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ORIGINAL ARTICLE

A STUDY ON THE OVIPOSITION BEHAVIOUR OF AEDES MOSQUITOES TO DIFFERENT COLOURED OVITRAPS IN DIFFERENT SEASONS OF HOSUR MUNICIPAL CORPORATION AREA, TAMIL NADU, 2023

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ABSTRACT

INTRODUCTION : This study investigates the oviposition behavior of Aedes aegypti mosquitoes concerning different colored ovitraps across pre- and post-monsoon seasons in Hosur Municipal Corporation, Tamil Nadu.

METHODS : A cross-sectional design was employed, involving the placement of seven colored ovitraps (black, red, orange, blue, yellow, violet, and green) in 50 houses per selected ward, with observations collected weekly during pre-monsoon and post-monsoon during 2023. Eggs were counted, and species were identified in a controlled laboratory setting.

RESULTS : The results demonstrate a significant preference for black ovitraps, which exhibited the highest positivity and egg count in both seasons, followed by red and orange traps. Notably, indoor settings accounted for the majority of oviposition events across seasons (64.75%-65.86%), emphasizing the importance of indoor breeding sites. Seasonal variations had minimal impact on oviposition patterns, suggesting that urban microclimatic conditions in Hosur might buffer environmental fluctuations.

CONCLUSION : These findings underscore the efficacy of black-colored ovitraps as a reliable vector surveillance tool. The study highlights the need for targeted indoor vector control measures, such as source reduction and habitat modification, to effectively combat dengue in urban settings. Further research into additional environmental and behavioral factors influencing Aedes oviposition is recommended to enhance control strategies. By optimizing ovitrap design and placement, public health programs can strengthen mosquito surveillance and mitigate the burden of vector-borne diseases like dengue.

KEYWORDS : Oviposition, Entomology, Aedes, Mosquito

INTRODUCTION

Dengue is a vector-borne viral disease endemic in five of six WHO regions (Africa, Americas, South-East Asia, Western-Pacific and Eastern Mediterranean). It poses a major international public health concern. Since 2023, WHO has recorded an incidence of 5 million cases and more than 5000 dengue-related deaths in more than 80 countries/territories and five WHO regions.[1] The four related but distinct dengue viruses (DENV-1, DENV-2, DENV-3 and DENV-4) belong to the genus Flavivirus (family Flaviviridae) and are circulating in disease-endemic settings in a human-to-mosquito transmission cycle. In 2024, Tamil Nadu has reported 19138 cases and seven deaths as of 31st October.[2] Aedes aegypti, a mosquito, is the main dengue vector in many endemic countries, including India. The vision of this mosquito plays a principal role in adult mosquito biology, including the location of hosts, food sources, mating, resting sites, and oviposition (egg-laying) sites. Adult female mosquitoes lay eggs on the inner walls of containers with water above the waterline. Mosquitoes only need a small amount of water to lay eggs. Bowls, cups, fountains, tires, barrels, vases, and any other container storing water make a great "nursery."[3]

Controlling the primary mosquito vector, Aedes aegypti is one of the key strategies to prevent dengue outbreaks in many low- and middle-income countries. Vector control management includes removing potential breeding sites, reducing vector populations, and minimizing individual exposure. This involves vector control strategies for larvae and adults (i.e., environmental management and source reduction), especially monitoring water storage practices, draining and cleaning household water storage containers weekly, and larvicide in non-potable water using larvicides at correct dosages. Implementing preventive measures targeting critical locations at specific times requires efficient vector surveillance tools and methods sensitive enough to predict or detect sudden mosquito population growth in real time.

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Hence, understanding their oviposition behaviour is crucial for developing effective vector surveillance and control strategies.

Ovitraps are a simple, inexpensive, and widely used sensitive tool for detecting the presence of Ae. Aegypti by attracting to lay eggs.[4] The design of these traps, particularly their color, significantly influences their effectiveness. Studies have demonstrated that Aedes mosquitoes exhibit color preferences when selecting oviposition sites. For instance, research conducted in western Rajasthan, India, revealed that red-colored ovitraps had the highest positivity (92.7%), followed by black and blue traps.[5]

Similarly, a study in Chennai indicated that black and blue ovitraps attracted more Aedes eggs compared to red, orange, and white ones.[6] Seasonal variations also play a pivotal role in Aedes mosquito dynamics. Monitoring in Jaipur from August 2021 to July 2022 showed significant seasonal fluctuations in Aedes populations, with peaks correlating with specific environmental conditions.[7]

While existing studies have explored the impact of ovitrap color on Aedes oviposition and noted seasonal population trends, the current study aims to understand the oviposition behavior of Aedes mosquitoes concerning various colored ovitraps across different seasons in the Hosur Municipal Corporation area. By analyzing the preferences and seasonal patterns, this research seeks to enhance the understanding of Aedes oviposition ecology, thereby contributing to the optimization of vector surveillance tools and the development of more effective, seasonally tailored vector control strategies in the region.

