



Original Research

Genetic Studies on Growth and Production Traits in Rambouillet Sheep

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Abstract

Data on 300 Rambouillet sheep records maintained at Government Sheep Breeding Farm Panthal, Reasi, J and K, India, were used in the present study. The least squares means were 2.608 ± 0.034 kg, 15.846 ± 0.179 kg, 17.921 ± 0.164 kg, 22.890 ± 0.205 kg, 30.463 ± 0.172 kg and 2.121 ± 0.042 kg for birth weight (BWT), weaning weight (WWT), 6-month body weight (6-BW), 12-month body weight (12-BW), mature body weight (MBW) and annual wool production (AWP), respectively. The period of lambing had significant effect on all the traits except for BWT. Sex had significant effect on all the traits under study except for 6-BW. The estimates of heritability for the present study in Rambouillet sheep varied from low to medium. The genetic correlations in Rambouillet sheep varied from -0.786 ± 0.630 (MBW and AWP) and 0.915 ± 0.336 (WWT and MBW). The moderate estimates of heritability of 6-BW and its high genetic correlation with MBW indicated that 6-BW can be used as selection criteria for MBW.

Key words: Birth Weight, Growth Traits and Heritability, Least-Squares Means, Rambouillet Sheep

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Introduction

Rambouillet is well known breed due to its excellence in maternal ability. It is one of the largest fine wool breed adaptable to wide variety of arid range conditions, has a well-developed flocking instinct and is long lived. The breed is also well known for its mutton. Rambouillet is intensively used for crossbreeding programme in India for improving the productivity of native sheep. Early growth traits are important factors influencing profitability in any meat producing enterprise. There are many genetic and non-genetic factors, which directly and indirectly influence the phenotypic expression of growth and production traits. Therefore, it is necessary to know the effect of different non-genetic factors on growth and production traits. Information about the phenotypic and genetic parameters of various economic traits is essential for selection strategies for higher productivity and efficient management practices. So, estimation of genetic parameters





is necessary for the prediction of future improvement. Therefore, the present study was undertaken to study the different factors influencing growth traits and wool production and to estimate the genetic parameters of various growth and production traits in Rambouillet sheep.

Materials and Methods

Performance data on 300 animals used in the present study were collected from history sheet of sheep maintained at Government Sheep Breeding Farm Panthal, Reasi, J & K, India. The Government Sheep Breeding Farm, Panthal, is located 52 kms on north-east of Jammu and lies between 33° 05' N latitude and 74° 5' E longitude. The farm follows semi-migratory production system. In middle of April the sheep are shifted to highland alpine pastures, at an altitude of 6000-8000 feet above sea level and allowed to graze there up to end of September. Ewes were mated in the month of August and October when ewes were flushed on nutritive highland pastures. The ewes were divided into groups, each group consisting of about 50 ewes. The performance data maintained at farm from 2002 to 2012 were classified into three different periods for present study. Growth traits included in the study were birth weight (BWT), weaning weight (WWT), 6-month bodyweight (6-BW), 12-month bodyweight (12-BW) and mature bodyweight (MBW), whereas the production trait was annual wool production (AWP). Rams with atleast five or more number of progenies for each trait were included in the analysis. Data with any recorded abnormalities and outliers were excluded prior to the analysis. The means, standard errors and coefficient of variations (CV) were computed statistically (Snedecor and Cochran, 1994). The effects of non-genetic factors such as periods and sex on these growth traits and various normalized production traits were analyzed by least squares analysis using the technique developed by Harvey (1990). The following model was used for present investigation with assumptions that the different components being fitted into the model were linear, independent and additive.

$$Y_{ijkl} = \mu + R_i + Y_j + S_k + C_l + e_{ijkl}$$

Where,

Y_{ijkl} = i^{th} record of individual of i^{th} Ram lambled in j^{th} period and k^{th} sex

μ = Overall population mean

R_i = Random effect of i^{th} Ram

Y_j = Fixed effect of j^{th} period of lambing

S_k = Fixed effect of k^{th} sex

e_{ijkl} = Error associated with each observation and assumed to be normally and independently distributed with mean zero and variance ($0, \sigma_e^2$).

