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Original Research Paper

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AEDES ALBOPICTUS (SKUSE) SURVEILLANCE WITH BIOGENTS MOSQUITITO(R) TRAPS AND LARVAL INDICES- A COMPARATIVE STUDY

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ABSTRACT Effective surveillance and monitoring of Aedes albopictus is essential for the possible prediction and implementation of the preventive measures. We tested BG sentinel mosquitito traps with BG lure to collect adults as an alternative surveillance tool in relation to larval indices. Study was carried out in Calicut District, Kerala, India. Three villages in the district were selected by random sampling as study area. In each village, 50 houses were selected as study site for trap collection, larval survey and fever surveillance. Study was conducted for six months from July to December, 2017. Number of adults of Ae.albopictus collected in BG sentinel traps was only 84 in 22 collections spanning over six months (mean 3.82, 95% CI-2.57-5.06).Though the larval indices were high; no epidemic was reported from the study area. There was no correlation between adults collected and larval indices. Adult collection showed a positive correlation with most of meteorological parameters. Larval indices showed no correlation with climatic factors.BG mosquitito trap was found to be not successful for adult surveillance in the area. More studies are required using different traps to suggest adult traps as an alternative to currently used larval indices. Larval indices were high but no cases reported. Our study shows that a more reliable monitoring mechanism is required for Ae.albopictus to enable prevention, to introduce abatement and its evaluation.

KEYWORDS : Aedes albopictus, Biogents trap, larval indices, surveillance, dengue, chikungunya

BACKGROUND

Epidemics of dengue and DHF in many South-east Asian countries brought to limelight the dynamics of role played by the Asian tiger mosquito (*Ae.albopictus*) in the epidemiology and transmission. Climate changes coupled with rapid urban development result in increasing the breeding and survival of Aedes mosquitoes, the vector for dengue, hence the success of dengue virus transmission. The spectacular global migration of *Aedes albopictus* in the last three decades has raised public health apprehension among health personnel since it is an able vector of several re-emerging viruses like the most widespread arbo-viral infection of humans, dengue virus (DENV). This has opened up a renewed and vigorous interest in the vector status of this mosquito in an effort to augment the surveillance, prevention and control of these diseases. In two decades, *Ae. albopictus* have become associated with several arboviruses such as Cache Valley, eastern equine encephalitis, Jamestown Canyon, La Crosse, and West Nile [1,2,3] Widespread epidemics of chikungunya have been reported in many parts of India starting in 2005 [4] following an outbreak in the south western Indian Ocean Islands. Dengue and chikungunya outbreaks have been reported from many states including Kerala [4,5] .

Many studies suggest *Ae.albopictus* as the primary vector of Dengue and chikungunya in the Southern state of Kerala, India [6,7]. The dominance of *Ae.albopictus* in the affected areas indicates the critical role of this species in the transmission of these diseases in Kerala while it plays only as a secondary vector in other parts of India. Not many reports are available on the changing eco-epidemiological dynamics of this species. New and innovative techniques are required for the surveillance and abatement of this mosquito

OBJECTIVES

We carried out trap studies using Biogents *mosquitito*(R) traps with BG lure to collect adults of *Aedes* as well as larval survey to find out any correlation between the two and to determine if adult collection by traps could replace conventional indices and carried out fever surveillance to detect any dengue/ chikungunya cases to correlate with indices and trap collections.

MATERIALS & METHODS

Calicut district is part of erstwhile Malabar region of southern Indian state of Kerala exhibiting typical tropical climate and topography. Climatic profile of the area shows an average rain fall of 3,000 mm provided by Southwest and Northeast monsoons, temperature ranging from 21 ^{0}C to 36 ^{0}C and RH of > 90%. Socio-demographic setting of this district is typical of Malabar region of Kerala and comprised of primarily of rural areas interspersed with urban and periurban conglomerations and a population of approximately 3 million. Villages in the district were first clustered as urban, rural and periurban areas. One village each of the cluster was selected using random sampling technique for trap collections and larval survey . Institutional Ethical committee approval was obtained prior to start of the study. In each selected area, 50 households were selected as study sites by random sampling technique. Biogents (BG) *mosquitito* traps with catch bags with BG lure procured from Biogents Ltd., Germany were used for the adult mosquito collection. Traps were fixed in two selected houses of each study site outdoors from 7AM to 6 PM coinciding with the biting activity of *Aedes* mosquitoes. Traps were hung from a tree branch one meter above ground. Traps were protected from rain by using an umbrella over the body of the trap. A 12 v battery unit was used as a power source for the trap. The catch bags were collected and brought to Department of Community medicine (Medical college) laboratory for identification of mosquitoes trapped.

