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Use of ovitrap surveillance to investigate the abundance & distribution of dengue vectors in Barkatullah University, Bhopal

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Abstract

Objective: The aim of this study is to determine the distribution and abundance of *Aedes sp*. Mosquitoes in Barkatullah University, Bhopal.
Methods: Ovitraps were randomly placed in the university campus. The sampling was completed after 10 independent trips. For each trip 30 ovitraps were installed and recovered after 7 days, but they all are examined daily from the next day of installation.
Results: The mixed infestation of *Ae*. *aegypti* and *Ae*. *albopictus* was observed in campus area. The abundance of *Aedes* population was indicated by Ovitrap index (OI) which ranged from 40% - 89.28% and the Mean number of larvae per ovitrap which ranged from 3. 35 - 10.60. In this study, ovitrap data indicated *Ae*. *albopictus* were dominant species in all the trips compared to *Ae*. *aegypti* populations. Although the presence of *Aedes aegypti* population ranged from 16.07% - 24.48%, whereas the presence of *Aedes albopictus* population ranged from 75.51% - 83.92%.
Conclusion: This study indicates that ovitrap is a sensitive, fast, more efficient tool to attract gravid females of mosquitoes to oviposit, and also to detect the presence of *Aedes* mosquitoes as compared to larval survey.

Keywords: Ovitraps, mixed infestation, ovitrap index, gravid females, oviposit

Introduction

Dengue, a major public health problem in India is an arbo-viral disease caused by the dengue virus (DENV) (Family: Flaviviridae) comprising four serotypes (DEN-1, DEN-2, DEN-3 and DEN-4) and female Aedes mosquito, mainly *Ae*. *aegypti* and *Ae*. *albopictus* play a role in the transmission of disease. Dengue Virus Infection (DVI) cause a spectrum of disease ranging from mild infection (dengue fever, DF) to a severe deadly disease - dengue haemorrhagic fever/dengue shock syndrome (DHF/DSS) [1]. In India, the annual incidence is estimated to be 7.5-32.5 million [2]. *Ae*. *Aegypti* is an urban mosquito that breed almost entirely in man-made containers (cistern, flower pots, tanks, tyres and cans) found in and around households, construction sites, factories etc. On the contrary, *Ae*. *albopictus* breeds in both man-made containers as well as in natural containers such as bamboo, tree holes and leaf axils. Dengue epidemics in central India started in 1966 and since then, they have been occurring regularly and more frequently. First outbreak of dengue in central India occurred in Jabalpur during October to July 1966. An epidemiology study indicated that approximately 25% of Jabalpur, Madhya Pradesh (MP) population was affected [3]. In September and October of 2009 an outbreak of dengue occurred which involved Bhopal, Indore and adjoining 8 districts of MP. In this epidemic 620 samples from patients suspected with dengue infection were tested positive for dengue antibodies by ELISA [4]. Ovitrap surveillance is the most common sampling method to monitor *Ae*. *aegypti* and *Ae*. *albopictus* populations through their egg laying activities [5]. It has been claimed to be a more effective and sensitive technique as compared to the conventional larval surveys, especially when the *Aedes* infestation rates were very low [6]. Lenhart *et al*. [7] recommended the ovitrap as a simple, inexpensive and sensitive tool for both monitoring oviposition and collecting large quantities of *Aedes aegypti* eggs. Thus, simplicity, specificity and effectivity of ovitraps are proven advantages of this technique as a surveillance tool [8]. The aim of this study is to determine the distribution and abundance of *Aedes sp*. Mosquitoes in Barkatullah University, Bhopal.

Materials and Methods

Study area

The study was conducted in Barkatullah University, Bhopal. Bhopal is the capital city of the Indian state of Madhya Pradesh (23.2500° N, 77.4167° E). Bhopal is known as the City of Lakes for its various natural and is also one of the greenest cities in India. It is the 16th largest city in India and 131st in the world. Barkatullah university was established in the year 1970 with the name Bhopal University. Its name was later changed in 1988 to give tribute to freedom fighter Prof. Barkatullah. The campus of Barkatullah university covers 360 acres (1.5km²). It is on the National Highway 12 which passes through Bhopal. Geographically Barkatullah University is positioned at latitude 23° 12' 01.83" N and longitude 77° 27' 12.50" E having an average elevation of 500 m.a.s.l. All ovitraps were placed randomly in different sites of the campus which were either partially or totally shaded to avoid from direct sunlight and heavy rain that may cause spillage.

