

## ESTABLISHMENT OF DIAGNOSTIC DOSES OF FIVE PYRETHROIDS FOR MONITORING PHYSIOLOGICAL RESISTANCE IN *Aedes albopictus* IN THAILAND

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**ABSTRACT.** Monitoring insecticide resistance of *Aedes albopictus* is required for implementing effective dengue and chikungunya vector control in Thailand. The World Health Organization standard susceptibility test for adult mosquitoes was used to determine the baseline susceptibility of a pyrethroid-susceptible laboratory strain of *Ae. albopictus* to 5 different pyrethroids (deltamethrin, permethrin, bifenthrin, cypermethrin, and  $\alpha$ -cypermethrin). Subsequently, the respective established diagnostic doses (0.026% deltamethrin, 1.024% permethrin, 0.570% bifenthrin, 0.237% cypermethrin, and 0.035%  $\alpha$ -cypermethrin) were used to test field-collected *Ae. albopictus* from Rayong, Koh Chang, and Pong Nom Ron. As expected, the laboratory strain was completely susceptible to all pyrethroid insecticides at the established concentrations. Rayong mosquitoes were found to be highly susceptible to bifenthrin, cypermethrin, and  $\alpha$ -cypermethrin. Koh Chang mosquitoes were susceptible to only deltamethrin and permethrin. Pong Nom Ron mosquitoes were resistant to all pyrethroids tested. Routine assessment of these baseline results should guide future resistance monitoring to pyrethroid insecticides in *Ae. albopictus* in Thailand.

**KEY WORDS** *Aedes albopictus*, diagnostic dose, pyrethroid, susceptibility

### INTRODUCTION

*Aedes albopictus* (Skuse) is the important vector of chikungunya (CHIK) virus in Thailand (Thavara et al. 2009) and regarded as an important secondary vector of dengue (DEN) virus (Srisawat et al. 2014). *Aedes albopictus* has been shown to be more competent for developing transmissible infection with CHIK virus than *Ae. aegypti* (L.) (Vega-Rua et al. 2014). In Thailand, this species is commonly found in rubber and coconut plantations (Thavara et al. 2001) and has been associated with areas of high numbers of human CHIK cases in southern Thailand (Charonviriyaphap et al. 2003).

The first confirmed case of CHIK in Thailand was seen in Bangkok in 1958 followed by epidemics in eastern, northern, and southern parts of Thailand (Hammon et al. 1960). Decades later a large outbreak occurred in 2009, affecting >46,000 people from central, northeastern, northern, and southern provinces of Thailand (Pulmanusahakul et al. 2011). Annually, reports of human CHIK infections occur, primarily in the southern part (Narathiwat, Phuket, Suratthani,

and Chumphon provinces) of the country, generally raising concern of new outbreaks of disease. In DEN- and CHIK-endemic areas, space spraying of insecticides plays an important role in preventing or stopping the spread of these viruses. Pyrethroids have been widely used for controlling adult *Ae. albopictus* in Thailand, although pyrethroid-resistant populations of *Ae. albopictus* have been documented (Chuaycharoensuk et al. 2011, Chareonviriyaphap et al. 2013). Similarly, Ponlawat et al. (2005) reported that *Ae. albopictus* larvae collected from Mae Sot (Tak Province) and Phatthalung Province were resistant to permethrin and slightly resistant to temephos (organophosphate used as a larvicide).

Insecticide resistance could become one of the major obstacles for the control of *Aedes* vectors; however, the extent and degree of resistance is unknown. The resistance status of adult mosquitoes, including *Ae. albopictus*, typically involves the use of the World Health Organization (WHO) tube assay with insecticide-treated papers (WHO 1998). This is a relatively simple technique for the routine evaluation of chemical susceptibility in mosquitoes and provides important data to support mosquito management strategies. The discriminating diagnostic concentrations of insecticides are typically those recommended by WHO from information gathered from WHO collaborating centers, and determined by consensus from expert committees and the WHO Pesticide Evaluation Scheme (Macoris et al. 2005). Currently, WHO recommended diagnostic concentrations are provided only for *Ae. aegypti*, *Culex quinquefasciatus* (Say), and *Anopheles*

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