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Ecology of dengue vector *Aedes albopictus* in the rubber plantation areas of a village in Palakkad district, Kerala

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Abstract
A larval survey for dengue vector *Aedes albopictus* were carried out in the rubber plantation areas of a village in Palakkad district to determine its breeding site preference. The larval indices were calculated using the WHO standard methods and it is correlated with climatological factors like temperature and rainfall during the pre-monsoon and monsoon periods of the year 2019. A total of 660 water holding containers were observed in which latex collection cup alone constitute about 82.12%.Highest House Index and Container Index were recorded during the month of May and lowest during April. Highest Bretaeu Index were recorded during the monsoon season and lowest during the premonsoon season. There is very strong and positive correlation between climatic factors like rainfall and mean minimum temperature with all the three larval indices. These indices shows negative correlation with maximum temperature. Climatic factors favours the breeding of *Aedes albopictus* in the study area and the high breeding indices for *Aedes* larvae above the threshold limit recommended by WHO in the study area imply their potential for dengue transmission and future outbreaks.

Keywords: *Aedes albopictus*, dengue, rubber plantation, containers, climatic factors

Introduction
Aedes albopictus, the vector of dengue fever, is abundant throughout the plantation belt of Kerala [1]. The abundance of vector species depends upon the availability of breeding habitats. This is governed by the practices of the human population, climate (temperature, rainfall etc. which governs the vector survival, and development of viruses), agricultural practices etc. The risk of dengue has been reported to be associated directly or indirectly with seasonal changes in climate [2] and mosquito larval indices [3]. Kerala is one of the endemic states of dengue fever (DF) in India where dengue cases are reporting every year in all district [4]. Dengue and Chikungunya virus from *Ae. albopictus* was already demonstrated in Kerala [5, 6] and it is recognized as the primary vector since it plays a significant role in transmission of dengue and chikungunya in Kerala [5, 7]. Breeding habitat of *Ae. albopictus* was reported in many parts of Kerala especially during the chikungunya outbreak of 2006 [4]. Sylvan environments, particularly rubber plantations in some district of Kerala, offer a unique habitat for *Aedes* mosquitoes [5]. Extensive breeding was found in containers used for collecting rubber sap in rubber plantations during the rainy season [8].
Directorate of health services, Kerala reported 21993 dengue fever cases and 165 death in 2017 and 3834 cases and 32 death cases in 2018.Palakkad district is one of the worst affected area where 2287 fever cases and 37 death in 2017 and 299 fever cases and 7 death cases reported in 2018 [9]. Peridomestic container breeding as well as rubber plantations largely support the population buildup of *Aedes albopictus* [10] and the vector density is more dependent on rainfall which fills up all the peridomestic containers during the monsoon season [11]. In this context a preliminary larval survey were carried out in the Vaniyamkulam panchayath which is located 4.5 Km west of Ottapalam taluk of Palakkad district where total 3813 families residing. Population density of the village is 1031 persons per km^2. The panchayat being a rubber plantation area and dengue fever is often reported in this panchayath. The specific objective of the study were to identify and enumerate the breeding habitat of *Aedes albopictus* in the study area, to estimate the larval indices like House index (HI), Container index (CI), and Breteau index (BI) in the pre-monsoon and monsoon season and to correlate the larval indices with climatic factors.

Materials and Methods

Five month larval survey was carried out at Vaniyamkulam panchayat from April to August, 2019 to understand the breeding ecology of *Aedes albopictus*. Period of study was divided into pre-monsoon (April-may) and monsoon (June, August). Five randomly selected plantations were taken as the unit of study. Approximately 100-150 rubber trees were present in each plantation and five to 10 houses were situated near to each plantations. In each survey, plantations and peri-domestic areas of houses were searched for larval breeding containers and other natural habitat like tree holes and leaf axils. Larvae from each positive breeding habitat is collected in properly labelled containers and reared to adulthood in the laboratory. The emerged adults were identified using standard light microscope and relevant taxonomic reference [12].

