



ISSN: 2348-5906
CODEN: IJMRK2
IJMR 2019; 6(3): 42-44
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Received: 25-03-2019
Accepted: 27-04-2019

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Contribution of shed leaf sheaths of areca nut palms and domestic containers as breeding habitats of *Aedes (Stegomyia) albopictus* (Skuse), 1894: A comparative study from Wayanad district, Kerala, India

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Abstract

During a survey from June to September 2018 in Wayanad district of Kerala *Aedes albopictus* breeding was observed in shed leaf sheaths of areca nut palms and domestic containers. While 15.3% of leaf sheaths supported *Aedes albopictus*, it was 35.0% in the case of domestic containers. *Aedes chrysolineatus* was the dominant breeder in leaf sheaths (51.4%). Besides *Aedes albopictus*, five other species viz., *Aedes chrysolineatus*, *Armigeres aureolineatus*, *Armigeres subalbatus*, *Culex quinquefasciatus* and *Heizmannia chandi* also bred in leaf sheaths. In domestic containers *Aedes albopictus* was the dominant breeder. Another 10 species viz., *Aedes chrysolineatus*, *Aedes vittatus*, *Armigeres aureolineatus*, *Armigeres subalbatus*, *Culex brevipalpis*, *Culex quinquefasciatus*, *Culex uniformis*, *Heizmannia chandi*, *Lutzia fuscana* and *Toxorhynchites splendens* were also found breeding in domestic containers.

Keywords: Shed leaf sheaths, domestic containers, *Aedes albopictus*, *Aedes chrysolineatus*, wayanad

1. Introduction

Aedes albopictus was described by Skuse as *Culex albopictus* in 1894 based on a specimen collected from Calcutta and called it 'the Banded mosquito of Bengal' [1]. Its role as a vector of dengue was suspected during an outbreak of the disease in Nagasaki, Kyushu, Japan in August 1942, which spread to other cities in Japan and recurred every summer until 1944 [2]. From India, the presence of dengue virus in *Aedes albopictus* was reported for the first time by Reuben *et al.* in 1988 in West Bengal [3]. Dengue virus was also detected from wild caught larval and adult mosquitoes from the South Indian state Kerala on two occasions between 2002-2005 [4, 5]. Besides, Chikungunya virus was also isolated from this species from the state in 2009 [6]. Being endemic to Dengue and Chikungunya, *Aedes albopictus* has a significant role in the epidemiology of these two diseases in Kerala [7, 8].

Aedes albopictus breeds in a wide range of habitats from artificial containers to natural habitats [9]. Besides various kinds of domestic containers and tyres, *Aedes albopictus* has been observed breeding in various types of habitats related to agricultural crops in Kerala like coconut, rubber, areca nut, cocoa and pine apple [10-15].

Areca Nut is a major cash crop in Kerala. In terms of production and area under cultivation of Areca nut Kerala ranks second in India behind Karnataka. The state has 99126 hectares of land under Areca Nut cultivation. Kasaragod and Malappuram districts rank first and second in the area under cultivation. Wayanad district with 13460 hectares is in third position (Source: Department of Economics and Statistics, Government of Kerala). Though it has been reported that shed leaf sheaths of Areca nut palms act as breeding habitats for *Aedes albopictus* during rainy season, no extensive studies on their potential as a significant breeding habitat have been carried out in any part of the world. Since source reduction involving the community is the major strategy for *Aedes* control, it is essential to rank the breeding habitats in the order of breeding potential. Hence, a detailed study to estimate the potential of shed leaf sheaths of Areca Nut palms and also to compare their potential with domestic containers was carried out in Wayanad district of Kerala from June to September 2018.

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2. Materials and methods

2.1 Study Area: The study was carried out in Wayanad district of Kerala during the South Western Monsoon season (June to September) in 2018. Wayanad is situated in an elevated picturesque mountainous plateau in the Western Ghats. It lies between north latitude 11 degree 26'28" and 11degree 48'22" and east longitude 75 degree 46'38" and 76 degree 26'11". It is bordered by Karnataka to north and north-east, Tamil Nadu to south-east, Malappuram district of Kerala to south, Kozhikode district to south-west and Kannur district to north-west and has a population of 817420 (2011 Census). The district is divided in to three Talukas viz., Mananthavady, Vythiri and Suthan Batheri. For the purpose of mosquito survey 15 Areca Plantations with area ranging from 0.5 to 2 hectares were selected from all the three Talukas (5 each). Survey of domestic containers was done in the houses at random around the Areca Nut plantations. Only those containers which were exposed to rain were surveyed.

2.2 Mosquitoes survey: Mosquito larvae and pupae from small containers were collected along with the water in plastic containers. From bigger containers samples were collected using droppers. From shed leaf sheaths of Areca Nut the entire populations of larvae and pupae from individual sheaths were emptied in to separate plastic containers. The samples were transported to the laboratory for rearing and identification.

2.3 Rearing: The larvae and pupae collected from the field were transferred to culture bowls and covered with nylon mesh. The larvae were fed on dog biscuit powder.

2.4 Identification: The adult mosquitoes emerged from the samples were identified using dichotomous keys of Barraud (1934) and Reuben *et al.* (1994) based on morphological characters [16,17].

