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Entomological Investigation of Dengue Outbreak in Dhanpur Village, Sepahijala District, Tripura State, India

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Abstract: An outbreak of Dengue was reported in Dhanpur Village of Sephijala district, Tripura, India in August 2023 wherein a total of 25 dengue cases were reported by the state health department. All the samples were confirmed using the dengue IgM ELISA test. An entomological survey was carried out to investigate the presence of vector mosquitoes in and around the area of all 25 affected persons. Larval collections were made from the major aquatic sites and emerging mosquito species were identified. Adult mosquitoes were collected by land bite collection method and battery-operated CDC miniature light traps. Rubber waste in surrounding areas is the main source of dengue vector mosquitoes. Species identified from the investigation were *Aedes albopictus, Anopheles barbirostris,* and *Anopheles annularis* from the larval collection, and *Culex spp.*, *Anopheles spp.*, and *Aedes albopictus* from the adult collection. Three out of four houses in these 25 houses surveyed, were positive for mosquito larvae. All three indices viz., House Index, Container Index, and Breteau Index which are considered better predictors are well above acceptable limits. Health Education and Community Action Plans with the help of Health authorities are recommended to reduce mosquito density and thereby prevent vector-borne disease outbreaks. Moreover, there is a need to study the role of climate change, especially rising temperatures in the context of increasing dengue cases in Tripura.

Keywords: Dengue, *Aedes albopictus*, *Culex spp.*, *Anopheles spp*., *Aedes albopictus*

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Introduction

Dengue fever emerged as one of the most serious arboviral diseases, affecting more than 129 countries, and reaching around 390 million infections. Approximately around 50% of the

world's population lives in areas with the risk of dengue transmission as of 2018 (Ghosh *et al*., 2020). The disease has a major socioeconomic and public health impact on the countries from where the epidemics are reported (Baidya *et al*., 2022).

Mosquitoes are the most important among other arthropod vectors and cause various human diseases like dengue, filaria, Japanese encephalitis, chikungunya, etc. in the tropical countries of the world. Different species of mosquitoes generally act as prime vectors of malaria protozoan, helminths, and viral agents (Bhatt *et al*., 2013). There are about 3,500 species and subspecies, under 140 subgenera in 42 genera of mosquitoes worldwide (Chakravati *et al*., 2012).

Global changes attributable to human activities, for example, changes in climate, healthcare, land use, pollution, population movements, and urbanization, can significantly alter the rates of transmission of mosquito-borne diseases in most parts of the world (Ganeshkumar et al., 2018). Also the climate change parameters like temperature, rainfall, humidity, other parameters such as atmospheric particle pollution and wind can also have an impact on the mosquito population, diversity, and disease transmission (Kraemer *et al*., 2015).

Tripura is a small constituent state of the North-Eastern region of India. It is situated between 22°35' and 22°95' N and 91°10' to 92°29' E and is surrounded by Bangladesh from three sides except for a narrow neck in the northeast direction where it borders Assam and Mizoram states (Prakash *et al*., 1998).

Many mosquito-transmitted diseases have been reported in North Eastern India including Tripura. In Tripura, the most common vector-borne diseases are malaria, dengue, filariasis, Japanese encephalitis, and chikungunya. The frequency of mosquito-transmitting diseases increases in the states probably due to major ecological changes in North East India. It has been reported that deforestation, industrialization, agriculture, urban development, migration of populations, new settlements, population explosion, non-planned urbanization, and unplanned garbage management system in the last two decades (Murhekar et al., 2019) have influenced the ecology of the region and the breeding and species composition of mosquitoes resulting in the diversification of the mosquito population in the region and resulting in several public health-related diseases, most of which are transmitted by several vector mosquito species (NVBDCP, 2010).

In 2021, Tripura has reported the highest number of annual dengue cases. A total of 255 dengue cases were reported across five districts which are more than 10 times the number of cases recorded the previous year. In an outbreak in November, 76 cases were found in the Gomati district, 56 in the Unakoti district, 27 in the Sepahijala district, and one case each in the North and South districts. A few positive cases have also arisen in the Niharnagar PHC region under the Rajnagar block of South Tripura.

In August 2023, there have been more than 25 Dengue cases from the Dhanpur PHC area of the Sephaijala district which was an alarming situation that may lead to an outbreak. To understand the present situation, a team was constituted for carrying out field research which consisted of medical scientist, laboratory technologists, and entomologists from ICMR-Model Rural Health Research Unit (MRHRU), Tripura to investigate the houses of dengue-infected persons in the Dhanpur area. The main aim of the survey was to identify the mosquito fauna in the surrounding places of the houses of infected persons and to predict the outbreak using the entomological indices.

