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Short communication

Population dynamics and evaluation of the partial selective treatment of crossbreed steers naturally infested with *Rhipicephalus* (*Boophilus*) *microplus* in a herd from the state of Minas Gerais in Brazil

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ABSTRACT

The present study aimed to evaluate the population dynamics of *Rhipicephalus* (*Boophilus*) *microplus* over a period of 13 months on a rural property located in the state of Minas Gerais in southeastern Brazil. Animals were treated for ticks indoors by whole body spraying when *R. (B.) microplus* had an average count equal or more than 30 ticks. The study also evaluated the possibility of a partial selective treatment for bovines to control *R.* (*B.*) *microplus* in which only a percentage of the population would be treated (specifically those bovines with tick counts of ≥20. Moreover, we examined the percentage of the population of *R.* (*B.*) *microplus* present on experimental bovines that did not come into contact with the chemical compounds used in the partial selective treatment. We concluded that in this particular region of Brazil, the crossbreed steers support up to five *R. (B.) microplus* generations per year and that the number of generations was primarily affected by the pluviometric precipitation. We sprayed the bovines with chemicals seven times during the course of the study. The results of the partial selective treatment method revealed that during the rainy and the dry periods, 42.1% to 60.0% and 61.9% to 79.2% of the animals, respectively, fulfilled the criteria to receive a chemical treatment to reduce the number of cattle ticks. In consideration of the need to slow the development of tick resistance with the chemical compounds used in the spraying treatment, the results showed that the percentage of animals that did not require treatment is not relevant. This was evidenced by the result that bovines that presented tick counts of ≥20 during the dry and rainy periods represented 91.5% and 90.6% of the total recorded *R.* (*B.*) *microplus* populations, respectively. Only 8.7% of the tick population remained free from exposure to acaricides during the 13 months of the study, which is an important point when considering the adoption of the partial selective treatment method. Future studies with larger herds must be conducted on these topics; however, our results suggest that the partial selective treatment method most likely will not slow the development of resistance in this *R.* (*B.*) *microplus* population against the chemical compound used in this study.

1. Introduction

The southern cattle tick, *Rhipicephalus* (*Boophilus*) *microplus*, is considered as one of the principle causes of the loss of productivity in the cattle industry throughout the world (Lopes et al., 2013, 2014; Gomes et al., 2015). The control of this ectoparasite is based primarily on the use of chemical acaricides (Cruz et al., 2015). Unfortunately, reports of tick resistance to several active

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components in chemical acaricides are increasing (Corrêa et al., 2015). A recent strategy developed for controlling the spread of *R.* (*B.*) *microplus* is the partial selective treatment of animals based on infestation level, the objective of which is to retard the development of resistance of the tick to the acaricides. Specifically, only bovines with an elevated number of ticks would receive chemical spraying; thus, a significant portion of the tick population would not be exposed to the formulation/molecule (i.e., those ticks present on the untreated animals). To date, few published studies have examined the effectiveness of this method (Paim et al., 2011; Molento et al., 2013; Nava et al., 2015).

The present study evaluated the population dynamics of *R.* (*B.*) *microplus* in naturally infested crossbreed steers (1/4 *Bos indicus* and 3/4 *Bos taurus*, non-castrated males) within an extensive grazing area (dominated by the grass *Brachiaria decumbens*) in the state of Minas Gerais in southeastern Brazil over the course of 13 months. This work also analyzed the viability of a partial selective treatment of bovines to control *R.* (*B.*) *microplus*, which considered the percentage of animals that should be treated within the herd based on tick counts and tick size (between 4.5 and 8.0 mm). Moreover, the percentage of the *R.* (*B.*) *microplus* population present in untreated animals that would have no contact with the chemical products if partial selective treatments were adopted was determined.

2. Material and methods

2.1. Study location, bovines, tick counts and chemical treatments

The experiment was conducted between October 2013 and October 2014 at the Bela Vista Farm located in the municipality of Formiga in the state of Minas Gerais in southeastern Brazil.

We started with an initial herd of nearly 50 bovines (1/4 *B. indicus* and 3/4 *B. taurus*, non-castrated males) from which 24, between 9 and 10 months were randomly selected. The 24 bovines were distributed evenly into two groups, using a randomized complete block design. The formation of the blocks was based on the arithmetic means of the number of female ticks (measuring 4.5–8.0 mm) on bovines that were counted over three consecutive days, as recommended by Wharton and Utech (1970).

