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Enhanced Tolerance of House Mosquito to Different Insecticides due to Agricultural and Household Pesticides in Sewage System of Tehran, Iran

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ABSTRACT

Different insecticides are being used for household and agricultural pest control in the capital city of Iran, Tehran. An investigation was carried out in order to evaluate the susceptibility level of laboratory and field collected mosquito, *Culex quinquefasciatus*in to different insecticides. Field strain was collected from sewage system of the city. Adult females were subjected to the diagnostic dose of different insecticides as recommended by WHO. Results showed that laboratory strains only exhibit resistant to DDT 4%, and susceptible to other insecticides. By using WHO criteria, field strain is resistant to DDT 4%, bendiocarb 0.1%, and tolerant to malathion 5%, permethrin 0.75%, deltamethrin 0.05%, lambdacyhalothrin 0.05% and etofenprox 5%. The field strain is still susceptible to cyfluthrin 0.15%.This findings indicate that routine use of pesticides in household and agricultural pest control may cause resistant in the wastewater mosquito, *Culex quinquefasciatus.*

Keywords: Culex quinquefasciatusin, *Insecticides, Resistant, Iran*

INTRODUCTION

Cx. *quinquefasciatus* (Diptera: Culicidae) is widely distributed in tropical and subtropical areas. Because of the anthropophilic and endophilic blood feeding habits of the female, it is closely associated with man and human habitations (Forattini et al., 1993).

Throughout much of its geographic range, *Cx. quinquefasciatus* is of public health interest because it is a domestic pest but, in many places. It is a highly efficient insect host for the larval development of the filarial parasite *Wucheria bancrafti* (Rosen, 1955; Crans 1973; WHO 1980; Manga, 2002; Prasittisuk, 2002).

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It has been shown to be able to carry Murray Valley Encephalitis (MVE) virus in laboratory studies MVE virus has been isolated from the species in northern West Africa, it has yielded an isolated of Ross River (RR) virus during an outbreak in new Cale donia. It is a vector (not particulary efficient) of dog heart worm, an important vector of fowl pox and possibly involved in myxomatosis transmission in some areas (Russell and Robinson, 1989).

A study in Taiwan showed that hepatitis C virus can be taken up with a blood meal by *Cx. quinquefasciatus* and the virus could persist, but not multiply, for up to 25 days (Dorothy, 2001).

In Iran *Culex quinquefasciatus* breeds in sewage system of the houses. The sewage system conducted from north to the south of

capital city, Tehran, where makes a suitable breeding places for mosquitoes. This species is considered as a main nuisance mosquito in the country. There are reports of disease transmission by *Cx. quinquefasciatus* in Iran. Saidi et al. (1974) reported the transmission of sindbis virus by *Cx. quinquefasciatus*, subsequently Mobedi et al. (1991) postulated that *Cx. quinquefasciatus* could be as a vector of microfilaria, Dirofilaria *immitis* (Fig.1).

According to Ministry of Health and Medical Education as well as Ministry of Jihad Keshavarzy of Iran, different insecticides are being used in the area for household and agricultural pest control. For instance, allethrin, bendiocarb, bioallethrin, bioresmethrin, permehrin, propoxur, pyrethrin, tetramethrin, cyfluthrin, dichlorvos, dursban, pirimiphos-methyl, diazinon, malathion, chlorpyrifos-methyl, lindane and carbaryl. In addition, different rodenticides based on anticoagulant effect are used for rat control. Use of such pesticides my indirectly cause selection pressure on the susceptibility of mosquitoes mainly breed in wastewater habitats.

The objective of this study was to find the efficacy of selection pressure using different pesticides against *Cx.quinquefasciatus*.

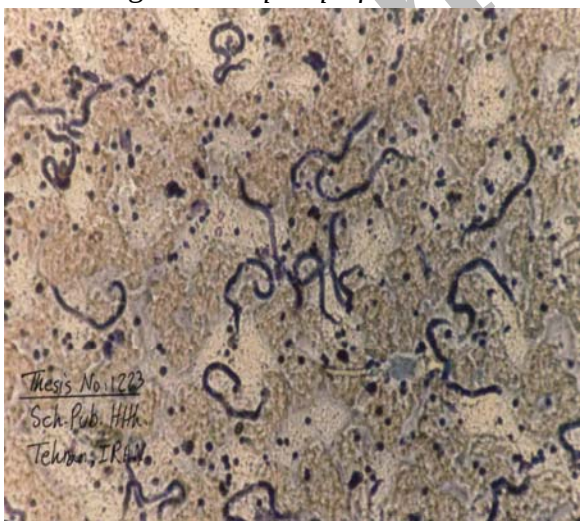

Fig. 1: *Dirofilaria immitis transmitted* by *Cx.quinquefasciatus*

MATERIALS AND METHODS

Study area: In the present study pupa and larvae of Cx. *quinquefasciatus* were collected from Varamin County, where the river Firoozabad reaches to this plateau. According to the preliminary studies and design and construction works which is taking place, Tehran wastewater treatment plants will be constructed and sited in the southern part of the city, therefore, it was decided to collect mosquitoes from such habitats of environment. Mosquitoes were transferred into the insectaria and maintained at 28-30 °C and 75-80% relative humidity. Laboratory strains also were bred at the same condition. This strain is maintained in the insectaria of the School of Public Health & Institute of Health Research, Tehran University of Medical Sciences, for several years and susceptible to all insecticides.

