EFFECT OF GENETIC AND NON- GENETIC FACTORS ON WOOL TRAITS IN MAGRA SHEEP[#]

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ABSTRACT

The main objective of the present study was to evaluate the effect of genetic and non-genetic factors on wool production and quality traits in Magra sheep. The least-squares mean for greasy fleece yield at first, second and third clip were observed to be 690.50 ± 4.71, 754.83 ± 5.57 and 670.93 ± 5.39 g, respectively. The least-squares means were observed to be 6.26 ± 0.04 cm, 0.92 ± 0.01 per cm and 33.31 ± 0.13 ì for staple length, crimp frequency and fibre diameter, respectively; and 54.74 ± 0.59, 33.25 ± 0.42, 12.01 ± 0.29 and 45.26 ± 0.59 % for the percentage of pure, hetro, hairy and medullated fibres, respectively The effect of sire was observed to be highly significant (P≤0.01) on all the wool traits under study. The effect of period of shearing was found highly significant (P≤0.01) for all the wool traits except at greasy fleece yield at third clip and fibre diameter. The effect of sex was found highly significant (P≤ 0.01) on greasy fleece yield at different clips and crimp frequency; and significant (P≤ 0.05) on fibre diameter. The effect of season of birth was found highly significant (P≤ 0.01) for all the wool traits except for pure, hetro and medullation percentage. The effect of lamb's age at shearing had highly significant (P≤0.01) effect on greasy fleece yield at different clips, crimp frequency and hetro fibres; and significant (P≤0.05) effect was found on medullation percentage. The significant factors should be given due importance in general management in order to obtain higher wool production and better wool quality.

Key words: Magra sheep, greasy fleece yield, wool quality, genetic and non- genetic factors

Introduction

Magra is an important carpet wool breed of eastern and southern Bikaner and adjoining area of Nagour, Churu and Jhunjhunu districts of Rajasthan (Acharya, 1982). This is perhaps the best breed available in Rajasthan as it produces lustrous wool and heavier lambs, in terms of body weight (Narula *et al.*, 2009). The economics of sheep production is greatly affected by the wool performance. Wool quality traits like fibre diameter, staple length, crimp frequency, medullation percentage etc contribute to price variation due to their effect on fibre processing properties and the ultimate quality of the products. Wool traits are largely affected by both genetic and non genetic factors, which must be evaluated before planning and implementing a sheep breeding plan. Hence, the present investigation was undertaken to study the wool performance and wool quality attributes of Magra sheep along with the genetic and non- genetic factors affecting it, so as to generate information that will be helpful in developing future breeding plans for genetic improvement and conservation of the breed.

Materials and Methods

The data used in the present study were collected over a period of 15 years from 2000-2014 from the database of Magra sheep, maintained at Arid Region Campus of Central Sheep and Wool Research Institute, Dist. Bikaner, Rajasthan. Traits included in the present study were wool production traits *viz.,* greasy fleece yield at 1st, 2nd and 3rd shearing, and wool quality traits *viz.,* staple length, crimp frequency, fibre diameter, pure fibres, hetro fibres, hairy fibres and medullation percentage. The data were adjusted for the effect of non-genetic factors viz. sex, season of birth and period of shearing as fixed effects, sire as random effect and lamb's age at shearing as a covariate. The data were analyzed by the Least squares procedure of fitting constants using LSMLMW programme (Harvey, 1990). The sires with less than four progeny were excluded for the estimation of heritability. The model that was employed to examine the effect of genetic and non-genetic factors on various wool production and quality traits is as follows:

$$Y_{ijklm} = \mu + a_i + B_j + C_k + D_l + b\ (DA_{ijkl} - DA) + e_{ijklm}$$

Where, Y_{ijklm} = Performance record of the m^{th} progeny of i^{th} sire, j^{th} period, k^{th} sex and l^{th} season; μ = Overall population mean; a_i = Effect of i^{th} sire; B_j = Effect of j^{th} period of shearing; C_k = Effect of k^{th} sex; D_l = Effect of l^{th} season of birth; b (DA_{ijkl} - DA) = The regression of the trait on age at shearing; e_{ijklm} = Random error NID ($0,\sigma^2$).

Duncan's multiple range test as modified by Kramer (1957) was used for comparing subgroup means.

