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Resistance of Santa Ines and crossbred ewes to naturally acquired gastrointestinal nematode infections

A.F.T. Amarante [a,*], I. Susin [b], R.A. Rocha [a], M.B. Silva [a], C.Q. Mendes [b], A.V. Pires [b]

[a] UNESP - Universidade Estadual Paulista, Departamento de Parasitologia, Instituto de Biociências, Caixa Postal 510, Botucatu, SP, CEP 18618-000, Brazil
[b] USP – Universidade de São Paulo, Departamento de Zootecnia – ESALQ, Piracicaba, SP, CEP 13418-900, Brazil

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ABSTRACT

This trial was carried out in Piracicaba, São Paulo State, Brazil, to comparatively evaluate the degree of resistance to naturally acquired gastrointestinal nematode infections in sheep of the following genetic groups: purebred Santa Ines (SI), SI crossbred with Dorper (DO × SI), Ile de France (IF × SI), Suffolk (SU × SI), and Texel (TE × SI). Fifteen ewes from each group were raised indoors until 12 months of age. At this age, they were moved to pasture that was naturally contaminated by nematode infective larvae and were evaluated from December to May, 2007. Rainfall ranged from 267 mm in January to 37 mm in April. Maximum and minimum mean temperatures ranged from 32.5 °C to 19.0 °C in March and from 25.9 °C to 12.8 °C in May. There was an increase in the mean number of eggs per gram of feces (EPG) after animals were placed on pasture with significant difference between the SI (80 EPG) and IF × SI (347 EPG) groups in January; and the DO × SI (386 EPG) and TE × SI (258 EPG) groups in May. The highest mean fecal egg count (FEC), 2073 EPG, was recorded for the TE × SI group in February. All groups showed a progressive reduction in body weight throughout the experiment of 12.0% (TE × SI) to 15.9% (SU × SI). In general, the animals with the highest FEC presented the lowest packed cell volumes (PCV); the highest correlation coefficient between FEC × PCV occurred in the SU × SI sheep in January ($r = -0.70$; $P < 0.01$). Similarly, there was an inverse relationship between FEC and blood eosinophil values, with the highest correlation coefficient in the TE × SI sheep in February ($r = -0.64$; $P < 0.05$). Immunoglobulin G (IgG) levels against *Haemonchus contortus* antigens increased in all groups as a result of the exposure to parasites and remained relatively constant until the end of the study, with the exceptions of SU × SI and TE × SI, which showed a rise in IgG levels during the last sampling that coincided with a reduction in mean FEC. In conclusion, crossbreeding Santa Ines sheep with any of the breeds evaluated can result in a production increase and the maintenance of a satisfactory degree of infection resistance, especially against *H. contortus* and *Trichostrongylus colubriformis*, the major nematodes detected in this flock.

1. Introduction

Parasitic gastroenteritis is a major health problem for the sheep industry worldwide, causing great economical losses due to reduced productivity, mortality of animals, and expenses with anthelmintics and labor. In addition, the frequent use of anthelmintics for the prophylaxis of gastrointestinal nematode (GIN) infections has led to the dissemination of populations of resistant parasites (Getachew et al., 2007).

Alternative control measures include breeding strategies with the selection or the use of sheep breeds with resistance to GIN. This strategy has demonstrated sustainability, as strong evidence suggests that important sheep

* Corresponding author. Tel.: +55 14 3811 6239; fax: +55 14 3815 3744.
E-mail address: amarante@ibb.unesp.br (A.F.T. Amarante).

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nematodes do not adapt to long-term exposure to sheep that are genetically resistant to GIN infections (Kemper et al., 2009). Some breeds of sheep demonstrate genetic resistance against *Haemonchus contortus*, the major parasite in tropical and sub-tropical areas; such breeds include the Florida Native (Amarante et al., 1999a) and Gulf Coast Native (Bahirathan et al., 1996; Li et al., 2001) sheep, raised in the south of the United States; St. Croix and Barbados Blackbelly (Courtney et al., 1984; Gamble and Zajac, 1992; Gruner et al., 2003), originating from the Caribbean islands; and the Red Maasai sheep from Africa (Mugambi et al., 1997). In Brazil, Santa Ines hair sheep demonstrate a greater resistance to GIN, when compared with some sheep breeds of European origin (Amarante et al., 2004; Rocha et al., 2004; Bricarello et al., 2005; Costa et al., 2007). These differences in breeds are usually the result of emphasis on different traits in selection, or of natural selection in breeds originating from different geographical locations.

