



## INFORMATION BRIEF (RAPID REVIEW)

# TREATED OVITRAP FOR VECTOR CONTROL

Malaysian Health Technology Assessment Section (MaHTAS)  
Medical Development Division  
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# TITLE: TREATED OVITRAP FOR VECTOR CONTROL

## PURPOSE

To provide a concise overview of the effectiveness, safety and cost-efficiency of using treated ovitraps for vector control.

## BACKGROUND

Vector control involves strategies to reduce or eliminate disease-carrying vectors, especially mosquitoes to prevent the spread of vector-borne diseases. It plays a crucial role in protecting public health, where no effective cures exist. By minimising human contact with vectors, these methods help reduce disease incidence, save lives and improve community well-being.<sup>1</sup>

Vector-borne diseases represent a significant and persistent global public health threat, accounting for over 700,000 deaths each year and more than 17.0% of all infectious diseases. Transmitted by vectors such as mosquitoes and ticks, these diseases include malaria, dengue, Zika virus, chikungunya, yellow fever, West Nile fever and Lyme disease. Among them, malaria and dengue are the most widespread and burdensome. Malaria alone caused an estimated 608,000 deaths in 2022, with 95.0% of fatalities occurring in the World Health Organization (WHO) African Region, particularly affecting children under five. Dengue, the most prevalent mosquito-borne viral infection threatens over 3.9 billion people across 132 countries, with around 96 million symptomatic cases and up to 40,000 deaths annually.<sup>2-4</sup> The Asia Pacific region bears a significant share of the global dengue burden, with about 75.0% of the exposed population living in this area. International travel to endemic regions, particularly Southeast Asia, has also contributed to the global spread of dengue.<sup>4</sup> Malaysia with its tropical climate and dense urban environments, faces consistently high rates of mosquito-borne diseases, particularly dengue. Incidence has risen dramatically, from 30.2 cases per 100,000 populations in 2000 to 261.6 in 2017. Between January and May 2023, dengue cases increased by 185.0% compared to the same period in 2022, accompanied by a rise in related deaths.<sup>5</sup>

Malaysia has made significant investments in dengue control, spending an estimated US\$73.5 million in 2010 alone. This country applies Integrated Vector Management strategies that include surveillance, source reduction, larviciding and insecticide use. However, despite these efforts, dengue continues to cause widespread outbreaks. Critically, there is limited evidence that mass insecticide use has significantly reduced transmission rates. This “persistence paradox” suggests that existing strategies may be inadequate, particularly in highly urbanised and endemic areas, and points to a need for more effective evidence-based interventions.<sup>6</sup> **Table 1** provides a concise, comparative overview of the immense scale and severity of the vector-borne diseases problem globally and specifically highlights the escalating burden in Malaysia. It visually reinforces the urgency and magnitude of the public health challenge, setting a compelling context for the discussion of innovative and sustainable solutions.

**Table 1:** Global and regional burden of key vector-borne diseases.<sup>2-6</sup>

DISEASE	PATHOGEN TYPE	PRIMARY VECTOR	GLOBAL CASES (ANNUAL, EST.)	GLOBAL DEATHS (ANNUAL, EST.)	POPULATION AT RISK	REGIONAL/MALAYSIA SPECIFICS (DENGUE)
<b>Malaria</b>	Parasite	<i>Anopheles</i>	249 million clinical episodes	>608,000	Nearly half world's population in 85 countries	95% deaths in WHO African Region
<b>Dengue</b>	Virus	<i>Aedes</i>	96 million symptomatic, 400 million infected	40,000	>3.9 billion people in >132 countries	Asia Pacific: 75% global exposed population ; Malaysia Cases (Jan-May): 13,650 (2022) vs. 25,283 (2023) ; Malaysia Deaths (Jan-May): 7 (2022) vs. 24 (2023) ; Malaysia Incidence Rate: 30.2/100K (2000) to 261.6/100K (2017)
<b>Chikungunya</b>	Virus	<i>Aedes</i>	47,868 (Americas, H1 2020)	-	Tropical/Subtropical	-
<b>Zika</b>	Virus	<i>Aedes</i>	8,277 (Americas, H1 2020)	-	Tropical/Subtropical	-
<b>Yellow fever</b>	Virus	<i>Aedes</i>	-	-	Tropical/Subtropical	-
<b>Japanese encephalitis</b>	Virus	<i>Culex</i>	-	-	Asia Pacific	-

Current vector control strategies encompass a wide spectrum of traditional and modern tools aimed at reducing vector populations and minimising human-vector contact. Conventional approaches include chemical control (e.g., insecticides like dichloro-diphenyl-trichloroethane and pyrethroids), environmental management (eliminating breeding sites), physical barriers (bed nets, screens) and biological control (using larvivorous fish, bacterial toxins or sterile insect techniques). While these methods have historically been effective, they face growing limitations due to rising insecticide resistance, environmental and health risks and community misuse. Additionally, climate change, logistical constraints and population movement further complicate control efforts.<sup>7,8</sup>

Meanwhile, modern approaches leverage advancements in science and technology for more targeted, efficient and sustainable solutions. These include genetic control, involving the release of genetically modified mosquitoes to reduce vector populations. Advanced surveillance and targeting utilise digital tools and satellite imagery to monitor and predict vector activity, enabling more precise targeting of habitats. The development of innovative biological agents and biopesticides also represents a modern frontier. Furthermore, advanced trapping technologies, such as the autocidal gravid ovitrap and gravid *aedes* trap, combine surveillance with control by trapping and killing adult mosquitoes or larvae.<sup>1,8,9</sup>

Ovitrap as shown on **Figure 1** are claimed to be simple and cost-effective tools designed to attract and control gravid female mosquitoes, especially *Aedes* species. They work by luring mosquitoes to lay eggs on treated substrates, often killing the adults or rendering eggs nonviable. Modern innovations like the lethal ovitrap, autocidal gravid ovitrap and dual-action lethal ovitrap trap have improved safety, efficiency and ease of use, often incorporating biodegradable materials and enclosed insecticides.<sup>9,10</sup> These traps have been reported to significantly reduce reliance on broad-spectrum insecticides, thus lowering risks to human health and the environment. Their affordability and simplicity make them ideal for community-led efforts, especially in resource-limited settings. Citizen science initiatives using ovitraps can expand surveillance coverage and reduce costs, enhancing public health responses.<sup>8,11,12</sup>