Fig 1: Map of India indicating Bhopal

Fig 2: Study area Barkatullah University Bhopal

Construction of ovitrap

An ovitrap is a device which consists of a dark container containing water and a substrate where mosquitoes can lay their eggs. The eggs then fall through the mesh into the water, where the larvae hatch and develop into pupas. When the adult mosquitoes emerge, they are trapped beneath the mesh and are unable to escape from the ovitrap. Ovitraps mimic the preferred breeding site for container breeding mosquitoes, including *Aedes albopictus* and *Aedes aegypti*.

Procedure

The following steps were taken in order to construct the ovitrap: -

Step 1

Firstly, we purchased 30 plastic containers each having capacity of 350ml, whose diameter is 6.5cm and 9.0cm in height. After that we marked two holes on the top with a sharpie for hanger rope and one bigger hole below for water overflow.

Step 2

We painted them into the black colour because black surfaces have been found to be most attractive in oviposition site selection [9]. Yap [10] also found that ovitraps which are black in colour were more attractive to mosquitoes. Tied the rope to hanger holes.

Fig 3: Painting the container into the black

Fig 4: Tying rope to hanger

Step 3

We used some scrap window screen and cut out some squares a little larger than the water overflow holes. And then superglued and gorilla taped them into the place.

Step 4

After that we took old socks and cut a strip out and pushed a bit down into the water to act as a water wick. Then, wrapped the rest of the sock around the rim of the container and taped into the place. And the same has done to all the containers.

Fig 5: Showing the window screen of container

Fig 6: Sock wrapped over the rim of container

Step 5

Now we filled the container with tap water until it started to pour out of the overflow holes and also pour water over the sock until it is soaked because the sock needs to stay wet to attract the mosquitoes. After that we added some amount of grass clippings to create stagnant water in just a few days.

So that's how we made our own Ovitraps, and hung them in shaded places away from wind and sun.

Ovitrap Surveillance

Ovitraps were randomly placed in Barkatullah University, Bhopal. The sampling was completed after 10 independent trips. For each trip, a total of 30 ovitraps were placed. Ovitraps in all sites were recovered after 7 days of placing in designated areas. The collected ovitraps were brought back to the laboratory and the contents were poured into a plastic container. Fresh water was added into the container and the larvae were allowed to hatch and colonize in the laboratory. The container was kept covered. Only hatched larvae were counted in this study, as the larval stage is closely associated with the actual field mosquito populations since not all eggs will hatch. Besides, mosquito populations are monitored in vector control programme to prevent any dengue occurrence. Therefore, greater concern should be focused on mosquito stages surviving into adults which have a potential to transmit dengue viruses

Mosquito Indentification

Mosquitoes undergo a complete metamorphosis during their life cycle: egg-larva-pupa-adult. The larval and adult stages are most frequently used in identification.

However, the eggs can also be differentiated.

Indentification of eggs

Eggs of mosquitoes were identified to species (Bova *et al*. 2016) [11] (i.e., shiny black-*Aedes albopictus or Aedes aegypti*) under Stereomicroscope.

Identification of larva

The hatched larvae were subsequently counted and identified under Stereomicroscope at 3rd instar and 4th instar [12]. The larval numbers were recorded individually for each positive ovitrap.

Indentification of adult mosquitoes

The adult emerged from the larva are counted and identified under Stereomicroscope using keys [13]. The adult numbers were also recorded individually for each positive ovitrap.