Materials and Methods

All 25 houses of Dengue-infected persons were investigated by the MRHRU team. All the water containers present in and around the house were inspected for the presence of immature mosquitoes and adult mosquitoes were collected by standard techniques (Fig. 1).

Fig. 1: Team Members in Dengue-positive areas of Dhanpur.

Fig. 2: Larval collection of various water sources.

Fig. 3: Setting up of CDC miniature light traps.

Collection of Larvae: All the containers or water staged in and around the house were inspected for the presence of immature larvae (Fig, 2). Positive containers were identified and with the help of standard dippers, ladles, and pipettes the larvae were collected in transparent containers. All the collected larvae were brought to the MRHRU and reared to adults for identification.

Table 1: Number of larvae collected from various sources in Dhanpur

Source of collection	Total Count
Bamboo	2
Broken Plastic Drum	9
Concrete Bowl	5
Drum	3
Bucket	4
Plastic Broken Bucket	6
Plastic Mug	7
Plastic Pot	8
Plastic Rubber Container	4
Rubber Cup	36
Rubber Pot	5
Steel Bowl	2
Under Construction Building Ramp Hole	5
Unused Rubber Sheet Tray	8

Table 2: Number of Adult mosquitoes collected in Dhanpur area

Species	Total Count
Aedes albopictus	36
Anopheles barbirostris	08
Anopheles annularis	06
Anopheles vagus	20
Anopheles spp.	38
Culex spp.	347

Adult Collection: Adult mosquitoes were collected by land bite collection method using mouth-sucking aspirators and battery-operated CDC miniature light traps were used between 6 pm to 5 am (Fig. 3).

Morphological Identification of Mosquito Species: Adults and emerged larvae were identified under the stereomicroscope using standard mosquito identification keys.

Entomological indices: Entomological surveillance has been standardized on different indices based on the simple determination of the presence or absence of larvae in containers or on the premises of surveyed houses. Thus various larval indices can be calculated namely House Index (HI), Container Index (CI), and Breteau Index (BI).

Data analysis: Descriptive analysis was done manually to calculate mosquito larval indices and the proportion of different types of containers.

Results and Discussion

During the investigation, 25 houses and their surroundings were inspected. Rubber plantation is the major livelihood for the people of the Dhanpur area which results in the disposal of waste materials/containers like rubber cups, plastic drums, bottles, tins, and other waste materials being left unnoticeably around their houses. In the present investigation, it is noticed that all these

water containers were positive for mosquito larvae.

Collection of Larvae: A total of 104 larvae were collected from the different containers and reared in the laboratory. Morphological identification was done after emerging and found that the majority of them were *Aedes albopictus* followed by *Anopheles barbirostris* and *Anopheles annularis* (Table 1).

Adult Collection: A total of 455 adult mosquitoes were collected from the houses and cattle sheds using the land bite method and CDC light trap method. Morphological identification was done with entomological keys and found that the majority of them were *Culex spp.* followed by *Anopheles spp.* and *Aedes albopictus* (Table 2).

Entomological indices: There were potential breeding sites (with or without larvae) in the surroundings of the houses. Positive containers (with larvae) were present in 16 of these 25 houses showing a calculated house Index of 64%. Out of 30 water collections with potential for *Aedes* breeding, larvae were identified in 19 leading to a calculated Container Index of 63.33% and Breteau Index of 76.0%. All these entomological indices were found to be above the critical level for the occurrence of outbreaks of mosquito-borne diseases.

Three out of four houses in these 25 houses surveyed, were positive for mosquito larvae. All three indices viz., House Index, Container Index, and Breteau Index which are considered better predictors are well above acceptable limits. The House Index of 64% is far above the safe limit of 10% and the Container Index of 63.33% is also far above the cut-off of 10%. The BI is well above 50% and hence, the area studied is at very high risk for outbreaks. In fact, in the last few years, many cases of dengue have been reported yearly, especially during monsoon. The present study recommends the following:

- Cleaning or emptying the water storage containers on a regular basis to reduce breeding habitats.
- Disposal of waste materials/containers like rubber cups, plastic drums, bottles, and tins in a proper manner to avoid stagnant water.
- Sensitize to use mosquito protection window screens, repellents, and coils.
- Awareness among the community is needed to minimize the risk of vector-borne outbreaks.
- Health Education and Community Action Plans with the help of Health authorities are recommended to reduce mosquito density and thereby prevent vector-borne disease outbreaks.
- Further studies to depict the time trend of the larval indices during different seasons of the year.

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