House to house survey was done in the selected 50 hoses of each area to record container breeding sites to determine the Aedes larval indices viz., container (CI), house (HI) and Breteau index (BI). Each study site was assigned to a trained health worker from local Primary health care centre to conduct

the survey. Larvae collected from positive containers were brought to laboratory and identified after emergence. Container types observed were recorded. The study was carried out from July to December, 2017 corresponding to monsoon season in the district when Aedes density peaks and transmission of diseases occur.

RESULTS

Two traps were used for adult collections and 22 collections were obtained during the period from three study sites during the six month period (Table 1). We could collect only 84 *Ae. albopictus* in these 22 trap collections (mean- 3.82, 95% confidence limits 2.57-5.06). Adult abundance was highest in July (mean-6.50, confidence limits-4.32-8.68) which also experienced maximum rainfall and humidity (Figure 1). The catch reduced progressively towards December showing a similar trend as that of climatic factors. Pearson correlation test of adults in traps with climate variables indicated a positive correlation with relative humidity and rainfall and showed a negative correlation with maximum temperature (Table 2).

Table 1 *Ae.albopictus* adults collected in traps and larval indices for the study sites, July- December, 2017

Month	No of collections	Ae. albo collected	Mean	95% conf limits	Container index	House index	Breteau index
July	6	39	6.50	4.32- 8.68	8.52	25.33	52.67
Aug	4	21	5.25	4.45- 6.05	6.31	18.00	35.33
Sep	3	14	4.67	0.00-11.84	0.47	0.67	1.33
Oct	3	4	1.33	0.00- 4.20	4.85	12.67	21.33
Nov	3	4	1.33	0.00- 2.77	16.50	18.00	55.33
Dec	3	2	0.67	0.00- 3.56	1.24	2.67	4.00

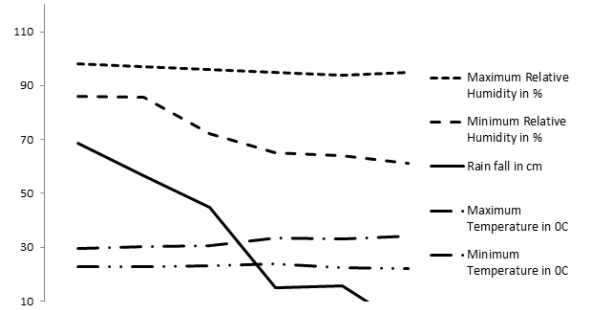

Figure 1 Meterological data of the study area for the period July to December, 17

Table 2 Correlation of adults collected in traps and larval indices with meteorological parameters

Variable	Temperature		Relative Humidity		Rain fall
	Maximum	Minimum	Maximum	Minimum	
No of Aedes in trap	-0.91*	0.14	0.97*	0.92**	0.93**
Container Index	0.08	0.09	-0.22	0.04	0.03
House Index	-0.45	0.30	0.43	0.60	0.52
Bretaue index	-0.32	0.18	0.19	0.41	0.37

*- p value <0.05 **-p value <0.01 (Pearsons correlation test)

The larval indices also showed a declining trend from July to December except for the month of November showing highest values which could be owing to the effect of North-east monsoon. No significant correlation was found between indices and climatic factors. Likewise, there was no significant correlation between indices and trap collection (Pearson correlation of traps with CI- 0.14, HI- 0.54, BI- 0.51). The sudden rise of indices during November denotes a post monsoonal rise in breeding of Aedes though we failed to obtain a similar trend in trap collections. Composition of container like breeding sites recorded during the household survey exemplifies the predominant role played by coconut shell and plastics (Figs. 2,3&4). The number of containers recorded were 3834 for the six month period out of which 255 (6.67%) was positive for *Ae.albopictus* larvae. The maximum number of containers were recorded during July (24.24 %) whereas maximum number of larval containers were observed in November (32.55%). A more than 70% of the container sites were coconut shells and plastics. Similar trend was observed in case of larval positive containers also. Plastic containers showed significantly different larval positivity compared to tin, tire, glass and pots (Fig 3). But there was no statistical difference in positivity rate of different container types (Fig 4).

