



Original Research

Susceptibility Level of *Ornithodoros spp.* (Acari: Argasidae) to Some Commercial Synthetic Pyrethroids in North Gujarat

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Abstract

Ticks are known to be a nuisance in the animal production sector and serve as vectors for several diseases of human, livestock and pets. In animals, tick infestations are much more severe than in humans. However, the prevalence of soft ticks is comparatively lower and wherever they are present they cause severe economic loss by sucking the blood of animals. Acaricides form the center of control and eradication efforts; however, their long term use has generated acaricide resistance among ticks. Commercially available preparations of 1.25% EC deltamethrin and 10% EC cypermethrin were used for assessment of their acaricidal activity against soft ticks; *Ornithodoros spp.* by using Larval Packet Test. The commercial preparations of both the pyrethroids (deltamethrin and cypermethrin) failed to show complete mortality either at the manufacturer's recommended dosage or at highest concentration employed in this study. The study revealed that there is an urgent need to study the acaricidal resistance status of soft ticks prevalent in different areas and as per result obtained.

Key words: Acaricides, Cypermethrin, Deltamethrin, *Ornithodoros*

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Introduction

Ticks distributed worldwide, parasitizing on mammals, birds and reptiles, are obligate blood sucker and are of enormous veterinary relevance owing to the direct damage they cause to their hosts (Telmadarrayi *et al.*, 2007). At the same time they are vectors of large variety pathogens (Matias *et al.*, 2007; Bouwknecht *et al.*, 2010). They are most competent and versatile arthropod vector for transmission of various pathogens in animals as well as humans (Shyma *et al.*, 2015a). Prevalence of soft ticks is comparatively lower than that of the other hard tick and also they act as a vector for comparatively fewer pathogens. It is therefore,



due to this reason these ticks garner little less attention of the livestock keepers for their control. However, these ticks are significant blood suckers and cause huge production loss. Massive numbers of ticks will feed on the lower legs of their hosts and toxins in the tick's saliva can cause paralysis and a toxemia which is sometimes fatal (Walker *et al.*, 2014). Acaricides form the center of control and eradication efforts because they offer relatively quick and cost-effective suppression of tick populations (Abbas *et al.*, 2014). Long term use, however, has generated acaricide resistance in many tick species (Shyma *et al.*, 2014, 2015a; Guerrero *et al.*, 2014, Shyma *et al.*, 2015b). Therefore it is important to investigate the efficacy of commonly used acaricides to control ticks so as to check their resistant or susceptible status and formulation of new control methods in case of treatment failure. Very few reports are available on susceptibility/resistance status of soft ticks (Ghavami *et al.* 2015; Sharma *et al.*, 2017). The present investigation was targeted to study the acaricidal effect of some of the commercially available acaricides (deltamethrin and cypermethrin) on buffalo soft ticks of Banaskantha district of North Gujarat.

Materials and Methods

Tick Collection and Laboratory Maintenance

The ticks were collected from Deesa taluka of the Banaskantha district which is in the northwestern part of Gujarat, at latitudes, longitudes and altitudes of 24.2585° N, 72.1907° E and 144.58 Meters at sea level, respectively. Annual ambient temperature and rainfall of the study areas were in the range of 11.8° C, through 41.5° C, and 221 mm, respectively. Live engorged adult female ticks were handpicked under close scrutiny from all kinds of surfaces including cervices and cracks on the walls of cattle and buffalo shelters, human dwellings, and indoor caves. Ticks were kept in vials covered with muslin cloth were brought to Entomology Laboratory, Department of Veterinary Parasitology, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat, India. Identification of ticks was done both by gross examination and with a microscope using tick identification sources (Ruedisueli and Manship, 2006; Telmadarraiy *et al.*, 2004; Walker *et al.*, 2014). Ticks were then washed, cleaned, labeled, and kept for egg laying at $28 \pm 1^\circ\text{C}$ and $85 \pm 5\%$ relative humidity. Ticks were kept up to two months for hatching of eggs into larvae. Further, larvae were kept for 12–14 days before performing experimental bioassay.

