

Gastrointestinal nematode infection in Purunã heifers raised in conventional and integrated livestock forest systems

*Infecção por nematódeos gastrintestinais em novilhas Purunã criadas em sistemas
integrados pecuária-floresta e convencional*

BAIAK, Barbara Haline Buss¹
<https://orcid.org/0000-0001-6036-7427>

MOLETTA, José Luis ²
<https://orcid.org/0000-0003-4971-2722>

GASPARINA, Jennifer Mayara¹
<https://orcid.org/0000-0002-7664-3665>

ROCHA, Raquel Abdallah da³
<https://orcid.org/0000-0002-0978-955X>

¹Universidade Estadual de Ponta Grossa – UEPG Programa de Pós Graduação em Zootenica, Ponta Grossa, PR, Brazil

²Instituto Agrônômico do Paraná - IAPAR, Ponta Grossa, PR, Brazil

³ Universidade Estadual de Ponta Grossa - UEPG Departamento de Zootecnia, , Ponta Grossa, PR, Brazil

* Corresponding author: barbara_baiak@hotmail.com

ABSTRACT

The objective of the study was to evaluate the resistance of Purunã heifers to nematode infection in two different production systems. In this study, 29 heifers were divided into eight pickets, four in an integrated livestock forest system (ILF) and four in a conventional pasture system (CPS). Feces were collected monthly to perform the *fecal egg count* (FEC), evaluate the degree of infection caused by gastrointestinal nematodes in cattle, and carry out coproculture, to identify the genus of the parasites. In addition, animal body weight was determined to evaluate performance. On the same day as the measurements, forage samples were collected to determine the number of infective larvae per kilogram of dry matter (L3/kg DM) in each picket. There were no statistical differences in FECs between the treatments. Although no significant differences were observed in the recovery of L3/kg DM, the contamination was higher in the ILF compared to CPS in December (344 and 37.7 L3/kg DM, respectively) and January (312 and 0 L3/kg DM, respectively). In March, the CPS (321 L3/kg DM) presented higher contamination than the ILF (80.7 L3/kg DM), but with no statistical difference. The weight of the animals was higher for the CPS compared to the ILF treatment throughout the whole experimental period, with a significant difference in December (343.30 kg and 314.08 kg, respectively).

The present study demonstrated numerically that greater numbers of L3 were recovered from pasture of the ILF, which could have resulted in higher contamination and lower performance of the animals.

Keywords: agroforestry systems, cattle, helminths.

RESUMO

O objetivo do estudo foi avaliar a resistência de novilhas Purunã às infecções por nematódeos gastrintestinais em diferentes sistemas de produção. Neste estudo, 29 novilhas foram divididas em oito piquetes, quatro no sistema integrado pecuária-floresta (ILPF) e quatro no sistema convencional de pastagem (SCP). Mensalmente, as fezes eram coletadas para realizar a contagem de ovos por grama de fezes (OPG), com o objetivo de avaliar o grau de infecção causada por nematódeos gastrintestinais em bovinos; e coprocultura, para identificar o gênero dos parasitas. Além disso, o peso corporal dos animais foi determinado para avaliar o desempenho. No mesmo dia das medições, amostras de forragem foram coletadas para determinar o número de larvas infectantes por quilograma de matéria seca (L3 / kg MS) em cada piquete. Não houve diferença estatística no OPG entre os tratamentos. Também não houve diferença significativa na recuperação de L3 / kg de MS, porém a contaminação foi maior na ILPF em comparação com a SCP em dezembro (344 e 37,7 L3/kg MS, respectivamente) e janeiro (312 e 0 L3/kg MS respectivamente), em março, o SCP (321 L3 / kg MS) apresentou maior contaminação que o ILPF (80,7 L3/kg MS). O peso dos animais foi maior para o SCP comparado ao tratamento com ILPF durante todo o período experimental, com diferença significativa em dezembro (343,30 kg e 314,08 kg, respectivamente). O presente estudo mostrou numericamente que o ILPF apresentou maior recuperação de L3 no pasto, o que poderia resultar em maior contaminação dos animais e menor desempenho.

Palavras-chave: bovinos, helmintos, sistemas agroflorestais.

