Biosciences, Biotechnology Research Asia Vol. **5**(2), 501-506 (2008)

Insecticide susceptibility of *Aedes aegypti* ,the vector of dengue fever, in Jeddah governorate , Saudi Arabia

KHALID M. S. AL- GHAMDI[1], Z.I. AL-FIFI[1], M.S.SALEH[2] H.A.AL-QHTANI[1] and J.A. MAHYOUB[1]

[1]Department of Biological Sciences, Faculty of Science, King Abdul-Aziz University, Jeddah (Saudi Arabia).
[2]Mosquito Research Laboratory, Jeddah (Saudi Arabia).

(Received: August 10, 2008; Accepted: September 09, 2008)

ABSTRACT

The larvicidal activity of five insecticides against *Aedes aegypti ,* the primary vector of dengue fever in Jeddah governorate , was evaluated using the WHO standard susceptibility tests .The tested compounds were two pyrethroid insecticides Snap and Icon , the bacterial insecticide Bacilod and two insect growth regulators (IGR) Baycidal and Sumilarv. Taking LC_{50} values (concentration which to kill 50 % of mosquito larvae) into consideration ,mosquito larvae of *A.aegypti* proved to be more susceptible to Icon (0.01 ppm) than Snap (0.048 ppm) and Bacilod (0.3 ppm) by about 4.8 and 30 folds, respectively. On the other hand, the records showed that treatments with IGR Baycidal and Sumilarv against the present mosquito larvae of *A.aegypti* produced various biological effects on immature stages and adults. According to IC_{50} values (concentration which to inhibit the emergence of 50 % of adults), Baycidal (0.0007 ppm) proved to be more effective against *A.aegypti* than sumilarv (0.003 ppm) by about 4.3 folds.

Key words: Susceptibility status, Mosquito larvae, Larval bioassay.

INTRODUCTION

Insecticide resistance is an increasing problem for mosquito control in different parts of the world (Canyon and Hii, 1999., Katyl *et a*l 2001., Saleh *et al*.,2003., Nazni *et al* .,2005.,Tawatsin *et al.,*2007*).* It is necessary, from time to time, to monitor the susceptibility status of local mosquito vectors to the insecticides used in the control programmes. Documentation of insecticides resistance will identify insecticides that are no longer effective and is a critical first step towards developing a resistance management programmes (Ponlawat *et al.*, 2005). Given the limited information on susceptibility levels of mosquito vectors to insecticides in Jeddah, our objective was to determine the current susceptibility status of *A.aegypti* ,the primary vector of dengue fever, to some insecticides commonly used in mosquito control programmes .

MATERIAL AND METHODS

Mosquito strain

Tests were performed on a field strain of *A.aegypti* raised from wild larvae ,collected from Jeddah governorate , Saudi Arabia , and had been maintained in the laboratory under controlled conditions of 27 ± 1°C and 70 ± 5 % RH., with a 14:10 (L:D) photoperiod.

Insecticides

The insecticides used for larval bioassay were:

1. Two pyrethroids: Snap 230 SC (permethrin 11 % + Tetramethrin 1% + Piperonyl Butoxide 11 % ., Astrachem Co). And Icon 2.5 EC (Lambada cyhalothrin 2.5 %., Astrachem Co).
2. The bacterial insecticide Bacilod, a wattable powder formulation of *Bacillus thuringiensis* var. *israelensis* (1200 ITU/mg.,LOD, Ltd.)
3. Two insect growth regulators: Baycilod WP25 (Triflumuron 25 %., Bayer Env. SC. SAS) and Sumilarv (Pyriproxyfen) 0.5 G(Sumitomo chem.. Co).