3. Results and Discussion

3.1 *Aedes albopictus* breeding (Table:1): Surveys in the Areca Nut plantations detected 72 shed leaf sheaths with rain water collection. Out of these 41 (56.9%) were with mosquito breeding. *Aedes albopictus* emerged from 11 (15.3%) leaf sheaths. Surveys around houses proximal to the Areca plantations detected 676 containers with rain water. There were 25 types of container habitats viz., plastic bucket (14.1%), folded plastic sheet (12.21%), latex collecting cup (7%), plastic mug (5.72%), plastic cup (5.34%), plastic tank (4.58%), tyre and paint bucket (4.19% each), disposable glass and tray (3.43% each), plastic cup, flower pot, hollow bricks, coconut shell and glass bottles (3.05% each); metal container and grinding stone (2.67% each), aluminium sheet, clay pot, steel plate and cement tank (2.29% each), thermocol container (1.9%), broken chair (1.52%), country boat and drums (1.14% each). Out of the 676 containers surveyed 524 (77.5%) were positive for mosquito breeding. *Aedes albopictus* emerged from 236 (35.0%) containers.

Table 1: *Aedes albopictus* breeding in shed leaf sheaths and domestic containers

S. No.	Breeding habitats	Number surveyed	Number positive (%)	Number Positive for <i>Aedes albopictus</i> (%)
1	Shed leaf sheaths	72	41 (56.9)	11 (15.3)
2	Domestic containers	676	524 (77.5)	236 5.0)

3.2 Species diversity: As shown in Table-2 six species were found breeding in shed leaf sheaths viz., *Aedes albopictus* (15.3%), *Aedes chrysolineatus* (51.4%), *Armigeres aureolineatus* (19.4%), *Armigeres subalbatus* (25.0%), *Culex quinquefasciatus* (2.8%) and *Heizmannia chandi* (2.8%). In domestic containers eleven species were found breeding viz., *Aedes albopictus* (35.0%), *Aedes chrysolineatus* (29.0%),

Aedes vittatus (0.6%), *Armigeres aureolineatus* (2.4%), *Armigeres subalbatus* (8.7%), *Culex brevipalpis* (8.7%), *Culex quinquefasciatus* (11.4%), *Culex uniformis* (0.6%), *Heizmannia chandi* (1.8%), *Lutzia fuscanus* (0.30%) and *Toxorhynchites splendens* (0.6%). In both categories of habitats the species bred either singly or in combination with other species.

Table 2: Species diversity of mosquitoes in shed leaf sheaths and domestic containers.

S. No.	Mosquito species	Number positive (%)	
		Shed Leaf sheaths	Domestic containers
1	<i>Aedes albopictus</i>	11 (15.3)	236 (35.0%)
2	<i>Aedes chrysolineatus</i>	37 (51.4)	194 (29.0%)
3	<i>Aedes vittatus</i>	0	4 (0.6%)
4	<i>Armigeres aureolineatus</i>	14 (19.4)	16 (2.4%)
5	<i>Armigeres subalbatus</i>	18 (25.0)	58 (8.7%)
6	<i>Culex brevipalpis</i>	0	58 (8.7%)
7	<i>Culex quinquefasciatus</i>	2 (2.8)	76 (11.4%)
8	<i>Culex uniformis</i>	0	4 (0.6%)
9	<i>Heizmannia chandi</i>	2 (2.8)	12 (1.8%)
10	<i>Lutzia fuscanus</i>	0	2 (0.30%)
11	<i>Toxorhynchites splendens</i>	0	4 (0.6%)

The study shows that both shed leaf sheaths of Areca Nut palms and domestic containers support breeding of *Aedes albopictus*. However, the potential of domestic containers was found significantly high as 35.0% of this category of habitats had *Aedes albopictus* breeding; whereas, it was only 15.3% in

the case of shed leaf sheaths. In an earlier study conducted in Thondarnad village of Wayanad district in April, 2007 Regu *et al.* observed 40.9% of the leaf sheaths with *Aedes albopictus* breeding in the month of April. In this study 22 sheaths were searched and 9 were positive for *Aedes*

albopictus (40.9%). Along with Wayanad, surveys were also conducted in three neighbouring districts (Kozhikode, Malappuram and Palakkad) and similar findings were recorded. In Palakkad district 57.7% of the sheaths were positive for *Aedes albopictus*. The percent positivity in Kozhikode and Malappuram districts were 55.2% and 50.0% respectively. Besides, breeding of only *Aedes albopictus* was recorded from all three districts [13]. In the present study 5 other species were also found breeding. The dominant species was found to be *Aedes chrysolineatus* (51.4%), a non-vector. The difference in percentage positivity of *Aedes albopictus* and diversity of species could be due to difference in the period of study. While the present study was done during rainy season, the aforesaid study was done in summer season. *Aedes chrysolineatus* was also found breeding in domestic containers but only secondary to *Aedes albopictus* (29.0%). Breeding of *Aedes chrysolineatus*, *Armigeres aureolineatus*, *Armigeres subalbatus*, *Culex quinquefasciatus* and *Heizmannia chandi* in shed leaf sheaths of Areca Nut palms have not been reported earlier. Though *Aedes albopictus* breeding in shed leaf sheaths was found to be low compared to domestic containers its importance as a major category of breeding habitat should not be underestimated. Since Areca Nut farms are located near human settlements in Wayanad, the chances of Man-Vector contact also is as high as in the case of mosquitoes emerging from domestic containers. Hence, this habitat should be included in the source reduction programme involving the local communities for the control of mosquito-borne diseases.

4. Conclusion

Shed leaf sheaths of Areca Nut palms supported breeding of *Aedes albopictus* in Wayanad district. However, its contribution was found less than that of domestic containers. Besides *Aedes albopictus* five more species were also found breeding in leaf sheaths viz., *Aedes chrysolineatus*, *Armigeres aureolineatus*, *Armigeres subalbatus*, *Culex quinquefasciatus* and *Heizmannia chandi*. Breeding of these species have not been recorded earlier. In domestic containers *Aedes albopictus* was the dominant species; where as in leaf sheaths it was *Aedes chrysolineatus*.

5. Acknowledgements

The authors wish to acknowledge the support rendered by the field staff of District Medical Office, Wayanad.

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