Standard *Aedes* larval indices like House Index (HI), Container Index (CI) and Breteau Index (BI) were calculated by the standard procedure [13]. Following formula was used for calculating the various indices.

$$\text{HI} = \frac{\text{No. of houses positive for Aedes larvae}}{\text{No. of houses inspected}} \times 100$$

$$\text{CI} = \frac{\text{No. of containers positive for Aedes larvae}}{\text{No. of containers inspected}} \times 100$$

$$\text{BI} = \frac{\text{No. of containers positive for Aedes larvae}}{\text{No. of houses inspected}} \times 100$$

The climatological data (rainfall, minimum and maximum temperature) for a period of five months from April 2019 to July 2019 recoded at the nearest meteorological station Palakkad were collected from the Indian Meteorological Department, Thiruvananthapuram (IMD). Pearson's correlation was used to correlate larval indices with climatological factors.

Result and Discussion

A total of 660 water holding containers were observed during the study. Latex collecting cup, plastic containers, metallic containers, coconut shells, mud pot, plant pot, tyre, tank and leaf axils are the potential breeding habitats observed. Of all the containers, latex collection cup was found to be major breeding habitat which constitute about 84.12% followed by plastic containers (4.5%), discarded coconut shell (3.03%) and so on (Fig 1). Breeding of *Ae. albopictus* in containers and latex collecting cup of rubber plantation of Kerala is well documented [5, 8].

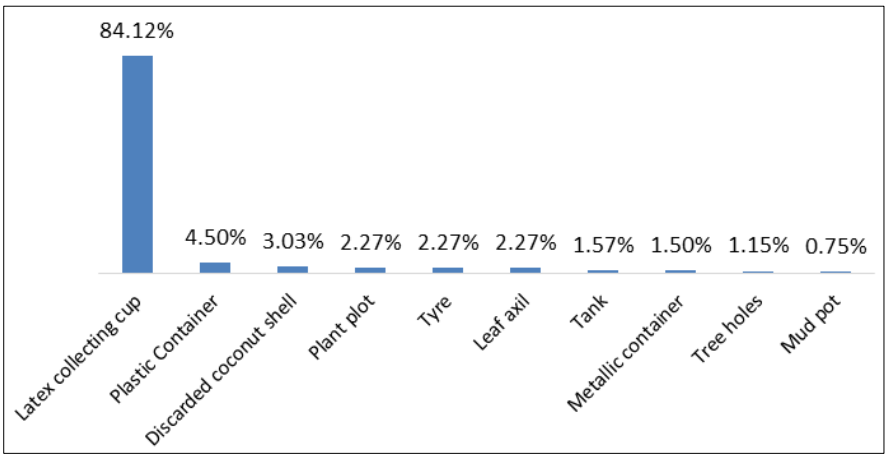

Fig 1: Potential breeding habitat observed in the study area

The entomological indices are important indicators to know the dengue fever transmission in which House Index and Container Index are important determinants of extent of breeding and intensity of mosquito breeding respectively [14]. The House Index has been widely used to monitor the infestation levels. In the present studya total of 125 houses were searched for monthly collection in which 72 houses were resulted positive for *Aedes albopictus***.** Monthly HI varied from 40 to 72. HI of 72 were observed during the month of May and HI value of 40 were observed during the month of April (Table 1). During the monsoon season HI value varied from 60 to 68. Container index provides valuable information on the proportion of water holding containers that are infested [14]. In the present study a low CI of 16 was recorded in April and high (62.5%) were recorded in May. During the monsoon season CI value varied from 26 to 37.5%. Intermittent rainfall towards the end of premonsoon period (May) makes positive containers which may be the reason for high HI and CI during this period when compared to monsoon season. Breateau index is an excellent risk indicator of dengue outbreak since it correlates the positive containers and houses inspected [15, 16]. In the present study highest Breateau index were recorded during the monsoon season (120) and lowest during pre-monsoon season (16).

