Differences of Susceptibility of Five Triatomine Species to Pyrethroid Insecticides – Implications for Chagas Disease Vector Control

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As pyrethroids are presently the favored group of insecticides to control triatomines, we performed a series of bioassays to determine the intrinsic activity of some of the main compounds used in the control campaigns, against five of the main species of triatomines to be controlled.

Comparing the insecticides it can be seen that lambdacyhalothrin is more effective than the other three pyrethroids, both considering the LD50 and 99 for all the three species with comparable results. On Triatoma infestans *the LD50 of lambdacyhalothrin was followed by that of alfacypermethrin, cyfluthrin and deltamethrin. On* Rhodnius prolixus *the sequence, in decreasing order of activity, was lambdacyhalothrin, alfacypermethrin, deltamethrin and cyfluthrin. Some modifications can be seen when we compare the LD99, that has more to see to what happens in the field.* T. brasiliensis *showed to be as sensible to lambdacyhalothrin as* T. infestans*, the most susceptible for this product. By the other side* T. sordida *is the least susceptible considering the LD99 of this insecticide.*

Key words: triatomine - insecticides - Chagas disease - *Triatoma* - *Panstrongylus* - *Rhodnius*

At present the elimination of vectorial transmission of Chagas disease is assumed as a priority for most governments of Latin American countries. The WHO/TDR Southern Cone Initiative, involving Argentina, Bolivia, Brazil, Chile, Paraguay, Peru, and Uruguay, where there are 11 millions of infected persons and 50 millions at risk of acquiring the disease, proposed to eradicate *Triatoma infestans* of their territories (except for Bolivia where this species is found in silvatic habitats). This commitment lead to significant reductions of incidence of the disease accordingly to WHO data (Moncayo 1999).

Recently two other country blocks interested in the control of transmission appeared. The Initiative of the Andean countries, involving Colombia, Ecuador, Peru, and Venezuela, where 5-6 million infected individuals and 25 million at risk can be found. The other block was organized by Central American countries, i.e., Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama. The main vectors in these two areas is *Rhodnius prolixus* (Guhl 1999, Ponce 1999).

In Brazil the eradication of *T. infestans* goal is almost achieved and growing attention is being paid to other species, considered as secondary vectors in the past, like *T. sordida, T. brasiliensis* and in a few areas, *Panstrongylus megistus*.

A series of laboratory and field assays performed by our group on the susceptibility of many triatomines species to organochlorines, organophosphates, carbamates and a few pyrethroids have shown marked differences between species (Oliveira Filho 1997, 1998a, 1998b, Oliveira Filho et al. 1981, 1982) As pyrethroids are presently the favored group of insecticides to control triatomines, we performed a series of bioassays to determine the intrinsic activity of some of the main compounds used in the control campaigns, against five of the main species of triatomines to be controlled. The objective was the straight comparison of the active principles, dissolved in acetone solutions and applied topically, envisaging the determination of lethal dosis of non-formulated compounds.

MATERIALS AND METHODS

Technical products, received from ICI, were certified by gas chromatography analysis performed at the NPPN, as containing lambdacyhalothrin 96.3%, (ICI) - deltamethrin 99.9% (Rousell-Uclaf), cyfluthrin 93.9% (Bayer) and alfacyper-methrin 96.2% (Shell).

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The triatomines species used were *T. infestans, T. brasiliensis*, *T. sordida*, *P. megistus* and *R. prolixus.* The laboratory colonies were maintained at 27±2ºC, 70±10% R.H., 12:12 hr light/dark periods and given a fortnightly opportunity to feed. The nymphs were synchronized chronologically and physiologically, i.e., only those that moulted to 5th instar in the same week and were fed in the next one, absorbing a similar amount of blood, were tested. Time of the test was between 14 and 21 days in the 5th instar.

