

DISCRIMINATING LETHAL CONCENTRATIONS FOR TRANSFLUTHRIN, A VOLATILE PYRETHROID COMPOUND FOR MOSQUITO CONTROL IN THAILAND

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ABSTRACT. Pyrethroids are commonly used to control malaria and dengue vectors in Thailand. The lack of specific lethal discriminating concentrations (DCs) for specific mosquito species has possibly compromised more accurate assessments of physiological susceptibility to various chemicals over time. Previous studies have established DCs of various residual pyrethroids against specific mosquitoes in Thailand. However, DCs for transfluthrin (TFT), a highly volatile pyrethroid compound, against mosquito vectors in Thailand has been lacking. The aim of this study was to determine the DCs and susceptibility baselines of TFT against pyrethroid-susceptible laboratory strains of *Aedes aegypti*, *Anopheles minimus*, and *An. dirus* using the World Health Organization adult susceptibility tube method. Final DCs of TFT of each species were determined based on doubling the 99% lethal concentration at the following percentages: *Ae. aegypti* (0.06824%), *An. minimus* (0.06382%), and *An. dirus* (0.01508%). Subsequently, the respective TFT DCs were used to test field-collected populations of *Ae. aegypti*, *An. harrisoni* (Minimus Complex species), and *An. dirus*. *Anopheles harrisoni* and *An. dirus* were found completely susceptible (100% mortality), whereas *Ae. aegypti* from Nonthaburi Province was resistant to TFT. The suitability of the testing system and procedures is discussed. Routine assessment of insecticide susceptibility should include pyrethroids with high-vapor-pressure characteristics for informing control programs and consumers of product and chemical effectiveness.

KEY WORDS *Aedes aegypti*, *Anopheles minimus*, *Anopheles dirus*, insecticide susceptibility, transfluthrin

INTRODUCTION

Mosquito-borne diseases such as dengue and malaria remain a public health problem in Thailand (Bhatt et al. 2013, Corbel et al. 2013). An annual average over 53,000 dengue infection cases were reported in 2017 (BVBD 2017). For malaria, most of the cases occur in the borders with Myanmar, Cambodia, and Malaysia, with more than 10,000 reported cases in 2017 (BVBD 2017). Despite advances in therapeutic and vaccine research, the control of mosquito-borne diseases is mainly dependent on vector control (Corbel et al. 2013). In Thailand, the control of dengue vectors has mainly been approached by the elimination of breeding sites as well as the use of chemical larvicides (e.g., temephos) and other biological control since 1949 (Phuanukoonnon et al. 2005). Meanwhile, pyrethroids have been used through space spraying for adult control in the event of an outbreak (Esu et al. 2010, Corbel et al. 2013). Indoor residual spraying

(IRS) has been used to combat malaria as the National Malaria Control Program since 1949. Insecticide-treated nets (ITNs) were subsequently introduced into the program in 1980 (Chareonviriyaphap et al. 2000, Corbel et al. 2013). However, some people may not be protected by both ITNs and IRS during dusk and dawn outdoor activities, and some forest-dwelling *Anopheles* species do not rest indoors either before or after feeding (Scanlon and Sandhinand 1965).

The importance of outdoor transmission has resulted in development and testing of compounds with sublethal spatial repellent (SR) mode of action (MoA) for preventing human–vector contact by disrupting normal mosquito behavioral patterns within a treated area or “safe zone” (Achee et al. 2012, Killeen 2014), one such example being the volatile pyrethroid transfluthrin (TFT) (Ogoma et al. 2012a, 2012b; Andrés et al. 2015; Govella et al. 2015; Masalu et al. 2017). Transfluthrin is a fast-acting pyrethroid with a strong repellency action that is used to control urban and peri-urban insect pests, i.e., flies, mosquitoes, ants, and cockroaches (Mulla et al. 2001, Tawatsin et al. 2002, Ogoma et al. 2012a). Furthermore, in sufficient concentration, TFT can effectively knockdown/kill mosquitoes around humans in a protected area, which reduces or prevents diversion to unprotected individuals nearby (Andrés et al. 2015, Ogoma et al. 2017). Although TFT has a significant repellent action that might mitigate the development of physiological resistance, like other insecticides, the extensive use of this compound for mosquito control still raises concerns

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