**Figure 1:** a) Conventional ovitrap is a simple device, typically a dark container filled with water and a surface for mosquitoes to lay eggs on. It is designed to mimic the natural breeding sites of mosquitoes.<sup>13</sup> The "treated" aspect is what makes it a lethal ovitrap. The trap is treated with a killing agent, which can be an insecticide, a larvicide, or an adhesive (sticky) surface, such as b) sticky ovitrap,<sup>9</sup> c) autocidal gravid ovitrap,<sup>9</sup> d) gravid *Aedes* trap<sup>9</sup> and e) dual-action lethal ovitrap.<sup>9</sup>

Besides that, ovitraps serve as effective surveillance tools, helping monitor mosquito populations and guide Integrated Vector Management strategies in Malaysia.<sup>6</sup> However, limitations include maintenance needs, competition from natural breeding sites and reduced effectiveness for non-container-breeding species. Despite some logistical and regulatory challenges, ovitraps are claimed to represent a scalable, sustainable and community-driven approach to vector control.<sup>12</sup> **Table 2** provides a structured, comparative overview of the different types of eco-friendly ovitraps, highlighting their evolutionary trajectory and specific characteristics. It allows for a quick and clear understanding of the technological advancements, the inherent trade-offs involved (e.g., cost vs. complexity vs. efficacy), and how each type addresses particular challenges in vector control.

Investigating the effectiveness, practicality and community acceptance of eco-friendly ovitraps in the Malaysian context is crucial for developing evidence-based public health strategies and informing national vector control policies. Such research supports the promotion of sustainable and environmentally responsible mosquito control methods, which are increasingly important amid growing concerns over insecticide resistance and environmental degradation. Furthermore, understanding how these interventions perform across Malaysia's diverse socio-economic and ecological settings can help ensure their scalability, long-term viability and integration into broader community-based vector management programs.

**Table 2:** Comparison of eco-friendly ovitrap types: features, advantages and considerations.<sup>8-12</sup>

OVITRAP TYPE	KEY FEATURES/ MECHANISM	PRIMARY ADVANTAGE(S)	KEY LIMITATION(S)/ CONSIDERATION(S)
<b>Handmade ovitrap</b>	Simple plastic containers, paper towel, water/ birdseed; hot water for ovicidal efficacy	Cost-effective (<\$0.20), accessible, environmentally friendly, high community acceptance, minimises insecticides	Requires weekly immersion in hot water for ovicidal efficacy
<b>Mass ovitrap (early)</b>	Small, dark cups with water/ organic attractants; removable substrates for egg collection	Lures female mosquitoes, collects eggs for destruction	Frequent servicing required, limited by alternative breeding sites
<b>Lethal ovitrap</b>	Environmentally friendly design, avoids harmful chemicals	Cost-effective, sustainable pest management, breakthrough innovation	-
<b>Zika lethal ovitrap</b>	Biodegradable materials, environmentally friendly attractants	Enhanced sustainability, broad appeal, versatile, scalable	-
<b>Autocidal gravid ovitrap</b>	Screened water reservoir, adhesive panels	Enhanced trapping efficiency, dual-purpose (surveillance and control)	-
<b>Gravid aedes trap</b>	Translucent light tunnel, residual insecticide, black nylon mesh barrier	Attracts and kills adult mosquitoes, prevents larval access to water	Monthly maintenance required
<b>Dual-action lethal ovitrap</b>	Polymer coating, insecticides contained within device, one-part/ one-step deployment	Consistent performance in all weather, user-friendly, minimises PPE, durable	-
<b>Yeast interfering RNA-baited trap</b>	Biorational control tool	Circumvents insecticide resistance, no known threat to non-target organisms	Still under development

## EVIDENCE SUMMARY

A systematic review was conducted. A total of 2,570 titles were retrieved through the Ovid interface: Ovid MEDLINE® All <1946 to 7 February 2025>, Embase and United States of Food and Administration. Google was used to search for additional web-based materials and information. There was no language limitation in the search and the last search was conducted on 29 May 2025. There were one systematic review and 10 experimental studies included. The studies were conducted mainly in Asia Continents (Malaysia, Indonesia, India, Sri Lanka, China) and followed by the America Continents (Brazil, Mexico, Puerto Rico).

## EFFECTIVENESS

Eleven studies reported on the effectiveness of ovitraps in managing vector control.

A **systematic review was conducted by Jaffal A et al. (2023) in Brazil** to assess the efficacy of interventions based on adult mosquito trap to control *Aedes* population densities and the disease they transmit worldwide. The inclusion criteria focused on studies targeting *Aedes albopictus* or *Aedes aegypti*, utilising lethal ovitraps or traps designed to capture host-seeking females for population control (excluding those used solely for surveillance), and incorporating a comparator such as [REDACTED] trap. Several studies have demonstrated the effectiveness of **lethal ovitraps** (autocidal gravid ovitrap, gravid-*aedes* trap and sticky traps) in reducing *Aedes* mosquito populations, particularly when integrated with other vector control strategies. In Brazil, one study reported a reduction of over 40.0% in female mosquito abundance, a 49.0% to 80.0% decrease in larval-positive containers, and a 56.0% to 97.0% reduction in average pupae per house at one site, although mosquito immigration posed challenges at another. Meanwhile in Thailand, initial efforts in 1999 showed negligible impact, but by 2000, significant suppression was achieved including a 47.0% reduction in adult females, 49.0% fewer larval containers, and a 56.0% decrease in pupal containers. When combined with additional control measures, lethal ovitraps contributed to marked improvements in entomological indicators; for instance, ovitrap positivity dropped from 49.6% to 10.4% and were associated with a complete absence of dengue haemorrhagic fever cases in treated areas compared to 322 cases per 100,000 in untreated ones.<sup>14, level I</sup>

In Colombia, a combined approach using lethal ovitrap, Bti larvicide, and social mobilisation reduced *Aedes aegypti* abundance across all study neighborhoods, including control areas with only social mobilisation, highlighting the added value of community engagement. Similarly, in Australia, combining lethal ovitraps with [REDACTED] traps and larval control significantly lowered adult female mosquito populations by 87.0% during the wet season compared to using larval control alone or no intervention.<sup>14, level I</sup>

