GENETIC AND PHENOTYPIC TRENDS OF WEANING AND SLAUGHTER WEIGHT TRAITS OF FAST-GROWING SHEEP IN SPAIN

M. Izquierdo¹, M.A. Jiménez¹ and E. Espinosa ²

¹ Servicio de Investigación y Desarrollo Tecnológico, Consejería de Agricultura y Medio Ambiente, Junta de Extremadura. Apartado 22. 06080 Badajoz, Spain
² Asociación Española de Criadores de Ovinos Precoces. Castelló, 45. 28001 Madrid, Spain

INTRODUCTION

One way of ascertaining whether or not the selection of a breed is being effective consists of assessing genetic trend evolution in time. Three fast-growing sheep breeds, namely Ile de France (IF), Precocious Merino (PM) and Fleischschaf (FL), included in the Spanish Association of Fast-growing Sheep Breeders (AECOP), were used. The economically important traits are the 30- and 70-day body weight and, chiefly, the post-weaning daily gain from 30 to 70 days of age. Even though the Breeding Plan was established in 1992, lambing and body weight routine controls started in 1994. The breeding plan progress has not been easy, due to difficulties in assigning sire genealogy and to the short lifespan of lambs and, therefore, the best lambs of each flock were selected on phenotype correcting for some environmental effects. In June of 2001, the first breeding value catalogue was published using the animal model and BLUP methodology (Henderson, 1973 and 1988). The main objective of the present study is to evaluate the genetic and environmental changes of growth traits since the start of the Breeding Plan.

MATERIAL AND METHODS

Data structure. To carry out the genetic evaluation, data on bodyweight typified to 30 (W30) and 70 (W70) days of age, as they corresponded to weaning and slaughter weights, as well as the mean daily gain (MDG) from 30 to 70 days, as an index of post-weaning growth, were used. Around 11,000 IF, 6,500 PM and 5,000 FL standardized weights were analyzed. Only sires used in artificial insemination and those used in controlled matings were considered. In summary, 206, 179 and 77 sires were evaluated for the IF, PM and FL breeds, respectively, and data where gathered from three lambings (spring, fall and winter) in 35 IF farms during 8 years and in 17 PM and 15 FL farms during 7 years.

Statistical analyses. Genetic values were calculated using a single-trait animal model with direct additive effects evaluating only the previously described three traits. The model is described as:

\[ Y_{ijklm} = \mu + CG_i + S_j + LT_k + DA_l + u_m + e_{ijklm} \]

Where \( Y \) : W30, W70 and MDG ; \( \mu \) : general mean ; CG : contemporary group composed of flock, year and birth season ; S : lamb sex; TB : Type of birth ; DA : dam age ; u : genetic effect of a given individual ; and e : residual effect. The contemporary group is defined as those individuals born in the same flock, year and season. This effect has 230 levels for the IF, 100 for the PM and 88 for the FL breed. Type of birth is divided in single, double and triple. Dam age is divided into four age classes (primiparous ewes, 2 to 3 year ewes, 4 to 7 year ewes, and
8 to 11 year ewes). Sex has two levels (Jiménez et al., 1998). Genetic parameter predictions were calculated using the restricted maximal likelihood method (REML), through the VCE program (Gronelved, 1998) and with a single-trait model which included the above described fixed effects. The genetic values were obtained using a single-trait animal model which only included direct additive effects, and using the BLUPAM software (Jurado et al., 1992). The genetic parameters used to calculate the genetic values are those previously calculated for each breed. Genetic trends were calculated as the regression between the mean genetic value and the year of birth. Phenotypic trends were calculated as the mean of phenotypic values per year of birth, and the environmental trends, subtracting the genetic from the phenotypic values. The slopes and intercepts of the already mentioned regressions were evaluated using the SAS program (1989).