The least squares means of significant effects were compared using Duncan's multiple range test (DMRT) as modified by Kramer (1957). Data were analyzed by paternal half-sib correlation methods for all the growth traits (Becker, 1975).

Result and Discussion

The overall means of birth weight, weaning weight, 6-month weight, 12-month weight, mature weight and annual wool production were 2.599 ± 0.034 kg, 15.172 ± 0.228 kg, 18.073 ± 0.166 kg, 22.951 ± 0.204 kg, 30.477 ± 0.174 kg and 2.127 ± 0.043 kg, respectively in Rambouillet sheep with corresponding coefficient of variations (CV) 22.47%, 26.04%, 15.89%, 15.41%, 9.86% and 35.16% (Table 1).

Table 1: Overall average estimates for different growth traits and annual wool production (AWP) in Rambouillet sheep

Traits	Mean $\pm$ S.E.	Std. Dev.	CV (%)
BWT(kg)	2.599 ± 0.034	0.584	22.47
WWT (kg)	15.172 ± 0.228	3.956	26.04
6-BW(kg)	18.073 ± 0.166	2.873	15.89
12- BW(kg)	22.951 ± 0.204	3.538	15.41
MBW (kg)	30.477 ± 0.174	3.008	9.86
AWP (kg)	2.127 ± 0.043	0.748	35.16

Das *et al.* (2014) also reported similar overall averages for BWT, whereas, lower WWT and GFW in Kashmir Merino sheep with lower CV (%). However, Khan *et al.* (2015) reported lower value for GFW but higher CV (%) in Rambouillet crossbred sheep. Zaffer *et al.* (2015a) reported higher BWT but, lower WWT, 6-BW, 12-BW, MBW and AWP in Dorper crossbred sheep, with lower CV (%) for the traits. Low to moderate co-efficient of variations among all the traits under study indicate low to moderate variability of these traits. Hence, collateral selection will help to improve these traits along with feeding, health and environmental managements. The least squares means were 2.608 ± 0.034 kg, 15.846 ± 0.179 kg, 17.921 ± 0.164 kg, 22.890 ± 0.205 kg, 30.463 ± 0.172 kg and 2.121 ± 0.042 kg for BWT, WWT, 6-BW, 12-BW, MBW and AWP (Table 2).

Table 2: Least -squares means of BWT, WWT, 6-BW, 12-BW, MBW and AWP in Rambouillet sheep

Particulars	No. of Obs.	BWT (Kg)	WWT (Kg)	6-BW (Kg)	12-BW (Kg)	MBW (Kg)	AWP (kg)
Overall mean	300	2.608 ± 0.034	15.846 ± 0.179	17.921 ± 0.164	22.890 ± 0.205	30.463 ± 0.172	2.121 ± 0.042
Period		NS	**	**	*	*	*
Period-1(2002-2004)	125	2.563 ± 0.051	$16.390^b \pm 0.270$	$18.783^c \pm 0.249$	$23.567^b \pm 0.310$	$30.863^b \pm 0.260$	$2.043^a \pm 0.064$
Period-2 (2005-2008)	102	2.587 ± 0.056	$16.693^b \pm 0.299$	$17.954^b \pm 0.276$	$22.271^a \pm 0.344$	$29.838^a \pm 0.288$	$2.300^b \pm 0.071$
Period-3 (2009-2012)	73	2.675 ± 0.067	$10.966^a \pm 0.365$	$17.028^a \pm 0.326$	$22.830^a \pm 0.407$	$30.688^b \pm 0.341$	$2.020^a \pm 0.084$
Sex		**	**	NS	*	**	**
Male	151	2.730 ± 0.047	16.664 ± 0.248	17.683 ± 0.228	23.375 ± 0.284	31.099 ± 0.238	2.285 ± 0.059
Female	149	2.486 ± 0.048	15.027 ± 0.252	18.160 ± 0.233	22.404 ± 0.290	29.827 ± 0.243	1.957 ± 0.060

