Reprinted from *International Pest Control*, **37**, 142–143

Laboratory larvicidal efficacy of etofenprox (Trebon) against four species of mosquitoes of public health importance

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Abstract: A laboratory evaluation was conducted on the efficacy of Trebon against four species of mosquito larvae viz., *Aedes aegypti, Anopheles dirus, Culex quinquefasciatus* and *Mansonia uniformis*. Results indicated that Trebon was most effective against *M. uniformis* (LD_{50} = 1.92 μg/l), followed by *A. aegypti* (LC_{50} = 3.51 μg/l), *C. quinquefasciatus* (LC_{50} = 7.59 μg/l) and *A. dirus* (LG_{50} = 21.05 μg/l). The effectiveness of Trebon when comparing to other insecticidal larvicides is discussed.

Introduction

Trebon (etofenprox) is a diphenyl compound consisting of C, H and O only. It was introduced in Japan in 1987 by Mitsui Toatsu Chemicals Inc (Udagawa, 1986; Thompson, 1992). Besides being marketed under the trade name Trebon, etofenprox is also sold commercially under the name Permit.

A literature review indicated that Trebon possesses good efficacy against various insect pests, particularly agricultural. It was shown to be highly effective against the brown planthopper *Nilaparvata lugens* without causing any resurgence (Udagawa, 1986). In addition, it has an exceedingly low acute mammalian toxicity (acute oral toxicity LD_{50} for rats, 40,000 mg/litre) and possesses good residual activity (Thompson, 1992).

Though various trials have been carried out to determine the efficacy of Trebon against agricultural pests, information on its efficacy against public health insects is lacking. The present investigation was undertaken to evaluate the comparative laboratory efficacy of the insecticide against mosquitoes of public health importance in Malaysia.

Materials and Method

Mosquitoes: Four species of mosquito were used in this study: *A. aegypti, A. dirus, C. quinquefasciatus* and *M. uniformis*. They were all from laboratory colonies which were established from field populations on Penang Island and northern peninsular Malaysia. These cultures have been reared at the Vector Control Research Unit, Universiti Sains Malaysia since 1980.

All mosquito larvae were maintained in enamel trays in the laboratory at 26 ± 2°C and relative humidity 65 ± 10%, except for *M. uniformis* larvae which were reared in plastic aquarium troughs with *Eichhornia crassipes* as host plants. The rearing procedures for each mosquito species were essentially as described in Gerberg (1970) and Foo and Yap (1982).

Bioassay Methods: The bioassay methods used in the tests were essentially those of Yap and Hanapi (1976). Technical grade Trebon (96.3%) was provided by Mitsui Toatsu Chemicals. Preliminary range finding of dosages which induced 15% to 85% mortalities for each species of mosquito larvae were conducted before the commencement of dose response studies.

Basically, bioassay tests were conducted using 1 ml of each dose of insecticide added to 99.0 ml of distilled water containing 20 late third or fourth instar mosquito larvae in a Pyrex 250 ml beaker and mixed thoroughly. For the control, 1 ml of acetone was added. Tests on the free swimming mosquito larvae were conducted following the standard bioassay method. However, five thin Styrofoam pieces were allowed to float on the surface of the solution for larvae attachment in the tests on *Mansonia*. Each dose and control were triplicated and from five to seven experiments were carried out on each species of mosquito. Larvae mortality counts were carried out after 24-hours' exposure.

For proper bioassay assessment, data with mortality percentages exceeding 20 and pupae formation percentages exceeding 10 in the control were discarded and the tests repeated. The data were analysed by a probit analysis program using an IBM AT microcomputer (Daum and Killcreas, 1966; Daum, 1970).

Results and Discussion

Results of the comparative efficacy tests are shown in Table 1. Trebon was shown to be most effective against *M. uniformis* larvae with LC_{50} and LC_{90} values of 1.92 and 3.78 μg/litre, respectively. Earlier, Yap and Hanapi (1976) had reported the effectiveness of chlorpyrifos and temephos against the larvae of the same species (LC_{50} values for chlorpyrifos and temephos were 1.54 and 1.92 μg/litre, respectively). When compared to the findings of this study, it can be inferred that Trebon has a similar toxicity to *Mansonia* larvae as chlorpyrifos and temephos.

