Journal of the American Mosquito Control Association, 41(1):47–49, 2025

OPERATIONAL NOTE

COMPARING DETECTIONS OF *AEDES AEGYPTI* FEMALES USING THREE TYPES OF AUTOCIDAL GRAVID TRAPS

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ABSTRACT. We compared the number of *Aedes aegypti* females per trap and the number of detections of this mosquito species per week during 8 wk in 3 types of autocidal gravid traps, the Centers for Disease Control and Prevention (CDC) Autocidal Gravid Ovitrap (AGO), Biogents Gravid *Aedes* Trap (GAT), and Singapore Gravitrap (SGT), in central Puerto Rico. These traps use the same principles for attracting gravid *Ae. aegypti* females as traditional ovitraps, such as dark colors, standing water, and decomposing plant materials. The traps differ in size, AGO being the biggest and SGT the smallest. Average captures of female *Ae. aegypti* per trap per week were 11.1, 7.2, and 1.7 in AGO, GAT, and SGT traps, respectively, a pattern consistent with the sizes of the traps. These results indicated that GAT traps and SGT traps captured 35.5% and 84.7% fewer females of *Ae. aegypti*, respectively, than AGO traps. Although *Ae. aegypti* was present in all 20 sites during the 8 wk of observations, AGO, GAT, and SGT traps did not catch specimens in 1, 9, and 58 out of 160 observations per trap type (trap-wk), respectively. Trap failures were 1, 6, and 1 for the AGO, GAT, and SGT traps, respectively. Despite the absence of females of *Ae. aegypti* at some sites and weeks in each of the traps, all 3 traps were able to detect the presence of this mosquito at each of the 20 sites during the 8 wk of observations and could be used for *Ae. aegypti* surveillance.

KEY WORDS *Aedes aegypti*, autocidal gravid traps, dengue, mosquito surveillance, Puerto Rico

Aedes aegypti (L.) is the main vector of important arboviruses that cause human disease in tropical and subtropical urbanized areas of the world, such as dengue (DENV), chikungunya (CHIKV), Zika (ZIKV), and yellow fever (YFV). Incidence of dengue has been high in recent years (2010–2023), with 10,912 travel associated cases in 56 states or territories and 34,349 locally acquired cases in 16 states or territories of the United States (CDC 2024). The number of reported dengue cases in the Americas has been increasing at record numbers since the 1980s, with more than 10 million cases recorded in 2024 (PAHO 2024). These numbers illustrate the challenge of effectively controlling *Ae. aegypti* and dengue. A key to controlling this mosquito species is having adequate tools to track its presence and abundance. It is important to define mosquito density thresholds based on *Ae. aegypti* females that would prevent local arbovirus transmission and serve as well-defined targets for mosquito control programs (Ong et al. 2021, Barrera 2022). Several passive traps that attract and capture gravid females of *Ae. aegypti* have been designed to monitor this species (Lee et al. 2013, Barrera et al. 2014, Ritchie et al. 2014). These traps use the same principles for attracting gravid *Ae. aegypti* females as traditional ovitraps, such as dark colors, standing water, and decomposing plant materials. A common trapping element is a sticky glue board placed inside a capture chamber where females mosquitoes land and get stuck while trying to reach the water, which is made inaccessible by means of a screen.

We compared the sensitivity of 3 sticky autocidal gravid traps: CDC Autocidal Gravid Ovitrap (AGO), Biogents Gravid *Aedes* Trap (GAT) (Biogents AG, Regensburg, Germany), and the Singapore Gravitrap (SGT) (Lee et al. 2013, Barrera et al. 2014, Ritchie et al. 2014). These traps are all dark, but they vary in size and components such as volume of water, capture surface, and plant materials (Fig. 1). They also vary in the recommended length of time each type of trap should be refreshed and how frequently mosquitoes should be removed, identified, and enumerated. We made efforts to prepare and use the traps following their original instructions.

The AGO trap is a 19-liter black plastic container that holds 10 liter of water and a 30-g bundle of hay grass, a 3.8-liter black plastic cylindric capture chamber and trap entrance that sits on top of a plastic lid, a ¾-inch black polypropylene netting at the entrance to the trap to block large debris, and a fine mesh at the chamber's bottom (Barrera et al. 2014). The traps were sampled and rotated weekly following a Latin Square design. No AGO trap maintenance was conducted because they need servicing only every 8 wk, which was the duration of this study (Acevedo et al. 2016). The BG-GAT trap is a 10-liter black plastic container with 3 liters of an alfalfa infusion, a translucent capture chamber, a black nylon screen placed between the base and the translucent chamber, a

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Fig. 1. Traps used for comparison study (left to right): CDC Autocidal Gravid Ovitrap (AGO), Biogents Gravid Aedes Trap (GAT), and Singapore Autocidal Gravid Trap (SGT).