For the meantime, multiple studies in Puerto Rico evaluating **autocidal gravid ovitrap** had provided evidence of reduced mosquito vector populations and some evidence of reduced viral transmission. Mass trapping with autocidal gravid ovitraps in urban areas had demonstrated substantial reductions in *Aedes aegypti* populations and associated virus transmission. Deployment of three to four traps per house at 81.0% coverage reduced female mosquitoes by 53.0% to 70.0% in 11 months; continued use averaged a 79.0% reduction, with intervention sites showing 88.0% fewer mosquitoes than controls. Studies also reported significant declines in infection rates of chikungunya virus, Zika virus and dengue virus in trap areas, with up to 95.0% reductions in virus-positive mosquitoes. Autocidal gravid ovitrap with community education, source reduction and larviciding achieved a 92.4% weekly reduction in mosquito counts per trap, and stepped-wedge trials confirmed significant suppression as coverage exceeded 80.0%.<sup>14, level I</sup>

**An experimental study by Institute for Medical Research Malaysia (2024)** explored the ovitrap efficacy (aquatain mosquito formulation versus no formulation) against *Aedes aegypti* in the semi-field condition. There were two strains of test system used which were laboratory strain and field strain. The study used F39-generation, laboratory-bred *Aedes aegypti* larvae and gravid females to assess trap efficacy, larvicide impact and oviposition rates, with susceptibility confirmed via WHO tube tests. Field strain mosquitoes were used for trap density tests in an open-field site with high *Aedes* population density. In terms of larval mortality and effective duration, the study reported that under semi-outdoor conditions, the ovitraps achieved 100.0% *Aedes aegypti* larval mortality within 24 to 48 hours post-exposure, sustained weekly for up to four weeks. In contrast, control traps showed 0.0% mortality throughout the study. For ovitrap efficacy in cage experiments, gravid *Aedes aegypti* females showed a significantly lower mean oviposition rate ( $p < 0.05$ ) in the ovitraps (46.0%) compared to control traps (73.0%).<sup>15</sup>

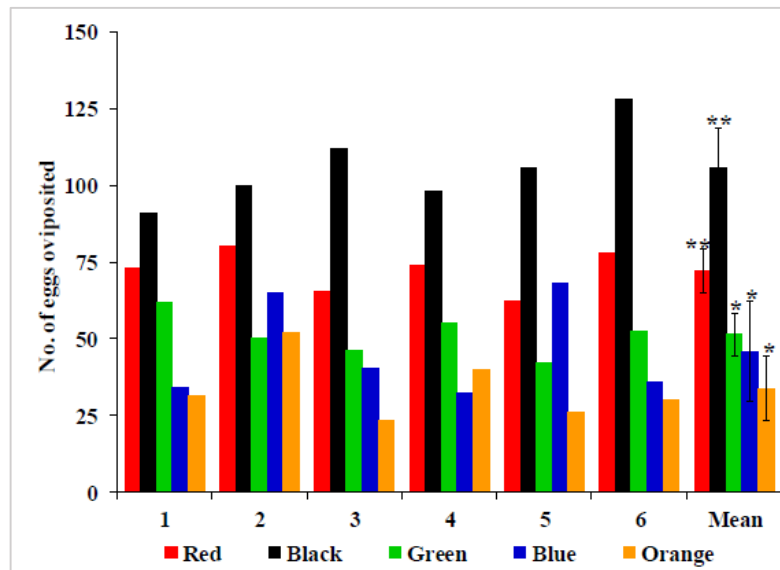
Meanwhile, in a small open-field evaluation using 50 released gravid *Aedes aegypti* mosquitoes, egg counts increased with three ovitrap units per area but slightly declined with

four units, suggesting an optimal trap density of up to three units. Lower egg counts compared to controls might be attributed to alternative breeding sites in the open environment, highlighting that results might not fully represent natural *Aedes* densities. During the study, the ovitraps showed some physical and performance issues: 200 to 300 ml of water leaked after 11 days, a noticeable odour developed by day seven in semi-outdoor settings and fungal growth appeared after two weeks. While water replacement helped maintain larvicidal effectiveness, *Aedes aegypti* larvae and pupae were still observed by the third water change.<sup>15</sup>

The institute also conducted another **experimental study (2024)** to assess the efficacy-testing of the ovitrap. The study evaluated the ovitrap under controlled laboratory conditions ( $27 \pm 2^\circ\text{C}$ ,  $80 \pm 20\%$  relative humidity) using third-instar *Aedes aegypti* larvae from a local susceptible colony. Two groups; treatment (with aquatain mosquito formulation) and control (without) traps were tested, each with four replicates. Trap efficacy was assessed using three water volumes (2.5 L, 2 L and 1 L) with 25 larvae introduced into each of the eight replicates per volume. The study also demonstrated 100.0% mortality of *Aedes aegypti* larvae in treatment traps at both 24 and 48 hours post-exposure, across all tested water volumes. In contrast, control traps showed 0.0% mortality, with live larvae and pupae present after 48 hours.<sup>16</sup>

A repeated-measures **experimental study was conducted by Aguilar-Duran et al. (2024) in Mexico**, from July to December 2022, across four low-income urban neighborhoods (~100 houses each) with a history of recurrent dengue. Areas were randomly assigned to one of four groups: control (no intervention), autocidal gravid ovitraps mass-trapping (three traps per household), Integrated Vector Control (involving source reduction; larvicide [spinosad] and adulticide [chlorpyrifos]) and a combined autocidal gravid ovitrap plus Integrated Vector Control strategy. Sixty sentinel autocidal gravid ovitraps were used to monitor female *Aedes aegypti* abundance, with 15 traps per area placed  $\leq 100\text{m}$  apart. Autocidal gravid ovitraps mass trapping was the most effective intervention, achieving a statistically significant 47.7% reduction in *Aedes aegypti* females and a 54.9% reduction compared to the control area. In contrast, Integrated Vector Control alone showed no significant impact, with mosquito abundance increasing by 19.0%, suggesting limited short-term effectiveness despite high coverage. The combined intervention however unexpectedly resulted in a 47.6% increase in mosquito abundance, likely due to low trap coverage (5.06%) caused by the presence of abandoned houses. This area also showed a 26.5% relative increase compared to the control, indicating ineffectiveness in that context. Meanwhile, the control area experienced a natural 16.3% increase in mosquito abundance, serving as a benchmark for evaluating the interventions.<sup>17</sup>

