

Parasitism level by helminths and weight gain of calves kept in organic and conventional grazing¹

Jenevaldo Barbosa da Silva^{2*}, Gisele Maria Fagundes³, João Paulo Guimarães Soares⁴ and Aivaldo Henrique da Fonseca⁵

ABSTRACT- Silva J.B., Fagundes G.M., Soares J.P.G & Fonseca A.H. 2013. **Parasitism level by helminths and weight gain of calves kept in organic and conventional grazing.** *Pesquisa Veterinária Brasileira* 33(5):586-590. Laboratório de Imunoparasitologia, Departamento de Patologia Veterinária, Faculdade de Ciências Agrárias e Veterinárias, Universidade Estadual Paulista (Unesp), Via de Acesso Prof. Paulo Donato Castellane s/n, Jaboticabal, SP 14884-900, Brazil E-mail: jenevaldo@hotmail.com

Sustainable production is a principle in which we must meet the needs of the present without compromising the capacity of future generations. Despite the successful development of pesticides against endo and ectoparasites found in domestic ruminants, these parasites are still the major problem of the herbivore production system. The purpose of this study was to know the population of gastrointestinal parasites and their influence on weight gain of calves kept in organic and conventional grazing. Thus, organic and conventional calves were randomly selected in 2008 and 2009. The fecal egg count (FEC) identified the following genera of helminths: *Haemonchus*, *Trichostrongylus*, *Oesophagostomum*, *Cooperia*, *Strongyloides*, *Trichuris* and oocysts of *Eimeria*. There was no significant difference ($p>0.05$) between FEC in organic and conventional animals. Calves younger than 6 months showed significant higher infection ($p<0.05$) than calves between 7 and 12 months of age. The weight gain observed during the study was of 327g/day and 280g/day for conventional and organic systems animals, respectively. Consequently, the combination of sustainable practices of grazing associated with the selective application of anthelmintics may be a feasible alternative for nematode control in a conventional system and in transition to an organic one.

INDEX TERMS: Anthelmintics, eimeriosis, haemonchosis, sustainable production, cattle.

RESUMO.- [Grau de parasitismo por helmintos e ganho de peso de bezerros mantidos sob manejo orgânico e convencional.] A produção sustentável é um princípio em que devemos atender as necessidades do presente sem comprometer a capacidade das gerações futuras. No presente, apesar do sucesso no desenvolvimento de pesticidas endo e ectoparasitas de ruminantes domésticos continuam

a representar um dos maiores problemas do sistema produção de herbívoros. O objetivo do estudo foi conhecer as populações de parasitos gastrointestinais e sua influência no ganho de peso em bezerros mantidos em sistemas orgânico e convencional. Para isso foram selecionados aleatoriamente bezerros orgânicos e convencionais durante os anos de 2008 e 2009. Através da contagem de ovos nas fezes (FEC) identificaram-se os seguintes gêneros de helmintos: *Haemonchus*, *Trichostrongylus*, *Oesophagostomum*, *Cooperia*, *Strongyloides*, *Trichuris* e Oocistos de *Eimeria*. Não foi observada diferença significativa ($p>0,05$) entre a FEC nos animais orgânicos e convencionais. Animais com idade inferior a seis meses apresentaram infecção significativamente superior ($p<0,05$) aos animais com 7-12 meses de idade. O ganho de peso observado durante o estudo foi de 327g/dia e 280g/dia para os animais dos sistemas convencional e orgânico, respectivamente. Assim, a combinação de práticas de manejo sustentáveis associadas a aplicação seletiva de anti-helmíntico pode ser a alternativa viável para

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² Laboratório de Imunoparasitologia, Departamento de Patologia Veterinária, Faculdade de Ciências Agrárias e Veterinárias (FCAV), Universidade Estadual Paulista (Unesp), Via de Acesso Prof. Paulo Donato Castellane s/n, Jaboticabal, SP 14884-900, Brazil. *Corresponding author: jenevaldo@hotmail.com

³ Centro de Energia Nuclear na Agricultura (CENA), Universidade de São Paulo (USP), Av. Centenário 303, Piracicaba, SP 13400-970, Brazil.