Larval bioassay

The larval susceptibility test was conducted according the method of WHO (1980).Treatments were carried out by exposing early 4th instar larvae of *A.aegypti* to various concentrations of the tested insecticides for 24 hr, in groups of glass beakers containing 100 ml of tap water. Five replicates of 20 larvae each per concentration, and so for control trials were set up. The larvae were given the usual larval food during these experiments. Larval mortalities were recorded at 24 hr post-treatment for the pyrethroid insecticides Snap and Icon as well as the biocide Bacilod. The dead larvae were identified when they failed to move after being probed by a needle in siphon or cervical region. In the case of the IGR Sumilarv and Baycidal, cumulative mortalities of larvae and pupae were recorded daily. Live pupae were transferred to untreated water in new beakers for further observation, i.e. normal emergence, presence of morphologic abnormalities or death. Partially emerged adults or these found completely emerged but unable to leave the water surface were recorded and scored as dead. Therefore, the biological effect of Sumilarv Baycidal was expressed as the percentage of larvae that do not develop into successfully emerging adults, or inhibition of adult emergence (WHO, 2005). Log concentration - Probability regression lines were drawn for the tested insecticides and statistical parameters were also calculated using the method of Litchfield and Wilcoxon (1949).

RESULTS AND DISCUSSION

Table 1 shows the toxicity of pyrethroid insecticides Snap and Icon as well as the bacterial insecticide Bacilod against mosquito larvae of *A.aegypti.*The effective concentrations of the above insecticides against 4th instar larvae were 0.02 - 0.015 ppm, 0.005 - 0.03 ppm and 0.2 -0.6 ppm, respectively. The corresponding larval mortalities were in respect 18 - 91, 20 - 93 and 24 - 95 %. Taking LC50 values obtained from toxicity lines into Consideration (Fig.1), the records showed that Icon (0.01 ppm) proved to be the most effective compound, followed by Snap (0.048) while Bacilod (0.3) was the least effective. These results indicate that mosquito larvae of *A.aegypti* were more susceptible to Icon than Snap and Bacilod by about 4.8 and 30 folds, respectively.

However , it has been suggested that the variation in susceptibility status of the present mosquito larvae to the test insecticides is a dynamic process depending on the frequency of use, type

Table 1: Susceptibility levels of *A. aegypti* mosquito larvae to Snap, Icon and Bacilod

Compound	Effective Concentrations (ppm)	Larval Mortality[a] (%)	LC_{50} [b] (ppm)
Snap	0.02 - 0.15	18 - 91	0.048
Icon	0.005 - 0.03	20 - 93	0.01
Bacilod	0.2 - 0.6	22 - 95	0.3

a .Five replicates, 20 larvae each ; control mortalities ranged from 0.0 - 2%

b .Obtained from toxicity lines (Litchfiled and Wilcoxon,(1949)).

of insecticides and its concentration (Salah and wright , 1989., Paul *et al .,*2006*)*. The fluctuations in the percentage mortalities obtained for the different concentrations of the test insecticides against the present *A.aegypti* larvae support this conclusion (Canyon and Hii, Sulaiman *et al*, 2007*).*

Table 2: The biological effects of the IGR Baycidal and Sumilarv on the developmental stages of *A. aegypti*

Compound	Effective Concentrations (ppm)	Larval mortality [a] (%)	Pupa produced (%)	Inhibitions of adult emergence [b](%)	IC_{50} [c] (ppm)
Baycidal	0.003 -0.006	4 - 31	36 - 69	36 - 89	0.0007
Sumilarv	0.001 - 0.02	6 - 15	94 - 85	20 - 92	0.003

a .Five replicates, 20 larvae each

b corrected with Abbott's formula (Abbott, 1925).

c_.Obtained from toxicity lines (Litchfiled and Wilcoxon, (1949)).

