (2015b) reported significant effect of sex on BWT, WWT and AWP, whereas, non-significant effect on YW in Dorper × Rambouillet crossbred sheep. Chakraborty *et al.* (2015) reported non-significant effect on BWT but significant effect on BWT and WWT and non-significant effect of sex on YW in Dorper crossbred sheep. Reddy *et al.* (2017) reported significant effect of sex on BW, 9BW and YW in Nellore brown sheep.

SUMMARY

The present investigation was conducted to study the non-genetic factors affecting performance traits, viz. birth weight (BW), weaning weight (WW), nine-month body weight (9BW), twelve-month body weight or yearling weight (YW) and annual wool production (AWP) in Rambouillet sheep. Data on growth and production traits of 8,872 animals used in present study were collected from the history sheets of Rambouillet sheep maintained at Government Sheep Breeding Farm, Zaban, Reasi, Jammu and Kashmir, India. The data were suitably classified to study the major effect of non-genetic factors like period of lambing, season of lambing, sex of lamb and type of birth. Based on these classifications, the significant effects were adjusted for performance traits. The overall least squares means were 3.10±0.03, 21.49±0.20, 24.11±0.09, 28.20±0.11 and 1.27±0.23 kg, for BW, WW, 9BW, YW and AWP, respectively. Lambs born during 2012–2015 had the highest birth weight. There was an increasing trend for birth weight over the period which is desirable and indicates that selection for birth weight over the years was successful. The period of lambing had significant effect on performance traits. However, there was significant difference between periods which may be due to differences of rams used for breeding, as well as in the availability of inputs in terms of feed and fodder, climatic variations in different periods etc. The effect of season of lambing was non-significant on all

performance traits except for WW where significant effect of season of lambing was obtained. The effect of type of birth i.e. single and twinning was significant for all performance traits except for AWP, which is also desirable. The effect of sex of lamb was highly significant on performance traits. Males were heavier than females for all the body weight traits which indicate that sex hormone plays an important role in controlling body weight. Therefore, it can be concluded that different non-genetic factors affecting the performance traits of Rambouillet sheep.

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