⁴ Laboratório de Doenças Parasitárias, Departamento de Epidemiologia e Saúde Pública, Universidade Federal Rural de Rio de Janeiro (UFRRJ), BR 465 Km 7, Seropédica, RJ 23890-000, Brazil. E-mail: adivaldo@ufrj.br

o controle de nematóides para sistemas convencionais e de transição para o orgânico.

TERMOS PARA INDEXAÇÃO: Anti-helmínticos, eimeriose, haemonchose, produção sustentável, cattle.

INTRODUCTION

Disease caused by internal parasites is arguably one of the most important health constraints affecting productivity in ruminants kept in organic and conventional system (Pruett et al. 2008, Silva et al. 2011, Chartier & Paraud 2012). This is of particular importance for many tropical and subtropical countries where cattle, goats and sheep play a vital role in the agricultural economies (Jackson et al. 2012).

In Brazil, conventional system producers control helminths mostly by the intensive use of anthelmintic ingredients. Although these drugs are efficient, the lack of protocols adapted for tropical regions combined with the disorganized use of therapeutic bases have caused the cost of production increase (Larsson et al. 2007). These factors added to the existence of resistant breeds (Amarante et al. 2004), higher level of contamination from water and food providers, and presence of drug residues in meat and dairy products (Coppieters et al. 2009) already represent a significant threaten for the sustainability of both systems.

The first description of intestinal parasites in organic production systems was given by Thamsborg et al. (1999). Helminths have been considered to represent the greatest cause of economic losses regarding organic cattle (Kaneene & Miller 1992). These losses have been exacerbated by the prohibition of anthelmintic treatment among such animals (Brasil 2011). Consequently, the prevalence of gastrointestinal nematodes in organically farmed animals tends to be higher than in conventional dairy herds.

Information about populations of nematodes in dairy cows and calves kept in organic production systems is scarce. Clearly, investigation on this topic is very important in order to clarify the epidemiology of these parasites in such systems (Höglund et al. 2010). Thus, the purpose of this study was to compare the evolution of parasitism level by helminths with weight gain in calves kept in organic and conventional systems.

MATERIALS AND METHODS

The organic system calves belonged to the herd of the Brazilian Organization for Agricultural Research (Embrapa Agrobiologia). The conventional system calves belonged to the Company of Agricultural Research of Rio de Janeiro (Pesagro-Rio). The experimental area is located in the metropolitan micro region of the city of Rio de Janeiro (22°45'S latitude, 43°41'W longitude, and 33 meters altitude). The calves were randomly selected to be monitored in the first grazing season, from January 2008 to December 2010.

Thirty calves were observed in the organic system every 15 days. The animals were crossbred (*Bos taurus* x *Bos indicus*) with blood level ranging from 1/2 to 5/8 *B. indicus*. To handle food, 0 to 2-year-old calves were kept in crates in the stable only at night. During the day they were kept in grazing areas with Coast-cross grass (*Cynodon dactylon* L. Pers., Coastcross), subdivided into three areas of 60m² each, and handled in rotational system with 14 days of grazing and 28 days for resting.

Two to 6-month-old calves were kept in an area of 0.47 ha, composed by a grazing of African Star grass (*Cynodon nlenfuensis*, Vanderyst) with the following legumes: Pinto Peanut (*Arachis pin-toi*), Desmodium (*Desmodium ovalifolium*), and *Estylosanthes* (*Estylosanthes guyanensis*), subdivided into 5 areas of 1175m², kept in rotational system with 8 days of grazing and 32 days for resting.