During the entire period of the trial, both experimental groups were kept in separate paddocks, each of which were filled with *B. decumbens* and had a stocking rate of 1.5 animal units per hectare. Water and mineral supplements were provided "*ad libitum*", and commercial ration and corn silage were used as feed.

For the evaluation of the *R.* (*B.*) *microplus* population dynamics, counts of female ticks on each animal were performed on days 3, 7, 14, 21, 28, and subsequently every 14 days until day 364 (Wharton and Utech, 1970). The counts were always conducted at the same time of the day by the same researcher.

Temperature, relative air humidity and rainfall data were retrieved daily from the climatological station (FORMIGA), located approximately 7 kilometers from the experimental site.

The chemical treatments to control *R.* (*B.*) *microplus,* were carried out on bovines from each group by whole body spraying using the following application: 15% Cypermethrin +25% Chlorpyriphos +15% Piperonyl Butoxide +1% Citronellal (Cyperclor Plus® Pulverização—CEVA Saint Animale). The spraying was carried out when a group had an average tick count equal to or more than 30 and an average tick length between 4.5 and 8.0 mm.

2.2. Evaluation of partial selective treatment of animals to control R. (B.) microplus

Prior to the spraying, we also analyzed the potential of the partial selective treatment method to control the number of *R.* (B.) *microplus* on bovines, according the standard previously established by Paim et al. (2011) and Molento et al. (2013), which stated that only animals that presented *R.* (*B.*) *microplus* counts of ≥20 should be treated.

However, in light of the ultimate goal of affecting a delay in the development of tick resistance to acaricides, we assert that the percentages obtained from the partial selective treatment method may be more important in terms of the animals that did not meet the criteria to be treated with a chemical compound. For this reason, on the same dates that each group received the chemical treatments, we evaluated the percentage of the *R.* (*B.*) *microplus* population present on the animals that were not treated. Thus, these ticks remained free of exposure to the chemical compounds. To this end, the following formulas were used:

Tick population (%) quantified on animals that would be treated with a chemical formulation when adopting partial selective treatments

$$= \frac{A - B}{A} \times 100$$

where A = Total of *R.* (*B.*) *microplus* (between 4.5 and 8.0 mm) quantified on animals of both groups on the treatment day, during each season, or throughout the study (13 months). B = Total of *R. (B.) microplus* (between 4.5 and 8.0 mm) quantified on animals with tick counts <20 on the treatment day, during each season, or throughout the study (13 months).

Both variables were analyzed in relation to season (dry and wet) and across seasons.

Tick population (%) quantified on animals that would NOT be treated with a chemical formulation when adopting partial selective treatments

$$= \frac{A - B}{A} \times 100$$

where A = Total of *R. (B.) microplus* (between 4.5 and 8.0 mm) quantified on animals of both groups on the treatment day, during each season, or throughout the study (13 months). B = Total of *R. (B.) microplus* (between 4.5 and 8.0 mm) quantified on animals with tick counts ≥20 the on treatment day, during each season, or throughout the study (13 months). Both variables were analyzed in relation to each season (dry and wet) and across seasons (13 months)

2.3. Data analysis

The meteorological parameters (temperature, relative air humidity and rainfall) and the *R. (B.) microplus* counts were correlated using the Pearson coefficient. According to Filho and Junior (2009), the range of possible values for the Pearson coefficient is between −1 and 1. Negative and positive values of the coefficient signify the following: 0.00–0.30 indicates a low correlation, 0.31–0.69 indicates a moderate correlation, and values greater than 0.70 indicate a high correlation. All analyses were conducted using STATISTICA data analysis software (Ver. 10; 2011) by StatSoft Inc. (www.statsoft.com).

3. Results

There were five peaks in *R.* (*B.*) *microplus* infestation observed over the course of the 13 months (Fig. 1). During the rainy period (October to March), we observed three *R.* (*B.*) *microplus* infestation peaks (October, December and March), whereas there were two peaks were observed in April and July during the dry season (April to September) (Fig. 1). Notably, the rainy season in 2014 lasted until April, and it is important to note that there was rainfall during the