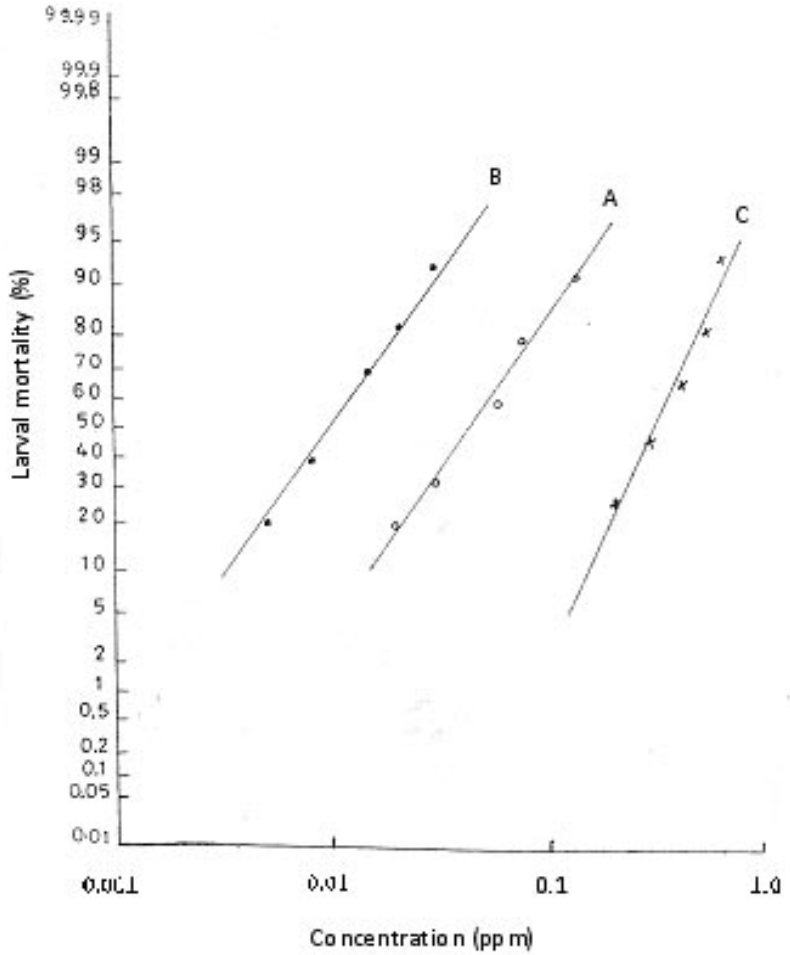

Fig. 1: The relation between concentrations of Snap (A), Icon (B) and Bacilod (C) and the percentage of larval mortality of *A. aegypti* following continuous exposure for 24hr

The results presented in table 2 show the percentage of larval mortality, pupation and the inhibition of adult emergence following larval treatments with different concentrations of the IGR Baycidal and Sumilarv. The effective concentrations of Baycidal and Sumilarv ranged from 0.003 - 0.006 ppm and 0.001 - 0.02 ppm, respectively. In general 4 - 31 % and 6 - 15 % larval mortalities were obtained when the early 4th instar larvae of *A.aegypti* were treated with the above compounds, respectively. However, the biological effects of the test compounds were often manifested by the formation of a type of larval–pupal intermediate. These abnormalities in the metamorphosis might be due to inbalance in the hormonal system (Bridges *et al.,* 1977*)*. Moreover, most pupae that pupated successfully often died either before the adult emerged or as albino pupa. Many adults emerged incompletely or left their tarsi attached in the pupal exuvia (Salah *et al*., 1981). Generally the corresponding percentages of inhibition of adult emergence were in respect 36 - 89 % and 20 -92