* $P < 0.05$; ** $P < 0.01$; NS- Non-significant; Means with different superscripts differ significantly among themselves

Higher BWT but lower body weights at different ages were reported by Khan *et al.* (2013) in Rambouillet crossbred sheep, Das *et al.* (2014) in Kashmir Merino sheep, Gupta *et al.* (2015) in Rambouillet crossbred sheep, Zaffer *et al.* (2015a) in Dorper crossbred sheep, Zaffer *et al.* (2015b) in Dorper x Rambouillet crossbred sheep and Chakraborty *et al.* (2015) in Dorper crossbred sheep. The period of lambing had



significant effect on all the traits under study for Rambouillet sheep except for BWT, where, non-significant effect was obtained (Table 2). Similarly, non-significant effect of year/period of lambing on BWT and significant effect on other traits under present study were also reported by Das *et al.* (2014) in Kashmir Merino sheep, Zaffer *et al.* (2015a) in Dorper crossbred sheep, Zaffer *et al.* (2015b) in Dorper x Rambouillet crossbred sheep and Chakraborty *et al.* (2015) in Dorper crossbred sheep. On contrary to the present findings, significant effect of year of lambing on BWT was reported by Khan *et al.* (2013) in Rambouillet crossbred sheep and Gupta *et al.* (2015) in Rambouillet crossbred sheep. Khan *et al.* (2015) reported significant effect of year of lambing on GFW in Rambouillet crossbred sheep. There was an increasing trend for BWT over the period of lambing, although, the values were non-significant. The highest MBW was obtained for P1 (2002-2004) which was not significantly different from P3 (2009-2012). The significant effect of periods for different growth and wool production traits may be due to the reason that the numbers of Rambouillet sheep were different over the periods, Rams used for breeding over the periods were of different merits and environmental conditions and climatic changes over the periods were different. Sex had significant effect on all the traits under study except for 6-BW in Rambouillet sheep. Similar findings for effect of sex were reported by Das *et al.* (2014) in Kashmir Merino sheep, Gupta *et al.* (2015) in Rambouillet crossbred sheep, Zaffer *et al.* (2015a) in Dorper crossbred sheep, Zaffer *et al.* (2015b) in Dorper x Rambouillet crossbred sheep and Chakraborty *et al.* (2015) in Dorper crossbred sheep barring exception for 12-BW, where it was reported non-significant by Zaffer *et al.* (2015a) in Dorper crossbred sheep, Zaffer *et al.* (2015b) in Dorper x Rambouillet crossbred sheep and Chakraborty *et al.* (2015) in Dorper crossbred sheep. Khan *et al.* (2015) and Gupta *et al.* (2015) reported significant effect of sex on GFW in Rambouillet crossbred sheep. Males were superior for body weight and wool production traits barring exception for 6-BW. Significant effect of sex on different body weight traits indicating that physiological and hormonal basis have influence in growth and wool production of both the sexes.

The estimates of heritability for the present study in Rambouillet sheep varied from low to medium and were 0.064 ± 0.095 , 0.124 ± 0.144 , 0.327 ± 0.279 , 0.333 ± 0.283 , 0.376 ± 0.309 and 0.124 ± 0.117 for BWT, WWT, 6-BW, 12-BW, MBW and AWP, respectively (Table 3). The highest estimate of heritability was obtained for MBW in Rambouillet sheep. Higher estimates of heritability for BWT, WWT, 6-BW and 12-BW by Chakraborty *et al.* (2015) in Dorper crossbred sheep, BWT, WWT and GFW by Gupta *et al.* (2015) in Rambouillet crossbred sheep and BWT, WWT, 6-BW, 12-BW, MBW and AWP by Zaffer *et al.* (2015b) in Dorper x Rambouillet crossbred sheep were reported. Khan *et al.* (2015) reported higher estimate of heritability for GFW in Rambouillet crossbred sheep. Low to moderate heritability estimates of the traits under study indicate direct selection will not be effective and genetic gain will be very low. Therefore, these traits can be improved through better breeding management along with feeding and health care managements and use of proper basis of selection.

