Scientific Note

The use of an experimental hut for evaluating the entering and exiting behavior of *Aedes aegypti* (Diptera: Culicidae), a primary vector of dengue in Thailand

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Received 6 June 2005; Accepted 22 July 2005

Dengue remains a serious health threat around the world, despite significant gains in its control (Gubler and Kuno 1997). Dengue is transmitted primarily by *Aedes aegypti*, a day-biting mosquito (Gould et al. 1968, Russell et al. 1969) and the prevention and control of this species has been a long-term problem for endemic areas. The interruption of dengue transmission relies heavily on vector surveillance through the detection of mosquito larvae or pupae and vector control methods. Control strategies focus on the elimination of larval habitats through source reduction, which can be expensive and require continuous community participation often resulting in failure (Kongmee et al. 2004). Efforts focused on adult control strategies using various synthetic compounds have shown success and are commonly being used elsewhere (Somboon et al. 2003).

Understanding the behavioral responses of vectors, especially avoidance behavior to residual insecticides, is of particular importance to any vector control program. There have been numerous attempts to accurately measure the behavioral responses of mosquitoes to insecticides using experimental huts, mainly on *Anopheles* species (Smith 1965, Roberts et al. 1984, Rutledge et al. 1999, Bangs[5], Grieco et al. 2000, Pates and Curtis 2005). However, no studies have been published on behavioral responses to investigate the entrance and exit behaviors of *Ae. aegypti* exposed to chemical insecticides using a portable hut. For this reason, the effect of chemical residue inside homes on reducing man-vector contact needs to be evaluated.

The portable huts used in the present study were based on the design of Achee et al. (personal communication) used to evaluate the flight behavior of *An. darlingi* in Belize, Central America. The dimensions of the huts were 4 m wide x 5 m long x 3.5 m high with three windows (1.125 m x 1.175 m) and one door (0.8 m x 2 m) onto which could be affixed entrance and exit traps. Huts were constructed in the fashion of indigenous Thai homes. Hut frames were made of iron pipe and custom-welded galvanized pipes. Pieces of non-treated wood plank, measuring 1 m x 2.5 m in length served as the side walls. Floors were adjusted and aligned with cement blocks and an A-frame style zinc roof was put in place. The top of the angled roof measured 3.5 m from the ground level. Three windows, one on each of three sides were affixed with entrance traps (Figure 1). In addition, a north-facing door was affixed with an exit trap (Figure 2).

The dimensions of the entrance traps were 0.84 m long, 1.065 m wide, and 1.065 m high, with an iron frame. Louvers made of 3/8-in non-treated plywood and fixed vertically at 60 degree angles were placed over the front opening of each entrance trap on each side of the opening, 1.065 m x 1.065 m, with a horizontal row of 10-cm wide slit openings made of 3/8-in non-treated plywood fixed vertically to 60 degrees. The louvers were placed in an open state producing a series of horizontal, 10-cm wide openings through which mosquitoes could enter. The traps moved forward and backward during the observation period by sliding them on a support platform (Figure 1). This allowed the collector to capture mosquitoes from the trap without having to be inside the hut. An exit trap, measuring 1.2 m long x 0.845 m wide x 2.10 m high, was fixed to the door opening. Twenty plywood louvers identical to those used in the window traps were installed over the front opening and were again fixed at 60 degree angles to the vertical (Figure 2). These were arranged to facilitate the movement of mosquitoes from the hut into the trap. Both trap types were covered by nylon insect netting. Cotton sleeve material was sewn over several holes in both types of trap to facilitate the removal of mosquitoes.

In order to test chemicals in the huts without applying a compound directly to the wall surfaces, a series of panels were developed for holding treated netting which could be positioned around the interior surface of the hut. The aluminum frame that houses the netting contained holes in each corner and were placed onto bolts attached to the hut

[5]Bangs, M.J. 1999. The susceptibility and behavioral response of *Anopheles albimanus* Weidemann and *Anopheles vestitipennis* Dyar and Knab (Diptera: Culicidae) to insecticides in northern Belize. Ph.D. Thesis. Uniformed Services University of the Health Sciences, Bethesda, Maryland 489 pp.

