

Bioecology and Vectorial Capacity Of *Aedes* Mosquitoes (Diptera: Culicidae) in Irinjalakuda Municipality, Kerala, India in Relation to Disease Transmission

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Abstract: The larval habitats of mosquitoes were investigated in Irinjalakuda, Thrissur in order to determine the breeding sites of the existing mosquito fauna belong to *Aedes* and its possible public health implications on the residents of the municipality. It has been officially reported that the study area is a disease prone zone having affected by 117 Chickunguniya, 779 dengue and 1419 malaria cases for the last 8 years. The 30 habitat spots were randomly selected and sampled using plankton nets, dippers and pippets. The 8 species of *Aedes* mosquitoes were encountered, namely; *Ae. scatophagoides*, *Ae. pseudotoeniatus*, *Ae. longerostris*, *Ae. egypti*, *Ae. vittatus*, *Ae. albopictus*, *Ae. walbus* and *Ae. vexans*. Out of these, *Ae. egypti*, *Ae. vittatus*, *Ae. albopictus* and *Ae. vexans* are potential vectors of communicable diseases. The study site provided diverse habitats to *Aedes* species such as tree hole, cemented tanks stream pools, fountains, ditches, mud pot, plastic containers, tyers, plant pot, rocky pool, pods, nuts, tin, flower bracts, internodes, latex collecting containers, bowls, duck weed ponds, coconut shell, leaf axils, temporary pools, fish ponds, bamboo and containers. Progressing history of disease outbreak by *Aedes* species in the study area inspire an intensification of the vector surveillance activities.

Key words: Mosquito, *Aedes*, habitat, vector, disease, dengue, Irinjalakuda

INTRODUCTION

Mosquito-borne diseases remain a major problem in the world, particularly in tropical and subtropical regions. These diseases contribute significantly to disease burden, death, poverty social debility in tropical countries (Jang *et al.*, 2002). Mosquitoes are the carrier of a number of vector-borne diseases, such as malaria, filariasis, yellow fever, brain fever, dengue fever, etc. (Jaswanth *et al.*, 2002).

Among the 13 genera of the family Culicidae, genus *Aedes* is considered dangerous because of their significant public health threat all over the world (Rajesh *et al.*, 2013). *Aedes* species are important vectors of yellow fever, dengue, encephalitis viruses and many other arboviruses and in a few restricted areas they are also vectors of *W. bancrofti* and *B. malayi* (Kalaivani *et al.*, 2012). In recent years, the average annual incidence of dengue-related serious disease in many tropical countries has been rising dramatically with the infection becoming endemic in areas where its occurrence was once sporadic. In India, dengue fever and dengue hemorrhagic fever has been documented in different parts of the country including Southern India (Kabilan *et al.*,

2003). The population of *Aedes* species fluctuates with temperature, rainfall and humidity. Dengue infections were generally encountered during or after rainfall, as an outcome of rise in vector population (Pandya, 1982). An explosive outbreak due to an arthropod-borne virus, Chikungunya Virus (CHIKV), affected for the first time in 2005-06 numerous islands in the Indian Ocean and notably La Reunion Island where one third of the population was infected (Renault *et al.*, 2007).

Biological control at the larval stage of development of mosquitoes is one of the techniques which affords a cheap, easy to use and environment friendly method of disease control. These disease situations can be best tackled by improving the knowledge about the vectors. The information could aid in the risk assessment of diseases transmitted and the planning of control measures in support of disease control programmes. Since, good health is a prerequisite to economic development, there is the need to focus on these vectors in order to put them in the right perspective. In the light of their economic importance, this study was undertaken to assess the mosquito species types in the study area, their vectorial capacity and the habitat characteristics that offer them proper breeding environment.

MATERIALS AND METHODS

Study site: Injalakuda municipality belongs to Thrissur District of Kerala, India (10.33°N 76.23°E). The study area is rich in diverse topography provides habitats for different mosquito species. Total 30 different spots were randomly selected with an intention to cover entire topography of the study area.

Suito larvae were collected from 30 different habitats both natural and artificial using plankton nets, dippers and pippets. Dippers and plankton nets were used in open sources and pippets in tree holes for sampling. All the sampling sites were visited periodically. Collections from each site were maintained separately in suitable containers and allowed them to emerge. Adult specimens were narcotized with petroleum ether following identification using systematic keys and catalogues of Barraud (1934) and Christophers (1933), catalogue of Knight and Stone (1977) and Rao (1981).