As such, problems with GIN infections in the sheep industry could be reduced by the use of resistant breeds; however, these resistant breeds can present inferior productivity when compared with other breeds selected for higher weight gain and meat quality. For example, the Ile de France is a breed notable for weight gain and carcass quality; however, its performance in tropical environments may not match that of tropical breeds adapted to the area, such as the Santa Ines hair sheep.

Therefore, the farmer has to choose between a less productive breed that is well-adapted to the local environmental conditions and resistant to parasites or a highly productive breed that is not well-adapted to the climate and is more susceptible to parasites that occur in the tropics. A third option to solve such a problem is the crossbreeding of a susceptible breed, of elevated productivity, with a resistant, but less productive breed. The variation between breeds presents opportunities to combine and improve the characteristics of two different breeds in order to enhance productivity. In addition, crossbred progeny usually show heterosis in performance. Thus, crossbreeding allows the opportunity to obtain progress in a generation that would normally need several generations of selection to be reached (Van Vleck et al., 1987).

At present, the Santa Ines sheep is predominant in most of the Brazilian territory due to its higher level of resistance to GIN (Amarante et al., 2004; Rocha et al., 2004; Bricarello et al., 2005; Costa et al., 2007). This trial was carried out to evaluate the degree of resistance of female sheep originating from the crossbreeding of Santa Ines ewes with Ile de France, Suffolk, Texel and Dorper sires, all breeds with a high potential for growth and meat production.

2. Materials and methods

2.1. Experimental area and animal management

This study was carried out on an experimental farm located at the University of São Paulo in Piracicaba, Brazil. The experimental area comprised 1 ha of grass pasture (*Cynodon* spp.) divided into a six-paddock rotational grazing system.

The average monthly relative humidity was always higher than 84% throughout the study. As usual for the region, rainfall was abundant in December, January and February (252 mm, 267 mm and 242 mm, respectively), with a total of 761 mm. In March (81 mm), April (37 mm) and May (58 mm), there was a decrease in precipitation. Maximum and minimum mean temperatures ranged from 32.5 °C to 19.0 °C in March 2007 and from 25.9 °C to 12.8 °C in May (ESALQ, 2009).

Each experimental genotype group was composed of 15 young ewes, as follows: purebred Santa Ines (SI); crossbred Dorper × Santa Ines (DO × SI); crossbred Ile de France × Santa Ines (IF × SI); crossbred Suffolk × Santa Ines (SU × SI); and crossbred Texel × Santa Ines (TE × SI). The ewe lambs used in this trial were obtained by crossing 300 Santa Ines females with five sires of each of the following breeds: Santa Ines, Dorper, Texel, Suffolk and Ile de France. Each sire was exposed to the same number of females to assure genetic variability inside each experimental group. The birth date, the birth weight and the weight at weaning (60 days of age) were recorded, as well as whether the lambs were single or twins. This procedure allowed homogeneity for each genetic group.

Animals were managed, according to routine procedures, at the sheep experimental farm. During late pregnancy, ewes were housed in pens with a concrete floor, where they were kept with their lambs until weaning. Ewes were vaccinated against clostridial disease (Sintoxan Polivalente®, Merial S.A., Uruguay), salmonelloses and pasteurelloses (Laboratório Prado S.A., Brazil) in the final third of the gestation. Lambs were vaccinated 15 days before weaning. Suckling lambs had free access to a concentrate with 18% crude protein in a creep feeding system.

After weaning, lambs received a diet containing 16% crude protein, and consisting of hay (10%) and concentrate (90%). The concentrate was formulated from soybean meal, ground corn and mineral supplement. In order to prevent coccidiosis, monensin (25 ppm; Rumensin®, Elanco, Australia) was added to the diet. From 6 to 12 months of age, animals were fed on a higher roughage diet to avoid excessive fat deposition. Until the beginning of the trial, all animals were kept housed with free access to drinking water.

At 12 months of age, the ewe lambs were released on pasture on December 19th, 2006, where they grazed, in a rotational system, as a single flock, in six paddocks until the end of the study. Pastures were expected to be naturally contaminated with infective larvae of GIN. In each paddock, ewe lambs had free access to water and mineral salt.

The animals were weighed monthly and individual samples of blood and feces were taken. To avoid deaths, ewes were individually treated with levamisole (7.5 mg/kg, Ripercol®, Fort Dodge, Brazil) whenever their fecal egg counts (FEC) were higher than 4000 eggs per gram (EPG) or their packed cell volume (PCV) was lower than 20% (Amarante et al., 1999b).

During the last two months of the study, two tracer lambs, free of infections of GIN, were placed together with the experimental animals. At the end of the study, these tracer lambs were sacrificed in order to identify species of helminths present in the flock.