Six to 12-month-old calves grazed together with the remaining herd, composed by dry and lactating cows at a total of 31 animals in thus grazing. The total grazing area was 7.8 ha divided into seven areas of 1.3 ha, composed by Tanzania grass (*Panicum maximum* cv. Tanzânia) combined with Calopo (*Calopogonium mucunoides*). The grazing system used was the rotational one with 7 days of grazing, 42 days for resting, and occupation rate of 2 UA/ha⁻¹ in the rainy period. The animals did not receive any chemical medicine for gastrointestinal worm control.

In Fall and Winter, in addition to the grass, 0 to 6-month-old calves were fed with *Gliricidia* hay (*Gliricidia sepium*), and the six to twelve months of age animals were fed with sugar cane (*Saccharum officinarum*) combined with Guandu (*Cajanus cajan*), and Elephant grass (*Pennisetum purpureum* Schum. cv. cameroon) with Siratro (*Macropitilium atropurpureum*) chopped daily into the feeder.

The calves were only weaned at 90 days of age according to the organic production legislation (Brazil 2008), and received 0.600 to 0.800 kg of concentrate per day (12% PB and 66% NDT), produced with organic ingredients up to 6 years of age, being limited for the inducement of forage consumption of good quality. From 6 to 12 months of age, the concentrate amount went from 1 to 2 kg/day, as the grazing was done with adult animals.

Twenty-seven calves were kept in conventional system. The animals were crossbred (*B. taurus* x *B. indicus*), with blood level ranging from 5/8 to 7/8 of *B. taurus* blood. After birth, the calves were kept with the cows just long enough to ingest the colostrum. Then, the calves were kept in individual crates during the first 15 days of life, receiving 4 kg of milk/animal/day. From 15 to 120 days of age the calves were kept in an area of 0.40 ha of a *Brachiaria humidicula* pasture. After that, the animals were transferred to the heifer sector, where all animals from the herd, with 4 to 12 months of age, were kept. In that area, the animals were grazing in a *Brachiaria humidicula* pasture, receiving 2 kg/animal/day of commercial food with 22% of crude protein and mineral salt.

In the conventional system, anthelmintic prophylaxis was administered once a month. The active ingredient used was Ivermectin (0.2mg/kg) single dosage shot. Faecal samples were taken directly from the rectum of the calves for fecal egg count (FEC) using a modified McMaster technique. Composite cultures were performed for each infected group. The larvae obtained were identified according to the description of Keith (1953). To monitor the weight gain of the animals, the calves from both systems were weighted in the first 24 hours after birth and at 120, 180, 240 and 365 days of age.

For the statistical analysis, the data from FEC were first subjected to the normality test (Kolmogorov-Smirnov) to ascertain whether the data conformed to normal distribution. Because the data did not show normal distribution even after logarithmic transformation to log₁₀(x+1), comparisons were made between averages by applying the Kruskal-Wallis test at 5% significance. The generalized linear model methodology was used, assuming Poisson distribution with a logarithmic link function. The operational procedures were done using the R Foundation statistical computing software, version 2.12.2 (2011).

RESULTS

The average values and standard deviations of the helminth eggs count of Trichostrongyloidea and Strongyloidea super family, in feces of calves kept in organic and conventional production system during the first grazing season, are found in Figure 1.

The level of infection in calves from the organic system ranged from moderate to heavy, being the higher FEC observed in February (800 EPG). In the conventional system, the infection ranged from light to heavy, being the higher FEC in May (1300 EPG). Thus, there was a significantly difference ($p < 0.05$) between the parasite load of organic and conventional systems animals only in February and May. In the other months, both groups presented similar parasite profile.

In organic system animals, there was no statistical difference ($p > 0.05$) in FEC due to the season of the year. However, in conventional system the infection was higher ($p > 0.05$) in the fall. In the comparison between each other, in the winter, spring, and summer there was no significant difference ($p > 0.05$), while in fall the conventional animals showed more parasitism ($p < 0.05$).

Among the fecal samples from organic system animals, 47% showed egg counts below 350 EPG, 33% between 350 and 500 EPG, and 20% higher than 500 EPG. In this system, the higher individual value observed was 3000 EPG in February. Among the conventional animals, 50% showed egg elimination below 3000 EPG, 10% between 350 and 500 EPG, and 40% above 500 EPG. In this system, the higher individual level was 500 EPG in May.