METHODS

This is a cross-sectional study carried out in two seasons of the year i.e. the pre-monsoon and post-monsoon. Considering the rainy days and possible disturbance of breeding sites during rainy days, hence data collection was not during the monsoon season i.e. July to September 2023.

Hosur is a developing industrial urban area. The growth of urbanization is very marked with rise in the number of residential areas and industries. Located on the NH connectivity between Chennai and Bangalore are the two capital cities of the states Tamil Nadu and Karnataka and there by the population movement is throughout the year. The area is vulnerable due to the migratory population to this area from other urban cities. Almost all wards have breeding sources for Aedes mosquitoes both during pre-monsoon and post-monsoon periods, the climate in the Hosur area is very conducive to the proliferation of the mosquitoes and longevity. The Hosur area has contributed 24.32% to 54.73% of the total cases of the district, Krishnagiri during the past 5 years.

The secondary data about the number of dengue cases reported month-wise and year-wise for each ward was collected from the health section of Hosur Municipal Corporation for the period from 2017 to 2022. Based on the reported number of cases, 10 wards were selected for study (Figure 1). All the wards are represented equally and the sample selection is made by probability sampling by Systematic simple random sampling. One in a fifth was selected as per the random sample. The following wards were selected. Ward No: 1, 6, 11, 16, 21, 26, 31, 36, 41 and 45 (Table 1). Then 50 houses in each ward were selected for the fixing of coloured ovitraps.

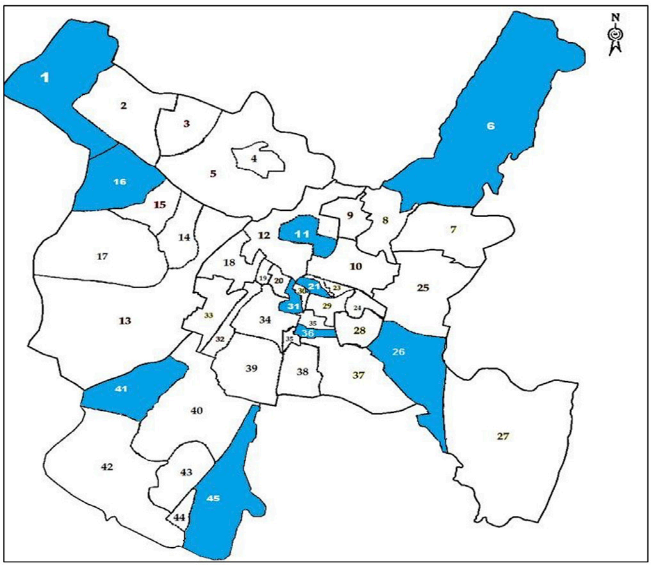

Figure 1: Hosur Municipal Corporation Area showing the study location

Table 1: Wards selected for the study in Hosur Municipal Corporation

Ward No	Ward Name	Ward No	Ward Name
1	Zuzuvadi	26	Parvathi Nagar
6	KCC Nagar	31	Raju street, Immambada
11	New Vasanth Nagar	36	Anthivadi
16	Arasanaty	41	R.K.Hudco
21	Kothur	45	Mathigiri

In each experimental house, seven different colored ovitraps were placed (Figure 2). The ovitraps were left for seven days. After a week, the paddles were removed and Ae.aegypti eggs on the walls of the ovitraps were gently dislodged and the water was filtered using a fine strainer. The number of eggs on the paddle and the walls was counted. Each ovitrap was cleaned well and refilled with water and a new paddle was used each time. During the study, eggs were allowed to hatch and develop into adults, in the laboratory, for species identification.

Figure 2: Different Coloured Ovitraps

The ovitraps designed for this study are a small plastic containers (Trap) of 20 cm in diameter having approximately 750ml water holding capacity, with wide-mouth were used. The ovitraps were of seven colours viz. black, green, orange, yellow, violet, blue and red (Figure 2). In each house, seven different coloured ovitraps were laid at different locations, i.e. bedrooms, bathrooms, kitchen store, lobby, etc (Both indoor and outdoor). Each coloured ovitrap was given an identification number for households and a separate number for its location-specific placement. Mosquito eggs were counted and identified after the collection of the traps at weekly intervals. These experiments were carried out covering pre and post-monsoon of the study area, Hosur. The collected data were pooled for the number of eggs laid in different colour traps.

We employed the following formulas to derive the prevalence of A.Aegepti mosquito population, intensity of oviposition, and the proportion of coloured ovitraps positivity.