INTRODUCTION

Pastures are the most economical source of nutrients for cattle. However, in this ecosystem, the infections caused by gastrointestinal nematodes are considered a sanitary problem (Amarante, 2011). Even though the signs are often subclinical, parasites cause metabolic alterations, with consequent decreases in host performance. Intensity varies with animal age and, especially,

with the production system (Stromberg et al. 2012).

Cattle production can be managed in either conventional or integrated systems. The latter includes the tree component, in which animals benefit from thermal comfort and greater moisture. However, adequate environmental conditions such as humidity, luminosity, and temperature, foster the development of infective larvae (L3) (Quadros et al. 2010). Only

5% of the parasite population is in the animals, with the remaining 95% in the environment (Bowman, 2003).

Thus, the current study aimed to evaluate the resistance of Purunã heifers naturally infected with gastrointestinal nematodes in an integrated livestock forest system (ILF) compared to a conventional pasture system (CPS) and the recovery of nematode infective larvae between the systems.

MATERIALS AND METHODS

The experiment was carried out at the Experimental Station of Fazenda Modelo, from the Agronomic Institute of Parana. According to Köppen, the climate in the region is Cfb type, subtropical humid mesothermic, with an average annual temperature of 17.6°C, ranging between 24.3°C (highest) and 8.5°C (lowest). The project number 010/2015 was approved by the Ethics Committee on Animal Use from the State University of Ponta Grossa.

Twenty-nine Purunã heifers (1/4 Charolais, 1/4 Aberdeen Angus, 1/4 Caracu, and 1/4 Canchim) aged from 15 to 16 months, with an initial mean weight of 329.75 kg were used. The animals were divided into groups according to weight similarity and placed in eight experimental pickets (5 pickets with 4 animals and 3 pickets with 3 animals), during the period from December 2014 to April 2015.

The 12 ha experimental area, (each picket having an area of 1.5 ha) consist of *Hemarthria altissima*, in which the following treatments were evaluated:

conventional pasture system (CPS) in full sun; and integrated livestock forest system (ILF) with the trees *Eucalyptus dunnii*, red sycamore (*Schinus terebinthifolius* Raddi), and grevillea (*Grevillea robusta* A. Cunn. Ex R. Br.). The trees in the LFI were planted in 2006, 3 m apart, in rows spaced 14 m apart.

For the diagnosis of infections caused by gastrointestinal nematodes, fecal samples were collected monthly directly from the rectal bulb, and fecal egg counts (FEC) were determined by flotation and quantification (Gordon & Whitlock, 1939). Coprocultures were performed to identify the genera of the nematodes present in the animal gut according to the experimental picket (CPS and ILF groups) (Keith, 1953; Roberts & O'Sullivan, 1950).

On the same day as the feces collection, body weight was determined using a digital scale after solid and liquid fasting of 12 hours. The animals were weighed at the beginning of the experiment on the day of picket entry, and every 28 days until the end of the experiment.

The L3 were recovered from the pasture by spontaneous sedimentation of pasture samples harvested close to the soil in each picket. Forage dry matter (DM) was determined in a greenhouse at 60°C for 72 hours, and the contents were examined under a microscope² to identify and quantify the nematodes (Keith, 1953). The result was expressed as L3/kg DM.

The FEC counts, body weight, and L3/kg DM data were subjected to analysis of variance using the F test, comparing the

two treatments (CPS and ILF), and, when significant, the means were compared by the Tukey test, at 5% and 10% probability, using the Minitab program, version 17. The FEC and L3/kg DM data were analyzed after being log (x + 1) transformed. However, the results are presented in arithmetic form (without transformation) to facilitate the interpretation of these two parameters.

RESULTS

There were no statistical differences in FEC between the treatments. The highest mean FEC was observed for ILF (77 FEC) followed by CPS (18 FEC) (Figure 1). During the experimental period, the mean for ILF (70 FEC) was higher than for CPS (48 FEC).

