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Is it feasible to select humid sub-tropical Merino sheep for faecal egg counts?

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ABSTRACT

Genetic parameter estimates for faecal egg counts (FEC), weaning and shearing weights and wool traits were evaluated in 720 Australian Merino lambs raised in Southern Brazil. Weaned lambs were naturally exposed to nematode larvae-contaminated pastures with the objective of recording individual gastrointestinal parasite infection responses. Phenotypic and genetic correlations among production traits such as birth, weaning and shearing weights and wool production traits (greasy and clean fleece weights, scouring yield, mean fibre diameter, and staple length) were estimated. Results showed a high variability for FEC counts among individuals, with a heritability estimate of 0.365 ± 0.001, and low phenotypic and genetic correlations between FEC and all productive traits, except for a negative shearing live weight ($r_G = -0.305 \pm 0.002$ and $r_P = -0.140 \pm 0.001$). These results indicate that selection for low FEC would ensure genetic progress in reducing gastrointestinal parasite infection levels without limiting major sheep production traits for Merino sheep raised in a humid sub-tropical environment.

1. Introduction

Gastrointestinal infections are the major sheep health concern in tropical and sub-tropical pastures, where *Haemonchus contortus*, a highly pathogenic helminth (Urquhart, 1987), is the most prevalent parasite species. Free-stage larvae survival is highly dependent on climatic conditions (Southcott et al., 1976) and found to thrive under humid and warm temperature conditions. Hence sheep lambs raised in sub-tropical biomes characterised by high rainfall and humidity, are particularly affected by *Haemonchus* infections.

Parasite control relies on chemotherapeutic treatments, however alternative methods are urgently needed due to the established parasite resistance to traditional anthelmintic drugs commercially available. Further approaches to control sheep parasites have been attempted by the use of two new drug formulae in the last five years, more expensive to farmers, however one of them have already developed parasite resistance when failed to lower *Teladorsagia circumcincta* and *Trichostrongylus colubriformis* faecal egg counts (Scott et al., 2013). Condensed tannins have proved to be effective in lowering FEC counts (Max, 2010; Juhnke et al., 2012) and the last advance has been the development of a *Haemonchus* vaccine containing native integral membrane glycoproteins (native H-gal-GP; Cachat et al., 2010) that later resulted in the launching of the Barbervax vaccine in Australia in 2013 under limited supply. However, these alternatives are still limited to geographic regions or still expensive to farmers.

In practice, controlling parasite infections under high levels of infective larvae in the pasture and parasite resistance to all drugs have been a serious obstacle for animal husbandry decision-making. Should selecting resistant sheep to gastrointestinal infections be advantageous to reduce the number of drenches and the contamination of infective larvae in pastures, breeding more resistant hosts could be one of the components for parasite control as seen in temperate and dry climates (Morris et al., 1995, 2005; Woolaston and Baker, 1996; Woolaston and Piper, 1996; Morris, 1998).

Sheep breeding programmes have benefitted from the high FEC variability observed amongst individuals (Woolaston, 1998; Gray et al., 1995; Eady et al., 1996) and have been able to increase the frequency of resistant sheep in commercial flocks (Eady et al., 1996; McEwan et al., 1995). Faecal egg count heritability estimates have been shown to vary from 0.14 to 0.44 (Piper, 1987; Watson et al., 1986; Baker et al., 1990; McEwan et al., 1992; Bishop et al., 1996), however heritability is defined as the ratio between genetic:environmental variances, hence genetic parameter esti-

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mates are expected to change according to environmental factors. Several studies have reported genetic parameter estimates for FEC and sheep production traits (Morris et al., 1995; McEwan et al., 1995; Bishop et al., 1996; Morris, 1998; Coltman et al., 2001; Cloete et al., 2007). This literature was mostly generated from temperate climates, where natural parasite challenge is performed or from dry environments, where parasite transmission is low, consequently artificial parasite challenges are regularly required.

Interestingly, Woolaston (1998) and Bishop and Morris (2007) have suggested that increasing host resistance could additionally bring an advantageous epidemiological outcome for flocks. The culling of high egg shedder individuals could, in the long term, reduce the amount of eggs and infective larvae in pasture, keeping transmission to a minimum. Nevertheless, it is expected there will be enough larvae in the pasture to expose naïve animals. If this holds true, it will allow the development of host immune response, whilst keeping low parasite burden, and reducing the risk of host morbidity and mortality.

The objective of this experiment was to evaluate individual FEC variability and to calculate FEC heritability, phenotypic and genetic correlation estimates with productive traits for Australian Merino sheep under warm and humid environments where sheep are continuously exposed to high *Haemonchus* sp. transmission in sheep.

2. Material and methods

An Australian Merino flock was experimentally designed to generate segregating individuals for faecal egg counts by mating low faecal egg count (FEC) sires to high FEC dams, and vice-versa. Lambs were born in three consecutive years (August to mid September each year). Soon after weaning (in January of the following year), they were monitored for FEC counts in a Southern Brazil (30° 47′S and 54° 23′W) commercial farm. Apart from the introduction of stud sires, where some level of selection for fleece weight was performed, no attempt has been previously made to select for reduced FEC or any other productive trait.