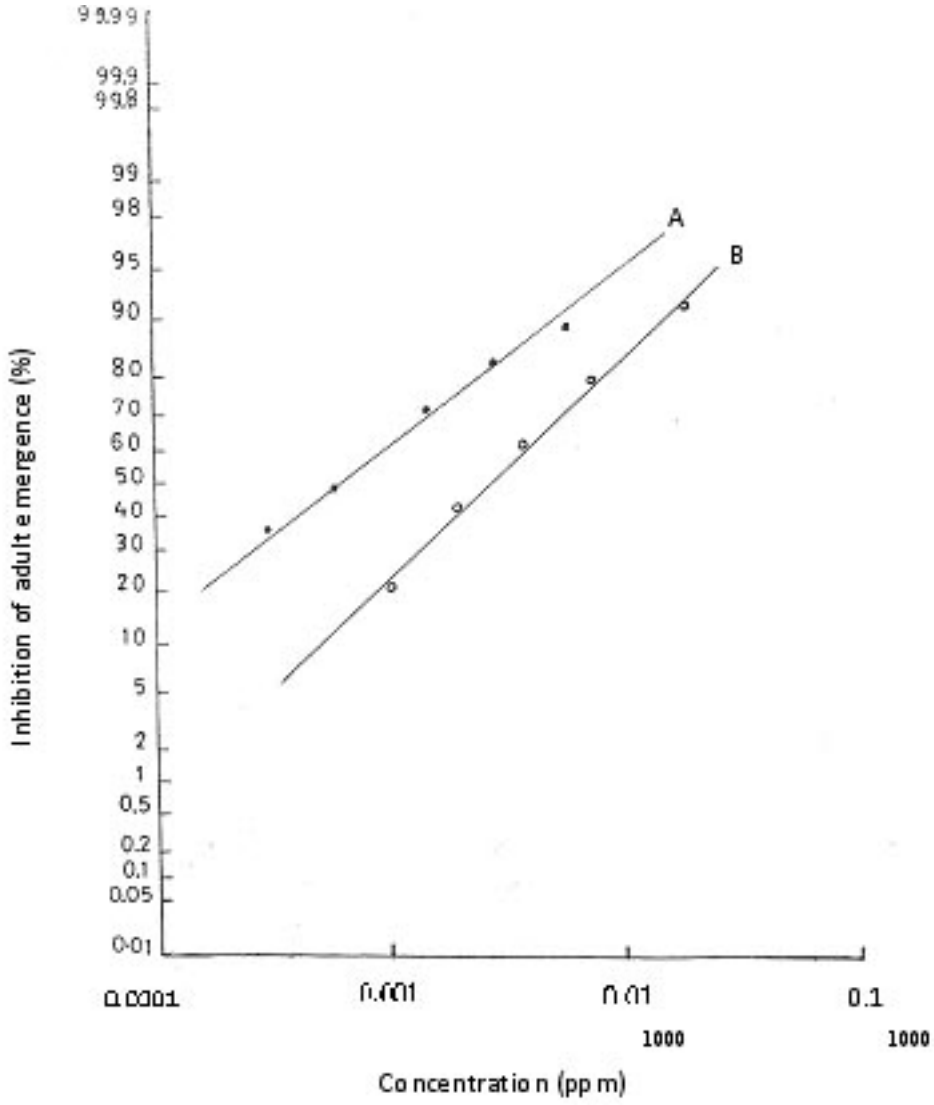

Fig. 2: The relation between concentrations of Baycidal (A) and Sumilarv (B) and the inhibition of adult emergence after treatment of fourth instar larvae of *A. aegypti*

%. Taking IC_{50} values (concentration which to inhibit the emergence of 50 % of adults) into consideration (fig 2), *A.aegypti* larvae proved to be more susceptible to Baycidal (0.0007ppp) than Sumilarv (0.003ppm) by about 4.3 times. Similar studies in this respect were carried out by several authors to determine the susceptibility level of different mosquito vectors to IGRs (Saleh and Wright (1990)) using cyromazine against *Culex pipiens* and *A. epacticus.,* EL_Shazly and Refaie (2002) using Sumilarv against *C. pipiens.,* Tawatsin *et al* (2007) using Novoluron against *C. quinquefasciatus)*. Generally, the present work suggested that continuous insecticide susceptibly monitoring should be conducted in different areas in Jeddah regularly to identify the efficacy of insecticides used for mosquito vector control and to facilate selection of insecticides with greatest promise for halting or minimizing dengue infections .