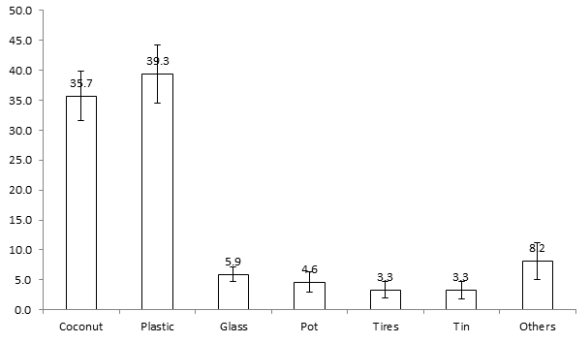

Figure 2: Water holding container like objects recorded (%) in the study area July -Dec,17

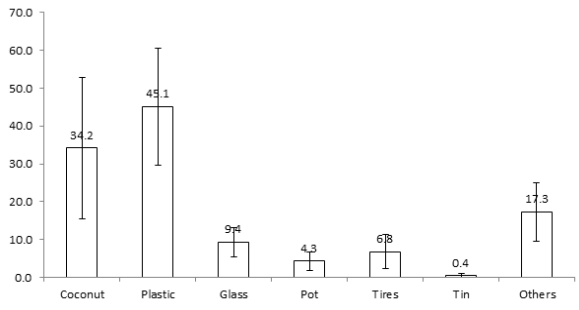

Figure 3 Contribution of different container types to *Aedes* larval infestation as percentage of total objects observed

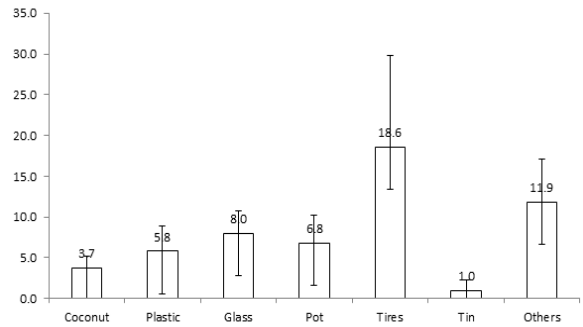

Figure 4 Percentage of larval infestation observed in individual type of containers

DISCUSSION

Standard surveillance in many developing endemic countries including India for *Ae.albopictus* is currently accomplished by conventional larval indices technique which is originally devised for *Ae.aegypti*. *Ae.aegypti* inimitably exhibits a domestic eco-geographical niche contrary to Ae,albopictus with wild and per domestic microcosm. Unlike the case of *Ae.aegypti*, larval monitoring about *Ae.albopictus* is fraught

with inadequacies due to vastness of prevalent area, innumerable natural and manmade breeding habitats ranging from leaf axils, fruit shells and tree holes to discarded plastics and tires along with human behavioral characteristics making it cost and labor intensive, operationally problematic and not often reliable. Adult surveillance is not regularly undertaken due to lack of adequate resources, skilled workforce and operational problems. World over many efficacy studies were conducted using various types of traps for *Ae. albopictus*.

A comparative study of 6 mosquito traps for effectiveness in collecting *Ae. albopictus* was carried out in Florida, US[8]. Authors argue that the results of these trials indicate that propane-powered commercial traps would be a useful surveillance tool for *Ae. albopictus*. In another study, the BG-Sentinel with BG-Lure and CO_2 collected 33 times more female *Ae. albopictus* than CO_2-baited CDC(Centre for Disease Control) light trap.. The BG Sentinel was found to be more efficient in collecting *Ae. albopictus* and collected a high proportion of this species[9].

