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Research paper

New approach for the strategic control of gastrointestinal nematodes in grazed beef cattle during the growing phase in central Brazil

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ABSTRACT

We evaluated the effect of different treatment protocols against gastrointestinal nematodes in Nelore beef cattle during the growing phase in the municipality of Terenos, MS, in central Brazil from May 2013 to April 2014 and from May 2014 to April 2015. Ninety-six Nelore calves were kept on *Brachiaria brizantha* grass during each trial period and were distributed into six experimental groups (replicate paddocks for each group) based on live weight and the number of eggs per gram of feces (EPG): T1 (control)—treated in May, July and September with a saline solution; T2—treated in May and November with 700 μg/kg doramectin; T3—treated in May (doramectin), July (4.7 mg/kg levamisole phosphate) and September (doramectin); T4—treated in May (doramectin), July (200 μg/kg moxidectin) and September (doramectin); T5—treated in May (doramectin), August (levamisole phosphate) and November (doramectin) and T6—treated in May (doramectin), August (moxidectin) and November (doramectin). The calves were weighed and feces were collected (for faecal culture and EPG counts) from calves every 28 days, concomitantly with the collection of forage samples. The efficacies of doramectin, moxidectin and levamisole were low, at 69.2, 65.9 and 69.4% in the first and 13.8, 92.6, and 76.5% in the second experimental periods, respectively, but only the untreated animals lost weight during the dry season. Final weight gains did not differ significantly ($p > 0.05$) among the animals in T2 (120.8 kg), T3 (131.4 kg), T4 (131.2 kg) and T5 (134.4 kg). T6 was the only group with a significantly higher final weight gain (140.9 kg) compared to the protocol with two annual dosages (T2). The weight gain was 31.9% higher in T6 than in the untreated animals (T1). None of the protocols affected the number of larvae on the pasture. Body weight was significantly and negatively ($r = -0.65$) correlated with EPG counts, which were significantly lower in June (T2, T3, T4 and T6), August (T3), September (T5 and T6), October (T5) and November (T5 and T6). *Haemonchus*, *Cooperia*, *Trichostrongylus* and *Oesophagostomum* were identified. Treatments in May and November, the most common practice in Brazil, did not increase the final weight gain, so an additional and intermediate treatment during the dry season (August) is recommended.

1. Introduction

Gastrointestinal nematodes (GINs) are a major disease in beef cattle around the world, and decreased production is its main consequence (Vercruysse and Claerebout, 2001; Knox et al., 2012; Van der Voort et al., 2013; Charlier et al., 2014). The consequences of cattle parasitism are generally more severe in tropical/subtropical than temperate regions due to the combination of high temperatures and rainfall (Waller, 1997), which promote the survival and maintenance of parasites throughout the year. GIN is controlled in Brazil almost exclusively by the use of anthelmintic agents, which can provide higher weight gains of 11.85–53 kg/head when properly administered (Pinheiro et al., 2000; Soutello et al., 2002; Bianchin et al., 2007; Borges et al. 2013). The incorrect application of anthelmintics will have little or no effect on parasite populations or the rising cost of production, and the insufficient selection pressure will increase the rate of development of anthelmintic resistance (Lanusse et al., 2014).

Eighty percent of farmers in Brazil, however, still use inappropriate anthelmintic dosages and treat animals at epidemiologically inappropriate times to coordinate handling with other activities,

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especially the compulsory vaccination against foot and mouth disease (FMD) (Bianchin, 1991; Soutello et al., 2007), which is usually in May and November in most of Brazil. The development of long-acting anthelmintics (e.g. avermectins and milbemycins) has thus greatly contributed to the control of GIN, because the long period of protection against reinfection favors a longer interval between treatments and decreases the stress from handling (Borges et al., 2013) compared to anthelmintics with short residual periods (e.g. benzimidazoles and imidazoles). The inappropriate use of long-acting anthelmintics, however, may have little or no impact on the parasite populations (Stromberg and Averbeck, 1999) and may aggravate the development of resistance, which is among the largest obstacles in cattle production in many countries around the world (Kaplan and Vidyashankar, 2012; Martínez-Valladares et al., 2015).

The reduced effectiveness of anthelmintics, the lack of perspective for introducing new molecules to the market (Lanusse et al., 2014) and the lack of practical implementation of selective treatments in large herds in tropical conditions (Höglund et al., 2009) has necessitated studies of the strategic, rational and sustainable use of anthelmintics for reducing the negative impact of nematodiasis on the productivity of beef cattle raised on pasture.

