

Evaluation of the effectiveness of ixodicides on *Rhipicephalus (Boophilus) microplus* in bovines in a population of the state of Nuevo León, Mexico

Avaliação da eficácia de ixodicidas em *Rhipicephalus (Boophilus) microplus* em bovinos em uma população do estado de Nuevo León, México

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ABSTRACT

The *Rhipicephalus (Boophilus) microplus* tick is of great importance in livestock due to its direct and indirect effects, it has a distribution of 69.4% of the national territory, with approximate losses of up to 573.61 million dollars per year in Mexico. Chemical control is the most widely used method, however, continuous, and indiscriminate use has led to the emergence of populations of resistant ticks. In this study, the efficacy of three synthetic ixodicides, a pyrethroid, an organophosphorade, and a pyrethroid- organophosphorade mixture were evaluated. in a field population through the adult immersion test, obtaining efficacy rates of 28.66%, 100%, and 96%, respectively. It was obtained that the organophosphate is the only ixodicide that can be used in this population.

Keywords: Tick, Resistance, synthetic ixodicide.

RESUMO

O carrapato *Rhipicephalus (Boophilus) microplus* é de grande importância na pecuária devido aos seus efeitos diretos e indiretos, possui uma distribuição de 69,4% do território nacional, com perdas aproximadas de até 573,61 milhões de dólares por ano no México. O controle químico é o método mais utilizado, porém, o uso contínuo e indiscriminado tem levado ao surgimento de populações de carrapatos resistentes. Neste estudo, foi avaliada a eficácia de três ixodicidas sintéticos, um piretróide, um organofosforado e uma mistura piretróide-organofosforado. em uma população de campo por meio do teste de imersão de adultos, obtendo taxas de eficácia de 28,66%, 100% e 96%, respectivamente. Obteve-se que o organofosforado é o único ixodicida que pode ser utilizado nesta população

Palavras-chave: Carrapato, Resistência, ixodicida sintético.

1 INTRODUCTION

Ticks are hematophagous ectoparasites, their importance has been recognized for their great impact due to their direct and indirect effects on human and animal health (Guglielmone et al. 2004). The species *Rhipicephalus (Boophilus) microplus* (Canestrini, 1888), also called the bovine tick, is distributed between parallel 32° North and 35° South (Estrada, et al. 2006), covering tropical, temperate and arid zones, with a distribution of 69.4% of the national territory (SENASICA, 2020), presenting up to four generations, with losses of up to 573.61 million dollars per year in Mexico (Rodríguez-Vivas et al. 2017).

In Mexico, it is known that, in most meat production herds, the control of *R. (B.) microplus* is carried out exclusively with the use of synthetic ticks, especially organophosphates, pyrethroids and amidines (Rodríguez, et al. al. 2006). The emergence of resistance to ixodicides has been generating serious problems in cattle production, with a worldwide trend. The main cause of the development of resistance is associated with the expression of intrinsic or biological factors related to the tick, such as; gene mutations (resistant dominant alleles) within populations, resulting in insensitivity of the site of action and enzymatic changes in metabolism (Guerrero, et al. 2001).

The factor biological, is mainly due to the operational factor related to the action of man in the control of the tick, because most producers use the chemical as the only tool for the control of

this ectoparasite, which leads to resistance by Selection pressure, since it is used in the wrong way, an example is the excessive use of ixodicides without knowing the biology and ecology of the tick, as well as the lack of detection of resistance (Rodríguez-Vivas et al., 2006) , which leads to one of the biggest problems in Mexican livestock. Organophosphates were used in the National Campaign to eradicate the tick between 1974 and 1984 in Mexico (Trapaga 1989), the first case of resistance of *R. (B.) microplus* was detected in the Mexican tropics in 1983 and soon became general in the central, eastern and southern regions of Mexico (Rodríguez-Vivas et al. 2012). Pyrethroids are the family of ixodicides that presents the greatest resistance problem, since 66 to 95% of the ranches in Mexico have resistant ticks. On the other hand, to improve the effectiveness of acaricides in the control of ticks in cattle, the use of mixtures has been suggested, this implies the application of two products together and thus the tick population is exposed to more than one toxic (Tabashnik, 1990). The basic principle for a mixture to be useful is that the two products have different modes of action and metabolism (Roush, 1993), hoping that there is synergy or potentiation,

The objective of this work was to evaluate by means of the Adult Immersion Test (PIA) the in vitro efficacy of commercial products, with active ingredients; pyrethroid, organophosphate and a pyrethroid-organophosphate association on a population of *R. (B.) microplus* collected in cattle from the municipality of General Bravo, Nuevo León.

2 MATERIALS AND METHODS

2.1 GETTING TICKS

In May 2019, sand approximately 200 teleogines were collected, in the municipality of General Bravo (25 ° 42'07.6" N and 100° 11'33.9" W) in Nuevo León, belonging to a ranch of red Brangus beef cattle. Specimens were collected manually directly from the body of naturally infested cattle, with at least 21 days without ixodicide treatment, and transported in a labeled container, with wet cotton (FAO 1999).

