

## Brief Communications

# Susceptibility of *Aedes aegypti* to temephos and cypermethrin insecticides, Brazil

Jonny E Duque Luna\*, Marcos Ferrer Martins\*\*, Adriana Felix dos Anjos\*, Eduardo Fumio Kuwabara\*\* e Mário Antônio Navarro-Silva

Laboratório de Entomologia Médica e Veterinária. Departamento de Zoologia. Universidade Federal do Paraná. Curitiba, PR, Brasil

### Keywords

*Aedes aegypti*. Insecticide resistance. Temephos. Insecticides, organophosphate. Pyrethrins. Mosquito control. Vector control. Insect vectors.

### Abstract

Bioassays were performed in order to detect the susceptibility of *Aedes aegypti* to the chemical insecticides temephos and cypermethrin. The results showed that this species is susceptible to temephos and presents resistance to cypermethrin.

The strategies for controlling the principal vector of dengue, *Aedes aegypti*, are based on the utilization of chemical and biological products, integrated with environmental management programs. In Brazil, the programs that aim to control *Aedes aegypti* mainly utilize chemical insecticides, among which organophosphates (OP) and pyrethroids (P) are prominent. These programs require constant monitoring.

The numbers of dengue cases are rising every year, and different factors influence this increase. Resistance to chemical products may favor an increase in the mosquito populations, thereby resulting in increases in the numbers of dengue cases.<sup>1,4</sup> For this reason, it is important to perform periodic monitoring of the susceptibility to insecticides of the populations implicated in the transmission of this disease.<sup>3</sup>

This study presents data on the susceptibility of a population of *Aedes aegypti* in the city of Curitiba, State of Paraná, for the first time. This population was submitted to two chemical insecticides: temephos (organophosphate) and cypermethrin (pyrethroid). The resistance ratio was compared with the data for the standard colony at the Centers for Disease Control and Prevention (CDC).

Immature specimens were collected from different

districts of Curitiba between January and April 2003. *Aedes aegypti* was only found in the sample from the Uberaba district, in an artificial breeding ground (automobile wreckage in a scrap metal yard). This was the only population originating from Curitiba utilized in the susceptibility tests.

The lineage utilized for making the comparison was the Rockefeller CDC. The insecticides utilized in the bioassays were temephos, "Temephos Fersol 1G" (granulated, 1%), and cypermethrin, "Cynoff 400 Pm" (powder, 25%). These products were diluted in mineral water to prepare the standard solutions with the same concentration of 50 ppm of active ingredient.

The process for the bioassays followed the standards of the World Health Organization (WHO).<sup>5</sup> The results were submitted to Probit analysis.<sup>2</sup> The following criteria were utilized for determining the resistance: if the mortality rate was greater than or equal to 98%, the sample was considered to be susceptible; if the mortality rate was 80 to 97%, the response was checked by repeating the experiment; and if the mortality rate was less than 80%, the sample was considered to be resistant.<sup>5</sup>

A total of 750 larvae were analyzed in relation to cypermethrin and 700 in relation to temephos, in-

### Correspondence to:

Mário Antônio Navarro-Silva  
Departamento de Zoologia - UFPR  
Caixa postal 19.020  
81531-980 Curitiba, PR, Brasil  
E-mail: mnavarro@ufpr.br

Funded by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq - Process n. 302350/2003-9).

\*CAPES bursary-holder. Postgraduate program in Entomology, Universidade Federal do Paraná.

\*\*CNPq bursary-holder. Postgraduate program in Entomology, Universidade Federal do Paraná.

Received on 30/10/2003. Approved on 2/6/2004.

cluding the various concentrations and the control. The test performed on larvae of *Aedes aegypti* from Curitiba, utilizing a diagnostic concentration of 0.0125 ppm of active ingredient of the organophosphate temephos, resulted in a survival rate of 10% and mortality rate of 90%. In the test using temephos at multiple concentrations, an  $LC_{50}$  of 0.0046 ppm of active ingredient ( $RR_{50}=1.7$ ) and an  $LC_{95}$  of 0.0191 ppm of active ingredient ( $RR_{95}=4.7$ ) were found. For cypermethrin, the survival rate was 35% and the mortality rate was 65% in the evaluation utilizing a diagnostic concentration of 0.0125 ppm of active ingredient. In the evaluation of multiple concentrations, an  $LC_{50}$  of 0.0096 ppm of active ingredient ( $RR_{50}=27$ ) and an  $LC_{95}$  of 0.0275 ppm of active ingredient ( $RR_{95}=4$ ) were found.

The diagnostic concentration of 0.0125 ppm of active ingredient of temephos and cypermethrin was also utilized to test the colony of Rockefeller lineage. This concentration of both insecticides produced a mortality rate of 100%. For cypermethrin, an additional diagnostic concentration of 0.009 ppm of active ingredient was evaluated, and this also resulted in a mortality rate of 100%. In the multiple concentration analyses for temephos,  $LC_{50}$  was 0.0027 ppm of active ingredient and  $LC_{95}$  was 0.0400 ppm of active ingredient. For cypermethrin,  $LC_{50}$  was 0.00035

ppm of active ingredient and  $LC_{95}$  was 0.00741 ppm of active ingredient.

The values presented indicate that chemical treatment using temephos is viable. However, the level of susceptibility in relation to the diagnostic and multiple concentration tests suggest that a system of constant monitoring of this mosquito population should be rapidly implemented. The results confirm the need for preventive strategies and alternative control methods that might diminish the selection of resistance. The selection process appears to have begun within this population.

The results for cypermethrin indicate that this product should no longer be utilized within the municipality of Curitiba. They suggest that there is a need for immediate replacement of this insecticide by some other product of chemical or biological origin.

## ACKNOWLEDGEMENTS

To Carlos Fernando S. Andrade, of the *Departamento de Zoologia, Instituto de Biologia*, Unicamp, for the donation of the CDC Porto Rico population of *Aedes aegypti*; and to Gregorio Guadalupe Carbajal Arízaga of LQES, *Universidade Federal do Paraná*, for his suggestions regarding the bioassays.

## REFERENCES

1. Campos J, Andrade CFS. Susceptibilidade larval de duas populações de *Aedes aegypti* a inseticida químicos. *Rev Saúde Pública* 2001;35:232-6.
2. Finney DJ. Probit analysis. Cambridge (UK): Cambridge University Press; 1971.
3. Gubler DJ. Epidemic dengue/dengue hemorrhagic fever as a public health, social and economic problem in the 21st century. *TRENDS Microbiol* 2002;10:100-3.
4. Macoris MLG, Andrighetti MT, Takaku L, Glasser CM, Garbeloto VC, Cirino VCB. Alteração de resposta de suscetibilidade de *Aedes aegypti* a inseticidas organofosforados em municípios do Estado de São Paulo, Brasil. *Rev Saúde Pública* 1999;33:521-2.
5. World Health Organization. Vector resistance to pesticides. Geneva; 1992. (WHO-Technical Report Series, 818).