RESULTS AND DISCUSSION

Mosquito larvae were collected from 30 selected spots in Irinjalakuda municipal area during the study period. A total of eight species belong to genus *Aedes* were identified and recorded. *Scatophagoides*, *pseudotoeniatus*, *longirostris*, *aegypti*, *vittatus*, *albopictus*, *walbus* and *vexans* were the representing species of *Aedes*. The *Aedes* species were preferred different habitats which offered them apt microenvironment for better proliferation (Table 1).

Among the 8 collected species of *Aedes* mosquitoes, 4 species were known to have vector status. These species include *Aedes aegypti*, *Ae. albopictus*, *Ae. vittatus* and *Ae. vexans*. *Ae. aegypti* is the primary vector of dengue and Chikungunya. They are also reported having potential ability to spread yellow fever and West Nile virus. *Ae. albopictus* is the secondary vector of dengue and transmit Chikungunya in Asia, Africa and Europe and also transmit West Nile virus. *Ae. vittatus* is a vector of Chikungunya and yellow fever. *Ae. vexans* is a major vector of Rift Valley fever virus and West Nile virus.

In the past 8 years there has been at least 11 officially recorded human death caused due to

mosquito born diseases in and around the study area. Cases of major mosquito born diseases recorded include 117 Chikunguniya, 779 dengue and 1419 malaria. The pattern of outbreak of these diseases shows variation in the past years. While taking two widely spread diseases, dengue and malaria, the *Aedes* born dengue shows progressive outbreak against *Anopheles* born malaria which is having invariable occurrence in the past 8 years.

Aedes aegypti is the primary vector of Yellow Fever (YF) and Dengue Fever (DF) flaviviruses worldwide (Black *et al.*, 2002). Chow *et al.* (1998) suggested that dengue viruses are transmitted principally by *Aedes aegypti* that breeds in stagnant water in all forms of receptacles in urban areas. In 1998, Zdenek and Jiri, demonstrated transovarial transmission of the West Nile virus by *Aedes aegypti*. Rajesh *et al.* (2013) reported that *Aedes vittatus* is a container breeding dengue vector, one of the dominant species in Tiruchirappalli district, Tamil Nadu, India. *Ae. vittatus* facilitate circulation of Chikungunya virus (Diallo *et al.*, 1999). *Aedes albopictus* can carry and transmit dengue virus acting as an important dengue vector in rural areas (Chow *et al.*, 1998). According to Turell *et al.* (2008), *Aedes albopictus* is susceptible to WNV. *Ae. albopictus* is a competent experimental vector of 7 Alphaviruses: Chikungunya, Eastern Equine Encephalitis (EEE), Mayaro, Ross River, Western equine encephalitis, Venezuelan equine encephalitis and Sindbis viruses (Moore and Mitchell, 1997). Cancrini *et al.* (2003) suggested *Ae. albopictus* as a natural vector of *D. immitis* nematodes in Italy. Goddard *et al.* (2002) reported that *Ae. vexans* exhibited moderate infection and transmission rates for WNV. According to Fontenille *et al.* (1998) *Ae. vexans* is the chief enzootic vector of RVF virus (Fig. 1).

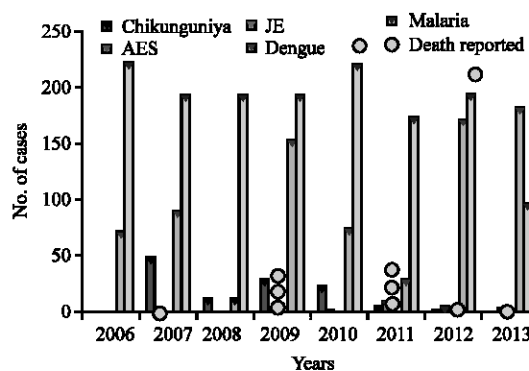


Fig. 1: A comparison of different mosquito borne disease cases and death reported in and around the study area for the last 8 years

Table1: List of collected *Aedes* species and their vector status

Mosquito species	Vector status
<i>Ae. aegypti</i>	West Nile virus, dengue, yellow fever, Chikungunya
<i>Ae. pseudotoeniatus</i>	-
<i>Ae. longirostris</i>	-
<i>Ae. scatophagoides</i>	-
<i>Ae. vittatus</i>	Chikungunya, yellow fever
<i>Ae. albopictus</i>	WNV, dengue
<i>Ae. walbus</i>	-
<i>Ae. vexans</i>	Rift Valley fever virus, WNV