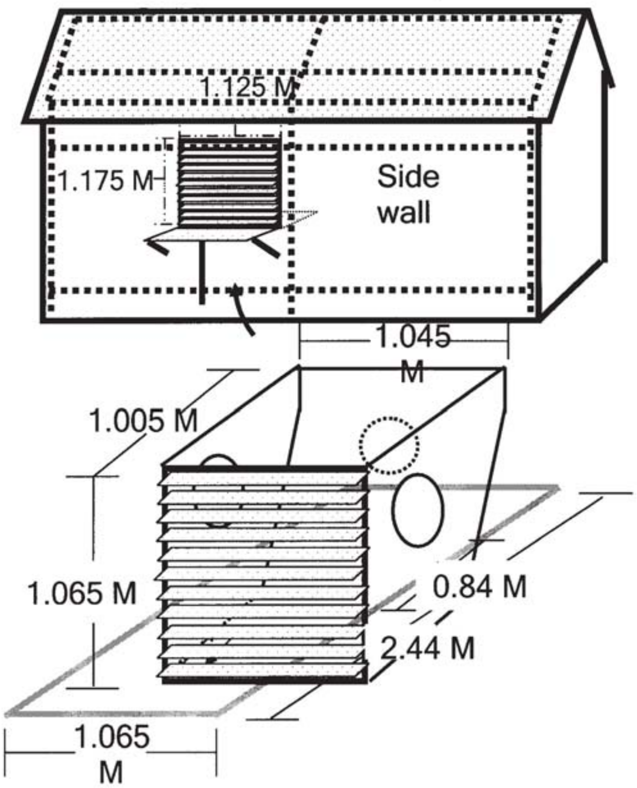

Figure 1. Removable entrance traps with a support platform.

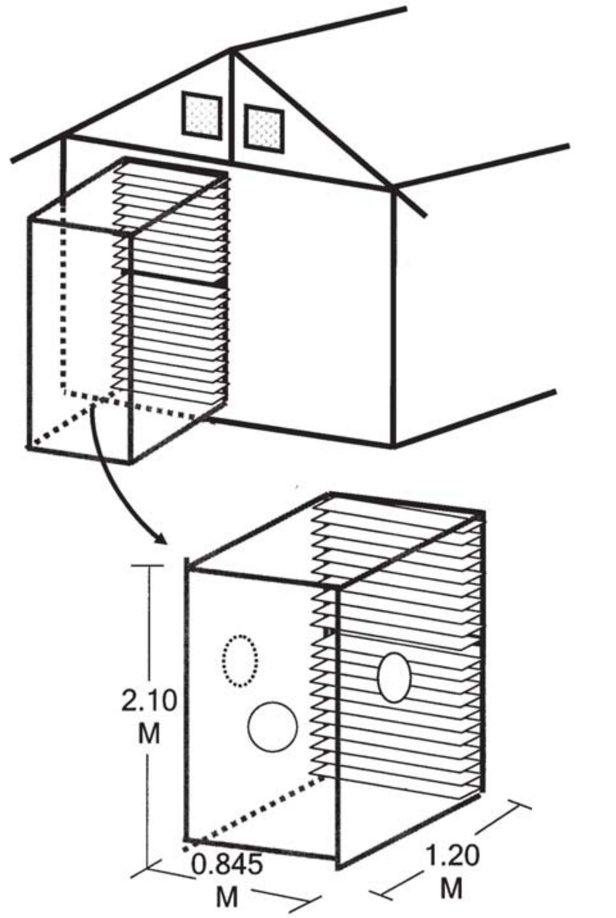

Figure 2. Exit traps fixed to the door opening.

walls. A 9-cm gap between the aluminum panel and the wood planks prevented the netting from touching the interior walls; wing nuts were also used to prevent aluminum panels from touching the wood and to assure the netting did not lean on the bolts due to wind or unexpected accidents. Four openings were constructed into the gables at the front and rear of the hut, measuring 0.45 m x 0.45 m. These openings were covered by 1/12-in aluminum wire mesh and served to reduce the temperature inside the huts. On the outside of the hut, a ten-inch wide and fifteen-inch deep channel filling with water was used as an ant trap.