The treatment consisted in the topical application, in the dorsal part of the abdomen of 5th instar nymphs, of 1µl of the insecticide solution in acetone, using a Hamilton mycrosyringe and a mycroaplicator. Ten nymphs were treated each time for each concentration and the test was repeated at least once in another occasion. Insects in the control group were treated with the same amount of solvent used for those that received the active ingredient. The insects were then maintained in clean glass jars fitted with filter paper roosts and closed with nylon netting. The readings were performed at 1, 2, 3, 7, 14 and 21 days after treatment, recording insects alive, intoxicate, moribund and dead. Moribund insects were considered as dead at the time of reading if they do not recovered after. The percent mortalities, obtained with each dose, three days after treatment, were plotted in a log-probit graphic with the help of a computer program (SPSS). At least three plots between 10 and 90% were obtained. The LD50 and LD99 were then obtained together with the 95% confidence upper and lower limits.

RESULTS AND DISCUSSION

Table reports the results obtained for the four insecticides tested in the three species belonging to three different genera bioassayied, plus the results of lambdacyhalothrin for *T. sordida* and *T. brasiliensis*. Figure expresses, in a more understandable way, the comparisons between insecticides and species. Considering the three species tested for all the insecticides *R. prolixus* is the most susceptible (except for lambdacyhalothrin for which *T. infestans* is the most susceptible), followed by *T. infestans* and *P. megistus*. This last species is the least susceptible by far, even considering the weight in µg of active ingredient/mg of live weight.

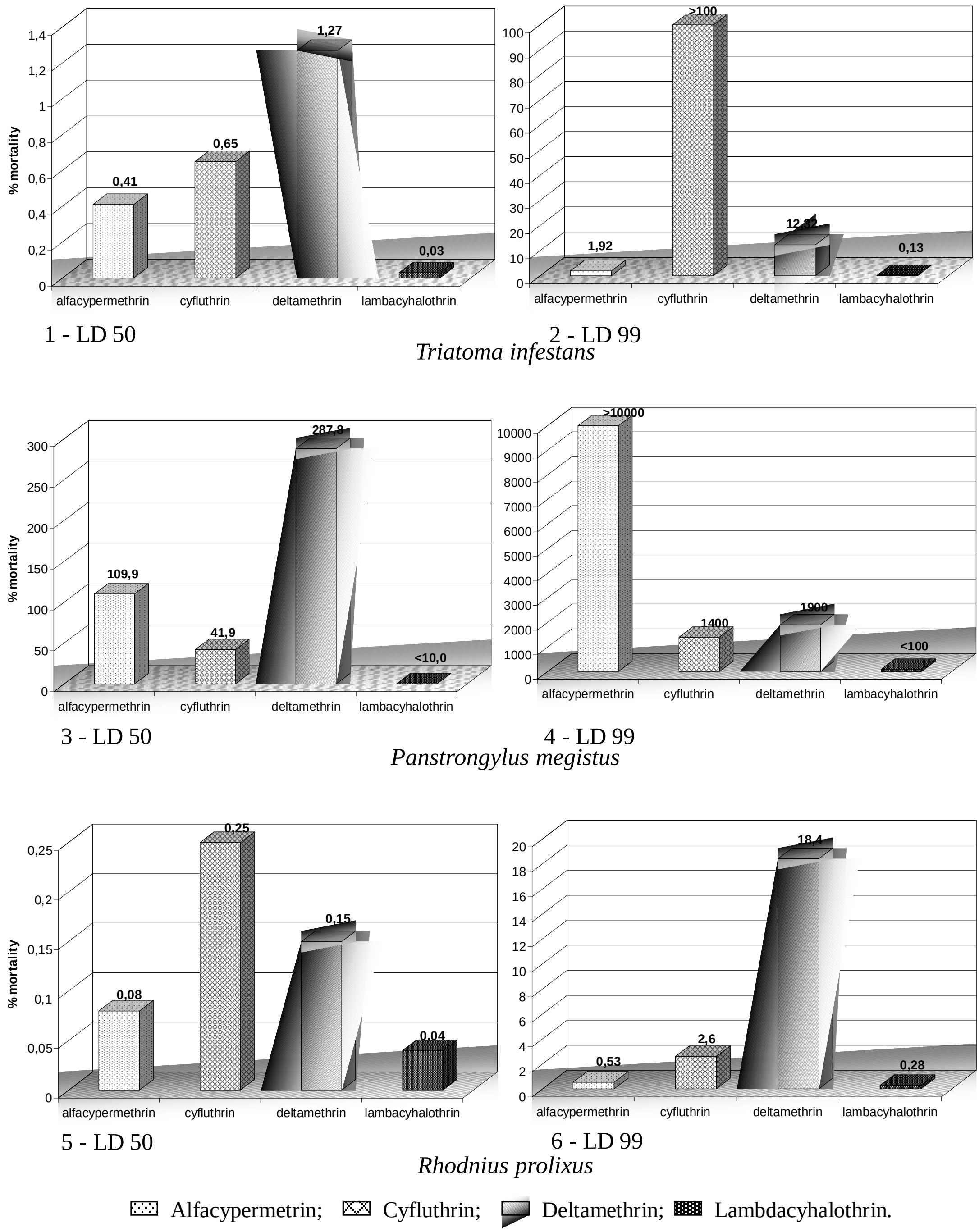
Comparing the insecticides it can be seen that lambdacyhalothrin is more effective than the other three pyrethroids, both considering the LD50 and 99 for all the three species with comparable results. On *T. infestans* the LD50 of lambdacyhalothrin was followed by that of alfacypermethrin, cyfluthrin and deltamethrin. On *R. prolixus* the sequence, in decreasing order of ac-

