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Phenotypic and Genetic Parameters of Pre-Weaning Growth Traits in *Gentile di Puglia* Lambs

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***Abstract*—**Data from 1731 Gentile di Puglia lambs, sired by 65 rams over a 5-year period were analyzed by a mixed model to estimate the variance components for heritability. The considered growth traits were: birth weight (BW), weight at 30 days of age (W30) and average daily gain from birth to 30 days of age (DG). Year of birth, sex of lamb, type of birth (single or twin), dam age at lambing and farm were significant sources of variation for all the considered growth traits. The average lamb weights were 3.85±0.16 kg at birth, 9.57±0.91 kg at 30 days of age and the average daily gain was 191±14 g. Estimates of heritability were 0.33±0.05, 0.41±0.06 and 0.16±0.05 respectively for the same traits. These values suggest there is a good opportunity to improve Gentile di Puglia lambs by selecting animals for growth traits.

***Keywords*—**heritability estimate, growth traits, lambs, Gentile di Puglia

I. Introduction

THE knowledge of non-genetic factors and the estimation of genetic parameters affecting growth performances are basics to formulate optimum breeding objectives and an effective programme of genetic improvement. Unavoidably estimates of heritability of genetic and phenotypic traits form the basis of such information.

The growth potential of the lambs is one of the most economically important traits in sheep production. The present study was undertaken to estimate the effects of various factors, such as the year and type of birth, the dam age, farm, sex and sire on growth traits (weights at birth, weight at 30 days of age and daily gains from birth to 30 days of age) in Gentile di Puglia lambs.

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Gentile di Puglia, also known as Italian Mérino [1] was a fine wooled breed reared in southern Italy. Development of this breed began in the 15th century but the main improvement occurred from the 18th century onward; it originated by crossing Spanish Merino with the local breed [2]-[4]. Saxony and Rambouillet breed were introduced during the 19th century. In the last half century the number of head has dramatically decreased and nowadays there are about 15,000 sheep mainly located in Puglia, Basilicata and Molise regions. The economic wane of the wool market enabled the breeders to looking for a new identity for this breed: the selective trend of this breed became geared more towards meat production and, to a lesser extent, towards the maintenance of a qualified wool production.

No previous information is available regarding the genetic and phenotypic parameters of growth traits for Gentile di Puglia lambs.

II. Materials and Methods

A. Animals

Data concerning Gentile di Puglia purebred lambs, progeny of 1205 ewes and 65 rams, born over a 5-year period in seven different farms located in Puglia region were collected aiming to study growth performances. The animals were reared following the traditional management practices of the area (animals are left to graze in daylight hours and return to the sheepfolds at sunset leaving the ewes with their lambs over the night).

The initial dataset (n=1731) involved only the lambs born in October and November (the most prosperous lambing season); a total of 17 records were excluded from the study in order to reduce variability since they did not reach the weaning age (30±3 days).

Weight at birth (BW) and at 30 days of age (W30) was individually measured; daily gains (DG) from birth to 30 days of age were calculated. Data were classified on the basis of sire's information, year and type of birth (single or twin), sex

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(male, female), dam age at lambing (<1.5, 1.5-2.5, 2.5-3.5, >3.5 years) and farm.

B. Statistical analysis

Variance components for BW, W30 and DG were estimated using the restricted maximum-likelihood method from Mixed Procedure of SAS software [5].

The data set was analyzed by the following model:

$$Y_{ijklmno} = \mu + B_i + L_j + S_k + F_l + DA_m + R_n + e_{ijklmno}$$

where $Y_{ijklmno}$ = the individual observations for trait Y; μ = the overall mean for the trait; B_i = the fixed effect of i^{th} birth year (1,...,5), L_j = the fixed effect of j^{th} type of birth (single, twin), S_k = the fixed effect of k^{th} sex (male, female), F_l = the fixed effect of l^{th} farm (1,...,7), DA_m = the fixed effect of m^{th} dam age at lambing (1,...4), R_n = the random effect of n^{th} sire (1,…,65) and $e_{ijklmno}$ = the random error associated with measurement of each individual observation.