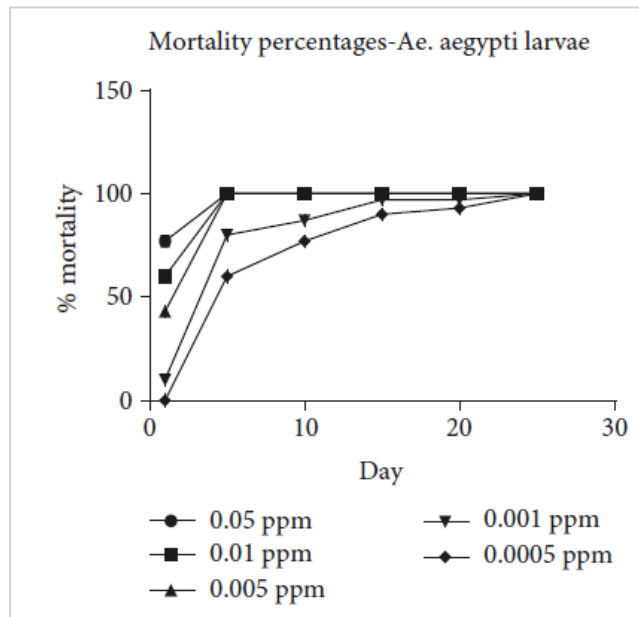
**Marin G et al. (2020) explored an experiment** to determine the effect of different colours on the oviposition response of *Aedes aegypti* females **in India**. The study was conducted from September to November 2019 in Poovancode, Kanyakumari district, Tamil Nadu, selected for its high *Aedes aegypti* adult density. The setup involved ovitraps with 1-liter plastic containers that had been painted in five colors (red, black, green, blue and orange), each containing a wooden paddle with filter paper as the oviposition substrate. An organic attractant made from a 50.0% rubber leaf infusion (250 mL/trap) was used. Six trials were conducted, with traps cleaned and refilled with fresh infusion and paddles before each trial. The analysis of oviposition preferences among *Aedes aegypti* females in **Figure 2** revealed a significant attraction to black ovitraps, which recorded the highest mean egg count ( $105.8 \pm 12.9$ ), followed by red ( $72.0 \pm 7.1$ ). In contrast, green ( $51.2 \pm 6.9$ ), blue ( $45.8 \pm 16.3$ ) and orange ( $33.7 \pm 10.7$ ) traps attracted fewer eggs. This trend was consistent across six trials, with black consistently outperforming all other colours ( $p=0.05$ ). The study suggested that darker trap colours, particularly black, are more effective in attracting gravid *Aedes aegypti* females for oviposition.<sup>18</sup>



**Figure 2:** Ovipositional preference of coloured ovitraps by *Aedes aegypti*.<sup>18</sup>

Another **experimental study was conducted by Withanage GP et al. (2020)** to evaluate the efficacy of a Novaluron-based autocidal gravid ovitrap for controlling *Aedes* mosquitoes in **Sri Lanka**. The study involved laboratory, semi-field and field experiments. Laboratory tests following WHO guidelines; used third instar larvae of *Aedes aegypti* and *Aedes albopictus* to determine minimum lethal concentrations and inhibition of adult emergence (IE%). Semi-field trials assessed optimum dosage (with 2 ppm Novaluron achieving 100.0% mortality), residual efficacy and the influence of trap colour and debris over two months. In the field, a year-long study compared 30 households in a treated area using Novaluron-filled autocidal gravid ovitrap (2 ppm) with a control area using untreated ovitraps.<sup>19</sup>

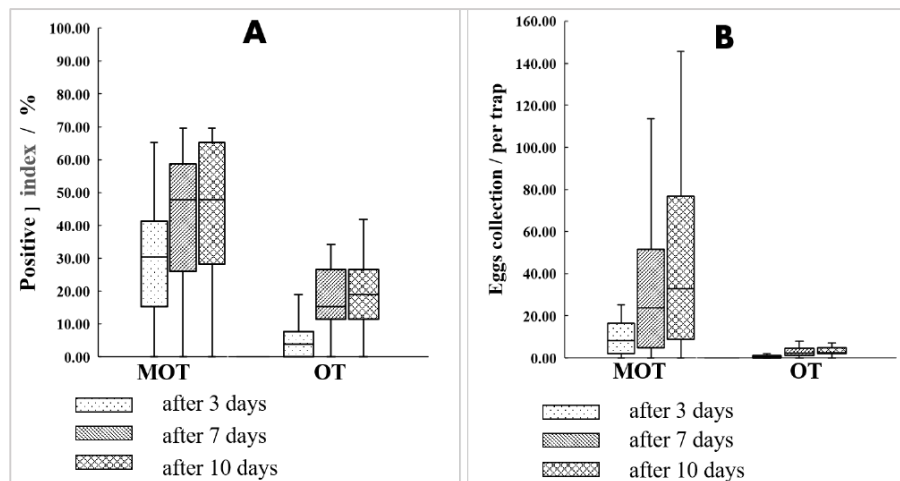
In laboratory assays, high concentrations (5.0 ppm to 0.01 ppm) caused rapid larval death, while lower concentrations (down to 0.5 ppb) achieved 100.0% adult emergence inhibition over time (**see Figure 3**). Probit regression analysis showed LD<sub>50</sub> and LD<sub>90</sub> (lethal dose of a substance [e.g., insecticide] required to kill a certain percentage of a test population) values were slightly higher for *Aedes albopictus* (0.3 to 0.4 ppb) than *Aedes aegypti* (0.2 to 1.0 ppb), suggesting the latter's greater tolerance. Semi-field trials confirmed 2 ppm as the optimal field dosage, providing 100.0% mortality within 14 to 21 days and a residual effect lasting 28 days. Notably, black autocidal gravid ovitraps attracted wild *Aedes* females more effectively than white ones, indicating colour influences oviposition. In the year-long field study, autocidal gravid ovitraps with 2 ppm Novaluron significantly reduced mosquito populations, particularly outdoors. Statistical analysis confirmed significantly higher mortality in treated areas versus controls, with no toxicity observed in non-target animals. Overall, Novaluron autocidal gravid ovitraps proved a safe and effective strategy for both indoor and outdoor *Aedes* control.<sup>19</sup>



**Figure 3:** Mortality percentage variations over the experiment time period for *Aedes aegypti* larvae.<sup>19</sup>

**Ahmad-Azri M et al. (2019)** compared the effectiveness of four types of ovitraps; standard ovitrap, mosquito larvae trapping device (MLTD), double sticky ovitrap, and nitrogen + phosphorus + potassium (NPK) fertiliser trap for monitoring *Aedes* mosquitoes in **Kuala Lumpur**. An experiment was first conducted in the field to determine the optimum concentration for the NPK fertiliser solution, which was selected as 0.25 g/L. The main comparative study utilised a 4x4 latin square experimental design with eight units of each ovitrap type placed at four different sampling points. Ovitrap traps were rotated to a different location every week over three replicates, comprising a total duration of three months. Based on the study, while there was no significant difference in ovitrap index among the four traps, the mean number of larvae per ovitrap showed significant differences across the methods ( $F [3, 44] = 7.76, p < 0.001$ ). The double sticky ovitrap collected the highest mean number of larvae ( $130.06 \pm 18.95$ ), which was significantly higher than standard ovitrap ( $53.19 \pm 10.23$ ) and MLTD ( $56.44 \pm 6.17$ ), though not significantly different from the NPK fertiliser trap ( $102.22 \pm 14.54$ ).<sup>20</sup>