2.2 ADULT IMMERSION TEST (PIA)

The day after the collection, in the laboratory of a health of the Faculty of Veterinary Medicine and Zootechnics of the Autonomous University of Nuevo León, sand performed the modified Adult Immersion Test (PIA), described by Drummond et al. (1973). For the evaluation of the biological effectiveness, the teleogines were washed with distilled water and selected according to their state and morphology. Subsequently, they were weighed and placed in groups of ten teleogynes per group with homogeneous weights, giving 6 groups with a total of 60 teleogynes, since the test was carried out in duplicate. The active principles of the ixodicides used were:

Cypermethrin and a combination of Clopyrifos and Permethrin, which were diluted in water, following the manufacturer's recommendations. After weighing, each group was immersed for five minutes in solutions containing the dilution of the ixodicides. Distilled water was used for the control group. After the dive, Each group of teleogynes was dried and fixed on a double-sided tape at the bottom of a previously identified Petri dish, with the genital opening and the mouthparts turned out of the tape so that the laying of the eggs was performed at the edges. of the plate. The plates were taken to a BOD (Biochemical Oxygen Demand) incubator heated at a temperature of 27 ° C (± 1 ° C) and a relative humidity greater than 80% for oviposition. After 7 days of incubation, the mortality of the teleogynes was evaluated and after 14 days the fertile egg mass of each group was evaluated, on day 30 the analysis of the hatching of the positions was carried out. From these data, the reproductive index (IR) and the efficacy index (IE) of each commercial product were evaluated, through the following formulas:

$$IR = \frac{(\text{Peso de huevos}) (\% \text{ eclosión}) (20,000)}{\text{Peso de la hembra adulta}}$$

$$IE = \frac{(\text{IR del grupo control} - \text{IR del grupo tratado})}{\text{IR del grupo control}} \times 100$$

3 RESULTS AND DISCUSSION

In table 1 we observe the results of the IAP, the highest mortality of teleogynes was observed with organophosphate. Regarding the mass of eggs, the pyrethroid was high with respect to the organophosphate that was slightly higher than the association, with respect to the percentage of hatching it was high in the pyrethroid with respect to the association, in the organophosphate it was null. The Efficacy Indices (EI) of the ixodicides demonstrate the low efficacy of both the pyrethroid on the analyzed population. According to the official Mexican standard NOM-006-ZOO-1993, the efficacy of acaricides for *R. (B.) microplus* must be greater than or equal to 98%, if applicable and this is lower in any of the mandatory tests. by the standard, but not less than 95%, could be considered, performing more test methods, Regarding the products analyzed, only the organophosphate was the one that is still within what is indicated by the standard, considering the association to carry out more test methods. In Mexico, the main control of *R. (B.) microplus* is through the use of organophosphates, pyrethroids and amitraz (Rodríguez, et al. 2006), however, its efficiencies have been reduced due to the presence of strains resistant to these chemicals (Cabrera et al., 2008). In the state of Nuevo León, the presence of ticks resistant to these ixodicides is known,

however, studies carried out between 2015 and 2017 by the National Center for Animal Health Verification Services (CENAPA) in the state of Nuevo León, do not indicate that there is a low efficacy of the pyrethroid and the pyrethroid-organophosphate association (Neri S. 2018), which differs from our study, which shows that most producers in the state do not send samples for resistance diagnosis when they have a significant resistance problem. On the other hand, the results in this study agree with that mentioned by Jonsson (1997), who describes that the low efficacy of acaricides varies according to the regions, depending mainly on factors such as; ecological niches, livestock management and the use of acaricides. In this case, the EIs obtained may be due to the presence of management failures such as performing an inappropriate application, having a loss in effectiveness over time, in agreement with Farías et al. (2008). In our study, the increase in EI of the pyrethroid associated with an organophosphate may be due to what was established by Rodríguez et al. (2006) where several organophosphates potentiate the action of pyrethroids such as deltamethrin and cypermethrin. In Mexico, the mixtures available in the market and that are used most frequently are Chlorpyrifos + permethrin, however, improper use and not having an efficacy diagnosis can and is leading to the presence of resistant populations nationwide. of these associations of ixodicides.

Table 1. Effect of ixodicides and control on teleogynes and their reproductive parameters through PIA.

Commercial product	Female mortality %	Egg mass weight (g)	Egg Hatching %	Product Effectiveness (%)
Ticoff Piretroide	20±14.14	0.755±0.03	85±0.00	28.66
Asuntol Organofosforade	90±0.0	0.08±0.11	0±0.0	100
GarraBan MO 29 Piretroide-Organofosforado	90±14.14	0.05±0.24	40±10.20	96
Control Water	0±0.0	0.91±0.15	100±0.00	--

4 CONCLUSION

In the state of Nuevo León, there is a low Efficacy Index of products derived from the pyrethroid active principle and from the organophosphate-pyrethroid association, according to the requirements established by NOM-006-ZOO-1993, the Organophosphate can be used for the control of this tick population. In addition, these results confirm the importance of diagnostic tests to observe and quantify the efficacy of chemical products on populations of *R. (B.) microplus* at the national level.

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