Table 1: larval indices in different season

Season	Month	House visited	House Positive	Container searched	Container positive	HI	CI	BI
Pre-monsoon	April	25	10	25	4	40	16	16
	May	25	18	40	25	72	62.5	100
Monsoon	June	25	15	60	20	60	33.33	80
	July	25	16	80	30	64	37.5	120
	August	25	17	90	24	68	26	96

Rubber plantations are important source for proliferation of *Aedes albopictus* [8]. In the present study a total of 790 containers were searched in rubber plantation out of which 280 were positive containers. The highest CI value (66.6) were observed towards the end of premonsoon season and the starting of monsoon season. Lowest CI value (20) were observed in the dry month of April (Fig 2).

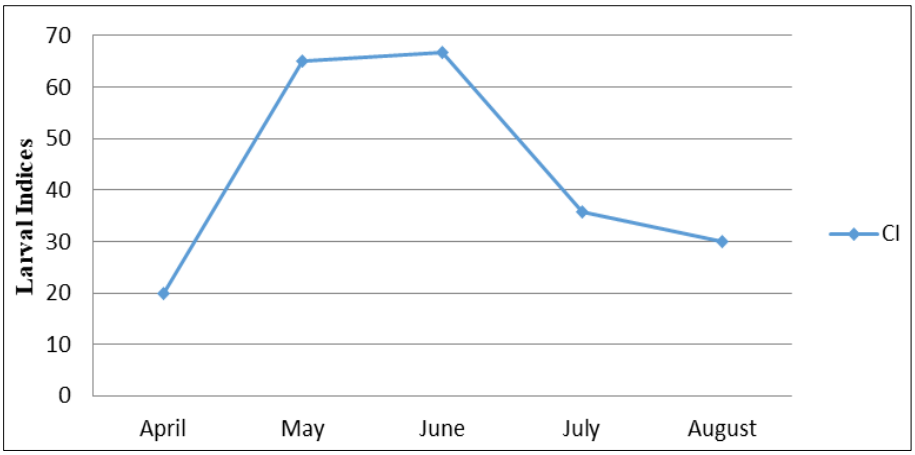

Fig 2: Larval indices of *Aedes albopictus* in different months from rubber plantation

The present study witnessed a higher BI and HI values with rainfall, while a lower value for CI is of concern (Fig 3). This could be due to increase in number of wet containers during rainy season. But due to heavy rainfall during the peak monsoon period of June, July and August the CI value decreases as the heavy rainfall spills out water from containers and kill the mosquito larvae. This is in agreement with another study at Pondicherry, South India where the size of immature population found to increase with increasing rainfall, though heavy rainfall resulted in population loss [17].