When the age was evaluated as a risk factor to the occurrence of worms, the study observed that FEC in animals aged up to 6 months of age was higher ($p < 0.05$) than in 6 to 12-month-old animals, both in organic and conventional system (Fig.2). In the comparison between production systems, the parasite load in animals aged 0 to 6 years of age and 6 to 12 years of age did not show statistical difference ($p > 0.05$).

In the organic system, 60% of animals aged 0 to 12 months showed egg count higher than 500 EPG, while it was only 20% in 6 to 12-month-old animals. In the conventional system, nearly 48% of the animals younger than 6 month of age showed egg elimination higher than 500 EPG in comparison to only 13% of the animals older than 6 months old.

The most prevalent helminths belonged to *Trichostrongylus* and *Oesophagostomum* genders, the percent values were equal between both production systems. Nearly 70% of the identified larvae were from *Haemonchus* spp. gender. During the dry season of the year (fall and winter), a significant increase ($p < 0.05$) in the number of *Trichostrongylus* spp. was observed, as well as reduction in the number of *Haemonchus*. In the same period, there was no alteration in the number of *Oesophagostomum* larvae. The *Cooperia* gender was observed only in some samples and still in low prevalence (<3%).

During the whole study, the animals kept in conventional system showed higher elimination ($p < 0.05$) of *Strongyloides papillosus* eggs in comparison to animals kept in organic system. The conventional animals showed FEC

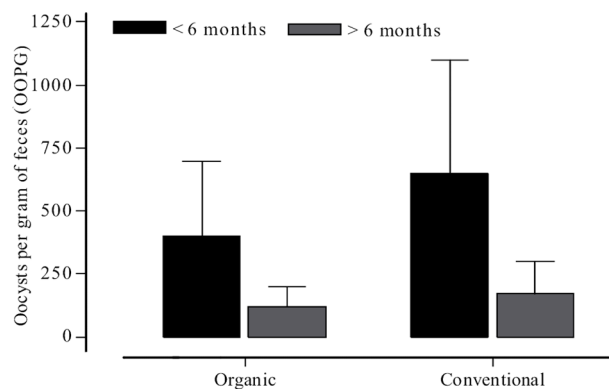


Fig.1. Mean value and standard deviation of helminth egg counts (Trichostrongyloidea superfamily) in feces of calves younger than 6 months and in 6 to 12-month-old calves, kept in the organic production system (Embrapa Agrobiologia) and in the conventional one (Pesagro-Rio), Seropédica, RJ, 2008/009.

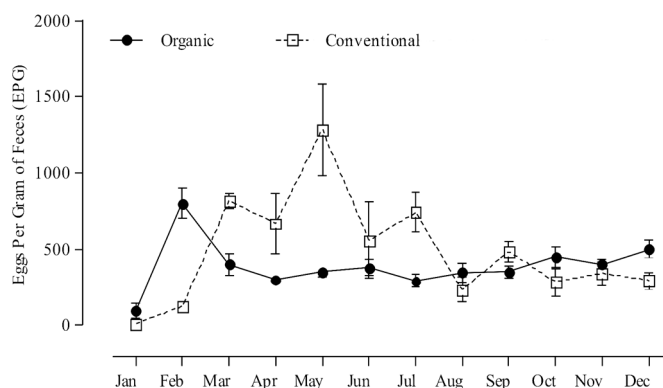


Fig.2. Mean value and standard deviation of helminth egg counts (Trichostrongyloidea superfamily) in feces of calves younger than 6 months and in 6 to 12-month-old calves, kept in the organic production system (Embrapa Agrobiologia) and in the conventional one (Pesagro-Rio), Seropédica, RJ, 2008/2009.

below 490 EPG, while in organic animals the counting was below 300 EPG. When the parasite load was evaluated according to age, it was noticed higher parasitism ($p > 0.05$) in animals younger than four months of age in both production systems.