Commercial Synthetic Pyrethroids

The commercial products, namely 1.25% EC deltamethrin at the concentrations of 12.5, 25, 50, 100 and 200 ppm and 10% EC cypermethrin 100, 200, 400, 800 and 1600 ppm respectively, were prepared in distilled water from the stock solution.

Larval Packet Test (LPT)

Larval packet test was conducted according to FAO (1971), guidelines with minor modifications (Shyma *et al.*, 2015a). A number of 3.75 cm by 8.5 cm filter paper rectangles (Whatman filter paper no. 1) were impregnated with six hundred microlitres of different concentrations of deltamethrin and cypermethrin in distilled water. The impregnated paper was dried by keeping the same for 30 minutes in an incubator at 37°C. The rectangles were folded in half to form an open-ended packet and sealed on the sides with adhesive tapes, to place tick larvae. Approximately 100 larvae were inserted and the packet was sealed with adhesive tape. Total three packets filled with larvae were kept for each concentration of drugs. These packets were then placed in desiccators in BOD incubator maintained at $28 \pm 1^\circ\text{C}$ and $85 \pm 5\%$ RH. The packets were removed after 24 h, and larval mortality was calculated after counting the number of live and dead larvae. Control packets impregnated with water were also prepared for each series of concentration to be tested.

Statistical Analysis

Dose–response data were analyzed by probit method (Finney, 1972). Regression curves of mortality of larva were also plotted against values of acaricide concentrations by log dosage probit mortality analysis and LC_{50} and LC_{95} values of both the synthetic pyrethroids were determined.

Results and Discussion

The morphological features particular to *Ornithodoros* spp. like size, oval rounded body with tough, corrugated, dusty colored integument with rounded tubercles revealed that the ticks collected were soft ticks belonging to family *Ornithodoros* spp. (Ruedisueli and Manship 2006; Telmadarraiy *et al.*, 2004; Walker *et al.*, 2003). The Scutum was absent and the mouthparts were small and ventrally placed (Fig. 1).



Fig.1: Macroscopic and microscopic view of *Ornithodoros* spp.

In the present study, very little mortality was recorded in the larvae of soft ticks treated with various concentrations of deltamethrin and the mean mortality varied from $0.16 \pm 0.16\%$ to $1.95 \pm 0.42\%$. The slope of mortality was 0.74 ± 0.13 whereas, the value of the coefficient of determination (R^2) for developed regression equation was 0.91 (Fig. 2). Similarly, comparatively low but significant (from control), mortality was recorded in the larvae treated with various concentrations of cypermethrin and the mean mortality varied from 4.61 ± 0.49 to $32.11 \pm 0.83\%$. The slope of mortality was 1.01 ± 0.06 whereas, the value of goodness of fit (R^2) was 0.99 (Fig. 2). Acaricidal effect of commercial preparations of deltamethrin and cypermethrin on *Ornithodoros* spp. ticks are presented in Table 1.

Table 1: Mortality, slope and coefficient of determinations of commercial formulations of deltamethrin and cypermethrin on larvae of *Ornithodoros* spp. ticks.

Acaricide	Conc. (ppm)	Mean Mortality (%)	Slope	R ²
Deltamethrin	12.5	0.16 ± 0.16	0.74 ± 0.13	90.94
	25	0.315 ± 0.19		
	50	1.18 ± 0.72		
	100	1.09 ± 0.33		
	200	1.95 ± 0.42		
Cypermethrin	100	4.61 ± 0.49	1.01 ± 0.06	99.04
	200	7.85 ± 0.33		
	400	11.76 ± 0.69		
	800	20.33 ± 1.20		
	1600	32.11 ± 0.83		
Control		0.8 ± 0.37		

