pubvet
MEDICINA VETERINÁRIA E ZOOTECNIA
ISSN 1982-1263
https://doi.org/10.31533/pubvet.v14n4a546.1-3

# Acaricide efficacy against a Brazilian *Rhipicephalus (Boophilus) microplus* isolated field population over a five-year period

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**Abstract.** The resistance of *Rhipicephalus (Boophilus) microplus* to acaricides is a concern. We evaluated an isolated population of the Brazilian semi-arid region during a period of five years. Significant variations in the efficacy of the acaricides studied were correlated with historical patterns of use, which varied significantly over the period.

**Keywords:** acaricide, *Rhipicephalus microplus*, resistance

# *Eficácia de acaricida contra população isolada de* Rhipicephalus (Boophilus) microplus *no Brasil por um período de cinco anos*

**Resumo**. A resistência do *Rhipicephalus (Boophilus) microplus* a acaricidas é uma preocupação. Avaliamos uma população isolada do semi-árido brasileiro durante um período de cinco anos. Variações significativas na eficácia dos acaricidas estudados foram correlacionadas com padrões históricos de uso, que variaram significativamente ao longo do período.

**Palavras chave**: acaricida, *Rhipicephalus microplus*, resistência

# *Eficacia del acaricida contra la población aislada de* Rhipicephalus (Boophilus) microplus *en Brasil por un período de cinco años*

**Resumen**. La resistencia de *Rhipicephalus (Boophilus) microplus* a los acaricidas es preocupante. Evaluamos una población aislada del semiárido brasileño durante un período de cinco años. Las variaciones significativas en la eficacia de los acaricidas estudiados se correlacionaron con patrones históricos de uso, que variaron significativamente durante el período.

**Palabras clave**: acaricida, *Rhipicephalus microplus*, resistencia

## Introduction

The cattle tick *Rhipicephalus (Boophilus) microplus* is highly prevalent in tropical and subtropical areas, where it is responsible for severe economic losses (Jonsson et al., 2014). This parasite has historically been controlled via the application of chemical, herbal, and homeopathic substances. However, during extended acaricides use, resistant ticks survive and multiply, producing descendants that will pass on even greater acaricide resistance to their offspring (Drummond et al., 1971; Guerrero et al., 2012).

In light of this situation, this study aimed to evaluate the efficacy of acaricides against a *R. microplus* isolated field population and to determine whether these patterns of efficacy are correlated with the history of acaricide use during the study period.

## Material and methods

This study was conducted on a cattle farm located in the municipality of Miguel Calmon, Bahia State (latitude: 11°24′31.40″ S; longitude 40°34′44.73″ W), a region with a tropical semi-arid climate, and a total area of 109 hectares. There have been no new animals introduced to the farm's flock since 2005, there are no cattle farms located close to the stud property, and the total number of cattle ranged from 50 to 80 animals. The herd was made up of cattle of a mixed zebu *vs.* European breed.

The acaricide treatments applied during the study period are listed in Table 1. Prior to the evaluation period, treatments made up of a combination of cypermethrin and chlorpyrifos were applied in March, April, August, October, and November of 2007. These treatments were applied as recommended by the veterinary doctor responsible for the farm, and conducted under veterinary supervision.

**Table 1.** Acaricide treatments used at the study farm during 2008–2012

| Year | Treatments |
|---|---|
| 2008 | Two applications of a cypermethrin–chlorpyrifos[1] combination |
| | Two applications of amitraz[1] |
| | Two applications of fipronil[2] |
| 2009 | Three applications of a dichlorvos–chlorpyrifos[1] combination |
| | Three applications of amitraz[1] |
| 2010 | Three applications amitraz[1] |
| | Three applications of abamectin[2] |
| 2011 | Two applications of abamectin[2] |
| 2012 | Two applications of abamectin[2] |

[1]Pour-on treatment; [2]Dip-vat treatment

## Results and discussion

Engorged female *R. microplus* ticks were collected from the farm's animals, and the time of parasite collection was made observing each compound residual action period. Ticks' susceptibility to acaricides was determined using the adult immersion test (AIT), as described by Drummond et al. (1971), with the modifications described by Patarroyo et al. (2002) and Raynal et al. (2013); each assay was repeated twice. The acaricides used in the experiment are listed in Table 2. All chemicals were diluted according to the manufacturers' instructions.

**Table 2.** Efficacy of acaricides against *Rhipicephalus microplus* from the study property (results are expressed as percentages)

| | Year | | | | |
|---|---|---|---|---|---|
| Acaricide | 2008 | 2009 | 2010 | 2011 | 2012 |
| Cypermethrin | 48.94 | 0.66 | 0.60 | 7.00 | 2.18 |
| Amitraz | 75.05 | 15.80 | 18.4 | 19.78 | 79.13 |
| Dichlorvos and chlorpyrifos | 5.82 | 22.14 | 3.72 | 19.38 | 22.75 |
| Dichlorvos and cypermethrin | 31.77 | 2.82 | 1.93 | 16.49 | 0.38 |
| Fipronil | 100 | 86.54 | 98.44 | 100 | 100 |

This work followed the efficacy of acaricides against *R. microplus* from an isolated beef cattle farm during a five-year period where no new animals were added to or in temporary contact with the herd. The farm's isolation ensured that the tick population was not affected by individuals originating from other populations, and that this study illustrates the development and loss of resistance in a single field tick population.

The efficacies of the acaricides used in this study are shown in table 2, where it is possible to observe marked variations in the ticks' acaricides susceptibility during the study period. These results are directly related to the selective pressure exerted by the acaricides treatments, as it can be seen by the comparison of the AIT results and the acaricide application schedule adopted by the farm. Amitraz was used in 2008, and by the next year, its efficacy dropped from 75.05% to 15.80%; two years after the suspension of amitrazine use, its efficacy was restored and reached 79.13%. A similar situation has already been

observed during a field trial in Mexico, which tested tick resistance to pyrethroids and amitrazine (Faza et al., 2013).

The dichlorvos and cypermethrin combination was used prior to the start of the experiment, and the first AIT test revealed a low level of efficacy, which persisted even after the three-year suspension of its use. Resistance to the combination pyrethroid-organophosphate has already been described (Faza et al., 2013). The study also showed that the lack of susceptibility can endure in a tick population over long periods, probably because the above compounds have been used for a long period in tick control, and resistance has been well established in many tick isolates. This assumption is confirmed by the observed low levels of susceptibility to the organophosphates dichlorvos and chlorpyrifos during our study.

Fipronil was used in 2008, and by the following year, susceptibility to this compound had dropped from 100% to 86.54%. However, after fipronil treatments ceased, its efficacy recovered to 98.44% in 2010, and reached 100% in 2011 and 2012. Although the use of fipronil to control ticks began more recently than the use of other acaricide compounds, resistance to this acaricide has already been observed. Reck et al. (2014) described a tick population resistant to fipronil and five other classes of acaricides. Resistance to fipronil was not widespread in the tick population examined in this study; thus, susceptibility was rapidly restored.

## Conclusion

In light of these results, it can be concluded that the resistance of *R. microplus* to acaricides can vary over time, and many compounds that were previously considered to be inefficient may become effective after being replaced with a different acaricide. Thus, it is important that cattle producers perform periodic acaricide efficacy assays: the results of these tests can be used to establish the rotational use of different acaricides to better maintain the efficacy of individual acaricides.

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**Recebido**: 10 de novembro, 2019.
**Aprovado:** 9 de dezembro, 2019.
**Publicado:** 14 maio 2020.