Livestock Science 147 (2012) 181–187

Contents lists available at SciVerse ScienceDirect

Livestock Science

journal homepage: www.elsevier.com/locate/livsci

# Genetic parameters for nematode resistance in periparturient ewes and post-weaning lambs in Uruguayan Merino sheep

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ARTICLE INFO

*Article history:*
Received 14 December 2011
Received in revised form
2 May 2012
Accepted 3 May 2012

*Keywords:*
FEC
Gastrointestinal parasites
Genetic correlation
Genetic progress
Heritability
Periparturient rise

ABSTRACT

Gastrointestinal (GI) parasites are one of the main sanitary and economic constraints for sheep production worldwide. In Uruguay, resistance to GI parasites has been included in genetic evaluations of Merino and Corriedale breeds since 1994, using Faecal worm Egg Count measured in post-weaning lambs (lambFEC) as a selection criterion. Although adult categories are more resistant to GI parasites, a temporary loss of acquired immunity is present in the periparturient period (=periparturient rise). The purpose of the present study is to estimate the genetic parameters of resistance to GI parasites in periparturient ewes and post-weaning Merino lambs. A total 2110 faecal samples of 748 periparturient ewes (eweFEC), the progeny of 107 sires, were collected in 2009 and 2010. 9458 lambFEC records from 7506 lambs born between 2001 and 2009 were analysed as well. (Co)variance components and systematic effects were estimated using a multi-trait animal model, with a Bayesian analysis using the Gibbs sampler algorithm. Direct and correlated responses (DR and CR) of eweFEC to selection using eweFEC and lambFEC respectively, were also estimated. Posterior medians (posterior standard deviation) for heritability ($h^2$) and repeatability were 0.25 (0.03) and 0.34 (0.02) for lambFEC, and 0.08 (0.03) and 0.18 (0.03) for eweFEC, respectively. Posterior median for genetic correlation between both traits was 0.81 (0.11). CR obtained by selecting for lambFEC was two times more efficient than DR from selection by eweFEC. In conclusion, eweFEC has a lower $h^2$ than lambFEC while their genetic correlation is moderate to high. Therefore, indirect selection by using lambFEC will be more effective than direct selection on eweFEC, and will produce ewes that eliminate less worm eggs, resulting in less pasture contamination.



## 1. Introduction

Gastrointestinal (GI) parasites are one of the main sanitary and economic constraints for sheep production in Uruguay and worldwide (Castells et al., 1995; Nieto et al., 2002; Perry and Randolph, 1999). Anthelmintic drugs have been used as the main control method for GI parasites, but its incorrect and continuous application, has led to problematic anthelmintic resistance (Waller, 1997). Therefore, alternative control strategies are considered, such as selection for increased genetic resistance to GI parasites. Animals with lower parasite charge, contribute to reduced pasture contamination and less need for the use of chemical drugs, thus delaying the development of anthelmintic resistance and reducing treatment costs (Bisset et al., 1996; Bishop and Stear, 2003; Nieto et al., 2002).

In Uruguay, resistance to GI parasites has been included in the genetic evaluations of Merino and Corriedale breeds since 1994. Faecal worm Egg Count (FEC) recorded in post-weaning lambs is used as a selection

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http://dx.doi.org/10.1016/j.livsci.2012.05.003

criterion. The genetic evaluation is performed by a repeatability animal model as described by Ciappesoni et al. (2010), and the genetic merit is published as FEC Estimated Breeding Value (EBV).

Lambs are the most susceptible to GI parasites, while ewes experience a temporary loss of acquired immunity around parturition called periparturient rise. This can be defined as a temporary but marked increase in nematode eggs output by periparturient ewes, that begins in the last weeks of gestation and reaches the maximum peak between six and eight weeks post-parturition (Crofton, 1954; Procter and Gibbs, 1968). It is an important event because it represents a pasture larval contamination source for newborn lambs (Bishop and Stear, 2001; Romero and Boero, 2001). The cause has not yet been determined, but it is generally accepted that the rise occurs after an immunity depression of the host by stressful factors like pregnancy, parturition, lactation, climate and malnutrition (Barger, 1993).