The strategic control of GIN in beef cattle during the growing phase in central Brazil currently consists of treating animals from weaning up to 18–24 months of age. This age group (from weaning up to 18–24 months of age) has a higher susceptibility to parasitism and consequently represents a higher financial loss. Animals should be treated at the beginning, middle and end of the dry season. The conditions at this time are unfavorable for both larval development in the environment, due to reductions in temperature and humidity, and for the cattle, due to the reduced quantity and quality of available forage for consumption. Anthelmintic treatments should therefore be concentrated in May, July and September (Bianchin et al., 1996).

The strategic program of deworming currently recommended, however, can decrease parasitic load and environmental contamination and is cost effective (Bianchin, 1991), even with proven efficiency in increased weight gain, but handling and labor can be inconvenient, because the frequency of anthelmintic dosage does not coincide with the handling times for other operations, except for May, on most of the farms in central Brazil. A new protocol for the treatment of GIN is thus needed for the growing phase, with dosages in May and November (time of vaccination against FMD) and an additional intermediate dosing to maintain the current recommendation of three treatments concentrated in the dry season.

The current scenario of anthelmintic resistance in beef cattle in Brazil, with almost complete ineffectiveness of most of the anthelmintic formulations used in the field, especially macrocyclic lactones (Borges et al., 2015), has necessitated a re-evaluation of these drugs for controlling gastrointestinal nematodes and avoiding their negative impact on the productive performance of the animals.

The goal of this study was thus to evaluate three general protocols for treatment against parasitic gastrointestinal nematodes in beef cattle, given the current scenario of anthelmintic resistance: the current recommended treatment in May, July and September; the commonly used treatment in May and November and a new protocol for treatment in May, August and November.

2. Material and methods

2.1. Experimental location

The experiment was conducted at the Farm School of the Federal University of Mato Grosso do Sul (FAMEZ/UFMS) in Terenos, Mato Grosso do Sul, Brazil (20°26′32″S, 54°51′37″W). The region is characterized by a tropical savannah climate, with hot, humid summers and cold, dry winters. The state's annual rainfall is approximately 1500 mm. The state of Mato Grosso do Sul is at the confluence of the main atmospheric systems in South America and thus has more than one type of rainfall regime, some areas with a "central Brazil" regime and others with a "southern Brazil" regime (Zavattini, 2009).

2.2. Animals

The study used a total of 192 male Nelore cattle with initial ages of 8–10 months, naturally infected with gastrointestinal nematodes and no history of anthelmintic treatment.

2.3. Experimental design

The experiment was conducted in two trial periods, the first from May 2013 to April 2014 and the second from May 2014 to April 2015. The animals for the first and second periods came from properties with natural mating and fixed times of artificial insemination, respectively.

The study used a randomized-block design, in which each block (i.e., trial period) had two area replicates for each treatment. Each experimental group thus consisted of eight animals (192 animals ÷ 2 trial periods ÷ 6 treatment protocols ÷ 2 replicates = 8 animals) and was kept in its own paddock throughout the trial period.

The following treatment protocols, each with two area replicates per trial period, were evaluated: T1 (control)—animals treated in May, July and September with a saline solution; T2—animals treated in May and November with doramectin; T3—animals treated in May (doramectin), July (levamisole phosphate) and September (doramectin); T4—animals treated in May (doramectin), July (moxidectin) and September (doramectin); T5—animals treated in May (doramectin), August (levamisole phosphate) and November (doramectin) and T6—animals treated in May (doramectin), August (moxidectin) and November (doramectin).

We used 3.5% doramectin (Treo® Ace, Zoetis Brasil) at a dose of 700 μg/kg (1 ml/50 kg), levamisole phosphate (Ripercol®L 150F, Zoetis Brasil) at a dose of 4.7 mg/kg (1 ml/40 kg), 1% moxidectin (Cydectin, Zoetis Brasil) at a dose of 200 μg/kg (1 ml/50 kg) and a 0.9% saline solution (Isofarma Industrial Farmacêutica Ltda.) at a dose of 1 ml/50 kg. All formulations were administered according to manufacturer's label recommendations, on the left side of the animal.

2.4. Grazing

Each experimental group (eight animals) was maintained in a separate 4-ha paddock containing the grass *Brachiaria brizantha* cv. Marandu. The same treatment protocols were assigned to the same paddocks for the two trial periods. The initial capacity rates were 0.68 and 0.84 AU/ha (1 AU (animal unit) = 450 kg body weight) in the first and second trial periods, respectively. This is an initial stocking rate below the commonly used for these same conditions; however, this was a strategy necessary to ensure forage availability by the end of each cycle, when stocking rates were 1.2 and 1:47 for the first and second cycle respectively.

2.5. Handling

The animals were allowed to recover from the stress of transportation and to adapt to their new surroundings for a pre-trial period of 20 days for each of the two trial periods. All cattle had access to mineral supplementation (Zoorecria 60), protein supplementation (Suplemax 45 R, daily consumption of 100 g for each