Results and Discussion

The overall least-squares mean for greasy fleece yield at first, second and third clip were observed to be 690.50 ± 4.71, 754.83 ± 5.57 and 670.93 ± 5.39 g, respectively (Table 1). The overall least-squares means were observed to be 6.26 ± 0.04 cm, 0.92 ± 0.01 per cm and 33.31 ± 0.13 µ for staple length, crimp frequency and fibre diameter, respectively (Table 2). The percentage of pure, hetro, hairy and medullated fibres were estimated as 54.74 ± 0.59, 33.25 ± 0.42, 12.01 ± 0.29 and 45.26 ± 0.59 %, respectively (Table 3). The estimated values of wool quality traits clearly indicate the suitability of Magra wool for carpet wool production.

The effect of sire was found to be highly significant (P≤ 0.01) on greasy fleece yield at first and second clip, and significant (P≤0.05) on greasy fleece yield at third clip. This shows that if greasy fleece weight of sire is higher, the lamb born will also produce high greasy fleece yield. This may be due to the genes of greasy fleece yield present in the sire. This

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result resembles with that of Tomar *et al.* (2000), Ahmad (2002), Kumar *et al.* (2013) and Nirban *et al.* (2016) in Bharat Merino, Avikalin, Chokla and Marwari sheep, respectively. The effect of sire was estimated to be highly significant ($P \leq 0.01$) on all the wool quality traits under study. This indicates that sires can be used effectively for bringing further genetic improvement in these traits. Similar result was also observed by Dixit *et al.* (2009) in Bharat Merino sheep.

The effect of the period was highly significant ($P \leq 0.01$) on greasy fleece yield at first and second clip ($P \leq 0.01$). The differences in the first and second greasy fleece yield over the periods were due to the difference in the number of clips in different periods. Prior to 2009, the animals were clipped twice a year. But from 2009 onwards, the shearing was done thrice a year which had reduced the fleece weight at each clip. Other factors like variability in rainfall, nutrition, management etc might also have contributed in variability in first greasy fleece yield over different periods. These results were in agreement with the findings of Mehta *et al.* (2004), Dixit *et al.* (2011), Kumar *et al.* (2013) and Nirban *et al.* (2016) in Magra, Bharat Merino, Chokla and Marwari breed of sheep, respectively. The effect of the period was found to be highly significant ($P \leq 0.01$) on all the wool quality traits except on fibre diameter. The staple length varied from 5.94 to 6.73 cm in different periods, which suits best to carpet industry for carpet manufacturing. The variability in wool quality in different periods might be due to variations in physical environmental conditions, feeding, forage availability prevailing in different periods for grazing resources and selection of rams. In 2007 and 2011, some animals with higher percentage of pure fibres and low medullation percentage were purchased and included in the flock. Selective breeding by using these superior rams and their lambs might have increased the percentage of pure fibres during P4 (2009-11) and P5 (2012-14). Similar results were reported by Dass *et al.* (2008) and Narula *et al.* (2012) in Marwari; Chopra *et al.* (2010) and Dixit *et al.* (2011) in Bharat Merino and Narula *et al.* (2011) in Magra sheep.