Not only in organic system animals but also in conventional ones, a higher egg count of *S. papillosus* eggs was observed in May. In this month, the higher individual elimination of eggs was 1500 EPG in a conventional animal, and 900 in an organic one. Starting from 9 months of age, all animals showed stabilization in egg elimination, being always below to 180 EPG.

The egg counting of *Trichuris* were low. Nearly 50% of the organic samples showed 0 EPG, 35% between 0 and 100 EPG, and 15% higher than 100 EPG. Among these animals, the higher individual counting of eggs was 400 EPG. In conventional animals, 70% showed 0 EPG, 25% between 0 and 100 EPG, and 5% above 100 EPG. The higher value of individual EPG was observed in an organic animal in August (600 EPG).

The oocysts counting of *Eimeria* spp. did not show significant difference ($p > 0.05$) between the organic and conventional animals, except in April when the infection in con-

ventional animals was significantly ($p < 0,05$) higher than in organic animals (Fig.3).

In the entire first year of grazing, the average counting of *Eimeria* spp. was below 400 EPG in both groups of animals, except in April in which the average value was 800 EPG for conventional animals. The higher individual value of oocysts counting was observed in April, when a conventional animal showed 3000 EPG.

The weight at birth, at six and twelve months of age animals kept in organic and conventional systems, is represented below (Table 1). The weight gain of animals at 7 months of age was 92.7 kg (515g/day) in conventional animals, and 81.0 kg (450g/day) in the organic ones. From the 7th to the 12th month, a weight gain of 25.0 kg (140g/day) was observed for conventional animals, and 20 kg (110g/day) for organic animals. Thus, from the birth to 12 months of age, the average weight gain observed was 107.8 (327g/day) in animals kept in conventional system, and 100.5 kg (280g/day) in organic animals.

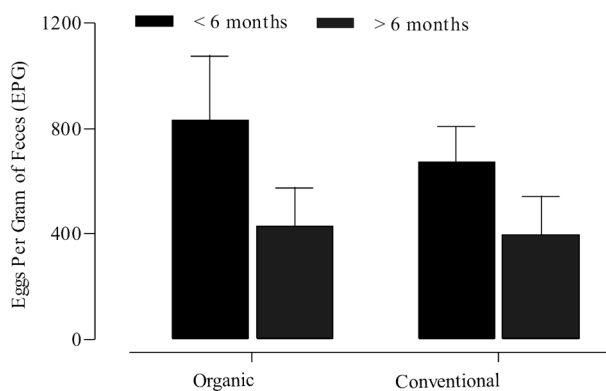


Fig.3. Average and standard deviation of the oocyst counts of *Eimeria* spp. in the feces of calves during the first grazing season, kept in the organic production system (Embrapa Agrobiologia) and in the conventional one (Pesagro-Rio), Seropédica, RJ, 2008/2009.

Table 1. Study of the production variables, birth weight and weight gain in calves maintained in the organic production system (Embrapa Agrobiologia) and in the conventional one (Pesagro-Rio), Seropédica, RJ, 2008/2009.

Evaluation of weight gain (kg) in calves kept on organic and conventional system			
Production system	Birth	Six months	Twelve months
Conventional	32.2±3.4	125±13.8	150±13.7
Organic	29.5±2.0	110±7.8	130±9.0

DISCUSSION

In this study, the grazing practices used in organic system and the use of anthelmintics in conventional system was efficient for the control of helminth diseases. Although the animals were infected during the entire study, there were no sick animals. Ploeger et al. (2000) observed a tendency of super protection of calves in conventional system. This practice, according to Vercruyse & Claerebout (2001), may be catastrophic, because it creates an improper development of the immune system acquired by the animals through lack of permanent contact with helminths.

The results observed in this study corroborate with Höglund et al. (2001), who noticed levels of infection ranging from low to moderate in organic calves of first grazing. Höglund et al. (2001) linked the low parasite load of the animals to the handling practices, such as grazing resting, low animal density, and nutritional supplementation.