ACKNOWLEDGEMENTS

The authors are indebted to the Deanship of Scientific Research for funding this project under No. 164/28. We are also thankful to all our colleagues and friends for their co-operation and encouragement during this work.

REFERENCES

1. Abbott, W.S. A method of computing the effectiveness of an insecticide. *J. Econ. Entomol*. **18**: 256-269(1925).
2. Brdges, A.C., J. Coke., J.K Olson and R.T.Mayer. Effects of new fluorescent insect growth regulators on larval instars of *Aedes aegypti*.. Mosquito News. **37**: 227-223 (1977).
3. Canyon D. and J. Hii. Insecticide susceptibility status of Aedes aegypti (Diptera: culicidae) from Townсvile. *Aust. J. Ent*. **38**(I): 40-43(1999).
4. EL_Shazly M.M and B.M. Refaie. Larvicidal effect of the Juvenile hormone mimic pyriproxyfeen on *Culex pipnies*. *J. Am. Mosq.Cont.Assoc.* **18**(4): 321-328 (2002).
5. Katyal R.,P. Tewari ., S.J.Rahman ., H.R.Pajni .,K.Kumar and K.S.Gill. Susceptibility status of immature and adult stages of *Aedes aegypti* against conventional insecticides in Delhi, India.Dengue Bull. **25**: 84-87 (2001).
6. Litchfield, J.T. and E.Wilcoxon. A simplified method of evaluating dose-effect experiments. *J. Phar. Exp. Ther*. **96**: 99-113 (1949).
7. Nazny, W.A., H.L.Lee and A.H.Azhari. Adult and larval insecticide susceptibility status of *Culex quinquefasciatus* (Say) mosquitoes in Kuala Lumpur Malaysia. *Tropical Biomedicine* **22**(1): 63-68 (2005).
8. Panlawat A., J.E.Scott and L.C.Harrington. Insecticide susceptibility of *Aedes aegypti and Aedes allopictus* across Thailand. *J. Med.Ent.* **42**(5):821-825 (2005).
9. Saleh M.S., I.A.Gaboub and Sh.M.Kassem. Larvicidal effectiveness of there controlled release formulations of Dursban and Dimilin on *Culex pipnies* and *Aedes aegypti* .J. Agric.Sci. Camb. **97**: 87 - 96(1981).
10. Saleh M.S. and R.E.Wright. Effects of the IGR cyromazine and the pathogen *Bacillus thuringiensis* var. *israelensis* on the mosquito *Aedes epacticus. J. Appl. Entomol.,* **108**: 381-385 (1989).
11. Saleh M.S., N.L.Kelada., Fatma A. El-Meniawi and H.M.Zahran. *Bacillus huringiensis* var. *israelensis* as sustained – release formulations against the mosquito *Culex pipiens* with special reference to the larvacidal effects of the bacterial agent in combination with three chemical insecticides. *Alex. J. Agric. Res.,* **48**(1): 53-60 (2003).
12. Sulaiman S., Fadhlina and O.Hidayctualfathi. Evaluation of pyrethrin formulations on Dengue Haemorrhagic fever vectors in the laboratory and sublethal effects. Iranian J. Arthropod-Borne Dis. **1**(2): 1-6 (2007).
13. Tawatsin A., U.Thavara., P. Bhakdeenuan

and J.Champoosn. Field evaluation of Novaluron, A chitin synthesis inhibitor larvicide, against mosquito larvae in polluted water in urban areas of Bangkok ,Thailand. *Southeast Asian J. of Trop. Med. and public Health*. **38**(3): 434-348 (2007).

14. World Health Organization. Instructions for determining the susceptibility or resistance of mosquito larvae to insecticides .WHO/ VBC. 81. 2007: 1-6 (1981).

15. World Health Organization .Guidelines for Laboratory and field testing of mosquito larvicides.WHO/CDS/WHOPES/CDPP/13 (2005).