TABLE

Lethal dosis 50 and 99 of five triatomine species, belonging to three different genera, of four pyrethroid insecticides used to control vectors of Chagas disease applied topically

Species	Lambdacyhalothrin				Alfacypermethrin				Cyfluthrin				Deltamethrin			
	LD50	upper lower	LD99	upper lower	LD50	upper lower	LD99	upper lower	LD50	upper lower	LD99	upper lower	LD50	upper lower	LD99	upper lower
Triatoma infestans	**0.03**	0.04 0.02	**0.13**	0.46 0.08	**0.41**	0.55 0.33	**1.92**	28.6 1.0	**0.65**	>1000 0.27	**396.7**	>1000 13.0	**1.27**	1.69 1.03	**12.32**	90.62 5.7
Panstrongylus megistus	**0.1**	0.25 0.07	**0.84**	168.2 0.3	**109.9**	572.0 29.1	**>1000**	- -	**41.9**	101.6 18.6	**>1000**	- -	**287.8**	537.3 177.0	**>1000**	- -
Rhodnius prolixus	**0.04**	0.05 0.03	**0.28**	0.86 0.17	**0.08**	0.10 0.06	**0.53**	1.85 0.31	**0.25**	0.32 0.13	**2.6**	61.10 1.19	**0.15**	0.26 0.09	**18.4**	199.1 5.1
Triatoma sordida	**0.18**	0.31 0.04	**4.17**	>1000 1.18	-		-		-		-		-		-	
Triatoma brasiliensis	**0.03**	0.05 0.01	**0.11**	0.54 0.07	-		-		-		-		-		-	

The upper and lower 95% confidence limits are also shown (Statistical analysis by SPSS). The values are expressed in µg/nymph. The average nymphs weight were for: *T. infestans* 143 mg, *T. brasiliensis* 118 mg, *T. sordida* 56 mg, *P. megistus* 141 mg and *R. prolixus* 73 mg.



Comparison of topical LD50 and DL99 of four pyrethroid insecticides obtained for three triatomine species.

tivity, was lambdacyhalothrin, alfacypermethrin, deltamethrin and cyfluthrin. Some modifications can be seen when we compare the LD99, that has more to see to what happens in the field. *T. brasiliensis* showed to be as sensible to lambdacyhalothrin as *T. infestans*, the most susceptible for this product. By the other side *T. sordida* is the least susceptible considering the LD99.

Three out of four of these pesticides has shown little effect on *P. megistus* and, by these results, should not be recommended when the control campaign is against this species – alfacypermethrin, cyfluthrin and deltamethrin. Having in mind these significant differences between products we tested again these species using the LD50 as the parameter of comparison. The results obtained were quite near 50% mortality, confirming that these hudge differences really exists.

Problably these different performances of technical products applied topically cannot be transferred to field situations, where formulated products interacts with the insect for longer time and suffer the influence of environmental factors like the reactivity of the substract, light, temperature, humidity, etc. However the intrinsic difference of toxicity will certainly result in different doses to be recommended for field use.

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