Farajollahi A ,et al (2009) [10] reported that, in New Jersey, a BG Sentinel with or without lures collected more *Ae. albopictus* compared with other traps. It was more specific for *Ae. albopictus*. Authors concluded that the BG Sentinel provides effective chemical and visual signals for host-seeking *Ae. albopictus*.

However, no reports are available of trap studies on adults of *Ae. albopictus* from Indian subcontinent. We carried out the BG *mosquitito* trap study as a monitoring tool for adults of *Aedes albopictus* in state of Kerala to check the effectiveness versus larval indices. The results of the study indicate that BG traps are not as effective under the conditions existing in these parts compared to other parts of the world as indicated by above cited studies. The effectiveness of BG lure possibly deteriorated rapidly over the six month period. This could be due to heavy rains during the monsoon and high humidity in the area. We feel that different traps should be evaluated comprehensively to reach more concrete conclusion before ruling out the traps as a tool for monitoring adults of *Ae.albopictus* under climatic conditions that exist in Kerala, India.

In Malaysia, the relationship between *Aedes* indices, Breteau Index and dengue outbreak was studied to analyze the effectiveness of using *Aedes* indices to predict dengue outbreaks. Majority of dengue outbreaks occurred in localities with low *Aedes* indices, although significant relationships between *Aedes* indices and dengue outbreak were found. *Aedes* indices were not effective in predicting dengue outbreaks [11]. Association of *Ae. aegypti* indices with dengue sero -prevalence and transmission was studied in Victoria (Trinidad, West Indies) found significantly more adults and immature during case investigations than during routine inspection and treatment cycles. Authors propose that dengue transmission occurs, not at a specific vector index but depends on many factors including sero-prevalence, mosquito density and climate [12]. A modified BG Sentinel (R) (BGS) trap was found to be more useful in collecting *Ae.albopictus* in a evaluation of four types of traps in USA[13]. In a similar study two types of BGS and BGS2 traps indicated no significant differences in collecting Aedes mosquitoes[14].

In this study though the indices remained very high during the study period no cases of dengue/ chikungunya reported. This could be due to large scale epidemic occurred during the previous years conferring acquired immunity to majority of population. Such high indices need not necessarily reflect the degree of risk of transmission or outbreak suggesting the role played by many confounding factors influencing the link between *Aedes* density and transmission for instance resistance status, population density , man-mosquito contact, virus strain and climate, which affects mosquito biology and mosquito virus interactions [15]. Study also provides an insight in to profiles of different type of breeding sites and relative importance. However, there was no significant correlation between trap collection and indices. Surveillance of *Ae.albopictus* is a difficult proposition in Kerala with its characteristic eco-geographical, climatic and anthropogenic paradigms. Further studies are required to find out a gold standard for monitoring and surveillance

Analysis of breeding sites showed extensive presence of container types of anthropogenic origin primarily consequential of behavioral inadequacies' and underdeveloped waste processing technologies. Coconut shells and tender coconut remains dumped into open along with plastic wastes comprised majority of habitats for *Ae.albopictus* in terms of numbers. Coconut is primarily consumed for dishes in every household producing coconut shells as a bye product. These discarded in the environment remain for a long time posing a health threat. Lack of eco-friendly, safe, locally appropriate and acceptable technological solution to dispose of plastics is a serious concern. Tires play an ubiquitous part in the population dynamics of *Ae.albopictus*, in aiding the invasion and spread to many countries [16]. Positivity rates in tires were much higher than other type of containers.

Natural microhabitats are innumerably high and widely dispersed making it untenable even to effectively quantify. *Ae.albopictus* found to breed in leaf axils of many plants viz., pine apple, banana, bromeliads, screw pine etc.[17] which are plentiful in the district. Ecological modifications like extensive deforestation, encroachments and settlements, increase in plantations and climate changes contributed towards the invasion, establishment and propagation of Asian tiger mosquito in different eco-geographical niches in the state of Kerala, India. Innovative and improved surveillance and abatement solutions are required to overcome the present danger.

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