Fig 7: Egg of Aedes

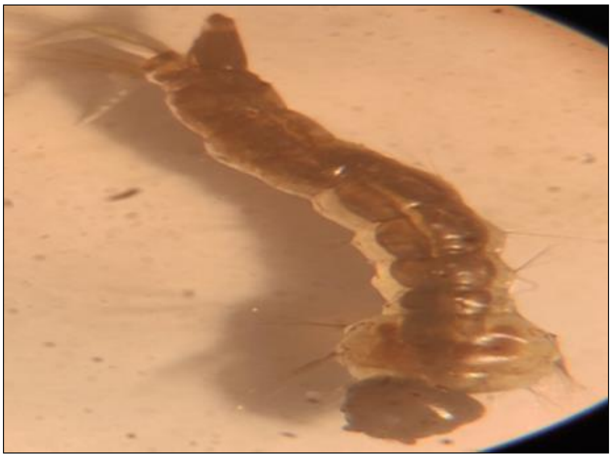

Fig 8: Larva of Aedes

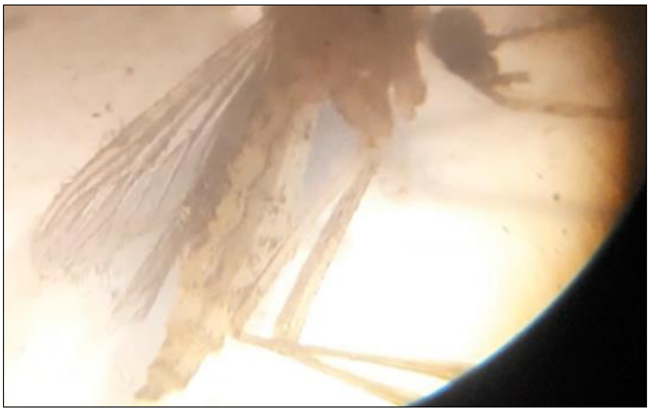

Fig 9: Adult Aedes

Data Analysis

All data obtained from this study was analysed as follow:

a) Ovitrap index (OI) = (Number of positive traps / Number of recovered traps) X 100%

b) Mean larvae per ovitrap = Total number of larvae / Number of recovered Ovitraps.

Results and Discussion

Table 1 described that during the study period, A total of 300 Ovitraps were randomly placed in the study areas, out of which 283 were successfully recovered after seven days for surveillance. The others had been disturbed/destroyed by human/animal intervention or by natural causes such as wind or rain. Of recovered Ovitraps, 194 were found to be positive for immature insect stages.

And all the positive Ovitraps were infested with either or both, *Ae. aegypti* and *Ae. albopictus*. In total, 1944 larvae were examined out of which 1418 adult were emerged. Out of 1418 adult 297 *Ae. aegypti* and 1121 *Ae. albopictus* were examined.

Table 1: Showing No. of ovitraps installed, recovered ovitraps, positive ovitraps, total no. of larvae and total no. of Adult mosquitoes

Ovitrap trips	Date of installation	Number of ovitraps installed	Recovered ovitraps	Positive ovitraps	Total no. of larvae	Total number of adult mosquitoes
1	15/09/19	30	28	25	297	233
2	23/09/19	30	29	25	257	200
3	01/10/19	30	27	23	248	170
4	09/10/19	30	27	21	171	117
5	17/10/19	30	29	22	299	241
6	25/10/19	30	30	21	242	178
7	02/11/19	30	29	17	142	96
8	10/11/19	30	29	15	95	56
9	18/11/19	30	28	14	105	68
10	26/11/19	30	27	11	88	59
Total	=	300	283	194	1944	1418

Table 2 showed the ovitrap index (OI) and the mean number of larvae per ovitrap of *Ae. aegypti* and *Ae. albopictus* obtained from Ten trips of ovitrap surveillance in campus area. The results showed the abundance of *Aedes* population in Barkatullah university with OI range of 40.00% - 89.28% (fig10). The mean number of larvae per ovitrap of *Aedes* mosquitoes ranged from 3.35 -10.60 (fig.11) This study demonstrated the mixed infestation (*Ae. aegypti and Ae. albopictus*) was consistently observed in Ovitraps deployed in study areas, whereas sometimes infestation of *Ae. aegypti* were not seen. In this study, ovitrap data indicated *Ae. albopictus* were dominant species in all the trips compared to *Ae. aegypti* populations. Although the presence of *Aedes aegypti* population ranged from 16.07% - 24.48% (fig.12), whereas the presence of *Aedes* population ranged from 75.51% - 83.92% (fig.12).

