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Genetic and non-genetic factors of greasy fleece weight in organized flock of Chokla sheep of Rajasthan

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Abstract

The data for present investigation were analyzed from records (1994-2011) of Chokla sheep research flock maintained at semi-arid region campus of the Central Sheep and Wool Research Institute (CSWRI), Avikanagar, Rajasthan. The overall least-squares means for greasy fleece weight of clip I was estimated as 0.915 ± 0.017 kg. The effect of sire, period of birth, sex, season of birth and dam's age was highly significant ($p \leq 0.01$) for clip I. The effect of age of shearing as a covariate was highly significant ($p \leq 0.01$) for clip I. The heritability estimates from WOMBAT (animal model 1) method for greasy fleece weight at clip I was low to medium.

Keywords: Chokla sheep, genetic and non-genetic factors, greasy fleece weight

Introduction

Chokla sheep is distributed in Churu, Jhunjhunu, Sikar and bordering areas of Bikaner, Jaipur and Nagaur districts of Rajasthan (Jain *et al.*, 2009) [7]. Chokla is a fine carpet wool producing sheep and reared for its wool production. Chokla breed one of the 44 distinguished sheep breeds of India. Animals true to the breed type are found in Sikar and Churu districts of Rajasthan. Chokla is fine carpet wool producing Indian sheep and reared basically for its wool quality and suitability for migration. Several non-genetic factors affect wool traits and directly obscure recognition of the genetic potential of animals. The effect of various factors like year of birth, season of birth, type of management and sex of animal on lamb growth of various wool breeds of sheep, has been studied (Mandal *et al.* 2003, Reddy *et al.* 2009) [10, 6]. The Chokla sheep, comparatively fine carpet wool producing type sheep among the Indian sheep breeds, is hardy and well adapted to the arid and semi-arid regions of Rajasthan and also best suited for the region where migration is common practice. The present study was undertaken to identify various factors (*viz.* period of birth, dam's age at lambing, season of birth and sex of lamb) influencing wool traits and to estimate heritability of these traits in Chokla sheep.

Materials and Methods

Chokla sheep is light to medium sized. The face, generally devoid wool, is reddish brown, and the colour may be extend up to the middle of the neck. The coat is dense and relatively fine, covering entire body including the belly and the greater part of legs. The wool of this breed is heterogeneous in quality and is finer than the wool of any other carpet wool producing sheep breeds in the country. Generally the animals were maintained under semi intensive system of feeding management where they are allowed to graze for 10–12 hour on natural pasture with supplementation of some amount of concentrate depending upon the status and age category of the animals. Normally, rotational grazing system was followed. Controlled mating was practised in the flock. Majority of the ewes (more than 80%) were bred during autumn (August-September), the main breeding season and some ewes were bred in spring breeding season (March-April), off breeding season. Heat detection of ewes was done with teaser ram in the morning and evening during the breeding season. The ewes in heat were mated in the morning with selected sires. Generally, one breeding ram was allowed to mate 25 to 30 ewes and used for 2 years. At birth, each lamb was weighed and identified by metal ear tag.

Weaning of lambs was generally done at 90 days. Shearing of animal was done twice in a year, i.e. in March–April and September–October. Animals were vaccinated against PPR, enterotoxaemia, FMD etc. The detailed descriptions of this breed along with distribution and production performance were described by Kushwaha *et al.* (1997) [25].

Data: Data on 3714 lambs of Chokla sheep, maintained at the Central Sheep and Wool Research Institute (CSWRI), Avikanagar, Rajasthan, The research project was initiated in August 1981 under AICRP. This project was converted into Network Project in 1991 for sheep improvement to undertake survey, evaluation and improvement of indigenous sheep breeds. The project “Evaluation and improvement of Chokla sheep for carpet wool” was started in April 1992, aiming to improve wool yield. The project has been shifted at ARC, Bikaner in 2013. The data used in the present study was collected over a period of 1994-2011 from the database of Chokla sheep, maintained at Semi-arid Region Campus of Central Sheep and Wool Research Institute, Avikanagar, Rajasthan. The greasy fleece weight in first clip were recorded and classified according to period of birth, season of birth, dam’s age at lambing and sex of lamb. The years of lambing were divided into 6 periods, each comprising 3 years. Each year of lambing was also divided in to 2 seasons, i.e. S–1 (May-October) and S–2 (November-April). Statistical analyses: Data were analyzed using a mixed model least-squares analysis for fitting constants (Harvey 1990) [6] including all main effects and interactions. Following linear model was employed to examine the effect of genetic and non-genetic factors on greasy fleece weight for clip I trait.