In so far as common vector mosquitoes are concerned, information on the efficacy of control agents (both chemical and biological) for the control of *Mansonia*, especially at the larvae stages, is thin (Yap, 1986). This may be due to the difficulty of culturing these mosquitoes in the laboratory. In addition, the habit of *Mansonia* larvae to attach themselves to aquatic plant roots is thought to make them less accessible to larvicides.

More recent laboratory and field tests of both chemical and microbial insecticides indicate that there are basically no major differences in the treatments of *Mansonia* larvae compared with other major genera of vector mosquitoes (Foo and Yap, 1983; Yap *et al.*, 1991; Yap *et al.*, 1992).

A. aegypti were also shown to be susceptible to Tre-

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Table 1: Comparative laboratory susceptibility of Trebon against four species of mosquitoes. A minimum of 360 late 3rd/early 4th instar larvae were used per test. Results analysed by probit analysis using microcomputer.

Mosquito species	No. of tests	LC_{50} (95% CL)*	LC_{90} (95% CL)*	Regression Slope ± Std Error
Aedes aegypti	6	3.51 (3.37-3.65)	7.82 (7.39-8.33)	3.69 ± 0.11
Anopheles balabacensis	6	21.05 (19.85-22.16)	32.58 (30.17-36.31)	6.76 ± 0.50
Culex quinquefasciatus	7	7.59 (7.53-7.65)	11.44 (11.29-11.59)	7.19 ± 0.12
Mansonia uniformis	5	1.92 (1.88-1.95)	3.78 (3.67-3.89)	4.35 ± 0.97

* CL = Confidential Limit

bon (LC_{50} value 3.51 µg/litre). However, when bioassays were conducted using permethrin and temephos against *A. aegypti* larvae, lower LC_{50} values of 0.64 and 1.74 µg/litre, respectively, were recorded (H.H. Yap unpublished).

Bioassays of Trebon against *C. quinquefasiatus* (LC_{50} value of 7.59 µg/litre) indicated that *Culex* is more tolerant when compared with *Mansonia* and *Aedes*. In addition, earlier studies using some pyrethroids against *C. quinquefasciatus*, indicated better efficacies with lower LC_{50} values. LC_{50} values (µg/litre) for the pyrethroids tested were as follows: cypermethrin, 0.05; fenpropathrin, 0.27; deltamethrin, 0.02-0.07; fenfluthrin and cyfluthrin, 0.70 (Mulla *et al.*, 1978; Daz and Kalyanasundaram, 1984; Rajavel *et al.*, 1986).

Finally, bioassay tests of Trebon against *A. dirus*, resulted in the highest LC_{50} value (21.05 µg/litre) in this study (Table 1).

In short, comparative laboratory bioassays of Trebon against four species of vector mosquito indicated that *M. uniformis* was the most susceptible, followed by *A. aegypti* and *C. quinquefasiatus*. *A. dirus* was the most tolerant of all the species tested. In comparison with earlier laboratory bioassay studies of other larvicides, higher dosages of Trebon are needed to achieve similar efficacy.

This may also imply that higher dosages of Trebon are needed to achieve desirable levels of mosquito vector control in the field. However, the need for higher dosages can be compensated for by the very low mammalian toxicity of Trebon compared with existing chemical larvicides. Further simulated and field trials are needed to substantiate the use of Trebon for vector mosquito control.

Acknowledgements

The authors would like to thank the following in connection with the above work: The Malaysian Government (IRPA Grant No. 3-07-06-05-02) for research support; The Dean, School of Biological Sciences and the Co-ordinator, Vector Control Research Unit (VCRU), Universiti Sains Malaysia for providing laboratory facilities; the staff of VCRU, especially Mr H.T. Tan, Mr Abdul Malek Yahaya, Mr Abdul Hamid Awang and Mr Rohaizat Baba, for technical assistance and Ms C.L. Tang for typing the manuscript.

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