This result also showed the variability in ovitrap index from 1st to 10th trip, (fig.10) that is initially it was more and later goes down due to low temperature and same has been seen in mean number of larvae per ovitrap. (fig.11).

Table 2: Showing ovitrap index (%), Mean larvae per ovitrap, percentage of *Ae. aegypti* and *Ae. albopictus*

Ovitraps trips	Date of trap collected	Ovitrap index (%)	Mean larvae per ovitrap	*Aedes aegypti* (%)	*Aedes albopictus* (%)
1	21/09/19	89.20%	10.6	21.03%	78.90%
2	29/09/19	86.20%	8.86	22%	78%
3	07/10/19	85.10%	9.18	20%	80%
4	15/10/19	77.70%	6.3	19.65%	80.34%
5	23/10/19	75.80%	10.3	24.40%	75.50%
6	30/10/19	70%	8	17.40%	82.50%
7	06/11/19	58.62%	4.8	20.84%	79.16%
8	13/11/19	51.72%	3.27	16.03%	83.90%
9	21/11/19	50%	3.75	22.05%	72.05%
10	29/11/19	405	3.25	22.04%	77.05%
Average Mean	=	68.46%	6.27	20.55%	79.34%

Ovitrap data are considered appropriate to assess presence/absence of *Aedes* mosquitoes in a given site. This study utilized ovitrapping technique for *Aedes* surveillance purpose and has been reported as an economical and effective tool as compared to larval survey especially when the *Aedes* infestation rate is low. The cryptic breeding sites of dengue vectors makes the conventional larval survey technique less sensitive and less efficient.

Earlier, it was stated that *Ae. aegypti* is strictly domiciliary, preferring less vegetation, biting indoors and primarily found indoors, while *Ae. albopictus* is found outdoors and breeds in all types of natural containers [14, 15]. In these aspects, there is a bit similarity with the results of our study. Further, similar results were obtained in a study on surveillance of *Aedes* mosquitoes in a University Camps in Kuala Lumpur [16]

In the current study, *Ae. albopictus* was found to be significantly abundant in terms of both the Ovitrap Index and the mean larval count per ovitrap than *Ae. aegypti* in all the trips. *Ae. aegypti* and *Ae. albopictus* are related species that occupy similar ecological niches (Klowden, 1993) [17]. In the current study, mixed breeding of *Ae. aegypti* and *Ae. albopictus* was observed in campus area.

