Pyrethroid induced behavioral responses of *Anopheles dirus*, a vector of malaria in Thailand

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ABSTRACT: Contact and noncontact behavioral actions of wild-caught *Anopheles dirus* in response to the operational field dose of three synthetic pyrethroids (bifenthrin, α-cypermethrin and λ-cyhalothrin) were evaluated using an exito-repellency test chamber. DEET was used as the repellency standard for comparison with the other three synthetic pyrethroids. Results showed that test specimens rapidly escaped from the test chamber when exposed to direct contact with a surface treated with each of the three synthetic pyrethroids and DEET. Alpha-cypermethrin demonstrated the strongest irritant action (84.9% escape), followed by DEET (77.0%), λ-cyhalothrin (68.6%) and bifenthrin (68.3%). In the noncontact configuration, fewer mosquitoes escaped from the test chambers as compared to contact trials, although a significant escape response was still observed as compared to the controls ($P<0.05$). We conclude that *An. dirus* exhibits both irritant and repellent actions in response the three pyrethroids testing in this study. The information obtained will allow us to better understand the behavioral responses of vectors to various chemicals and provide guidance when designing control strategies for targeting specific disease vectors. ***Journal of Vector Ecology* 37 (1): 187-196. 2012.**

Keyword Index: Bifenthrin, DEET, α-cypermethrin, λ-cypermethrin, *Anopheles dirus*, Thailand.

INTRODUCTION

Many people living in tropical and subtropical areas of the world are at risk of infection from a wide variety of vector-borne diseases most notably malaria. Globally, between 100-300 million people live in malaria endemic areas (World Health Organization [WHO] 2009), where the four human malaria parasites (*Plasmodium*) are transmitted by mosquitoes in the genus *Anopheles* (Service and Townson 2002). In Thailand, all major malaria vectors belong to a species complex of which the respective sibling species are not able to be morphologically distinguished from one another (Rattanarithikul and Panthusiri 1994). Among these complexes, members of the *Anopheles dirus* complex serve as the most efficient malaria vectors in Thailand; two of the five species, namely *An. baimaii* and *An. dirus* are the most important (Manguin et al. 2008, Sungvornyothin et al. 2009, Singha and Chandra 2011).Both *An. baimaii* and *An. dirus* have proven extremely difficult to control due to a diverse array of host seeking behaviors and preferences, biting patterns and larval breeding habitats (Pates and Curtis 2005, Sinka et al. 2011). Despite decades of extensive research, efficacious and commercially viable vaccines for malaria are not yet available. Therefore, the prevention and control of malaria in Thailand remains dependent on various vector control measures (i.e. indoor residual spraying (IRS) and use of insecticide-impregnated bed nets) to reduce the risk of transmission by reducing the occurrence of blood feeding. The primary chemicals currently employed for vector control are the synthetic pyrethroids (Roberts and Andre 1994, WHO 1999, Reiter and Gubler 1997, Grieco et al. 2007).

Synthetic pyrethroids elicit a repellent response from many insect species and cause mosquitoes to move away from sprayed areas (Lockwood et al. 1984, Lindsay et al. 1991). The extensive and continued use of pyrethroids should act as a stimulus to increase attention on the behavior of the mosquito vectors. The use of IRS in homes has served as a major means of controlling malaria transmission, yet little is known of the precise role irritant and repellent actions have on specific malaria vectors, especially those that feed and rest indoors prior such as *An. dirus.*

Anopheles dirus was selected as the test species as it represents a major malaria vector in the forest and forest-fringe regions of Thailand and commonly exhibits both endophagic and anthropophilic behaviors in the areas where it occurs (Ismail et al. 1974, Rosenberg and Maheswary 1982, Baimai 1988, Baimai et al. 1988). Little is known or fully appreciated of the behavioral responses of *An. dirus* to the synthetic pyrethroids that are currently being used in public health vector control program in Thailand. Such information is needed to accurately assess the full impact of these chemicals prior to initiating a large scale vector control program using any of these three synthetic pyrethroids. The objective of this study was to use the exito-repellency test system to evaluate behavioral responses in wild-caught populations of *An. dirus* exposed to three commonly used synthetic pyrethroids: bifenthrin, α-cypermethrin and λ-cyhalothrin. Besides, DEET is one of the most commonly used chemicals for disrupting human-