$$Y_{ijklmn} = \mu + a_i + B_j + C_k + D_l + F_m + b(AS_{ijklmn} - \overline{AS}) + e_{ijklmn}$$

Where,

Y_{ijklmn} = Greasy fleece weight of the n^{th} progeny of i^{th} sire born in j^{th} period belonging to k^{th} sex and l^{th} age group of dam’s age at lambing and m^{th} season

μ = Population mean

a_i = Random effect of i^{th} sire.

B_j = Fixed effect of j^{th} Period

C_k = Fixed effect of k^{th} Sex of lamb

D_l = Fixed effect of l^{th} age group of dam’s age at lambing

F_m = Fixed Effect of m^{th} season on greasy fleece weight

$b(AS_{ijklmn} - \overline{AS})$ = The regression of the trait on age at shearing of the lamb

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

Heritability was estimated by univariate analysis of Animal model (Meyer, K., 2007) [11]. Data were adjusted by least square analysis method. Only significant factors are included in model while calculating the genetic parameters by Animal model.

Following single trait linear model was used.

$$y = x\beta + z_a a + \varepsilon$$

Where,

y is the vector of records

β , a and ε are vectors of fixed, direct additive genetic and residual effects, respectively with association matrix x and z_a .

Assumption in the model were

$$V(a) = A \sigma_a^2 \text{ and } VI = I \sigma_e^2$$

Where,

I is an identity matrix

A is numerator relationship matrix between animals

σ_a^2 and σ_e^2 additive direct and residual variance, respectively.

The comparison of different sub-groups mean was made by Duncan’s Multiple Range Test (DMRT) as described by Kramer (1957) [26].

Result and Discussion

The overall least-squares means for greasy fleece weight of clip I was estimated as 0.915 ± 0.017 kg (Table 1). The effect of sire was found highly significant ($p \leq 0.01$) on greasy fleece weight for clip I. This indicated that sire selection could be effectively used for improvement for greasy fleece weight. Similar finding were also reported by Nehra (1991) [16] and Nirban (2013) [17] in Marwari, Sharma (1999) [20] in Marwari and Karakul sheep, Aora *et al.* (2007) [2] in Jaisalmeri, Gowane *et al.* (2010) [4] in Malpura, Narula *et al.* (2007, 2009 and 2011) [14, 15, 13] and Parihar (2012) [18] in Magra sheep, Kumar *et al.* (2013) [9] in Chokla sheep. Non-significant effect was reported by Dass *et al.* (2003) [3] in Magra sheep and Singh (1990) [6] in Karakul sheep. The effect of sex was found highly significant ($p \leq 0.01$) on greasy fleece weight for clip I. The least-squares mean for greasy fleece weight for clip I was estimated as 0.938 ± 0.018 kg and 0.89 ± 0.018 kg in male and female lambs, respectively (Table 1). The males being heavier having a larger body size and more surface area hence, produced more wool. Similar finding were also reported by Murdia *et al.* (2003) [12], Narula *et al.* (2011) [13] and Parihar (2012) [18] in Magra sheep, Kumar *et al.* (2013) [9] in Chokla sheep and Gowane *et al.* (2010) [4] in Malpura.

The effect of period of birth was highly significant ($p \leq 0.01$) on greasy fleece weight for clip I. The least-squares mean of on greasy fleece weight for clip I was lowest in the period P3 (2000-2002) as 0.69 ± 0.037 kg and highest in period P6 (2008-2011) as 1.46 ± 0.053 kg. There was variation in wool production over different periods because of variation in environmental and managemental conditions and it might be most favourable in P6. Significant effect of period of birth on greasy fleece weight for clip I were reported by Murdia *et al.* (2003) [12], Narula *et al.* (2011) [13] and Parihar (2012) [18] in Magra sheep, Kumar and Singh (2011) [13], Kumar *et al.* (2013) [9] in Chokla sheep. Non-significant effect of period of birth on greasy fleece weight was reported by Singh *et al.* (1980) [22] in Corriedale and Tomar (1980) [23] in Gaddi sheep. The effect of season of birth on greasy fleece weight for clip I was highly significant ($p \leq 0.01$). The least-squares mean for greasy fleece weight for clip I was estimated lowest in season 1st (May-October) as 0.83 ± 0.021 kg and highest in season 2nd (November-April) as 1.00 ± 0.017 kg. There was variation in wool production over different season because of variation in environmental and managemental conditions.