Another **experimental study** compared the effectiveness of three traps; mosq-ovitrap, ovitrap, and CO<sub>2</sub>-light trap monitoring *Aedes albopictus* (**Gao Q et al., 2019**). Conducted over eight months in five downtown **Shanghai** areas, the methodology involved placing one CO<sub>2</sub>-light trap and two to three pairs of mosq-ovitrap and ovitraps at eight specific field sites, separated by approximately 20 metres to minimise competition. Mosq-ovitrap and ovitraps were deployed for 10 days and checked after three, seven and 10 days, while CO<sub>2</sub>-light trap collected adult mosquitoes for 24 hours every 10 days. Across all three exposure durations, **Figure 4** shows egg collections from mosq-ovitrap were significantly greater than ovitraps (e.g., at 10 days, mosq-ovitrap collected 50.16 per trap compared to ovitraps's 3.98 per trap,  $p < 0.001$ ), and the percent of positive traps was also significantly higher for mosq-ovitrap compared to ovitraps ( $p$  values all  $< 0.001$  for three, seven and 10 days respectively).<sup>21</sup>



**Figure 4:** Comparison of mosquito collection indices between mosq-ovitraps and ovitraps with different exposure durations.<sup>21</sup>

**Reza M et al. (2016) conducted an experimental study**, evaluating the application of copper as a larvicide in ovitraps for *Aedes spp.* control. The study was conducted in **West Sumatra, Indonesia** in 2015. The methodology involved placing plastic pots filled with a 10 ppm copper solution (prepared from copper solution;  $\text{CuSO}_4$ ) as ovitraps in 21 local houses. Each house received five pots: one control with only tap water and four copper-treated pots. These were distributed with two copper and one control pot placed inside, and two copper pots placed outside (within 5m and protected from rain). The ovitraps were left for 14 days with maintenance checks every three days. On day 14, researchers counted the number of live and dead *Aedes spp.* larvae in each pot.<sup>22</sup>

The results demonstrated that copper-treated ovitraps at a concentration of 10 ppm were highly effective in killing *Aedes spp.* larvae. Larval infestation was observed in 70.2 % (66/94) of the pots overall, and all larvae found were *Aedes spp.* There was no statistical difference in the proportion of pots with larvae between the control (64.7%), indoor copper (73.7%) and outdoor copper (69.2%) groups, nor in the mean number of total larvae (live and dead) collected per pot, suggesting that female mosquitoes laid eggs readily in both copper-treated and control pots and did not avoid the 10 ppm copper solution. However, the critical finding was the studied difference in larval mortality. Larvae mortality rate in the copper-treated pots was extremely high at 98.3%. In contrast, all 875 larvae observed in the control pots were viable and thriving, with no dead larvae found. Statistical analysis confirmed a highly significant difference ( $p < 0.01$ ) in the mean number of live larvae, with virtually none surviving in the indoor copper pots (mean 0.0) and very few in the outdoor copper pots (mean 1.7) compared to the control pots (mean 51.5). The dead larvae in copper pots were predominantly first and second instars. While a few surviving larvae were noted in two outdoor copper pots at one house, they appeared weak or dying.<sup>22</sup>

Another **experimental study** evaluated boric acid ( $\text{H}_3\text{BO}_3$ ) at five concentrations (0.1% to 1%) as a control agent for *Aedes aegypti* and *Aedes albopictus* eggs and larvae (**Bhami LC et al., 2015**) in **India**. The methodology involved two main assays. For oviposition attraction and ovicidal activity, paper cups containing boric acid solutions or control water were placed in cages with mated female mosquitoes, and egg laying and hatching were recorded over 24 hours. For larvicidal activity, ten third and fourth instar larvae of each species were exposed to the same concentrations, with mortality scored after 24 hours. The study determined effective concentrations for attracting egg-laying, killing eggs and killing larvae.<sup>23</sup>

Based on the study, the number of eggs laid generally decreased as boric acid concentration increased. However, 0.5% boric acid recorded the highest oviposition for both species (280.5

$\pm 1.41$  eggs for *Aedes aegypti* and  $295.5 \pm 1.47$  eggs for *Aedes albopictus*). The study found that egg hatching decreased significantly with increasing boric acid concentration. At the 1.0% concentration, the hatching percentage was extremely low, measuring just 0.07% for *Aedes aegypti* and 0.09% for *Aedes albopictus*. In addition, both *Aedes aegypti* and *Aedes albopictus* III instar larvae are more sensitive to boric acid than their IV instar counterparts, suggesting that boric acid is more effective on earlier larval stages. This was possibly due to less developed detoxification mechanisms or thinner cuticles. The LC<sub>50</sub> (lethal concentration 50: describes the amount of chemical inhaled by test animals that causes death in 50.0% of test animals used during a toxicity test study) values were comparable between species, with *Aedes aegypti* exhibiting slightly higher sensitivity in both instars. The differences were minimal, with 0.29% versus 0.30% for III instars and 0.42% versus 0.40% for IV instars (*Aedes aegypti* versus *Aedes albopictus*, respectively). Overall, all LC<sub>50</sub> values fell within a narrow range of 0.29% to 0.42%, indicating consistent moderate toxicity of boric acid across both species and developmental stages (see Table 3).<sup>23</sup>

**Table 3:** Toxicity response of *Aedes aegypti* and *Aedes albopictus* larvae to boric acid.<sup>23</sup>

S. No.	% Concentration of boric acid	% Mortality (24 h)			
		<i>Ae. aegypti</i> larvae		<i>Ae. albopictus</i> larvae	
		III instar	IV instar	III instar	IV instar
1.	0.1	30	20	30	20
2.	0.25	50	30	50	40
3.	0.50	70	60	70	60
4.	0.75	90	90	90	80
5.	1	100	100	100	100
24 h LC <sub>50</sub> (in %)		0.29	0.42	0.30	0.40