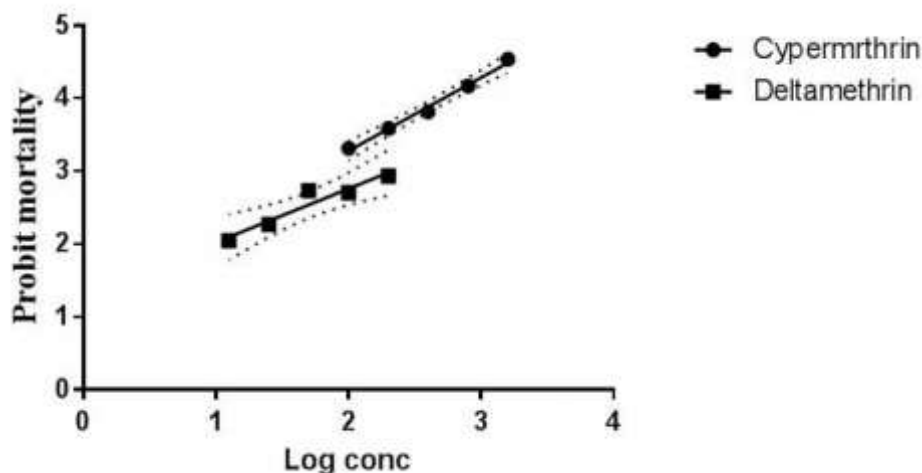


Fig. 2: Dose dependent mortality of *Ornithodoros* spp. against cypermethrin and deltamethrin

Soft ticks are equally important as hard ticks in the spread of infectious diseases to animals and humans and also suck blood leading to anemic condition, severe economic loss due to loss of production and stress

in animals. Natural selection for resistance in tick populations is a major consequence of artificial extensive application of acaricides and a major threat to the efficacy of control programs against tick borne diseases. In the present study, the mortality of larvae of *Ornithodoros* spp. was very low against both deltamethrin and cypermethrin at its market recommended dosage. These chemicals could not produce cent percent mortality even in the highest concentration. Due to the lack of reference resistance or susceptible strain of *Ornithodoros* spp. tick, it was difficult to determine the level of resistance. In present study we have got results which indicate very high concentrations of acaricide at which 50 or 95 % mortality could be registered. There are only a few studies related to susceptibility/resistance status of *Ornithodoros* spp. ticks against various acaricides. In a previous study, Sharma *et al.* (2017) reported susceptibility of *Ornithodoros* spp. ticks against deltamethrin and cypermethrin, although from different area of Banaskantha district. However, this study is in contrary to the finding of Sharma *et al.* (2017). This further necessitates an urgent need to develop baseline information on discriminating concentration in susceptible line of *Ornithodoros* spp. to determine the status of susceptibility or resistance of the field population of these ticks. The present study, however, suggests the emerging resistance in soft tick against the commonly used acaricides and further study has to be undertaken to determine the mechanism of resistance in these ticks. A comparative study has been conducted by Telmadarraiy *et al.* (2007) for estimation of comparative susceptibility of cypermethrin in *Ornithodoros lahorensis* Neuman and *Argas persicus* Oken field populations in Iran. Comparison of the resistance ratio of collected strains with susceptible strain showed a resistance ratio of 56.7 and 2.4-folds for cypermethrin in *O. lahorensis* Mesh and *A. persicus* West Ap strains, whereas the *O. lahorensis* West Ol completely susceptible to cypermethrin. Ghavami *et al.* (2015) worked on susceptibility level of *Ornithodoros tholozani* to some pesticides in North West of Iran.

Conclusion

Different levels of resistance to deltamethrin and cypermethrin were observed in various populations of *Ornithodoros* spp. of Banaskantha district of Gujarat, reviewing and refining the control measures against ticks, applying new formulations of acaricide mixtures and monitoring the susceptibility level of acaricides seem necessary in these regions. Moreover, future studies to identify the molecular characteristics of resistance to acaricides and determining the effective acaricide are highly recommended in these areas.

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