The effect of dam’s age on greasy fleece weight for clip I was highly significant ($p \leq 0.01$). The least-squares mean for on greasy fleece weight for clip I was estimated lowest in the dam’s age 1st as 0.85 ± 0.024 kg and highest dam’s age 4th as 0.96 ± 0.021 kg. The difference in greasy fleece weight for clip I over the dam’s age might be due to variation in environmental and managemental conditions. Akhtar *et al.* (2014) [11] observed that effect of dam’s age at lambing was significant on clip I in Buchi sheep. The effect of age at shearing on greasy fleece weight for clip I was highly significant ($p \leq 0.01$). The regression coefficient of greasy fleece weight for clip I on age of shearing was 0.0035 ± 0.0003 indicating the increase age at shearing than increase greasy fleece weight for clip I. Significant effect of age at shearing on

greasy fleece weight was reported by Gupta and Singh (1983)^[5] in Bikaneri sheep, Nehra (1991)^[16], Ganai (1992)^[27] in Marwari sheep. Parihar (2012)^[18] also found highly significant effect of age at shearing on I clip in Magra sheep. Non-significant effect of age at shearing on greasy fleece weight was reported by Tomar (1980)^[23] in Gaddi and its crossbred, Kishore *et al.* (1983)^[8] in Avikalin sheep.

Table 1: Least-mean (\pm S.E) for main effects on average greasy fleece weight (kg) at first clip I in Chokla lambs

Effects	CLIP 1
Overall Mean (μ)	0.915 \pm 0.017 (2884)
SIRE	**
PERIOD	**
P1 (1994-1996)	0.79 \pm 0.044 ^c (313)
P2 (1997-1999)	0.73 \pm 0.041 ^b (391)
P3 (2000-2002)	0.69 \pm 0.037 ^a (467)
P4 (2003-2005)	0.89 \pm 0.042 ^d (470)
P5(2006-2008)	0.94 \pm 0.046 ^e (531)
P6(2009-2011)	1.46 \pm 0.053 ^f (712)
SEX	**
Male	0.938 \pm 0.018 (1390)
Female	0.89 \pm 0.018 (1494)
SEASON	**
May-October	0.83 \pm 0.021 (596)
November-April	1.00 \pm 0.017 (2288)
DAM'S AGE	**
1 (<2 year)	0.85 \pm 0.024 ^a (307)
2 (2-3 year)	0.90 \pm 0.020 ^b (621)
3 (3-4 year)	0.92 \pm 0.021 ^b (584)
4 (4-5 year)	0.96 \pm 0.021 ^c (470)
5 (5-6 year)	0.93 \pm 0.022 ^{bc} (402)
6 (\geq 6 year)	0.93 \pm 0.023 ^{bc} (474)
AGE AT SHEARING	**
Regression coefficient(kg/day)	0.0035 \pm 0.0003

Note: No. of observations are given in parenthesis. Figure with different superscripts differ significantly ** - Highly significant ($p \leq 0.01$); * - Significant ($p \leq 0.05$); NS - Non-significant.

Heritability estimates from WOMBAT (animal model 1) method for Heritability estimates for greasy fleece weight in clip I was 0.126 \pm 0.028. Various workers reported heritability estimates for first clip by Sharma (1998)^[19] as 0.35 \pm 0.084 and Nirban (2013)^[17] as 0.37 \pm 0.065 in Marwari sheep, respectively.

Conclusion

The study suggests that all the effects included in the study were highly significant ($p \leq 0.01$) sources of variation for greasy fleece weight. The heritability estimates from WOMBAT (animal model 1) method for greasy fleece weight was low to medium. The heritability estimates were in the range of low to moderate, indicating greater scope of improvement in animals through pedigree combined with index selection.

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