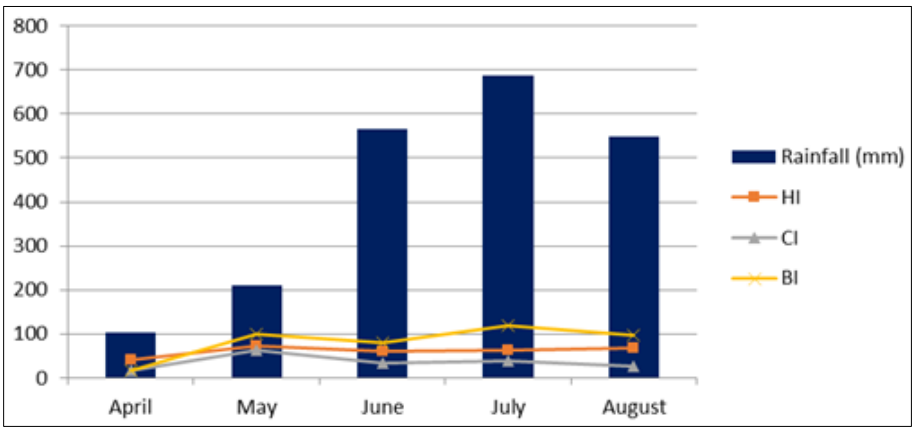

Fig 3: Association of larval indices with rainfall

An area can be treated as a 'High risk Transmission Place' for Dengue virus when HI and CI are higher than 5% and BI higher than 20% [13]. In the study area all the three larval indices are higher than the threshold level, during most of the months. So study area can be treated as a high risk transmission place for Dengue virus / Chikungunya virus, provided the vector *Ae. albopictus* is viraemic (infected with virus).The high breeding indices for *Aedes* larvae in the study area imply their potential for dengue transmission and future outbreaks as in the previous studies [18].

Table 2: Climatological data of the study area

Month	Rainfall (mm)	Mean max temperature (^{0}C)	Mean min temperature (^{0}C)
April	103	35.1	25.7
May	211	33.2	25.2
June	566	30.5	23.6
July	687	28.6	22.9
August	549	28.7	23.5

Table 3: Pearson's correlation between larval indices and climatological data

Larval Indices	Rain Fall (mm)	Mean Max Temp (^{0}C)	Mean Min Temp (^{0}C)
HI	0.4797	-0.5928	0.4791
CI	0.0264	-0.0097	0.0365
BI	0.7199	-0.0778	0.0726
CI from plantation	0.2023	-0.0523	0.456

Meteorological variables affect mosquito population [19]. Temperature and precipitation are important in virus development in different climatic regions and may be useful in understanding spatio-temporal variations in dengue risk [20]. In present study the meteorological factors were correlated with the larval indices. The result shows that there is very strong and positive correlation between climatic factors like rainfall and mean minimum temperature with all the three larval indices and the most important climatological factor is the rainfall that influences the larval indices. All other

climatic factors depend on rainfall. These indices shows negative correlation with maximum temperature (Table 2 & 3). High temperature results in drying up of water holding containers which in turn reduces all the three larval indices.

Conclusion

In the present study, latex collecting cup was found to be the dominant breeding habitat in the study area and the larval indices recorded were found to be greater than the normally accepted limit in premonsoon and monsoon season. It was also noticed that climatic factors like rainfall and temperature favours the breeding of *Aedes albopictus* and intermittent summer rain that occurred during April- May months makes positive containers which may be the reason for high HI and CI during this period which are responsible for vector borne diseases like dengue and chikungunya during the onset of monsoon season. In many rubber plantations taping is suspended during dry months. So that water collected in latex collecting cups during summer rains may remain long for the completion of many life cycles of vector mosquito. People are lazier in source reduction during pre-monsoon as there is no serious consequence of vector borne diseases at that time. Increase in plantations especially rubber plantation contributed to the rapid spread of this mosquito in Kerala.