The effect of sex on greasy fleece yield at different clips was found to be highly significant ($P \leq 0.01$). The significant difference of wool yield between male and female animals might be due to physical and hormonal differences between them. Moreover, wool production is directly proportional to the body surface area of the sheep (Owen, 1976) and the surface area has positive correlation with body weight of the animal. The males being heavier in body weight and having a larger body size had more surface area and produced more wool. Similar results were reported by Arora *et al.* (2007), Dass (2007), Dixit *et al.* (2011), Gupta *et al.* (2015) and Nirban *et al.* (2016) in Jaisalmeri, Pugal, Bharat Merino, Patanwadi and Marwari breed of sheep. Highly significant ($P \leq 0.01$) and significant ($P \leq 0.05$) effect of sex was found on crimp frequency and fibre diameter, respectively. Significant effect of sex on crimp frequency was also reported by Dass *et al.* (2008) and Narula *et al.* (2012) in Marwari sheep; Prajapati *et al.* (2012) in Bikaneri Chokla sheep and Narula *et al.* (2011) in Magra sheep. Dixit *et al.* (2011) also reported significant effect of sex on fibre diameter in Bharat Merino sheep. The effect of season of birth on greasy fleece yield at different clips was found to be highly significant ($P \leq 0.01$). The possible reason for heavier fleece yield at first and second clip of the season 1st born lambs might be the better nutrition and also due to plentiful succulent grasses available and coincided with favourable weather conditions. The significant effect of season of birth on greasy fleece yield at third clip might be due to the fact that usually, the animals were reared throughout the year facing all seasonal variability within year and then, reached to third shearing stage. The greasy fleece yield at different stages was significantly affected by season as reported by Mehta *et al.* (2004), Arora *et al.* (2007) and Dixit *et al.* (2011) in Magra, Jaisalmeri and Bharat Merino sheep, respectively. Among wool quality traits, significant effect ($P \leq 0.01$) of season of birth was found only on staple length, crimp frequency and fibre diameter. It might be due to variability in nutrition, management and climatic conditions in different seasons. Similar results were reported by Chopra *et al.* (2010) and Dixit *et al.* (2011) in Bharat Merino and Das *et al.* (2014) in Kashmir Merino sheep. Regression of greasy fleece yield at different clips on lamb's age at shearing was found to be highly significant ($P \leq 0.01$). Positive regression coefficient at subsequent clips indicates that the more fleece yield was produced by lambs whose age at shearing was higher. Significant effect of age at shearing on first greasy fleece yield was reported by Chopra *et al.* (2010) and Dixit *et al.* (2011) in Bharat Merino sheep; and Nirban *et al.* (2016) in Marwari breed of sheep. However, Regression of the wool quality traits on lamb's age at shearing was found to be non-significant for most of the traits except crimp frequency, hetero fibres and medullation percentage. This might be due to the fact that the estimation of wool quality traits is usually done at the time of first shearing when all the animals are younger and of approximately same age. Moreover, certain trait like fibre diameter is a life time trait and is not affected by the age of the animal at shearing. Similar to our result, non- significant effect of age at shearing on the staple length and fibre diameter was found by Tabbaa *et al.* (2001) in Awassi sheep. Behdad *et al.* (2013) also found significant effect of age of lamb at shearing on hetro fibres in Bakhtiari breed of sheep. The outcomes of the study demonstrate the need of giving proper attention to the significant factors and requirement of efficient flock management to achieve optimum productivity. It is necessary to adjust the wool production and quality records prior to further investigation in order to obtain unbiased prediction of breeding values and genetic parameters.

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Table 1: Least-squares means (± S.E) of greasy fleece yield (g) at first, second and third shearing in Magra lambs.

Traits/ factors	GFY I	GFY II	GFY III
Overall Mean (μ)	690.50 ± 4.71 (2873)	754.83 ± 5.57 (2342)	670.93 ± 5.39 (779)
Sire	**	**	*
Period	**	**	NS
P1 (2000-2002)	691.44 ± 10.60^{c} (349)	540.08 ± 13.07^{a} (247)	-
P2 (2003-2005)	671.80 ± 9.05^{c} (574)	872.16 ± 10.96^{d} (424)	-
P3 (2006-2008)	858.17 ± 9.29^{d} (534)	931.34 ± 11.49^{e} (376)	-
P4 (2009-2011)	599.69 ± 7.12^{a} (703)	751.60 ± 7.97^{c} (685)	667.34 ± 7.82 (401)
P5 (2012-2014)	631.39 ± 6.86^{b} (713)	678.95 ± 7.87^{b} (610)	674.53 ± 8.45 (378)
Sex	**	**	**
Male	723.72 ± 5.81 (1447)	820.72 ± 7.037 (1121)	746.95 ± 7.99 (360)
Female	657.28 ± 5.83 (1426)	688.93 ± 6.69 (1221)	594.91 ± 7.25 (419)
Season	**	**	**
1st(Jan- June)	704.62 ± 3.93 (2273)	810.80 ± 4.75 (1812)	613.46 ± 8.33 (381)
2nd (July- Dec)	676.37 ± 8.70 (600)	698.85 ± 10.10 (530)	728.41 ± 7.89 (398)
Age at shearing	**	**	**
Regression coefficient	0.41 ± 0.13	1.47 ± 0.16	0.89 ± 0.30

No. of observations are given in parenthesis.Figure with different superscripts differ significantly.**Highly significant (P≤ 0.01); *Significant (P≤0.05); NS-Non-significant

Table 2: Least-squares means (± S.E) of staple length (cm), crimp frequency (per cm) and fiber diameter (i) of wool in Magra lambs.

