# Susceptibility and avoidance behavior by *Culex quinquefasciatus* Say to three classes of residual insecticides

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ABSTRACT: The behavioral responses of three colonized strains of *Culex quinquefasciatus*, two from recent field collections in Thailand (Nonthaburi and Mae Sot) and one from a long-established colony from the National Institute of Health (NIH), Ministry of Public Health, Thailand, were compared during and after exposure to deltamethrin (0.02 g/m$^2$), propoxur (0.2 g/m$^2$), and fenitrothion (0.2 g/m$^2$) using an excito-repellency escape chamber system. We observed striking differences in behavioral response and excito-repellency between mosquito strains and test compounds. Greater escape responses were observed in the NIH strain during direct contact with deltamethrin and fenitrothion compared with the two field populations. Deltamethrin was the most irritant, followed by fenitrothion. Escape responses with propoxur were significantly delayed but increased slightly towards the end of the 30-min exposure period, more notably in the Nonthaburi strain ($P<0.05$). Non-contact repellent responses were generally much weaker than irritancy, with the greatest escape response seen with NIH and Nonthaburi. Deltamethrin showed the weakest repellent response overall (< 10% escape), while propoxur again demonstrated a delayed effect (NIH and Mae Sot) before escape occurred. We conclude that irritant and repellent behavioral responses by *Cx. quinquefasciatus* are important components for assessing the impact of residual spraying in mosquito control programs. A better understanding of chemical properties that elicit behavioral responses in mosquitoes should be considered in formulating control strategies designed to control mosquitoes or mitigate disease transmission risk. ***Journal of Vector Ecology* 31 (2): 266-274. 2006.**

*Keyword Index: Culex quinquefasciatus*, behavioral avoidance, excito-repellency, deltamethrin, propoxur, fenitrothion.

## INTRODUCTION

The tropical house mosquito, *Culex quinquefasciatus* Say, is an important vector of Bancroftian filariasis and arboviruses in various areas of the world (Sasa 1976). Both Chikungunya and Japanese encephalitis viruses have been isolated from field-collected adults in southeastern Asia, but *Cx. quniquefasciatus* is considered an inefficient vector of low medical importance (Halstead et al. 1969, Nguyen et al. 1974). Adult and larval stages have been difficult to control because of their prolific reproduction and resulting high population densities and the development of resistance to various insecticides that has made indoor and outdoor spray applications nearly ineffective (WHO 1984).

Most organized efforts to control populations of *Cx. quinquefasciatus* (*Cx. fatigans, Culex pipiens fatigans,* and *Cx. pipiens quinquefasciatus*) in Asia and elsewhere have been directed at the immature stages (Subra et al. 1969, Self and Tun 1970, Graham et al. 1972, Curtis and Feachem 1981, WHO 1984). Much of the early research concentrated on the organochlorines (chlorinated hydrocarbons), in particular DDT, lindane (BHC), and dieldrin, compounds no longer in widespread use for public health applications. Organophosphate and carbamate compounds, like fenitrothion, malathion, temephos, and propoxur, have been shown to have diminished effectiveness controlling *Cx. quinquefasciatus* and have been reported as a generally widespread problem. In Asia, varying degrees of tolerance/resistance to the toxic properties of fenitrothion and various carbamate and pyrethroid compounds have been documented in this species (WHO 1992).

For decades, several classes of compounds, including organophosphates, carbamates, and synthetic pyrethroids, have been widely used in the national public health vector control program in Thailand (Chareonviriyaphap et al. 1999, Somboon et al. 2003). Among these, the residual insecticides deltamethrin (a synthetic pyrethroid), propoxur (carbamate), and fenitrothion (organophosphate) represent among the most widely used compounds for controlling evening and indoor biting mosquitoes, in particular *Anopheles* malaria vectors. All three chemicals are listed as Class II (moderately hazardous to human health) pesticides depending on formulation and use. All three compounds have recognized contact and air-borne toxic modes of