The error was assumed to be randomly and independently distributed, with mean of zero and a variance of $\sigma^2 e$. Heritability estimates were based on sire component of variance ($\sigma^2 s$) as follow:

$h2 = 4\ \sigma^2\ s\ /(\sigma^2\ s + \sigma^2\ e)$.

The standard error of heritability was approximated using the method described by Becker [6].

III. Results And Discussion

Number of observations, phenotypic means and standard deviation (SD) for body weights of Gentile di Puglia lambs at birth and at 30 days of age, for average daily gain from birth to 30 days of age and the results of the analysis of variance for the same traits are shown in Table 1. Average BW and W30 were 3.85 and 9.57 kg respectively, the average daily gain was 191 g; these values were similar to those reported by Gallo *et al.* [7] in Gentile di Puglia breed.

As shown in Table 1, the effect of the year of birth on the W30 of the lambs and on the average daily gain was highly significant (P<0.001); a less significant results was found considering the effect of the year of birth on BW (P<0.05). As expected, the type of birth strongly affected all the considered traits (P<0.001). The sex of lamb affected mostly the W30 (P<0.001) than the birth weight and the average daily gain (P<0.01). The dam age was significant for all traits even if the significance was higher considering W30 and DG (P<0.01). This finding may be related to the dam's milk production in terms of quantity. Finally the fixed effect of farm affected all the considered traits (P<0.05).

Estimates of sire's and environmental variance components and heritability estimates are reported in Table 2. BW and W30 were highly heritable (0.33 and 0.41 respectively): similar results were previously reported by Dario *et al.* [8] for birth weight of Altamurana lambs (0.32), by Gabriilidis *et al.* [9] in Chios lambs (0.35) and by Ercanbrack and Price [10] in Targhee and Rambouillet lambs (0.30 and 0.26 respectively). Boujenane and Kerfal [11] found estimates of 0.34 and 0.23 for BW and W30 respectively in a population of D'man lambs. The estimates of heritability of weaning weight reported in the literature ranging from 0.06 to 0.31 [12]-[15] being lower than that reported in the present study. A possible explanation for this finding may be related to the traditional selection conditions of the flock which aimed to increase the slaughtering weight over 10-12 kg.

Finally, a very low heritability value for DG (0.16) was found in the studied population, being close to the estimates of 0.08 and 0.16 for Black- Brown Mountain and White Alpine lambs [16]. Heritability estimate of Bonaiti *et al.* [17] for average daily gain from birth to 30 days of age in a sample of Merino d'Arles (0.24) was slightly higher if compared with that obtained in the present study. However, the heritability value found for DG in Gentile di Puglia was within the range reported by other authors (0.09-0.27) [14], [18]-[20].

IV. Conclusions

The high estimates of heritability of growth traits indicated that these traits, if included in selection criteria, could lead to body weight improvement of Gentile di Puglia lambs. In particular W30 could be used as a desirable selection criterion.

The results of the present study give some comforting and positive indications concerning the future possibility of this breed. In fact the estimates of heritability for weights at birth and at 30 days of age show a high genetic variability which let us suppose that this breed would answer rapidly to a selection programme.

TABLE I
MEAN, STANDARD DEVIATION AND ANALYSIS OF VARIANCE FOR WEIGHTS AND DAILY GAIN OF *GENTILE DI PUGLIA* LAMBS

	BW (kg)	W30 (kg)	DG (g)
Number of lambs	1731	1714	1714
Mean	3.85	9.57	191
Standard deviation	0.16	0.91	14
Analysis of variance			
	df	Significance of effect in the model	
Year of birth	4	*	***	***
Type of birth	1	***	***	***
Sex of lamb	1	**	***	**
Dam age	3	*	**	**
Farm	6	*	*	*

***P<0.001; **P<0.01; *P<0.05 df = degrees of freedom

TABLE II
ESTIMATES OF SIRE'S (Σ^2_S) AND ENVIRONMENTAL (Σ^2_E) VARIANCE COMPONENTS, HEREDITABILITY (H^2) AND STANDARD ERROR (SE_{H^2}) FOR *GENTILE DI PUGLIA* LAMBS GROWTH TRAITS

TRAITS	σ^2_s	σ^2_e	h^2	SE_{h^2}
BW	11.32	124.99	0.33	0.05
W30	62.72	556.01	0.41	0.06
DG	17.01	415.23	0.16	0.05

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