RESULTS AND DISCUSSION

Means and standard deviations for W30, W70 and postweaning MDG were calculated. Mean values for W30 (from 12.1 to 12.9 kg), for W70 (from 24.8 to 23.4 kg) and for MDG (from 281 to 300 gr) indicate a fast growth for all breeds. According to Waldron et al. (1993), genetic parameters calculated with an additive direct model without accounting for maternal effects may be overestimated. However, a study conducted with this data by Jiménez et al. (1999) stated the difficulty of separating maternal and permanent environmental effects from the direct effect, and also, in that study the magnitude of the maternal effects were small for both traits in IF breed. For this reason, breeding values were computed with a model including only direct effects. Direct heritabilities presented in Table 1 are medium for IF and FL (0.26 and 0.27 for W30, and 0.23 and 0.26 for W70, and 0.18 and 0.23 for MDG) and small for PM (0.17, 0.15 and 0.12 for W30, W780 and MDG, respectively). These small heritabilities for PM also correspond to small genetic variance. There are many different heritability estimates in the literature for these traits. For example, Vaez et al. (1996) obtained estimates of 0.55 for weaning weight in Australian Merino with a direct model like the one used in this study, and Analla et al. (1998) obtained an heritability value of 0.06 in Spanish Merino with a model including direct and maternal effects. To evaluate the genetic trends of these breeds since their establishment in Spain, it is important to realize that they were imported as highly selected breeds and, therefore, their genetic progress is expected to be considerably smaller than for other, non selected breeds. The genetic and environmental trends for W30 and W70 are depicted in Figures 1 (a and b) for the three breeds, and the slopes corresponding to these trends appear in Table 2. Slopes in Table 2 indicate that, for the IF breed, there is a slight but positive genetic trend (0.01 kg and 0.016 kg/year for W30 and WP70, respectively, and 0.21 g/year for MDG) from 1985 to 1999. More specifically, as depicted in Figure 1, although there is no trend from 1985 to 1991 for any trait, there are positive trends from 1991 onwards, specially for W70. This can be explained by the fact that 1994 was the starting point for field controls and selection of lambs in each flock according to W70, adjusted by sex and type of birth. This phenotypic selection has also resulted in a small genetic improvement of this breed. The FL breed was included in the breeding plans in 1995. The genetic trends for this breed presented in Figure 1(b), whose slopes are 0.0056 and 0.003 kg/year for W30 and W70, respectively, and 0.084 g/year for MDG from 1988 a 1999, indicate an almost negligible genetic progress for this breed. The slopes of the genetic trends for the PM breed (0.0011 y 0.0009 kg/year for W30
and W70, respectively, and –0.0025 g/year for MDG) indicate as well a null genetic progress for this breed, possibly due to a smaller genetic variance for these traits in comparison with that from the IF breed, as indicated in Table 1.

Table 1. Heritabilities, standard error, and genetic and environmental variances of 30- and 70-day bodyweight and mean daily gain traits of the three ovine breeds under study

<table>
<thead>
<tr>
<th>Ile de France</th>
<th>Precocious Merino</th>
<th>Fleischschaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>W30</td>
<td>W70</td>
<td>W30</td>
</tr>
<tr>
<td>$h^2_d$</td>
<td>0.26</td>
<td>0.23</td>
</tr>
<tr>
<td>SE</td>
<td>0.018</td>
<td>0.018</td>
</tr>
<tr>
<td>$\sigma^2_d$ : genetic variance ; $\sigma^2_e$ : environmental variance ; $h^2_d$ : heritability ; SE : standard error of the heritability. W : bodyweight at 30 (W30) or 70 (W70) days of age ; MDG : mean daily gain.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Regression slopes of genetic(GT), environmental (ET) and phenotypic (PT) trends and intercept of phenotypic trends (IP) for growth traits of the sheep breeds under study

<table>
<thead>
<tr>
<th>Ile de France</th>
<th>Precocious Merino</th>
<th>Fleischschaf</th>
</tr>
</thead>
<tbody>
<tr>
<td>W30</td>
<td>W70</td>
<td>W30</td>
</tr>
<tr>
<td>GT</td>
<td>0.0092</td>
<td>0.016</td>
</tr>
<tr>
<td>ET</td>
<td>0.2352</td>
<td>0.265</td>
</tr>
<tr>
<td>PT</td>
<td>0.3109</td>
<td>0.4088</td>
</tr>
<tr>
<td>IP</td>
<td>11.43</td>
<td>22.82</td>
</tr>
<tr>
<td>W (Kg) : bodyweight at 30 (W30) or 70 (W70) days of age ; MDG (g) : mean daily gain.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1 also depict the environmental trends of W30 and W70 for two breeds. Environmental trends for IF and MP breeds showed a decrease during the first years (1992 to 1996), but in 1997 the environmental effect increased. After 1997 these trends shortly increased for IF breed and decreased for MP breed. Environmental trends for the FL breed are negative. Negative environmental trends can be easily explained because when these selected breeds were imported, the management and nutrition level of these original flocks were good, but once the breeds spread from the imported flocks the management and nutritional level decreased causing negative environmental trends. A clear example is the FL breed. In this breed, the regression intercept shows a phenotypic mean of 26.18 kg for W70 in 1995, which is much higher than the breed general mean of 24.2 Kg.

CONCLUSION

A slight genetic improvement occurred in the IF breed since 1994, mainly as the adjustments for fixed effects within the flocks started. No genetic change took place for the PM and FL breeds along the years of study, and therefore it is necessary to start selecting individuals according to their genetic value. Due to the short lifespan of lambs and the impossibility of doing genetic evaluations every 50 days, it is recommended to select lambs using the genetic values of their parental. With an adequate application of the breeding value catalogue published on June 8th.
of 2001 and subsequent genetic evaluations, a more effective improvement of these breeds is expected.

**Figure 1. Genetic and Environmental trends for 30 and 70-day body weight of two ovine breeds. GV : genetic value ; EV: Environmental value**

**REFERENCES**