Table 3: Estimates of heritability (diagonal), genetic (upper diagonal) and phenotypic correlations (below diagonal) of growth and production traits in Rambouillet sheep

	BWT	WWT	6-BW	12-BW	MBW	AWP
BWT	0.064 ± 0.095	-0.076 ± 0.529	-0.692 ± 0.776	NE	0.543 ± 0.277	>1.00
WWT	0.277** ± 0.056	0.124 ± 0.144	0.854 ± 0.318	0.802 ± 0.436	0.915 ± 0.336	-0.013 ± 0.464
6-BW	0.196** ± 0.057	0.684** ± 0.042	0.327 ± 0.279	0.061 ± 0.074	0.896 ± 0.114	-0.617 ± 0.725
12-BW	0.187** ± 0.057	0.464** ± 0.051	0.654** ± 0.044	0.333 ± 0.283	0.727 ± 0.032	-0.485 ± 0.684
MBW	0.226** ± 0.057	0.361** ± 0.054	0.513** ± 0.050	0.845** ± 0.031	0.376 ± 0.309	-0.786 ± 0.630
AWP	0.101 ± 0.058	0.065 ± 0.058	-0.048 ± 0.058	0.113 ± 0.058	0.167** ± 0.057	0.124 ± 0.117

**P<0.01; NE-(Not estimable)

The genetic and phenotypic correlations of different growth and production traits have been presented in Table 3. The genetic correlation in Rambouillet sheep varied from -0.786±0.630 (MBW and AWP) and 0.915±0.336 (WWT and MBW). The negative genetic correlations were obtained between BWT with WWT (-0.076±0.529) and 6-BW (0.692±0.776) in Rambouillet sheep indicate that selection on the basis of birth weight will not improve the WWT and 6-BW and there will be deterioration in these traits for selection on the basis of BWT. Similarly, negative genetic correlations of BWT with WWT and 6-BW were also reported by Zaffer *et al.* (2015b) in Dorper x Rambouillet crossbred sheep. On contrary to present findings, positive genetic correlations of BWT with other growth traits were reported by Chakraborty *et al.* (2015) in Dorper crossbred sheep. The highest phenotypic correlation value was obtained between 12-BW and MBW (0.845±0.031) in Rambouillet sheep. Most of the phenotypic correlations were positive and highly significant barring few exceptions. There was only negative and non-significant phenotypic correlation was obtained between 6-BW and AWP. Chakraborty *et al.* (2015) reported positive phenotypic correlations among growth traits in Dorper crossbred sheep. Zaffer *et al.* (2015b) reported significant phenotypic correlations among all the traits in Dorper x Rambouillet crossbred sheep.

The negative genetic correlations of annual wool weight with different growth traits in the present study indicate that selection on the basis of growth traits will not improve AWP and AWP will reduce. Hence, to improve both growth traits and AWP restricted selection index (RSI) should be applied. The moderate estimates of heritability of 6-BW and its high genetic correlation with MBW indicated that 6-BW can be used as selection criteria for MBW. After the weaning the maternal effect is also less, so it will help for accurate estimate of genetic gain. It will help to select individuals at an early age so that there will be more genetic gain as generation interval will be reduced.

Conclusion

It can be concluded from the present study that different genetic factors like period and sex are affecting growth and production traits in Rambouillet sheep. The moderate estimates of heritability of 6-BW and its high genetic correlation with MBW indicates that 6-BW can be used as selection criteria for MBW.



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