Table 2: Habitat preferences of different Aedes species in the study area

Habitat	<i>Ae. scutophagoides</i>	<i>Ae. pseudotoeniatus</i>	<i>Ae. longirostris</i>	<i>Ae. aegypti</i>	<i>Ae. vittatus</i>	<i>Ae. albopictus</i>	<i>Ae. walbus</i>	<i>Ae. vexans</i>
Tree hole	+			+	+	+		
Cemented tanks				+		+	+	
Stream pools				+		+	+	
Fountains								
Ditches	+							
Mud pot				+	+			
Plastic containers				+	+			
Tyres				+		+		
Plant pot				+	+			
Rocky pool					+			
Pods		+						
Nuts		+		+				
Tin						+		
Flower bracts		+						
Internodes		+						
Latex collecting containers					+			
Bowls				+		+		
Duck weed ponds			+					
Coconut shell				+	+			
Leaf axils		+				+		
Temporary pools						+	+	
Fishponds	+		+					
Bamboo						+		
Containers				+		+		

Agro-industrial modifications of habitats of mosquitoes along with climatic variations influence outbreak of these diseases by mosquito species as vectors in the study area. Mosquitoes utilize a great variety of water sources for breeding. These include ground pools, water in artificial containers, water holding tree holes and leaf axils. Depending upon the species involved, the distance of dispersal from breeding areas varies from a few meters to many kilometers. As a result, mosquito larvae are found in different habitats (Service, 1976). Important habitats chosen by Aedes species in the study area include tree hole, cemented tanks, stream pools, fountains, ditches, mud pot, plastic containers, tyres, plant pot, rocky pool, pods, nuts, tin, flower bracts, internodes, latex collecting containers, bowls, duck weed ponds, coconut shell, leaf axils, temporary pools, fishponds, bamboo and containers (Table 2).

The habitat preference by Aedes species has found to be similar as described by earlier studies. The major breeding habitats of Aedes mosquitoes are both natural and artificial containers, such as temporary pools, cemented tanks, stream pools, tyres, tree holes, buckets, trashcans, planter dishes and traps (Aditya *et al.*, 2006). The breeding habitats of *Ae. scutophagoides* are freshwater ponds and ditches (Charlwood *et al.*, 2013). *Ae. egypti* predominates in urban areas while *Ae. albopictus* predominates in rural areas. *Ae. aegypti* commonly breeds in artificial water containers than does *Ae. albopictus* and it is hypothesized that during dry conditions, people may increase their use of rain water collection containers, providing areas for *Ae. aegypti*

breeding (Poveda *et al.*, 1999). Devi and Jauhari (2005) described *Ae. aegypti* is an urban mosquito that breed almost entirely in man-made containers found in and around households, construction sites, factories, etc., larval population has been recorded in drains, pits, streams, canals, containers and tree holes.

Studies have shown that *Ae. albopictus* prefers to oviposit in open containers with leaf litter compared with closed containers. *Aedes albopictus* breeds in both man-made containers as well as in natural containers, such as bamboo, tree holes and leaf axils, larvae were recorded from tanks, pools, streams, containers and tree holes (Devi and Jauhari, 2005). *Aedes longirostris* mosquitoes mainly breed in shallow permanent pools include fishponds, duck weed ponds, etc. The current study also could confirm the same preferences of habitat by *Aedes longirostris* while *Ae. vexans* prefers temporary fresh water pools. *Ae. vittatus* prefers rock pools, tyres, coconut shell, latex collecting containers, mud pot, plant pot, plastic container, rocky pool, tank and tree hole/tree stump (Jomon *et al.*, 2009). Temporary pools, cemented tanks and stream pools are the preferred habitats of *Ae. walbus* (Aditya *et al.*, 2006). *Ae. pseudotoeniatus* prefers natural containers (plant origin) include tree holes, internodes, leaf axils, flower bracts, fronts, nuts and pods.

CONCLUSION

Conclusively, the presence of diverse habitats and water availability and the progressing history of disease outbreak by Aedes species in the study area inspire an intensification of the vector surveillance activities.

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