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Unconventional breeding habitats of *Aedes (Stegomyia) albopictus* (Skuse) related to agriculture crops in Kerala, India: A review

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Abstract

Aedes albopictus is the vector of Dengue, Chikungunya, Yellow fever and Zika viruses. It is one of the world's worst invasive species. Adaptability of the species to a wide range of habitats is believed to contribute to its invasiveness. In recent years this species has been reported to breed in several unconventional breeding habitats related to Agricultural ecosystems. A review of the literature on this aspect has revealed that the first reports in the world on the breeding of *Aedes albopictus* in Agro-ecosystems were from the South Indian state Kerala. The agriculture crops considered in this review were Coconut, Areca Nut, Rubber, Cocoa and Pineapple. The breeding habitats with *Aedes albopictus* breeding reported in these crops were primary rachis of shed coconut fronds, shed Areca nut leaf sheaths, latex cups on Rubber trees, Cocoa pods and leaf axils of pineapple.

Keywords: *Aedes albopictus*, primary rachis, shed leaf sheaths, latex cups, cocoa pods, leaf axils

1. Introduction

Aedes (Stegomyia) albopictus (Skuse) has been gaining prominence in the history of global public health as a fierce invasive species and vector of several arbo-viral diseases. Its rapid expansion affects an increasingly larger proportion of the world population [1]. In the Southern Indian state Kerala, it has been incriminated as the principal vector of Dengue and Chikungunya [2]. During an extensive vector survey in three Chikungunya affected districts of the state this was the only vector species encountered. Its more famous cousin *Aedes aegypti* was altogether absent. The presence of Dengue virus (DEN) and Chikungunya virus (CHIKV) have been demonstrated from wild caught adults as well as adults emerged from larvae collected from the field by various authors from different parts of Kerala [3-5]. Mosquito surveys in connection with Dengue and Chikungunya have revealed several unconventional breeding habitats of *Aedes (Stegomyia) albopictus* related to different kinds of Agro-ecosystems. This is an attempt to compile such breeding habitats related to Coconut, Areca Nut, Rubber, Cocoa and Pineapple farms and plantations in Kerala which were also the first reports in the world. The review gains importance because the Agriculture crops referred in are prevalent in other states of India as well as other countries in the world, especially those with high prevalence of Mosquito-borne diseases.

2. Coconut (*Cocos nucifera*)

Coconut is a large palm growing up to 30 meters with pinnate leaves. It is a plantation crop with wide global distribution, especially in tropical countries. Indonesia is the largest producer of coconut followed by the Philippines and India. Kerala ranks first in the production and area under cultivation of coconut in India. According to the latest statistics available, the area under coconut cultivation in the state is 790223 Ha (Source Department of Economics and statistics, Government of Kerala). Coconut shell, as a breeding habitat for mosquitoes, has been known since the beginning of 20th century [6]. Hence, it is not considered in this review. The possibility of leaf axils and crowns of coconut palms as breeding habitats of mosquitoes was meticulously probed way back in 1927 and the result was emphatically negative [7]. Since then, there have been no similar studies from anywhere in the world. During an extensive survey of mosquito breeding habitats in three chikungunya affected districts of central and South Kerala

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in June 2007, among a plethora of habitats primary rachis of shed coconut fronds were found to support breeding of *Aedes albopictus*. Coconut fronds are periodically shed and collect rainwater in the concavity of the broader basal part of the primary rachis. 5% of this habitat was found positive for *Aedes albopictus*. Considering the large area under coconut cultivation in the state, this number is quite significant [2].

3. Areca nut (*Areca catechu*)

Areca palms are cultivated for its nuts. It is distributed in Asia, tropical Pacific and parts of east Africa. India is the largest producer of Areca nut in the world followed by China and Myanmar. 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. In 2006 Areca Nut husk was reported as a breeding habitat of *Aedes albopictus* in Thailand [8]. However, there have been no such reports from Kerala. In 2007, while conducting mosquito survey in Wayanad district high density of *Aedes albopictus* adults was observed in a cashew plantation. However, there were no visible breeding habitats in the vicinity. On further probing profuse breeding of *Aedes* mosquitoes was observed in the shed leaf sheaths of Areca Nut palm. Subsequently, Areca Nut plantations in the neighbouring districts of Kozhikode, Malappuram and Palakkad districts also yielded similar results. All the emerged adults were *Aedes albopictus*. About 37% of the leaf sheaths were with rain water and on an average, 52.3% of these water holding leaf sheaths were positive for *Aedes albopictus*. A leaf sheath can hold on an average one litre of water. One hectare of Areca plantation has approximately 1300 palms and each palm sheds 5 leaves in a year. Hence, the potential of shed leaf sheaths as a breeding habitat for *Aedes albopictus* is significantly high [9]. This observation was also the first of its kind in the world. Subsequently, in a survey conducted throughout Wayanad district from June to September 2018, breeding of *Aedes albopictus* was encountered in 15.3% of the leaf sheaths surveyed [10].