Lima (1998) demonstrated that gastrointestinal nematohelminths may infect animals of any age; however, the problem was more severe in young animals. In this study, although the animals were infected during the whole study, it was noticed that age is a risk factor for helminth disease, once until 6 months of age the animals must be more carefully monitored as this period is critical for occurrence of the disease. In Europe, Shaw et al. (1998) observed that at 56 days after birth, the calves showed FEC higher than 200 EPG, with frequent outbreaks of the disease. In this study, animals kept in organic system showed egg elimination above 200 EPG, from 30 days of age on. In conventional animals, it happened from 60 days of age.

We observed that among the species that infect calves, gender *Haemonchus* was the more spreading one. Pimentel Neto & Fonseca (2002), studying the prevalence of *Haemonchus*, observed that the parasite directly influences the productive performance of the herd, according to the age group with intensity of infection and low nutritional state of animals. These same authors observed that moderate infection levels, when *Haemonchus* is the predominant helminth, cause usually mortality in young animals. In this study, no mortality was observed due to the presence of *Haemonchus*, probably because the level of animal parasitism was not constantly high.

The results of this study concerning *Strongyloides papillosus* corroborate with Pimentel Neto & Fonseca (2002) and Jimenez et al. (2010) who, while studying gastrointestinal parasites in calves, noticed low prevalence of this agent among the animals. However, the high incidence of *S. papillosus* in calves until 4 months of age is mainly related to trans-cutis infection (Jimenez et al. 2010). Concerning *Trichuris* gender, the results of the present study were close to the ones observed by Jimenez et al. (2010) who verified frequency of 7.8 to 14.5%. These same authors observed high parasite load in only 10% of the animals. The lack of clinical signs noticed in this our study may be related to the handling of young animals (Keyyu et al. 2006).

The elimination of *Eimeria* oocysts by animals in both systems was similar to the one observed by Höglund et al. (2001). These authors did not notice any clinical case of coccidiosis, and justified the results with the grazing handling and the nutritional state of the animals. In this our study, the young animals were kept apart from the adult ones, aiming to avoid the calves' infection by oocysts constantly eliminated by adult animals.

Thamsborg (2001), studying the population of gastrointestinal parasites in calves, observed that animals kept in organic system showed higher elimination of oocyst in feces than conventional animals. These same authors noticed that eimeriosis is a serious problem in organic farms, once 14% of the organic herds showed diarrhea, and only 6% in conventional system. Thus, infections with endoparasites

may represent a problem in the production of organic milk, but the variation among the farms is considerable. Most problems are related to calves younger than 3 months, without food supplementation, good quality grazing, and use of grazing rest procedures (Thamsborg 2001).

Many studies have associated the subclinical infection to the low weight gain (Borgsteede et al. 1985, Shaw et al. 1998). This study considered that the use of anthelmintics in animals kept in conventional system may be responsible for average gain of 17.3 kg/year (47g/day), more than animals kept in organic system and anthelmintic free. Shaw et al. (1998) observed weight gain of 40g/day in animals with subclinical infection and not treated with chemotherapeutics during the first grazing season. On the other hand, animals treated with anthelmintics demonstrated significantly higher weight gain, about 160g/day (Shaw et al. 1998). In this our study, this difference was observed as well, but without statistical difference.

CONCLUSIONS

The present study indicates that worm infection is a parasitic disease problem in organic and conventional dairy herds of the farm studied.

It also shows that gastrointestinal parasites may be kept on low to moderate levels through good management and without prophylactic anthelmintic treatment.

The management practices adopted in the organic production system were efficient for the control of helminth infection.

In contrast, monthly applications of anthelmintics were not efficient to combat helminths.

Conventional herds were more likely to use intensive grazing, what may have accounted for their higher rate of gastrointestinal nematodes as compared with organic herds.

Better knowledge about the effects of strategic nutritional supplementation on the level of parasitism needs to be accomplished through further experimentation.

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