Pyrethroid susceptibility and behavioral avoidance in *Anopheles epiroticus*, a malaria vector in Thailand

Wanapa Ritthison[1*], Rungarun Titgratog[1], Krajana Tainchum[1], Michael J. Bangs[1,2], Sylvie Manguin[3], and Theeraphap Chareonviriyaphap[1✉]

[1]*Department of Entomology, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand, faasthc@ku.ac.th*
[2]*Public Health & Malaria Control, Kuala Kencana, Papua 99920, Indonesia*
[3]*Institut de Recherche pour le Développement (IRD, UMR-MD3, 34093 Montpellier, France*

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ABSTRACT: The physiological susceptibility to insecticides and the behavioral responses of four wild-caught populations of female *Anopheles epiroticus* to synthetic pyrethroids (deltamethrin, permethrin, and alpha-cypermethrin) were assessed. Test populations were collected from different localities along the eastern coast, Trat (TR), Songkhla (SK), and Surat Thani (ST) and one population from the western coast, Phang Nga (PN). Results showed that all four populations of *An. epiroticus* were susceptible to all three synthetic pyrethroids tested. Behavioral responses to test compounds were characterized for all four populations using an excito-repellency test system. TR displayed the strongest contact excitation ('irritancy') escape response (76.8% exposed to deltamethrin, 74.1% permethrin, and 78.4% alpha-cypermethrin), followed by the PN population (24.4% deltamethrin, 35% permethrin, and 34.4% for alpha-cypermethrin) by rapidly escaping test chambers after direct contact with surfaces treated with each active ingredient compared with match-paired untreated controls. Moderate non-contact repellency responses to all three compounds were observed in the TR population but were comparatively weaker than paired contact tests. Few mosquitoes from the SK and ST populations escaped from test chambers, regardless of insecticide tested or type of trial. We conclude that contact excitation was a major behavioral response in two populations of *An. epiroticus*, whereas two other populations showed virtually no escape response following exposure to the three pyrethroids. The explanation for these large unexpected differences in avoidance responses between pyrethroid-susceptible populations of the same species is unclear and warrants further investigation. ***Journal of Vector Ecology* 39 (1): 32-43. 2014.**

Keyword Index: *Anopheles epiroticus*, behavior avoidance, pyrethroids, excito-repellency.

INTRODUCTION

Malaria is one of the most important mosquito-borne diseases in Thailand with approximately 30,000 reported cases each year. The disease is relatively common in hilly-forested areas, especially near the Thai-Myanmar and Thai-Malaysia national borders where favorable environmental conditions and efficient malaria vectors are present. Malaria transmission also remains prevalent in some foci along the coastal zones of Thailand where *Anopheles epiroticus* Linton & Harbach is active (Manguin et al. 2010, Dusfour et al. 2007). *Anopheles epiroticus* (formerly *Anopheles sundaicus* species A) is a member of the *Anopheles sundaicus* complex and has been shown epidemiologically to be an important vector of human plasmodia on the Southeast Asian mainland (Dusfour et al. 2004). In Thailand, this species has been regarded as a secondary or focally important vector of malaria in insular and coastal areas of the country (Gould et al. 1966, Harinasuta et al. 1974, Prasittisuk 1985, Sumruayphol et al. 2010).

DDT was the chemical of choice in the 1950s and was used extensively in malaria endemic areas. Its use was gradually phased out in Thailand between 1995 and 2000 and replaced by two pyrethroids, deltamethrin and permethrin (Chareonviriyaphap et al. 1999, 2000). Deltamethrin has been used primarily for indoor residual spraying (IRS) of house surfaces and permethrin for treatment of bed-nets and window and door curtains (Chareonviriyaphap et al. 2004). Additionally, alpha-cypermethrin has gradually become more common for protection against indoor and outdoor biting mosquitoes, including *Anopheles* (Grieco et al. 2007, Mongkalangoon et al. 2009). As pyrethroids have begun to lose effectiveness against mosquitoes that have developed significant resistance against them in many places worldwide (Corbel and N'Guessan 2013), it is crucial to continue monitoring how mosquitoes respond to synthetic pyrethroids, including behavioral responses to sub-lethal concentrations.

Understanding the behavioral responses of different mosquito populations to insecticides can facilitate vector control by selecting and implementing the most effective interventions that better target the primary mosquito vectors. In general, two types of stimulus-mediated responses by mosquitoes to insecticides have been recognized, excitation ('irritancy') and repellency, which disrupt normal patterns of host-seeking or resting behavior (Roberts et al. 2000). As defined, irritancy occurs following physical (tarsal) contact with chemical residues, whereas spatial repellency acts at a distance from an insecticide-treated surface

*Present address: Center for Advanced Studies for Agriculture and Food, Kasetsart University Institute for Advanced Studies, Bangkok 10900, Thailand (CASAF, NRU-KU, Thailand)