Traits/ factors	Staple length	Crimp frequency	Fiber diameter
Overall Mean (μ)	6.26 ± 0.04 (2073)	0.92 ± 0.010 (2073)	33.31 ± 0.13 (2073)
Sire	**	**	**
Period	**	**	NS
P1 (2000-2002)	6.16 ± 0.08^{b} (309)	0.81 ± 0.02^{a} (309)	32.50 ± 0.28 (309)
P2 (2003-2005)	6.73 ± 0.08^{c} (378)	0.95 ± 0.02^{b} (378)	33.62 ± 0.27 (378)
P3 (2006-2008)	5.94 ± 0.08^{a} (421)	1.02 ± 0.02^{c} (421)	33.32 ± 0.26 (421)
P4 (2009-2011)	6.03 ± 0.06^{b} (576)	1.06 ± 0.02^{d} (576)	33.16 ± 0.20 (576)
P5 (2012-2014)	6.42 ± 0.07^{c} (389)	0.78 ± 0.02^{a} (389)	33.95 ± 0.23 (389)
Sex	NS	**	*
Male	6.33 ± 0.05 (1142)	0.89 ± 0.01 (1142)	33.12 ± 0.16 (1142)
Female	6.18 ± 0.05 (931)	0.96 ± 0.01 (931)	33.51 ± 0.17 (931)
Season	**	**	**
1st (Jan- June)	6.08 ± 0.04 (1617)	0.87 ± 0.01 (1617)	31.68 ± 0.12 (1617)
2nd (July- Dec)	6.43 ± 0.07 (456)	0.98 ± 0.02 (456)	34.94 ± 0.25 (456)
Age at shearing	NS	**	NS
Regression coefficient	0.003 ± 0.002	-0.002 ± 0.0004	0.005 ± 0.006

No. of observations are given in parenthesis. Figure with different superscripts differ significantly. **Highly significant (P≤ 0.01); *Significant (P≤0.05); NS - Non-significant

Table 3: Least-squares means (± S.E) for pure (%), hetro (%), hairy (%) and medullation per centage (%) of wool in Magra lambs.

Traits/ factors	Pure	Hetro	Hairy	Medullation
Overall Mean (μ)	54.74 ± 0.59 (2073)	33.25 ± 0.42 (2073)	12.01 ± 0.29 (2073)	45.26 ± 0.59 (2073)
SIRE	**	**	**	**
PERIOD	**	**	**	**
P1 (2000-2002)	53.67 ± 1.26^{ab} (309)	33.60 ± 0.88^{b} (309)	12.73 ± 0.62^{c} (309)	46.33 ± 1.26^{bc} (309)
P2 (2003-2005)	51.28 ± 1.22^{a} (378)	31.79 ± 0.86^{ab} (378)	16.93 ± 0.60^{d} (378)	48.72 ± 1.22^{c} (378)
P3 (2006-2008)	52.52 ± 1.18^{ab} (421)	36.71 ± 0.83^{c} (421)	10.77 ± 0.58^{b} (421)	47.48 ± 1.18^{bc} (421)
P4 (2009-2011)	59.95 ± 0.88^{c} (576)	30.75 ± 0.62^{a} (576)	9.30 ± 0.43^{a} (576)	40.05 ± 0.88^{a} (576)
P5 (2012-2014)	56.28 ± 1.04^{b} (389)	33.39 ± 0.73^{b} (389)	10.33 ± 0.51^{ab} (389)	43.72 ± 1.04^{b} (389)
SEX	NS	NS	NS	NS
Male	54.36 ± 0.70 (1142)	33.47 ± 0.49 (1142)	12.17 ± 0.35 (1142)	45.64 ± 0.70 (1142)
Female	55.12 ± 0.78 (931)	33.03 ± 0.55 (931)	11.85 ± 0.38 (931)	44.88 ± 0.78 (931)
SEASON	NS	NS	**	NS
1st (Jan- June)	55.69 ± 0.53 (1617)	33.26 ± 0.37 (1617)	11.05 ± 0.26^{a} (1617)	44.31 ± 0.53 (1617)
2nd (July- Dec)	53.79 ± 1.13 (456)	33.23 ± 0.79 (456)	12.97 ± 0.55^{b} (456)	46.21 ± 1.13 (456)
Age at shearing	NS	**	NS	*
Regression coefficient	0.048 ± 0.025	-0.061 ± 0.018	0.008 ± 0.012	-0.056 ± 0.026

No. of observations are given in parenthesis. Figure with different superscripts differ significantly. **Highly significant (P≤ 0.01); *Significant (P≤0.05); NS-Non-significant

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