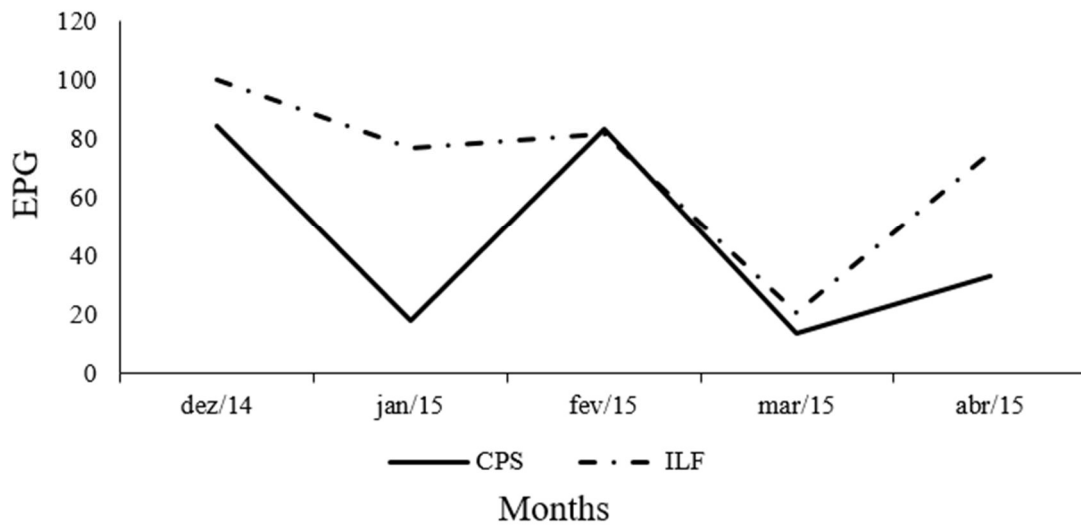


Figure 1. Mean FEC values for Purunã heifers naturally infected with gastrointestinal nematodes in the conventional pasture system (CPS) vs. integrated livestock forest system (ILF) during the periods evaluated.

The L3 counts from the pastures (Figure 2) were higher in December (344 L3/kg DM) and January (312 L3/kg DM) for ILF compared to CPS (37.7 and 0 L3/kg DM, respectively). However, in March, the CPS (321 L3/kg DM) presented higher contamination than the ILF (80.7

L3/kg DM), although the difference was not statistically significant ($P > 0.05$).

Recovery L3/kg of DM

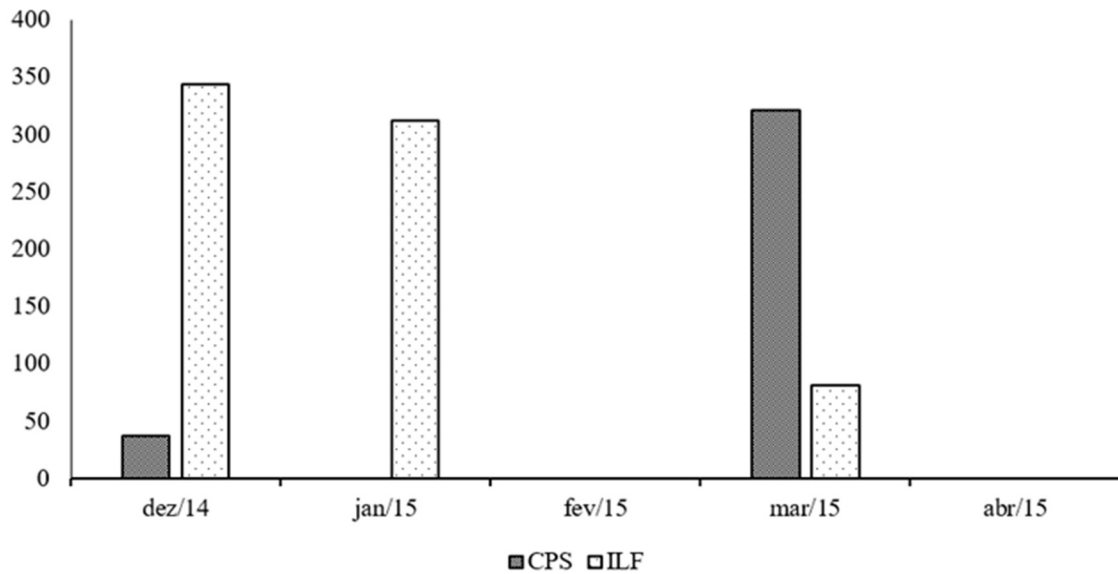


Figure 2. Recovery of nematode infective larvae (L3/kg DM) from the conventional pasture system (CPS) vs. integrated livestock forest system (ILF) during the periods evaluated.