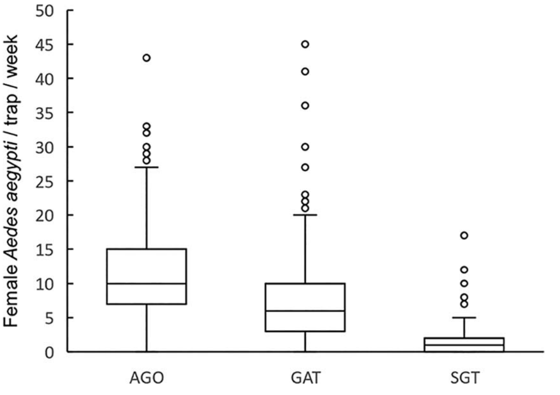

Fig. 2. Box plot of the number of *Aedes aegypti* females per trap per week in 3 types of autocidal gravid traps in Caguas, Puerto Rico.

black funnel on top of the translucent capture chamber that serves as the entrance to the trap, and a sticky card inside the capture chamber (Eiras et al. 2014, Ritchie et al. 2014). Sampling and rotation of the BG-GAT traps were done weekly, with complete infusion and sticky board replacement every 2 wk. The SGT trap is a 1.2-liter black plastic container that has an inner adhesive glue lining above 500 ml of 10% hay grass infusion. A wire netting prevents the escape of mosquito adults, and 2 draining holes at the level of the wire net keep water level below the net. Sampling, rotation, and replacement of the sticky lining of the SGT were done weekly. However, the infusion was replaced twice a week because of water evaporation (Lee et al. 2013). The glue used in the 3 types of traps came from the same manufacturer (UVR 32, Atlantic Paste and Glue, Bayonne, NJ). The study was conducted in Villa del Rey community in Caguas city, Puerto Rico (18°12′52″N, 66°03′9″W; 91 masl). Villa del Rey is a residential neighborhood with 1- or 2-story houses, piped water supply, residential garbage pickup, and sewerage. We deployed a total of 60 traps (20 traps from each type) in each of every 20 pairs of adjacent houses with 3 traps for each pair of houses. Traps were placed at the front of the houses. Distance between traps was 20–25 m. The presence and abundance of *Ae. aegypti* females were monitored by transferring the specimens from the sticky liner to a paper towel, where they were identified and counted in the field. The integrity of the traps was monitored twice a week to replace any missing traps or trap components.

A Generalized Linear Mixed Model analysis was conducted to compare average weekly captures of female *Ae. aegypti* attracted to the 3 types of sticky gravid traps. We used a negative binomial distribution function with log link to account for the count and over dispersed nature of the data. A first-order autoregressive covariance was used to account for repeated measures (weeks). The model included trap types as the main factors and trap ID as a random effects factor to account for individual trap variation. The results of the analysis showed significant differences in the average captures among each trap type during the 8 wk of the study ($F_{2,471} = 80.2$; $P < 0.001$; Fig. 2). Model estimated means revealed substantial disparities in capture rates among trap types. Captures of female *Ae. aegypti* per trap per week were 11.1 (9.1–13.5; 95% CI) in AGO traps, 7.2 (5.9–8.7) in GAT traps, and 1.7 (1.4–2.1) in SGT traps. These results indicated that GAT traps and SGT traps captured 35.5% and 84.7% fewer females of *Ae. aegypti*, respectively, than AGO traps.

The results showed that *Ae. aegypti* was present in all 20 sites during the 8 wk of observations. Monitoring mosquitoes in 3 trap types in 20 sites for 8 wk produced a total of 480 observations. The AGO, GAT, and SGT traps did not catch specimens in 1, 9, and 58 out of the 160 observations conducted on each trap type (trap-weeks), respectively. Trap failures were 1, 6, and 1 for the AGO, GAT, and SGT traps, respectively. Trap failures included missing and disturbed traps. Despite the absence of females of *Ae. aegypti* at some sites and for weeks in the traps, all 3 traps were able to detect the presence of this mosquito at each of the 20 sites during the 8 wk of observations.

Field studies using AGO traps in other locations in Puerto Rico found similar numbers of female *Ae. aegypti* per trap per wk to the present study. A study conducted in Jacksonville, Florida (Cilek et al. 2017), using a modified AGO trap captured fewer specimens of *Ae. aegypti* (1.05 ± 0.28). Discrepancies among studies are expected because of differences in local abundance of mosquitoes and modifications of the traps. For example, the Jacksonville study used AGO traps with 3 liters of an oak infusion instead of the 10 liters and a pack of hay grass. The GAT traps captured a number of female *Ae. aegypti* in Cairns, Australia (5.7 ± 6.1) similar to those in the present study (Ritchie et al. 2014). Captures conducted with the SGT in Singapore were much lower (0.07–0.12) than in the present study, possibly reflecting the lower *Ae. aegypti* abundance due to an aggressive control program (Lee et al. 2013, Ong et al. 2020, Ho 2023). It is not surprising that AGO traps captured more specimens of female *Ae. aegypti* and detected the presence of this species on more trapping instances than the smaller gravid traps compared in this study (Harrington et al. 2008). The AGO traps are bigger, hold a larger volume of water, and have a greater sticky surface. Capturing more specimens can be useful, but other aspects of a trap are also important, including its sensitivity to detect the presence of *Ae. aegypti*, cost of traps that could affect the deployment density, and logistics of maintenance and deployment of the surveillance network of traps. Missing the presence of this mosquito species may overestimate the impact of vector control or missed important detections of *Ae. aegypti* in areas where this mosquito may be expanding its distribution. Although the results of this brief study showed that all 3 traps were adequate to monitor the presence of *Ae. aegypti*, increasing the number of smaller traps is required to improve their sensitivity. This study has the limitations of a relatively short duration of field assays, and it was conducted in only 1 urban area. Longer comparative studies are needed to establish how trap captures in each of the 3 trap types correlate with each other. One limitation of this study is that the plant materials used as attractants (hay grass, alfalfa) and their presentation (infusion, hay bundle) varied for each type of trap. We compared traps based on their original descriptions and field usage to provide comparative values for interpreting published reports.

We thank Kristen Adkins, Veronica Acevedo, and Jesus Estudillo for their support in the field and laboratory. We acknowledge funding support for a summer internship from the Public Health Entomology for All (PHEFA) program, Division of Vector-Borne Diseases, CDC. The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the CDC.

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