References

1. Kumar NP, Suresh A, Vanamail P, Sabesan S, Krishnamoorthy KG, Mathew J *et al*. *Chikungunya virus* outbreak in Kerala, India, 2007: A seroprevalence study. Memorias doInstituto Oswaldo Cruz. 2011; 106:912-916.
2. Hales S, de Wet N, Maindonald J, Woodward A. Potential effect of population and climate changes on global distribution of dengue fever: an empirical model. The Lancet. 2002; 360(9336):830-834.
3. Arunachalam N, Tana S, Espino F, Kittayapong P, Abeyewickreme W, Wai KT *et al*. Eco-bio-social determinants of dengue vector breeding: a multi-country study in urban and peri- urban Asia. Bulletin of World Health Organization. 2010; 88(3):173-184.
4. Paulraj PS, Victor JLS, Govindarajan R, Satish Babu R, Nagaraj J, Dilip Kumar *et al*. Anthropophilic Behavior of *Aedes albopictus*: A Predominant Vector of Dengue/Chikungunya in Thiruvananthapuram district, Kerala, South India. Journal of Communicable. Diseases. 2016; 48(1):1-11.
5. Thenmozhi V, Hiriyan J, Tewari SC, Philip S. Natural and vertical transmission of dengue virus in *Aedes albopictus* in southeren India, State Kerala. Japanese Journal of Infectious Diseases. 2007; 60:245-49.
6. Niyas KP, Abraham R, Unnikrishnan RN, Mathew T, Nair S, Manakkadan A *et al*. Molecular characterisation of chikungunya virus isolates from clinical samples and adult *Aedes albopictus* mosquitoes emerged from larvae from Kerala, South India. Virology Journal. 2010; 7:189.
7. Kannan M, Rajendran R, Sunish IP, Balasubramaniam R, Arunachalam N, Paramasivan R *et al*. A study of Chikungunya outbreak during 2007 in Kerala, South India. Indian Journal of Medical Research. 2009; 129:311-5.
8. Sumodan PK. Potential of rubber plantations as breeding source for *Aedes albopictus* in Kerala, India. Dengue Bulletin. 2008; 27:197-198.
9. http://idsp.nic.in. Link to dhs.kerala.gov.in. 26 October, 2019.
10. Eapen A, Ravindran JK, Dash AP. Breeding potential of *Aedes albopictus* (Skuce, 1895) in chikungunya affected areas of Kerala, India. Indian journal of Medical Research. 2010; 132:733-35.
11. Almeida AP, Baptista SS, Sousa CA, Novo MT, Ramos HC, Panella NA *et al*. Bioecology and vectorial capacity of *Aedes albopictus* (Diptera: Culicidae) in Macao, China, in relation to dengue virus transmission. Journal of Medical Entomology. 2005; 42:419-28.
12. Barraud PJ. The fauna of British India including Ceylon and Burma. Taylor & Francis, London, 1934; 5:1-463.
13. World Health Organization. Regional Guideline on Dengue and Dengue Hemorrhagic Fever Prevention and Control. World Health Organization SEARO Publication, Delhi, 1999.
14. Bhat MA, Krishnamoorthy K, Khan AB. Entomological surveillance of dengue vectors in Tamil Nadu India. Journal of entomology and zoology studies. 2014; 2(6):158-164.
15. Bhat MA, Krishnamoorthy K. Entomological investigation and distribution of *Aedes* mosquitoes in Tirunelveli, Tamil Nadu, India. International Journal of Current Microbiology and Applied Sciences. 2014; 3(10):253-259.
16. Tun-Lin W, Kay BH, Branes A, Forsyth S. Critical examination of *Aedes aegypti indices*: correlations with abundance. American Journal of Tropical Medicine and Hygiene. 1996; 54(5):543-547.
17. Jeelani S, Sabesan S. Aedes vector population dynamics and occurrence of dengue fever in relation to climate variables in Puducherry, South India. International Journal of Current Microbiology and Applied Sciences. 2013; 2(12):313-322.
18. Vijayakumar K, Sudheesh Kumar TK, Zinia TN, Farook U, Anu K. A study on container breeding mosquitoes with special reference to *Aedes* (Stegomyia) *aegypti* and *Ades albopictus* in Thiruvananthapuram District, India. Journal of vector borne diseases. 2014; 51:27-32.
19. Rodrigues MDM, Marques GRAM, Serpa LLN, Arduino MDB, Voltolini JC, Barbosa GL *et al*. Density of *Aedes aegypti* and *Aedes albopictus* and its association with number of residents and meteorological variables in the home environment of dengue endemic area, São Paulo, Brazil. Parasites and Vectors. 2015; 8(1):1-9.
20. Mutheneni SR, Morse AP, Caminade C, Upadhyayula SM. Dengue burden in India: Recent trends and importance of climatic parameters. Emerging Microbes and Infections. 2017; 6(8):1-10.