An experimental study was conducted by de Melo DP et al. (2012) in Belo Horizonte, Brazil, to evaluate the correlation between dengue fever occurrence and three *Aedes aegypti* surveillance methods: larval surveys, ovitraps and [REDACTED] TRAPs. Data on confirmed dengue cases and positive vector findings from these methods were analysed to detect spatial (location) and temporal (timing) clusters. The methodology then assessed the space-time intersections (overlap) between dengue and vector clusters, evaluated cluster reliability and calculated the average precedence (how many days vector clusters appeared before dengue clusters). Analyses were conducted using a range of maximum cluster sizes (200m to 800m).<sup>24</sup>

Of the 13,007 premises inspected during larval surveys, only 458 were positive and notably, no spatial or temporal overlap was observed between larval survey data and dengue fever clusters, indicating its poor predictive value. In contrast, both [REDACTED] TRAP and ovitrap data showed spatial intersections with dengue clusters: 22 for [REDACTED] TRAP and 16 for ovitrap, suggesting moderate agreement between vector detection and actual dengue cases. Although the spatial performance was similar [REDACTED] TRAP clusters were generally shorter in duration (averaging 81.83 to 95.60 days) compared to longer ovitrap clusters (167.00 to 258.00 days), implying more brief outbreak indicators. Importantly, [REDACTED] TRAP clusters preceded dengue fever clusters by an average of 80 days (ranging 65.5 to 94.0 days), providing a more accurate temporal signal, while ovitrap clusters appeared much earlier (97.0 to 283.0 days before), which likely reduced their practical relevance for timely intervention. Overall, the [REDACTED] TRAP demonstrated superior capability in both spatial and temporal alignment with actual dengue fever clusters, making it a more reliable tool for early warning and targeted dengue control efforts.<sup>24</sup>

Table 4 summarised all the reported effectiveness of ovitraps in managing vector control .

**Table 4:** Effectiveness of bio-insecticide treated ovitrap for vector control.

Study	Country/ Primary Vector	Intervention/ Killer Agent		Findings
		Treatment	Control	
Jaffal A et al./2023/SR <sup>14</sup>	Brazil/ <i>Aedes albopictus</i> , <i>Aedes aegypti</i>	Lethal ovitrap/ deltamethrin or permethrin or canola oil	██████████ NI	<ul style="list-style-type: none"> <li>• Brazil: A site showed over 40.0% fewer female mosquitoes, a 49–80.0% drop in larval-positive containers and a 56–97.0% decrease in average pupae per house.</li> <li>• Thailand: Significant suppression was achieved, with a 47.0% drop in adult females, 49.0% fewer larval containers, and a 56.0% reduction in pupal containers.</li> <li>• Colombia: A combined approach using lethal ovitraps, Bti larvicide and social mobilisation reduced <i>Aedes aegypti</i> abundance in all neighborhoods, underscoring the added impact of community engagement.</li> <li>• Australia: Combining lethal ovitraps with ██████████ traps and larval control reduced adult female mosquito populations by 87.0% during the wet season compared to larval control alone or no intervention.</li> <li>• Puerto Rico: Using 3–4 traps per house at ≥81.0% coverage, along with community education and other controls, reduced female mosquitoes by up to 88.0%, virus-positive mosquitoes by 95.0%, and achieved a 92.4% weekly drop in trap counts, with strong suppression confirmed in trials.</li> <li>• Lethal ovitraps, combined with other measures, reduced ovitrap positivity from 49.6% to 10.4% and were linked to zero dengue haemorrhagic fever cases, compared to 322 per 100,000 in untreated areas.</li> </ul>
IMR/2024/Exp <sup>15</sup>	Malaysia/ <i>Aedes aegypti</i>	██████████ biotrap/ aquatain AMF	██████████ biotrap/ no aquatain AMF	<ul style="list-style-type: none"> <li>• Under semi-outdoor conditions, ovitraps caused 100.0% <i>Aedes aegypti</i> larval mortality within 24–48 hours, sustained weekly for up to four weeks.</li> <li>• In cage experiments, gravid <i>Aedes aegypti</i> laid significantly fewer eggs in ovitraps (46.0%) than in control traps (73.0%, p&lt;0.05).</li> <li>• In a small open-field test with 50 gravid <i>Aedes aegypti</i>, egg counts peaked with three ovitraps but declined with four.</li> </ul>
IMR/2024/Exp <sup>16</sup>	Malaysia/ <i>Aedes aegypti</i>	██████████ biotrap/ aquatain AMF	██████████ biotrap/ no aquatain AMF	<ul style="list-style-type: none"> <li>• Treatment traps showed 100.0% <i>Aedes aegypti</i> larval mortality at 24 and 48 hours across all water volumes.</li> </ul>
Aguilar-Duran et al./2024/Exp <sup>17</sup>	Mexico/ <i>Aedes aegypti</i>	AGO/ NI	No intervention/ NA, AGO + IVC/ spinosad and chlorpyrifos, IVC alone/ spinosad and chlorpyrifos	<ul style="list-style-type: none"> <li>• AGO mass trapping was the most effective intervention, reducing <i>Aedes aegypti</i> females by 47.7% and 54.9% compared to the control.</li> <li>• AGO + IVC led to a 47.6% rise in mosquito abundance, likely due to low trap coverage (5.06%) from abandoned houses, and a 26.5% increase over the control, indicating ineffectiveness in that area.</li> </ul>
Marin G et al./2020/Exp <sup>18</sup>	India/ <i>Aedes aegypti</i>	Black ovitrap/ NI	Other colours of ovitrap (red, green, blue, orange)/ NI	<ul style="list-style-type: none"> <li>• Black ovitraps showed the highest egg attraction (105.8 ± 12.9), followed by red (72.0 ± 7.1).</li> <li>• Across six trials, black consistently outperformed all other colours (p=0.05).</li> </ul>

