A High Throughput Screening System for Determining the Three Actions of Insecticides Against *Aedes aegypti* (Diptera: Culicidae) Populations in Thailand

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ABSTRACT Chemicals can protect humans from the bites of hemophagous arthropods through three different primary actions: irritancy (excitation), repellency, or toxicity, actions that can be evaluated using a laboratory-based assay system. In this study, the deterrent and toxic actions of three synthetic pyrethroids and DDT were characterized on six field strains of *Aedes aegypti* from Thailand under laboratory-controlled conditions using the high throughput screening system. All six strains showed significant contact irritant responses to the three synthetic pyrethroids, but significantly weaker irritant responses to DDT. Marked repellency responses were seen in all six *Ae. aegypti* test strains exposed to DDT, whereas the synthetic pyrethroids resulted in greater toxicity than DDT under similar test conditions. Although significantly different in actions, irritancy and repellency may reflect and be influenced by the background insecticide susceptibility status of a particular mosquito population. Results from this study can be used to guide decision making regarding more effective *Ae. aegypti* adult control in Thailand.

KEY WORDS *Aedes aegypti*, behavioral responses, HITSS, synthetic pyrethroids, DDT

Dengue fever and dengue hemorrhagic fever are considered the most important arthropod-borne viral disease manifestations in humans and globally a problem that continues to grow in scope and importance (Gibbons and Vaughn 2006). The four dengue virus serotypes are most commonly transmitted by *Aedes aegypti*, a common peridomestic and indoor day-biting mosquito with a widespread geographic distribution throughout most tropical and subtropical countries (Gubler 1998, Guzman and Kouri 2002). This mosquito preferentially feeds on human blood and is recognized as a highly efficient vector because of its proximate relationship with humans (Swaddiwudhipong et al. 1992, Edman et al. 1992, Chansaeng et al. 1993, Chareonviriyaphap et al. 2003). Currently, the primary methods for controlling dengue rely on chemical and nonchemical control applications against the mosquito to reduce human-vector contact (WHO 1999).

Theoretically, chemical compounds can protect humans from vector-borne diseases in two primary ways, as follows: either by killing or by nontoxic action modifying mosquito behavior to inhibit blood feeding (Davidson 1953, Roberts and Andre 1994, Roberts et al. 1997, Rutledge et al. 1999). Most previous works have been done on insecticide toxicity; little has been focused on nontoxic properties and actions (Roberts et al. 1997). Recently, three types of insecticidical actions were distinguished in the context of toxicants, contact irritants, and noncontact repellents effects (Grieco et al. 2007). For purposes of this report, we have defined contact irritancy as an excitatory effect resulting from insects making direct (tarsal) contact with chemical residues on a treated surface before eliciting a stimulus-mediated response, whereas repellency occurs as a result of spatial chemical detection from a distance, i.e., without making physical contact with an insecticide-treated surface (Roberts et al. 2000). The combined locomotor stimulant effects of both irritancy and repellency have long proven to inhibit or disrupt normal behavioral patterns and in particular drive sensitive insects away from treated surfaces (i.e., escape) and/or inhibit normal blood

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