Scientific Note

Semi-field evaluation of a modified commercial My Mosquito Deleter larval trap with sticky paper against *Aedes aegypti*

Asghar Talbalaghi[1], Muhammad Farooq[2], Whitney A. Qualls[2], Kai Blore[2], and Rui-De Xue ✉[2]

[1]*Italian Mosquito Control Association (IMCA), San Lazzaro di Savena (BO), Italy*
[2]*Anastasia Mosquito Control District, 120 EOC Drive, St. Augustine, FL 32092, U.S.A.*
xueamcd@mail.com

Aedes aegypti (L.) is a major vector of yellow fever, dengue, and Zika viruses, and its management can be difficult, especially in situations where insecticide usage is restricted and resistance is present. Traps and trapping techniques have mostly been used for monitoring populations of adult mosquitoes, but several commercially available traps have been evaluated and used to reduce nuisance populations of adult mosquitoes (Kline 2006). Suppression of *Ae. aegypti,* in particular, requires a suite of integrated control measures. One measure gaining more attention is to attract and kill gravid females by exploiting their oviposition behavior. Recently, a commercial larval trap for control of *Culex* mosquito larvae has been developed and marketed. The commercial brand name is My Mosquito Deleter (MMD; Destin, FL). When gravid female *Culex* mosquitoes lay their eggs in the MMD larval trap filled with water, the larvae after hatching from eggs will fall downward through the MMD's baffle system. The mosquito larvae cannot come to the surface due to the physical barrier from the baffle ring and black cone, resulting in larval mortality. During the preliminary experiment with the original MMD trap full of water, no adult mosquitoes were collected when larval mosquitoes were commonly recorded, because the gravid mosquitoes flew away after they laid their eggs. In order to catch gravid *Aedes* mosquitoes when they come to the trap to lay their eggs on water within the containers, we modified the MMD trap by placing sticky paper around the inside at the top of the trap (at the water line) after removing the baffle ring and lowering the water level to create an air pocket. The purpose of the study was to investigate the capability of a trap originally designed to trap *Culex* larvae to attract and kill gravid *Ae. aegypti* females with a simple and inexpensive modification by adding a piece of black sticky paper and lowering the level of water, in contrast to the unmodified MMD trap with a lower level of water.

My Mosquito Deleter (MMD) larval traps (www.mymosquitodeleter.com) were provided by the product distributor. The original MMD larval trap was a small plastic bucket (2.5 liters) with an attraction black cone (pointing downward) inside of the bucket, and with four holes (2 x 1 cm) in the center. The trap allows mosquito larvae, after hatching from eggs or egg rafts, to enter at the bottom of the water when the water level (2.4 liters) is high and close to the top lid. The trap also allows them to access the water when the water level (under 400 ml) is low due to evaporation in the field after several days and enter through the holes of the black cone for oviposition. The original MMD trap is operated with the baffle ring inside, then adding 400 ml well water and two accelerator tablets to promote the growth of algae to make the water more stagnant, thus attracting gravid mosquitoes to lay their eggs. The modified MMD larval trap, without the baffle ring and a piece of black sticky paper (50 x 5 cm, Atlantic Paste and Glue, Winchester, VA), was placed inside the trap and above the water surface (Figure 1) after lowering the water level. A total of two unmodified MMD larval traps with low levels of water (400 ml) to create air pockets and two modified MMD larval traps (Figure 1) were used for the evaluation, collection, and control of gravid *Ae. aegypti* in outdoor enclosures at Anastasia Mosquito Control District (AMCD), St. Augustine, FL.

Figure 1. Original unmodified My Mosquito Deleter with a white baffle ring inside (above left) after adding a low level of water (400 ml), and a modified MMD (above right) with black sticky paper (right), but without the white baffle ring inside, after adding a low level of water (400 ml).

Female *Ae. aegypti* mosquitoes, 1952 Orlando strain, were originally obtained from the Center for Medical, Agricultural, and Veterinary Entomology (CMAVE), Gainesville, FL, but maintained as a colony at the AMCD. Blood-fed mosquitoes were released at day four post-blood

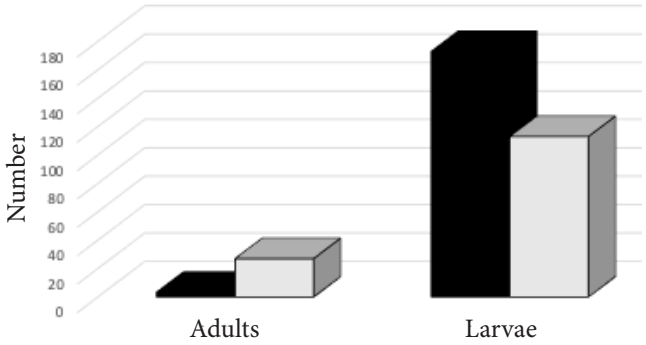

Figure 2. Mean number of adults and larvae of Ae. aegypti collected by original trap (black bars) and modified trap (gray bars).

feeding for the experiment as described by Liu et al (2019). The two unmodified MMD with low levels of water and two modified MMD larval traps were distributed on each side of the test screened enclosure. The screened enclosure dimensions were 12.2 x 4.6 x 6.1 m with a centrally located 10.9 m² covered pavilion, as described by Khater et al (2019). For each experiment, two traps (replicates) each were used for both unmodified MMD traps and modified MMD traps, and the entire experiment was repeated three times. The trap positions in the enclosure were rotated at each experiment.

