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Evaluation of Carbon Dioxide– and 1-Octen-3-Ol–Baited Centers for Disease Control Fay–Prince Traps to Collect *Aedes Albopictus*

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Abstract

During the summer of 2001, field studies were performed to evaluate the effects of carbon dioxide (CO_2) and 1-octen-3-ol (octenol) on the ability to collect *Aedes albopictus* with Centers for Disease Control (CDC) Fay–Prince traps. Results from these studies indicated that *Ae. albopictus* is significantly more attracted to CO_2- or CO_2 + octenol–baited CDC Fay–Prince traps than unbaited or octenol-baited traps. However, the difference between the responses to CO_2 and CO_2 + octenol was not statistically different, indicating that CO_2 is driving the response of *Ae. albopictus* to CDC Fay–Prince traps.

Keywords

Aedes albopictus; attractants; octenol; carbon dioxide; Fay–Prince trap

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Aedes albopictus (Skuse), the Asian tiger mosquito, has become one of the most notorious human-biting mosquitoes in the southeastern and mid-Atlantic regions of the United States. This species is well established in most urban and suburban areas and is rapidly becoming the most important pest species in these regions. The species has been implicated in the transmission of several mosquito-borne diseases, such as dengue, yellow fever, La Crosse encephalitis, eastern equine encephalitis, and West Nile encephalitis (Mitchell 1991, Mitchell et al. 1992, Vazeille-Falcoz et al. 1999, Gerhardt et al. 2001, Holick et al. 2002). Recent laboratory studies have demonstrated that this species is a highly competent vector for West Nile virus (Turell et al. 2001a, 2001b; Sardelis et al. 2002). Its widespread distribution and vector potential make *Ae. albopictus* an urgent problem.

Previous studies have investigated the efficacy of 1-octen-3-ol (octenol) in conjunction with carbon dioxide (CO_2) to attract various mosquito species, to enhance vector-borne disease surveillance, and as a potential control method (Kline 1994, 2002; Vaidyanathan and Edman 1997a, 1997b; Kline and Lemire 1998; Kline and Mann 1998; Rueda et al. 2001; van den Hurk et al. 2001). The results indicated that octenol has species-specific effects. However, few studies have ventured into urban and suburban habitats and none have focused on *Ae.*

albopictus. Only 1 study has utilized the Centers for Disease Control (CDC) Fay–Prince trap (Canyon and Hii 1997), which originally was developed to target *Aedes aegypti* (L.) (Fay and Prince 1970) and also has been utilized in efforts to collect *Ae*. al*bopictus*.

Popularity of commercial mosquito traps, which utilize CO_2 and octenol as olfactory attractants, is increasing in areas where *Ae. albopictus* is the primary mosquito species. Because of the increase in use of these traps by homeowners and the potential for this species to transmit endemic viruses (e.g., West Nile virus), it has become important to understand the effect of octenol on the collection of *Ae. albopictus*. The purpose of this study was to evaluate the effectiveness of octenol and CO_2 at increasing the efficacy of CDC Fay–Prince traps for collecting *Ae. albopictus*.

During the weeks beginning on July 23, August 13, and September 10, 2001, trials were conducted at 12 locations in Baltimore City, Howard County, and Anne Arundel County, Maryland. The 12 sites were chosen because they had active populations of adult *Ae. albopictus* and a significant number of artificial containers providing breeding grounds for the tiger mosquitoes. Containers found at each site included tire piles, flowerpots, tarps, pool covers, birdbaths, children's toys, corrugated pipes, and cemetery vaults.

A CDC Fay–Prince battery–powered trap (model 712, John W Hock Co., Gainesville, FL) was operated at each site. Each trap was suspended from a natural or man-made structure 0.9 m above the ground and equipped with an attractant combination (see below). The traps were set each day between 1100 and 1400 h, and operated for 24 h. Collected mosquitoes were kept cool until arrival in the laboratory, killed in the freezer, sorted on a chill table, and identified to species by morphological characteristics by using a series of dichotomous keys (Darsie and Ward 1981, Slaff and Apperson 1989). The number of male and female mosquitoes of each species was counted, recorded, and entered into a database. Each species was pooled (into groups of up to 40) and tested for West Nile virus by the Maryland Department of Health and Mental Hygiene (results not reported here).

The 4 attractant schemes evaluated in the field trials were no bait, octenol, CO_2, and CO_2 + octenol. Carbon dioxide was released from a 1.9-liter plastic Igloo® beverage cooler containing approximately 1.4 kg of dry ice suspended directly above the trap. The approximate release rate of CO_2 was 53 g/h. Three milliliters of octenol (Aldrich, Milwaukee, WI) was supplied in a 5-ml microreaction vial (Supelco, Bellefonte, PA) fitted with a plastic cap and neoprene septa with a 1.5-mm hole bored through it. The octenol was released by inserting a pipe-cleaner wick (Dills 15-cm), which had been doubled over, into the hole such that 1.5 cm protruded above the septum. This provided a release rate of approximately 44 mg/h. The reaction vial was attached 5 cm below the entrance to the trap.