To assemble the hut, side-wall metal frames were prepared. For each one, metal pipes served as poles connected together by metal pipes horizontally, at the bottom and top, into the welded pieces and were then fixed to prevent frame shifting. Similarly, the other three side walls were prepared in the same manner and connected together to make the hut frame. Welded pieces were used for all base support legs, corner and wall joints, and roof angles. Height from the ground level to apex of roof was 5 m. There were four eaves between the top of the wall and roof on the front (2 eaves) and rear (2 eaves) walls. The eaves were sealed by 1/12-in aluminum wire mesh fastened across the eave opening. Once frames had been completed, wood planks were put in place together with window and door traps to make a furnished hut.

These portable huts were used to evaluate the endophilic behavior of *Ae. aegypti* field populations in Kanchanaburi and Chiangmai provinces, Thailand. Briefly, 100 marked female mosquitoes were released either inside the hut (to measure exit behavior) or outside the hut (to measure entrance behavior). Released populations were marked with different colors following the methods of Muir and Kay (1998) and Tsuda et al. (2001) on *Ae. aegypti*. Mosquitoes were released at 0500 h and collections were made from the traps at 20 min intervals, from 0600-1800 h. Human hosts were covered by mosquito nets. This prevented humans from being bitten during the study. The movement patterns for natural populations of *Ae. aegypti* into (entrance) and out (exit) of huts with the presence of human hosts in the huts are presented in Figure 3.

Reproducible results were obtained. This was the first time a portable experimental hut was used to document the entrance and exiting behavior of *Ae. aegypti*. The whole system is easy to assemble and can be disassembled in 3-5 hr, depending on weather conditions and manpower. In brief, both traps indicated a high degree of movement through the windows and doors with peaks entering occurring at 0840-1040 h and 1240-1320 h and peak exiting occurring at 1640-1740 h (Figure 3). The portable hut design affixed with entrance and exit traps has demonstrated success in collecting entering and exiting *Ae. aegypti* in Thailand. The portable hut can serve as a means for testing exiting/entering behavior

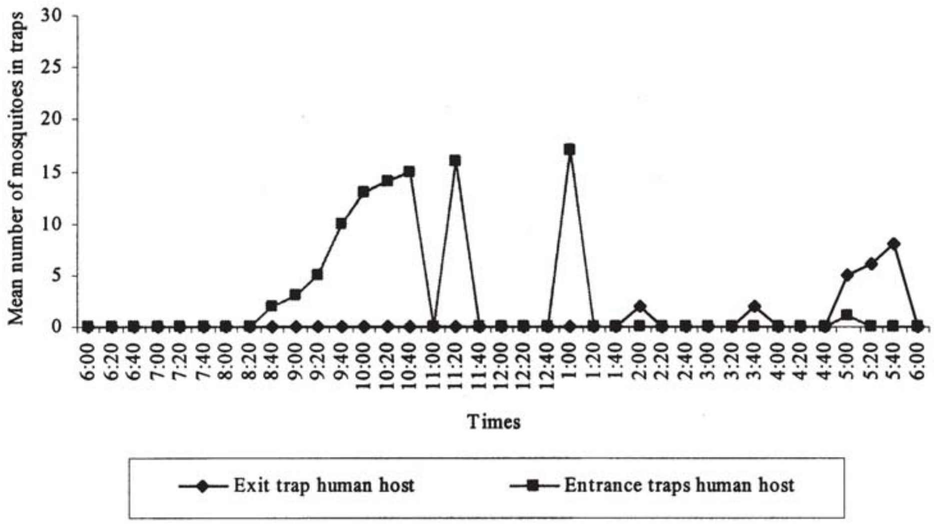

Figure 3. Movement patterns for *Aedes aegypti* into (entrance) and out (exit) of the huts in the presence of human hosts.

in response to chemical compounds for the control of *Ae. aegypti*, a notoriously efficient dengue vector.

Acknowledgments

The authors thank the Disease Control Department, Ministry of Public Health, Nontaburi Province, Thailand for helpful advice during implementation of this work. We also thank the Armed Forces Development Command, Sai Yok District, Kanchanaburi Province for supporting a study area. Special thanks go to the students who helped with the construction of huts. This work was supported by a grant from the National Institutes of Health (grant no. 5U01AI054777-02).

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