Two-hundred gravid female *Ae. aegypti* were released into the enclosure from the central pavilion and the traps were collected after seven days. The sticky paper of each modified trap was removed to count the trapped mosquitoes, and the water containing larvae and eggs in each trap was poured into a new container for rearing and further observation in the laboratory, and the number of larvae were counted. The number of adult mosquitoes caught on the black sticky sheet and the number of larvae in the water were separately analyzed by a one-way ANOVA.

The unmodified MMD larval trap with a low level of water collected a higher number of mosquito larvae (mean ± SE:173 ± 72) and a lower number of adult mosquitoes (mean ± SE: 3.3 ± 1.8). The modified MMD larval trap collected lower numbers of mosquito larvae (mean ± SE: 113 ± 26) and higher numbers (mean ± SE: 27.2 ± 29) of adult mosquitoes after adding paper (Figure 2). The modified MMD larval trap collected significantly more adult mosquitoes, compared with the original MMD larval trap after lowering the water level ($F = 21.08$, $P = 0.001$), but the modified MMD trap collected a non-significantly lower number of larvae ($F = 0.603$, $P = 0.455$). Probably, some gravid females were caught on the sticky paper due to oviposition activity after entering the traps without laying their eggs.

Sticky ovitraps have been used for surveillance and control of *Aedes* mosquitoes in several studies (Ritchie et al. 2003, Chadee and Ritchie 2010, De Santos et al. 2012). The MMD trap was designed and developed to attract gravid *Culex* mosquitoes to lay their eggs and at the same time kill the larvae through a physical barrier. The modification with the addition of sticky paper increased the collection and control of adult *Ae. aegypti* mosquitoes after the water level was lowered under the black cone. The modified MMD trap is not only collecting and controlling gravid *Aedes* mosquitoes but also collecting and controlling mosquito eggs and larvae, compared with the autocidal gravid ovitrap that only collects and controls gravid mosquitoes because of the isolation between catch camber and the infusion water (Mackay et al. 2013). Also, the cost for the small-sized MMD trap is much less than for the AGO and other type of traps.

Modification of some existing low-cost and environmentally compatible mosquito control traps/devices (Khater et al 2019, Zhu et al 2019) to enhance their efficiency in specific environments, such as houses, courtyards, and gardens, etc. is desirable. We have evaluated the modified version of MMD and showed that the modification increased the collection of adult *Ae. aegypti* mosquitoes. This could be developed as an efficient and low-cost tool/device for control of container-inhabiting *Aedes* mosquitoes in backyard environments.

REFERENCES CITED

Chadee, D.D. and S.A. Ritchie. 2010. Efficacy of sticky and standard ovitraps for *Aedes aegypti* indices in Trinidad, West Indies. J. Vector Ecol. 35: 395-400.

De Santos, E.M.M., M.A.V. de Melo-Santos, C.M.F. de Oliveira, J.C. Correia, and C.M.R. de Albuquerque. 2012. Evaluation of a sticky trap (*Aedes*Trap), made from disposable plastic bottles, as a monitoring tool for *Aedes aegypti* populations. Parasit. Vectors 5: 195.

Khater, E., D. Zhu, and R.D. Xue. 2019. Semi-field evaluation of modified 00ZZZero® traps with sticky paper to increase the collection efficacy of gravid *Aedes aegypti*. J. Am. Mosq. Contr. Assoc. 35: 137-139.

Kline, D.L. 2006. Traps and trapping techniques for adult mosquito control. J. Am. Mosq. Contr. Assoc. 22: 490-496.

Liu, H., D. Dixon, C. S. Bibbs, and R.D. Xue. 2019. Autocidal gravid ovitrap incorporation with attractants for control of gravid and host-seeking *Aedes aegypti* (Diptera: Culicidae). J. Med. Entomol. 56: 576-578.

Mackay, A.J., M. Amador, and R. Barrera. 2013. An improved autocidal gravid ovitrap for the control and surveillance of *Aedes aegypti*. Parasit. Vectors 6: 225.

Ritchie, S.A., S. Long, A. Hart, C.E. Webb, and R.C. Russell. 2003. Anadulticidal sticky ovitrap for sampling container-breeding mosquitoes. J. Am. Mosq. Contr. Assoc. 19: 235-242.

Zhu, D., E. Khater, S. Chao, D. Dixon, C.S. Bibbs, and R.D. Xue. 2019. Modifying the autocidal gravid ovitrap (AGO) with a powered suction fan and additional lures to increase the collections of released *Aedes aegypti* and a natural population of *Aedes albopictus* (Diptera: Culicidae). J. Vector Ecol. 44: 282-284.