A gridlike Latin-square design, typically used to evaluate different baiting schemes, was not practical or possible in an urban and suburban environment. However, our method allowed us to test each of the 4 schemes simultaneously in triplicate at sites that were similar in their potential for breeding by *Ae. albopictus*. Sampling was conducted on 4 consecutive nights with the bait at each site chosen randomly such that each bait was only tested once at a given site in a given week. Three replicates of the trial were run. Attractant, date, and site effects were evaluated by using 3-way analysis of variance for total number of female *Ae. albopictus*. SigmaStat (SPSS Inc., Chicago, IL) was used for all statistical analyses.

Over the 144 trap nights, a total of 1,121 female *Ae. albopictus* was collected. No statistical difference was found between the numbers of female tiger mosquitoes collected for each trial. A small, overall difference among sites was seen; however, Tukey's post hoc comparison revealed that the individual sites did not differ significantly. The overall response for the average number of tiger mosquitoes caught each night for each bait type was CO_2 + octenol > CO_2 > no bait > octenol (Table 1). However, the response to CO_2 + octenol did not differ significantly from the response to CO_2. The only statistically significant difference found was between the response to CO_2 + octenol or CO_2 and no bait or octenol ($P \leq 0.05$, Tukey's studentized range test) and this response was replicated during each trial (Fig. 1).

After the initial report that octenol is a potential attractant for mosquitoes (Takken and Kline 1989), several studies have investigated its use in a variety of habitats and for a range of mosquito species (van Essen et al. 1994, van den Hurk et al. 1997, Beavers et al. 1998, Kline and Mann 1998, Mboera et al. 2000). This is the 1st study to investigate the effectiveness of CO_2 and octenol in collecting *Ae. albopictus*. Similar to these previous studies, octenol alone was not seen to be a potent attractant. Furthermore, although CDC Fay–Prince traps baited with CO_2 + octenol collected the greatest number of female *Ae. albopictus*, the difference between the mean number of the species collected in these double-baited traps and the traps baited with CO_2 alone was not statistically significant ($P > 0.05$, Tukey's studentized range test). The difference between the mean number of *Ae. albopictus* collected in traps baited with CO_2 or CO_2 + octenol and unbaited traps or traps baited with octenol alone was statistically significant ($P \leq 0.05$, Tukey's studentized range test). The results of this study suggested that octenol did not decrease catch success for *Ae. albopictus*, which has been reported with *Ae*. *aegypti* (Canyon and Hii 1997), and that CO_2 is driving the response of *Ae. albopictus* to a CDC Fay–Prince trap. Because this study evaluated the response of tiger mosquitoes to baited and unbaited Fay-Prince traps and did not differentiate the potential visual effect of the contrasting black and white panels of the Fay–Prince trap, future studies might include additional trap types with the same attractant combinations. Nonetheless, the addition of octenol for surveillance purposes or to augment the trapping capability of commercial mosquito traps appears to be unnecessary for *Ae. albopictus*.

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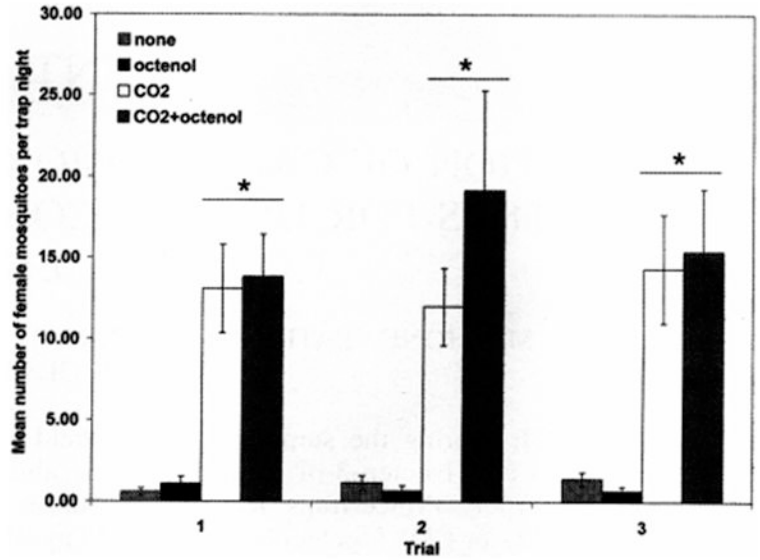

Fig. 1.

Mean (females/trap night) response of *Aedes albopictus* collected in Centers for Disease Control Fay–Prince traps baited with octenol, CO_2, and CO_2 + octenol for each trial (* $P \leq 0.05$).

Table 1

Mean number of female *Aedes albopictus* (SE) collected for each bait type (n = 36).

Bait	Mean (SE)
No bait	1.06 (0.21)
Octenol	0.81 (0.20)
CO_2	13.14 (1.60)
CO_2 + octenol	16.14 (2.52)