2.1. Parentals experimental challenges

A reduction FEC test was performed prior the beginning of the experiment to assess the level of resistance of the *Haemonchus* sp. field strain to ten commercially available anthelmintic drugs. Only those with >95% efficacy levels were used for drenching the flock. The parental population for this experimental flock was selected out of 1600 adult sheep. These animals were exposed to infective larvae in three successive one-month natural challenges for individual FEC evaluation. The more resistant (FEC average < 600) and more susceptible (FEC average > 2000) adults (n = 607 dams) were used as parentals to be mated according to their FEC phenotypes: five low FEC sires mated to high FEC dams, and vice-versa, to allow wide FEC genetic variation in the progenies. The pedigree file comprised 10 sires and 607 dams (base population).

The experimental challenges were conducted using the following steps: (a) sheep were drenched to zero their egg counts; (b) weekly monitoring of faecal samples from 10% of the animals; (c) when FEC averages in (b) reached 800 eggs/g of faeces, all sheep were individually sampled for FEC counts, (d) drenched to zero their egg counts, and re-start a new challenge. Natural pastures with high larval contamination were used to allow host re-infestation. The challenge period was from February to May–June each year, to coin-

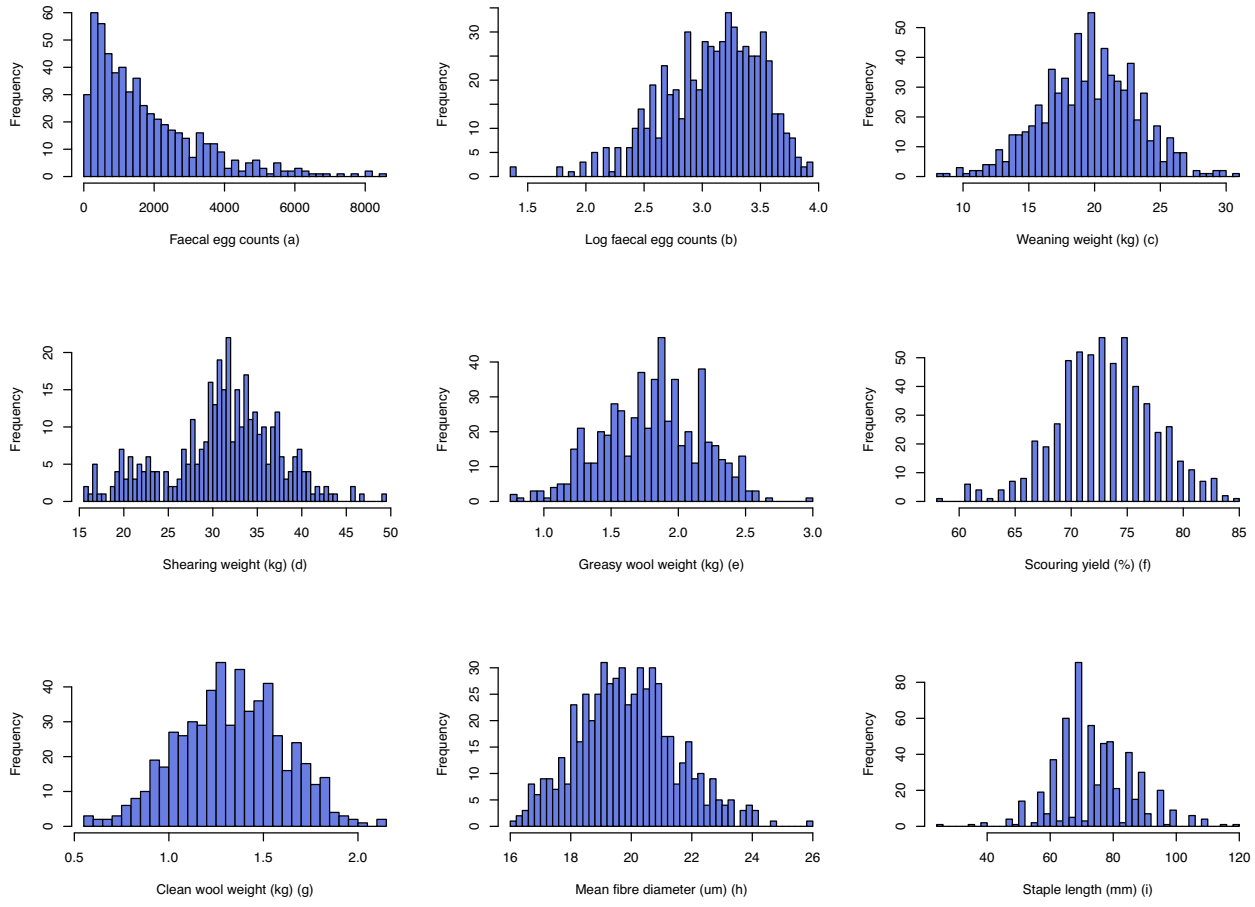

Fig. 1. Histogram of faecal egg counts (back- and log-transformed data) and productive traits.