The coprocultures of the animals kept in different production systems predominantly identified the gastrointestinal nematode *Haemonchus* spp. (67.75%ILF and 70.53% CPS), followed by *Trichostrongylus* spp. (19.45%ILF and 16.00% CPS), *Cooperia* spp. (12.00% ILF and 4.60%CPS), and *Oesophagostomum* spp. (5.10% ILF and 10.50% CPS).

The weights of the animals managed under the CPS system were higher throughout the experimental period (Figure 3), but with no statistical difference. There was a significant difference in the weight of the animals when the experiment began in December (343.30 kg for CPS and 314.00 kg for ILF).

DISCUSSION

In relation to eggs per gram of feces (EPG) values, according to Ueno & Gonçalves (1998), infections in both types of systems are categorized as mild (<200), since moderate infections present values from 200 to 700 and massive above 700. It is important to note that although the EPG value detected is low, it is not possible to affirm whether this parasite load could be a high source of contamination. Similar results were found by Oliveira et al. (2017), studying the behavior of the infection caused by gastrointestinal nematodes in beef cattle reared in integrated and conventional systems; the animals in the integrated system had

higher means of EPG during the majority of the experimental period, but without difference ($P > 0.05$) between the systems. Golçalves et al. (2020) also found no difference ($P > 0.05$) in the EPG between conventional and integrated systems in beef cattle.

The integrated system has been mentioned as an alternative control system for gastrointestinal parasites, due to the increase in fauna in the environment, which may include direct predators and competitors in the substrate (Soca et al. 2007; Auad & Carvalho, 2011). However, in the current study, the ILF had a higher number of L3 / kg DM in December and January. Faria et al. (2016) also recovered a higher number of L3 from the integrated system compared to the conventional system, with grass monoculture. The environmental conditions favored by the ILF system, such as the low incidence of solar radiation and milder temperatures are ideal conditions for the development of gastrointestinal nematodes (Molento et al. 2016), probably due to the presence of trees, which provide conditions suitable for the survival, migration, and viability of the larvae of these parasites (Besier et al. 2016). Thus, this environment can be considered a risk factor for the large intake of L3 gastrointestinal nematodes and, thus, recontamination with L3 (Faria et al. 2016).

The significant drop in the contamination level of the ILF pasture in March probably resulted from the high precipitation recorded on the day prior to forage sample collection. The

experimental ILF area had a greater slope than the CPS area. This fact caused horizontal migration of the L3 to the lower portions of the pickets during rainfall. Torrential rains can eliminate many larvae (Verschave et al. 2015) or result in excessive moisture, preventing aeration of fecal matter and the soil surface layer, negatively influencing the development of larvae (Carneiro & Amarante, 2008). It is important to note that the numbers of L3 recovered throughout the experiment were low, and it is not possible to state whether this parasitic load is a high source of contamination.

Haemonchus spp. has been demonstrated to be more resistant to the diversity imposed by the systems, and consequently, was the most prevalent in the detected infections. *Haemonchus* spp. is the most commonly found nematode in cattle (Cezar et al. 2010) which is explained by the fact that females of this genus are more prolific than females of the genera *Cooperia* spp. and *Oesophagostomum* spp. (Furlong et al. 1985). Recent studies which evaluated infection with gastrointestinal nematodes in beef cattle raised in integrated and conventional systems, also found prevalence of the genus *Haemonchus* spp. (Golçalves et al. 2020; Oliveira et al. 2017).

The lower weight of the ILF animals during the evaluated months is possibly related to the shading provided by the trees, which lowered the yield of pasture dry matter and led to a low density of tillers, consequently limiting the performance of the animals (Paciullo et

al. 2007). The animals in the CPS had access to higher amounts of forage dry matter, and this may have contributed to greater resistance to parasitic infections. The nutritional status of the host affects immunity by increasing resistance to the adverse effects of parasitism, since nutrition plays an important role in the production of immunoglobulins, essential for helminth control (Amarante, 2014).

There were no differences between the systems in relation to the values of EPG and L3, so it was not possible to confirm whether one system is better than the other. However, the results of the present study showed numerically that greater numbers of L3 were recovered from pasture of the ILF, as well as higher EPG values, demonstrating that this production system, if not well managed, could be a relevant risk factor for infection with gastrointestinal nematodes in Purunã cattle, in the state of Paraná.

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