1. Prevalence=Total positive ovitraps / Total ovitraps installed
2. Intensity=Total no. of Ae. aegypti eggs collected / Total positive ovitraps
3. % Positivity of coloured ovitrap = Total positive ovitraps / Total ovitraps installed X 100

RESULTS

The observation of the present study of different coloured ovitraps revealed the black ovitraps had the highest positivity (33/168) followed by orange (29/168) and red (26/168) in the pre-monsson period. During the post-monsoon period, highest positivity observed in black (30/128), followed by red (25/128) and orange (18/128). The violet, yellow and green ovitraps yeilded less than 18 during October through December (i.e. post-monsoon period). The details are shown in Table 2. The breeding site preference by Ae.aegypti was found to be 64.75% indoor and 35.25% outdoor during the pre-monsoon period and it was 65.86% indoor and 34.14% outdoor during post post-monsoon period.

During the pre-monsoon period, 50% of the black bowls were found to be attractive. The ovipositing sites preference was 38.59% and 71.4% respectively for outdoor and indoor during pre-monsoon. The same was observed as 65.8 % and 35.3 % respectively for indoors and outdoor during post post-monsoon period. The result showed that black-coloured ovitraps fetched the highest percentages of eggs than other colours (Table 3).

Table 2: Positivity of Different Coloured Ovitraps during the Study Period

Pre Monsoon Period							
Bowl colour	No of bowls installed	No of bowls positive	No.of eggs	Prevalence	Intensity	Mean egg density	% Positivity of colour ovitrap
Red	250	26	523	0.1	20	2	10s
Blue	250	18	379	0.07	21	2	7
Violet	250	21	418	0.08	20	2	8
Green	250	23	583	0.09	25	2	9
Orange	250	29	540	0.12	19	2	12
Yellow	250	18	334	0.07	19	1	7
Black	250	33	1673	0.13	25	3	13
Total	1750	168	4450	0.1	26	3	10

Post Monsoon Period							
Bowl colour	No of bowls installed	No of bowls positive	No of eggs	Prevalence	Intensity	Mean egg density	% Positivity of colour ovitrap
Red	250	25	551	0.1	22	2	10
Blue	250	16	278	0.06	17	1	6
Violet	250	10	195	0.04	20	1	4
Green	250	14	245	0.06	18	1	6
Orange	250	18	364	0.07	20	1	7
Yellow	250	15	418	0.06	28	2	6
Black	250	30	1254	0.12	42	5	12
Total	1750	128	3305	0.07	26	2	7

Table 3: Proportion of eggs collected from each coloured ovitraps during Pre & Post Monsoon seasons, Hosur Municipal Corporation, 2023

Ovitrap Colour	Pre-monsoon	Post-monsoon
	No of positive eggs collected (%)	No of positive eggs collected (%)
Red	523 (12)	551 (17)
Blue	379 (9)	278 (8)
Violet	418 (9)	195 (6)
Green	583 (13)	245 (7)
Orange	540 (12)	364 (11)
Yellow	334 (8)	418 (13)
Black	1673 (38)	1254 (38)
Total	4450	3305

DISCUSSION

This study highlights the oviposition behavior of Aedes aegypti in response to different colored ovitraps and seasonal variations in the urban landscape of Hosur Municipal Corporation. Key findings indicate that black-colored ovitraps attracted the highest number of eggs in both pre-monsoon and post-monsoon periods, followed by red and orange traps. Notably, oviposition occurred predominantly in indoor environments during both seasons.

The preference for black-colored ovitraps aligns with global and regional literature, where black is consistently identified as the most attractive color for gravid Aedes mosquitoes. Studies by Hoel et al. (2011) and Rina et al. (2014) corroborate our findings, underscoring the utility of black ovitraps in vector surveillance, even in areas with low mosquito density.[8] The consistent indoor breeding preference observed in this study mirrors the findings of Hasini et al. (2015), emphasizing the necessity for targeted interventions in indoor environments to disrupt breeding cycles.[9]

This study also offers novel insights into the negligible impact of seasonal variations on oviposition behavior in this region. While previous studies, such as those conducted in Jaipur, reported significant seasonal influences on mosquito dynamics, the urban microclimatic conditions of Hosur might buffer such fluctuations, leading to relatively stable oviposition patterns. This finding suggests that continuous vector control measures are essential throughout the year, regardless of seasonal changes.

We acknowledge the limitations, as first, while the study employed a systematic sampling method across selected wards, the generalizability of the findings to other urban or rural settings requires further investigation. Second, the study did not explore potential environmental, temperature variations, or chemical attractants that could interact with color preferences. Future research could address these aspects to refine the application of ovitraps in diverse ecological settings.

CONCLUSION

The study underscores the significance of ovitrap color and placement in optimizing Aedes aegypti surveillance and control. Key conclusions are 1. Black-colored ovitraps are the most effective in attracting Aedes mosquitoes, suggesting their potential as a standard surveillance tool, 2. Indoor breeding preference necessitates rigorous indoor vector control measures, such as source reduction measures, 3. Awareness on avoiding indoor water containers in dark colors.

By leveraging these insights, public health programs can enhance the efficiency of mosquito surveillance and contribute to reducing the burden of vector-borne diseases like dengue in urban settings.

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CONFLICT OF INTEREST

None

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