Withanage GP et al./2020/Exp <sup>19</sup>	Sri Lanka/ <i>Aedes aegypti</i> , <i>Aedes albopictus</i>	AGO (with different percentage)/ Novaluron	No intervention	<ul style="list-style-type: none"> <li>High concentrations (5.0–0.01 ppm) caused rapid larval death, while lower concentrations (down to 0.5 ppb) fully inhibited adult emergence over time.</li> <li>Statistical analysis showed significantly higher mortality in treated areas with no toxicity to non-target animals.</li> </ul>
Ahmad-Azri M et al./2019/Exp <sup>20</sup>	Malaysia/ <i>Aedes</i>	Standard ovitrap/ NI	MLTD/ NI, Double sticky ovitrap/ NI, NPK fertiliser/ nitrogen + phosphorus + potassium	<ul style="list-style-type: none"> <li>The double sticky ovitrap collected significantly more larvae (130.06 ± 18.95) than the standard ovitrap (53.19 ± 10.23) and MLTD (56.44 ± 6.17).</li> </ul>
Gao Q et al./2019/Exp <sup>21</sup>	China/ <i>Aedes albopictus</i>	Ovitrap/ NI	■■■■-ovitrap/ NI, CO <sub>2</sub> -light trap/ Ni	<ul style="list-style-type: none"> <li>■■■■ovitrap collected significantly more eggs and had higher trap positivity rates than ovitraps at all time points (e.g., 50.16 vs. 3.98 eggs/trap at day 10; p&lt;0.001).</li> </ul>
Reza M et al./2016/Exp <sup>22</sup>	Indonesia/ <i>Aedes</i>	Ovitrap/ copper	Ovitrap/ no copper	<ul style="list-style-type: none"> <li>Copper-treated ovitraps at 10 ppm were highly effective, killing all <i>Aedes spp.</i> larvae found in 70.2% (66/94) of infested pots.</li> <li>Copper-treated pots showed a larvae mortality rate of 98.3%.</li> <li>Statistical analysis (p&lt;0.01) showed almost no live larvae in copper pots (mean indoor: 0.0; outdoor: 1.7) vs. controls (mean: 51.5), with most dead larvae being early instars and few weak survivors in only two outdoor pots.</li> </ul>
Bhami LC et al./2015/Exp <sup>23</sup>	India/ <i>Aedes aegypti</i> , <i>Aedes albopictus</i>	Ovicidal trap (with different concentration)/ boric acid	No intervention	<ul style="list-style-type: none"> <li>Oviposition peaked at 0.5% boric acid, with 280.5 ± 1.41 eggs for <i>Aedes aegypti</i> and 295.5 ± 1.47 eggs for <i>Aedes albopictus</i>.</li> <li>III instar larvae of both <i>Aedes aegypti</i> and <i>Aedes albopictus</i> were more sensitive to boric acid than IV instars.</li> </ul>
de Melo DP et al./2012/Exp <sup>24</sup>	Brazil/ <i>Aedes aegypti</i>	Ovitrap	■■■■TRAP, Larval surveys	<ul style="list-style-type: none"> <li>■■■■TRAP and ovitrap data showed moderate spatial overlap with dengue clusters, with 22 and 16 intersections respectively.</li> <li>■■■■TRAP clusters were shorter (82–96 days) and occurred closer to dengue outbreaks (65–94 days prior), offering a more accurate temporal signal than ovitraps, which appeared much earlier (97–283 days) and were less timely for intervention.</li> </ul>

SR, systematic review; NI, no information; IMR, Institute for Medical Research; Exp, experimental; AMF, attractant mixture formulation; NA, not available; AGO, autocidal gravid ovitrap; IVC, integrated vector control; MLTD, mosquito larvae trapping device; NPK, nitrogen + phosphorus + potassium; CO<sub>2</sub>, carbon dioxide

## SAFETY

There was no complete, formal safety report for ovitraps in managing vector control. However, some details regarding the safety and handling of the materials were mentioned.

**Boric acid** was described as a weak acid of boron that is often used as an insecticide. It was registered in the United States of America as a domestic insecticide and was generally considered to be safe for use in households. Boric acid was less toxic compared to different pesticides and that technical boric acid was practically non-toxic to birds and fish. It was also noted that dilute boric acid solution at a concentration non-lethal to human beings attracts mosquitoes to oviposit.<sup>23</sup>

Meanwhile, **copper** at a concentration of 10 ppm was used in ovitraps. While the United States Environmental Protection Agency had limited the concentration of copper to 1 ppm in drinking water, the use of copper at 10 ppm in contained water environments such as ovitraps might be a reasonable measure. However, careful application and strict control from local governments are needed to avoid environmental damage due to excessive or irresponsible use of copper.<sup>22</sup>

An Insect Growth Regulator like **Novaluron** was used at a concentration of 2 ppm in autocidal gravid ovitraps. The studies on its toxicity levels for animals and drinking water demonstrated extensive metabolism of absorbed Novaluron and rapid excretion. Novaluron was stated to be noncarcinogenic. In the field experiments, no animal poisoning of Novaluron in the autocidal gravid ovitraps was reported in the treated area. Although susceptible to ultraviolet rays and organic pollutants, which could limit its persistence, this also suggested environmental pollution may not be long-lasting, making it a favourable mosquito control agent.<sup>19</sup>

Based on the study by Institute for Medical Research, the [REDACTED] trap (**Aquatrain AMF - Blocks**) has specific storage and handling instructions: it should be stored and handled in a cool, well-ventilated, humid area, kept away from ignition sources or suitable flammable storage and retained in its tightly sealed original packaging. It was generally stable except might react with strong oxidising agents. Field observations noted a "noticeable scent" from the trap that was well accepted by users, suggesting potential for indoor use if user acceptance is considered. Issues like water cloudiness and fungal growth were also observed, indicating the need for maintenance.<sup>15,16</sup>

A systematic review on mass trapping interventions noted the growing aversion to the use of **insecticides** by authorities and citizens due to concerns about their efficacy, the emergence of insecticide resistance, and their environmental and health impacts. It also highlighted that the impact of traps on non-target species was poorly documented, and further studies were needed to assess these potential effects on non-target fauna (arthropods, amphibians, reptiles, etc.).<sup>14</sup>

Meanwhile, the United States Food and Drug Administration had published a proposed field trial of genetically engineered OX513A *Aedes aegypti* in Key Haven, Florida. The document stated that, the ovitraps had been used in Key Haven since 2012 and in prior trials involving OX513A, demonstrating their effectiveness in monitoring population changes and gene dissemination.<sup>27</sup>

While these details provide some context on the perceived or observed safety aspects of the interventions, they do not constitute a formal safety report detailing comprehensive toxicity data, environmental impact assessments or risk evaluations.

## ECONOMIC IMPLICATION

There were no studies found addressing the economic implications of using ovitraps for vector control.