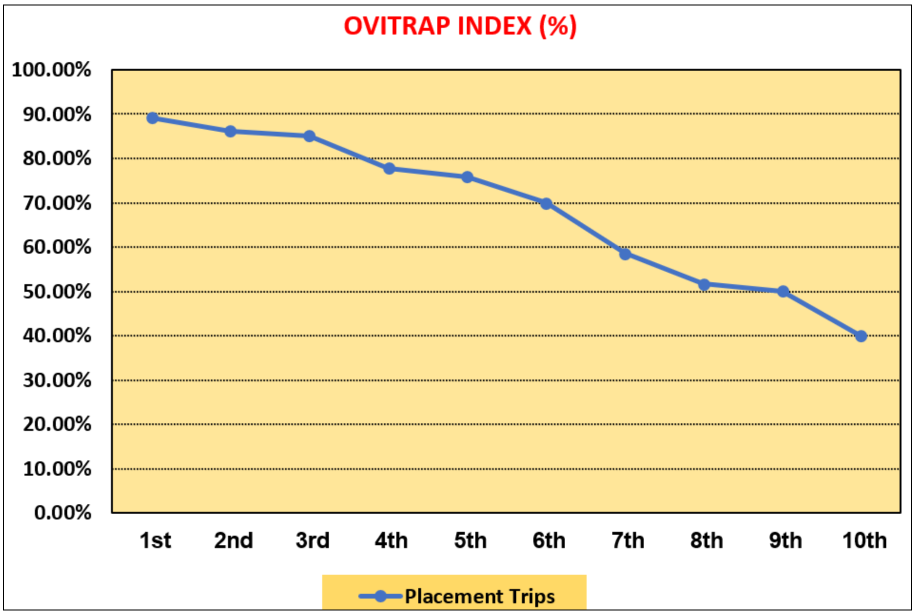

Fig 10: Ovitrap index (%) in 10 trips

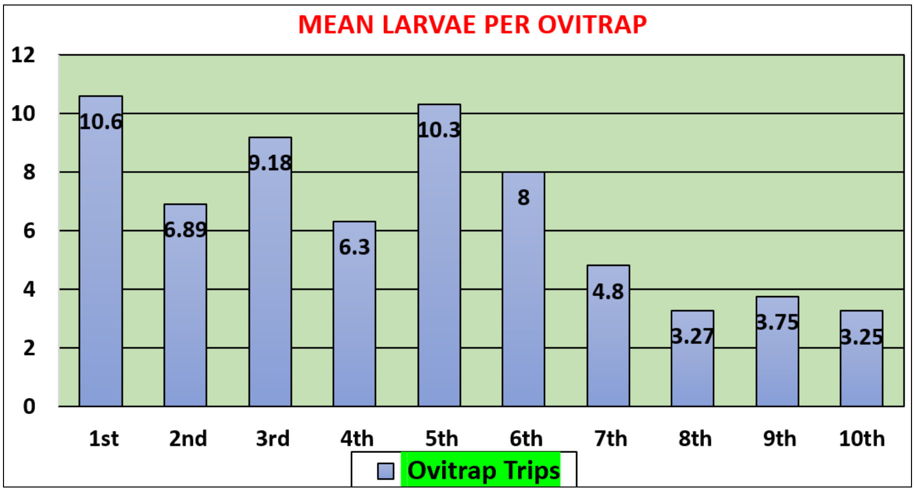

Fig 11: Mean larvae per ovitrap

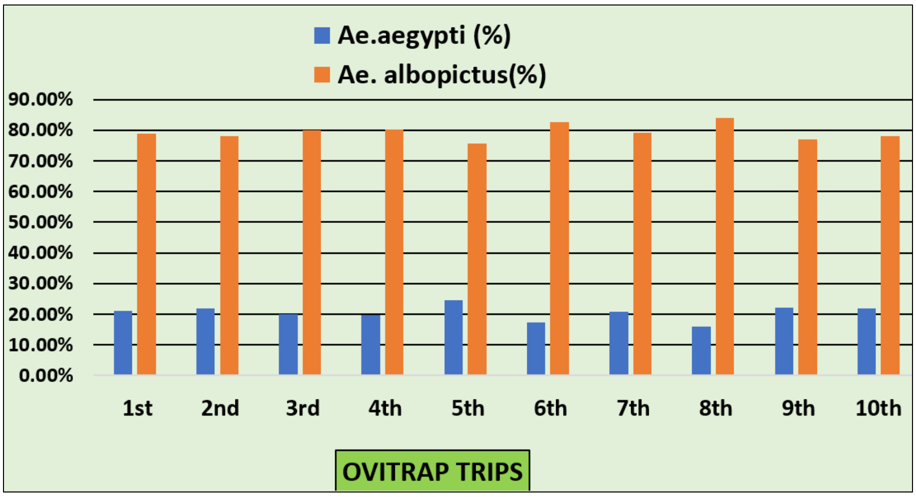

Fig 12: Showing the percentage of *Ae. aegypti* and *Ae. albopictus* in campus area

Conclusion

The present study has shown that all the positive ovitraps were infested with *Aedes* mosquitoes (*viz*., *Ae*. *aegypti* and *Ae*. *albopictus*) in study areas. And also revealed that *Ae*. *albopictus* was the dominant species in the campus area. Besides that, this study also proved that ovitrapping technique is still a reliable and sensitive tool for early detection of dengue vectors in natural environment in comparison with larval survey. While exhibiting the versatility of ovitrap surveillance, this situation urges the respective authorities to look for effective vector control strategies such as surveillance studies, insecticide application, biological control, education and public awareness as well as personal protection should be implemented in the campus in order to monitor and control the populations of both dengue vectors within the campus. Routine adulticiding should also be carried out in the university campus to suppress the *Aedes* populations, especially when the ovitrap index is 10% or more. According to Tham (2000), an Ovitrap Index above 10% for *Aedes* species in an area may indicate a possible risk of dengue outbreak. In the current study, all the surveyed areas exhibited an OI greater than 10% for either or both *Aedes* species.