Ewe's genetic resistance to GI parasites during the periparturient rise (eweFEC) is not as well documented as resistance in post-weaning lambs (lambFEC). Despite the limited information available about genetic parameters, resistance to GI parasites in the periparturient period would be moderately heritable (Bishop and Stear, 2001; Morris et al., 1998; Watson et al., 1995; Woolaston, 1992) and favourably genetically correlated with resistance in lambs (Morris et al., 1998). If the correlation is positive and moderate to high, this implies that selection of lambs resistant to GI parasites will lead eventually to a decrease in eweFEC during the periparturient rise. Thus, genetic selection to increase resistance to GI parasites should be carried out mainly with two objectives: increasing resistance in lambs and reducing pasture contamination by ewes in order to maximize both genetic and epidemiological benefits of selection (Bishop and Stear, 2001).

Due to the fact that eweFEC may be a selection objective with economical relevance, the aims of the present study were (1) to estimate the genetic parameters of this trait in Uruguayan Merino sheep, (2) to estimate the genetic correlation with lambFEC, in order to study if they are the same or different traits, and (3) to assess the potential annual genetic progress for eweFEC.

## 2. Materials and methods

### 2.1. Animals and management

Animals from three flocks, genetically connected by reference rams and representing nearly 40% of the data recorded for the FEC National Merino Genetic Evaluation, were analysed. The first flock is the Fine Merino Nucleus (FMN), belonging to "Glencoe", a research station of the National Research Institute for Agricultural (INIA) of Uruguay (Latitude 32°00′S and longitude 57°08′W). The FMN was established in 1999 and its principal selection objectives have been to decrease fibre diameter and maintain clean fleece weight; both traits are included in a selection index (Montossi et al., 2005). The two other flocks are from two Merino studs: "Talitas" and "La Gringa" (Latitude 31°02′S and longitude 56°53′W), owned by the same sheep breeder, where the same selection index as for FMN is applied. The three flocks are located in the northern part of Uruguay, characterized by the same warm and wet climate, with a mean annual temperature of 18–19 °C, relative humidity of 70–72% and an average annual rainfall of 1400–1500 mm (Castaño et al., 2011).

The lambing season in these flocks is Spring, with most births taking place in September and October. In FMN, ewes are managed in parturition groups, according to the average expected day of lambing. A pre-partum strategic drenching is performed every year as a management control measure (approximately one month before parturition). Anthelmintic used were DOVENIX® in 2009 and TRIMIX® in 2010.

In "Talitas" and "La Gringa", ewes are managed in a single group. In these stud flocks, ewes were not dewormed before parturition because drenching is performed strategically, i.e. periodically faecal samples are collected from a random sample of animals, and according to FEC results, a control strategy is established.

### 2.2. Animal sampling

#### 2.2.1. Ewe records

A total of 2500 faecal samples were collected in 2009 and 2010, during lambing season. The age of ewes ranged between of 2 and 10 years old and litter size was recorded as single or multiple ($\geq$ two lambs). The experiment was conducted between days $-50$ and $+68$ with respect to lambing (day 0). Each ewe was sampled on average three times, under natural infection. All ewes in the same parturition group were sampled on the same day. The first sample was collected in late pregnancy and the others in early and mid-lactation. The number of post-lambing measurements depended on the degree of parasitic infestation. After each sampling, when FEC counts reached certain levels at which animal welfare and health could be compromised, the process was to immediately drench all animals belonging to a parturition group, in the case of FMN, or to the whole flock in the case of "Talitas" and "La Gringa" studs. In FMN, ewes were sampled in the two years of the experiment. In 2009, a total of six measurements were performed on 293 ewes divided in four parturition groups, obtaining a total of 742 records. In 2010, five measurements were performed on 345 ewes (of which 185 were also sampled in 2009) divided in three parturition groups, obtaining a total of 881 samples. In "La Gringa" and "Talitas" studs, only 349 and 173 females, respectively, were sampled in 2010, with two measurements performed in each flock, obtaining a total of 877 samples (596 and 281, respectively).

FEC counts were determined using a modified McMaster technique (Whitlock, 1948), where each egg observed represented 100 eggs per gram of faeces. In addition, in 2010, faecal cultures of infective larvae were prepared to assess the species composition of nematode infection in each flock.