In Malaysia, ovitraps are available for MYR25.00 to MYR36.00 (approximately USD5.30 to USD7.60) per unit on online shopping platforms and from pest control suppliers, with some offering bulk discounts (e.g., MYR22.00 per unit for purchases of five or more). Additionally, international and online retailers offer a 4-pack of "██████████ Traps" for around USD64.99 (MYR274.78) or USD16.25 (MYR68.70) each. Other mosquito control traps with similar functions, though not strictly ovitraps, range from USD10 (MYR42.28) to over USD50 (MYR211.40) per unit. Specialised traps can be more expensive, for example, the ██████████ costs between USD120 (MYR507.36) and USD160 (MYR676.48) per unit, while a gravid *aedes* trap may cost less than USD8 (MYR33.82). The price of an ovitrap can vary significantly depending on several factors, including type of ovitrap (standard, lethal, specialised), source/ manufacturer, quantity and locations.<sup>25,26</sup>

## CONCLUSION

The review showed that treated ovitraps are effective in reducing *Aedes* mosquito populations and, in some cases, virus transmission, especially when used widely or with other control methods. Treatments like copper and Novaluron showed strong larvicidal or emergence-inhibiting effects, while boric acid attracts oviposition at low doses and acts as a larvicide at higher ones. Beyond control, traps like ██████████ TRAPs and ovitraps may help predict dengue clusters. Available evidence suggested boric acid, copper and Novaluron are generally less toxic than traditional pesticides, but careful use is still necessary due to potential non-target effects.

## REFERENCE

1. Ojayli SA, Yahya Asseri YA, Mokeli AH et al. Vector Control Strategies in Public Health - Challenges and Innovative Solutions: A Systematic Review. *Migration Letters*. 2022; 19(5): 1558-1566.
2. Vector-borne Diseases. World Health Organization. 2024.
3. Malaria's Impact Worldwide. US Centers for Disease Control and Prevention. 2024.
4. Dengue Yellow Book. US Centers for Disease Control and Prevention. 2025.
5. Wan-Fei K, Mang CY, Tan LA et al. Dengue Mortality in Malaysia: A 10-year Study. Ministry of Health Malaysia. 2024.
6. Roza S, Ku Nurhasni KAR, Balqis AG et al. Health Technology Assessment: Integrated Vector Management for Aedes Control. Ministry of Health Malaysia. 2019.
7. Kumar G, Baharia R, Singh K et al. Addressing Challenges in Vector Control: A Review of Current Strategies and the Imperative for Novel Tools in India's Combat Against Vector-Borne Diseases. *BMJ Public Health*. 2024; 2(1).
8. Teslim B. Traditional vs. Modern Vector Control Methods: A Comparative Study. 2023.
9. The Evolution of Lethal Ovitrap for Mosquito Control: A Breakthrough in Urban Vector Management. Available from <https://insecto.com/post/the-evolution-of-lethal-ovitraps-for-mosquito-control-a-breakthrough-in-urban-vector-management/>. Accessed on 29 May 2025.
10. Arrieta-Ángel K, Polo-Silva K, Ospino-Sierra N et al. Handmade Ovitrap and Hot Water: Auxiliary Strategy to Control Aedes Aegypti Mosquitoes in Colombia. *PAHO*. 2025; 49.
11. Winter K, Stewart ATM, Igieda J et al. Assessment of Trinidad Community Stakeholder Perspectives on the Use of Yeast Interfering RNA-baited Ovitrap for Biorational Control of Aedes Mosquitoes. *PLoS ONE*. 2021; 16(6).
12. Palmer JRB, Oltra A, Collantes F et al. Citizen Science Provides a Reliable and Scalable Tool to Track Disease-carrying Mosquitoes. *Nature Communications*. 2017; 8(916).
13. Lina Farhana Ramli, Suhainizam Saliluddin, Mohd Rafee Baharudin et al. Effect of Artificial Lights on Aedes Eggs in Strata Residential in Selangor, Malaysia: A Field Cluster Randomized Control Trial. *Research Square*. 2023.
14. Jaffal A, Fite J, Baldet et al. Current Evidences of the Efficacy of Mosquito Mass-trapping Interventions to Reduce Aedes Aegypti and Aedes Albopictus Populations and Aedes-borne Virus Transmission. *PLoS Negl Trop Dis*. 2023; 17(3).
15. Institute for Medical Research Malaysia. Efficacy of [REDACTED] traps Against Aedes Aegypti: Small-scale Field Testing. Ministry of Health Malaysia. 2024; MELPT 24/06.
16. Institute for Medical Research Malaysia. Laboratory Evaluation of [REDACTED] traps Against Aedes Aegypti: Efficacy-testing of Trap. Ministry of Health Malaysia. 2024; MELPT 24/05.
17. Aguilar-Duran JA, Hamer GL, Reyes-Villanueva F et al. Effectiveness of Mass Trapping Interventions Using Autocidal Gravid Ovitrap (AGO) for the Control of Dengue Vector, *Aedes (Stegomyia) Aegypti*, in Northern Mexico. *Parasites and Vectors*. 2024; 17(344).
18. Marin G, Mahiba B, Arivoli S et al. Does Colour of Ovitrap Influence the Ovipositional Preference of Aedes Aegypti Linnaeus 1762 (Diptera: Culicidae). *Int J Mosq Res*. 2020; 7(2): 11-15.
19. Withanage GP, Viswakula SD, Gunawardene YS et al. Use of Novaluron-Based Autocidal Gravid Ovitrap to Control Aedes Dengue Vector Mosquitoes in the District of Gampaha, Sri Lanka. *Biomed Res Int*. 2020.
20. Ahmad-Azri M, Syamsa RA, Ahmad-Firdaus MS et al. A Comparison of Different Types of Ovitrap for Outdoor Monitoring of Aedes Mosquitoes in Kuala Lumpur. *Tropical Biomedicine*. 2019; 36(2): 335-347.
21. Gao Q, Cao H, Fan J et al. Field Evaluation of [REDACTED]-ovitrap, Ovitrap and A CO<sub>2</sub>-Light Trap for *Aedes Albopictus* Sampling in Shanghai, China. *PeerJ*. 2019; 7: e8031.
22. Reza M, Ilmiawati C and Matsuoka H. Application of Copper-based Ovitrap in Local Houses in West Sumatra, Indonesia: A Field Test of a Simple and Affordable Larvicide for Mosquito Control. *Tropical Medicine and Health*. 2016; 44: 11.
23. Bhami C and Das SSM. Boric Acid Ovicidal Trap for the Management of Aedes Species. *J Vector Borne Dis*. 2015; 52: 148-152.
24. de Melo DP, Scherrer LR and Eiras AE. Dengue Fever Occurrence and Vector Detection by Larval Survey, Ovitrap and [REDACTED] TRAP: A Space-Time Clusters Analysis. *PLoS ONE*. 2012; 7(7): e42125.
25. Online Shopping Platform. Shopee. 2025.
26. Online Shopping Platform. Amazon. 2025.
27. Environmental Assessment for Investigational Use of *Aedes aegypti* OX513A. United States Food and Drug Administration. 2016.

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