Adult susceptibility test: Tests on adults were carried out according to WHO method (WHO, 1981, 1998). At each test at least 100 mosquitoes representing 4-5 individuals' replicates of 25 females were tested. To reduce variability in the replicates engorged females were used. The exposure tubes were held in a vertical position during the test. The exposure period for each insecticide was one hour followed by 24-h recovery period. Insecticide exposure took place in a room with a temperature of 25± 2 ^{o}C and relative humidity 55-60%.

Insecticides impregnated papers:

The following insecticides impregnated papers were supplied by WHO; DDT 4%, bendiocarb 0.1%, malathion 5%, permethrin 0.75%, deltamethrin 0.05%, lambdacyhalothrin 0.05%, etofenprox 5%, cyfluthrin 0.15%. For the control oil impregnated papers were used.

RESULTS

The mortality rates of *Cx. quinquefasciatus* after one hour exposure followed by 24-h recovery period are given in Table 1.

Table 1: Mortality rates of *Cx. quinquefasciatus* adult females to different insecticides

Insecticides	Mortality rate	
	Lab strain	Field strain
DDT 4%	88.0	53.0
Malathion 5%	100	90.0
Bendiocarb 0.1%	100	66.0
Permethrin 0.75%	100	98.0
Deltamethrin 0.05%	100	96.0
Lambdacyhalothrin .05%	100	95.0
Cyfluthrin 0.15%	100	99.0
Etofenprox 5%	100	90.0
Control	2.0	0.00

By applying WHO criteria (98-100% mortality indicates susceptibility, 80-97% mortality requires confirmation of resistance with other methods and <80% mortality suggests resistance), it was found that field strain is resistant to DDT and bendiocarb, susceptible to cyfluthrin and tolerant to other insecticides. Laboratory strain only exhibited resistant to DDT and susceptible to other insecticides.

DISCUSSION

In this study DDT resistant was observed in both laboratory and field collected strains of *Cx.quinquefasciatus.* Although lab strain performed susceptibility to all insecticide used but filed strain exhibited resistant to DDT, bendiocarb and tolerant to malathion, permethrin, deltamethrin, lambdacyhalothrin and etofenprox. Use of DDT in Iran coincides with malaria eradication campaign which back to half a century ago. In a parallel study, Duran et al (1983) reported that *Cx.quinquefasciatus* was highly resistant to DDT but susceptible to malathion 5%. Majori et al (1986) found resistant to DDT and temepohs. Kampuchean strain of *Cx. quinquefasciatus* exhibited DDT resistance (Kohn, 1991). A study conduced in Patna Bihar, India, demonstrated that this species is resistant to DDT and dieldrin but susceptible to organophosphate and pyrethroid insecticides (Mukhopadhay et al., 1993).

Characterization of resistance to organophosphate insecticides, carbamates, and pyrethroids in *Cx. quinquefasciatus* from the State of Miranda, Venezuela was studied by Bisset et al. (1999). Resistance of *Cx. quinquefasciatus* to the organophosphate insecticides malathion and chlorpyrifos was higher than 30-fold whereas resistance to pirimifos-methyl, fenthion, cypermethrin, deltamethrin, permethrin and lambdacyhalothrin and to DDT was lower than 4-fold.

Adult and larval insecticidal tests conducted in Panaji, Goa, revealed that Cx. *quinquefasciatus* adults were resistant to DDT, dieldrin, malathion and fenitrothion (1.0%), and larvae were highly resistant to DDT but showed low resistance to malathion and fenitrothion (Thavaselvam et al., 1993).

The susceptibility of *Cx. quinquefasciatus* to insecticide in northern Thailand was monitored by using the WHO standard susceptibility test. This species was resistant to DDT and etofenprox, with a slight increase in tolerance to permethrin, deltamethrin, malathion and fenitrothion. No resistance to lambda-cyhalothrin was detected in any of the species studied (Somboon et al., 2003).Agricultural chemicals can indeed select for resistance in mosquitoes, for some form of insecticide resistance has been recorded in 48 species of Anopheles, in 13 of which agricultural insecticides are presumed to have contributed to selection for resistance in at least some populations (Lines, 1988).

Even the most effective mosquito abatement program cannot totally eliminate the nuisances caused by mosquitoes. Therefore it is necessary at times and in certain environment to employ personal protection geared at minimizing biting mosquitoes (Robert, 2001).

Curtis et al. (2002) proposed that where *Cx. quinquefasciatus* breeding in pits form a major component of the vector population, use of polystyrene-bead layers could assist considerably in the process of eliminating lymphatic filariasis by mass drug administration

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