References

1. World Health Organization. Dengue haemorrhagic fever: diagnosis, treatment, prevention and control. 2nd ed. Geneva: WHO; c1997.
2. Gupta N, Srivastava S, Jain A, Chaturvedi UC. Dengue in India. Indian J Med Res. 2012 Sep;136(3):373-390.
3. Shegal PN, Kalra NL, Pattanayak S, Wattal BL, Shirvastav JB. A study of an outbreak of dengue epidemic in Jabalpur, Madhya Pradesh. Bull Indian Soc Mal Com Dis. 1947;4:91-108.
4. Baruah K, Singh PK, Mohalia MM, Dhariwal AC. A study on dengue outbreak during 2009 in Bhopal and Indore districts of Madhya Pradesh India. J Commun Dis. 2010 Sep;42(3):273-279.
5. Service MW. Importance of ecology in *Aedes aegypti* control. Southeast Asian J Trop Med Public Health. 1992 Dec;23(4):681-688.
6. Lee HL. Sequential sampling: its application in ovitrap surveillance of *Aedes* (Diptera: Culicidae) in Selangor, Malaysia. Trop Biomed. 1992 Jan;9(1):29-34.
7. Lenhart AE, Walle M, Cedillo H, Kroeger A. Building a better ovitrap for detecting *Aedes aegypti* oviposition. Acta Trop. 2005 Oct;96(1):56-59.
8. Wan-Norafikah O, Nazni WA, Noramiza S, Shafa'arKo'ohar S, Heah SK, Azlina NAH, *et al*. Ovitrap surveillance and mixed infestation of *Aedes aegypti* (Linnaeus) and *Aedes albopictus* (Skuse) in northern region and southern region of Malaysia. Health Environ J. 2011;2(1):1-5.
9. Beckel WE. Oviposition site preference of *Aedes* mosquitoes (Culicidae) in the laboratory. Mosq News. 1955;15(4):224-228.
10. Yap HH. Preliminary report on the colour preference on oviposition by *Aedes albopictus* (Skuse) in the field. Southeast Asian J Trop Med Public Health. 1975;6(451):1-2.
11. Bova J, Paulson S, Paulson G. Morphological differentiation of the eggs of North American container-inhabiting *Aedes* mosquitoes. J Am Mosq Control Assoc. 2016 Sep;32(3):244-246.
12. Farajollahi A, Price DC. A rapid identification guide for larvae of the most common North American container-inhabiting *Aedes* species of medical importance. J Am Mosq Control Assoc. 2013 Sep;29(3):203-221.
13. Rueda LM. Pictorial keys for the identification of mosquitoes (Diptera: Culicidae) associated with dengue virus transmission. Zootaxa. 2004 Aug 16;589:51-60.
14. Sucharit S, Tumrasvin W, Vutikes S, Viraboonchai S. Interactions between larvae of *Ae. aegypti* and *Ae. albopictus* in the mixed experimental populations. Southeast Asian J Trop Med Public Health. 1978 Mar;9(1):93-97.
15. Foo L, Lim TW, Lee HL, Fang R. Rainfall, abundance of *Aedes aegypti* and dengue infection in Selangor, Malaysia. Southeast Asian J Trop Med Public Health. 1985 Dec;16(4):560-568.
16. Wan-Norafikah O, Chen CD, Soh HN, Lee HL, Nazni WA, Sofian-Azirun, *et al*. Surveillance of *Aedes* mosquitoes in a university campus in Kuala Lumpur, Malaysia. Trop Biomed. 2009 Aug;26(2):206-215.
17. Klowden MJ. Mating and nutritional state affect the reproduction of *Aedes albopictus* mosquitoes. J Am Mosq Control Assoc. 1993 Jun;9(2):212-216.