4. Rubber (*Hevia brasiliensis*)

Natural rubber is obtained from the South American tree *Hevia brasiliensis*. This tree is cultivated in plantation in several countries of Asia and Africa. The largest producer of Rubber is Thailand followed by Indonesia, Malaysia and India. In the case of Rubber cultivation also Kerala ranks first in the country with an area of 550840 Ha. One hectare of plantation has on an average 500 trees. Latex is obtained from the bark of the rubber tree by tapping. Tapping is a process of controlled wounding during which thin shavings of bark are removed. The aim of tapping is to cut open the latex vessels in the case of trees tapped for the first time or to remove the coagulum which blocks the cut ends of the latex vessels in the case of trees under regular tapping. Tapping is done in the morning hours on alternate days or every third day. In olden days Coconut shells were used in Kerala for collecting latex. Today, it has been replaced by plastic containers of 500 ml capacity. The oozing latex, which flows out for about four hours, is led into the cup by a galvanised 'spout' that has been attached to the tree. During South-West monsoon season tapping is temporarily suspended and rain water gets collected in the latex cups. In June 2002, while investigating a suspected dengue case in Wayanad district and a suspected dengue death in the neighbouring Kannur district profuse

breeding of *Aedes albopictus* was observed in rainwater-filled latex cups in the rubber plantations. In Kannur district, out of 802 latex cups surveyed 788 (98.3%) were positive for *Aedes albopictus* breeding. In Wayanad district, out of 917 cups 534 (58.2%) supported breeding [11]. This was the first published report of *Aedes albopictus* breeding in latex cups. Subsequent to this preliminary study exhaustive surveys were done in Kannur, Wayanad and Kozhikode districts from June 2005 to September 2010. In Kannur district 50% of the sites surveyed were positive for this species. In Wayanad and Kozhikode districts it was 62.5% and 77.8% respectively. [12, 13] In another study conducted in the rubber growing areas of Central Kerala from February 2008 to January breeding of *Aedes albopictus* was observed in latex cups [14].

5. Cocoa (*Theobroma cacao*)

Kerala ranks first in the production as well as area under cultivation of Cocoa in India. It has an area of with 13,924 Ha under Cocoa cultivation. The pods of Cocoa attract rodents for the sweet endocarp. They eat the endocarp by boring the hard shell like rind. In the process, the pods get transformed in to water holding containers. During rainy seasons in 2003 and 2004 breeding of *Aedes albopictus* was observed in such excavated Cocoa pods. Breeding was noticed both in hanging and grounded pods. It was also observed that such pods remain on the Cocoa trees for approximately six months. On an average 25 immature stages of *Aedes albopictus* could be collected from each pod. Out of this 36% were I/II instar larvae, 58% were III/IV instar larvae and 6% pupae [15].

6. Pineapple (*Ananas comosus*)

Kerala ranks fourth in terms of area under pineapple cultivation. It has an area of 7911 Ha under Pineapple cultivation. It is a known fact that mosquitoes breed in the leaf axils of a variety of plants. However, breeding of *Aedes albopictus* in the leaf axils of Pineapple plants was not reported till 2007. In June 2007, extensive surveys conducted in 5 districts of Kerala which had witnessed massive outbreaks of Chikungunya brought to light the potential of Pineapple plantations as breeding habitats of *Aedes albopictus*. Though many plants were found to provide breeding habitats for *Aedes albopictus*, 80.8% breeding occurred in the axils of Pineapple [2]. However, the percentage pineapple plants with *Aedes albopictus* breeding was not reported.

7. Conclusion

Mosquito borne diseases, especially those vectored by *Aedes albopictus* have been on the rise globally. One of the most important reasons for this increase is the invasiveness of this vector. Adaptation of *Aedes albopictus* to lesser known habitats is also creating obstacles in the containment of this species [16]. In this review five crops in Kerala, were found contributing to five different unconventional habitats viz., rachis of shed coconut fronds, shed Areca nut leaf sheaths, latex cups on Rubber trees, Cocoa pods and leaf axils of pineapple. Such studies need to be undertaken in all *Aedes albopictus* countries reveal the potential habitats in various agricultural crops. Being man made, agro-ecosystems have the potential for playing a significant role in the epidemiology of diseases transmitted by *Aedes albopictus* as happened in the case of rubber plantations in Kerala, where it played crucial roles in the outbreaks of dengue and chikungunya in the state [17].

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9. References

- Bonizoni M, Gasperi G, Chen X, James AA. The invasive mosquito species *Aedes albopictus*: current knowledge and future perspectives. *Trends Parasitol.* 2013; 29(9):460-468.
- Eapen A, Ravindran John K, Das AP. Breeding potential of *Aedes albopictus* (Skuse, 1895) in chikungunya affected areas of Kerala, India. *Indian Journal of Medical Research.* 2010; 132(6):733-735.
- Das BP, Kabilan L, Sharma SN, Lal S, Regu K, Saxena VK. Detection of Dengue Virus in Wild Caught *Aedes albopictus* (Skuse) around Kozhikode Airport, Malappuram District, Kerala, India. *Dengue Bulletin.* 2004; 28:210-212.
- Thenmozhi V, Hiriyan J, Tewari SC, Philip Samuel P, Paramasivam R, Rajendiran R *et al.* Natural Vertical Transmission of Dengue Virus in *Aedes albopictus* (Diptera: Culicidae) in Kerala, a Southern Indian State. *Jpn. J. Infect. Dis.* 2007; 60:245-249.
- Niyas PK, Abraham R, Nair RU, Mathew T, Nair S, Manakkadan A, *et al.* Molecular characterization of Chikungunya virus isolates from clinical samples and adult *Aedes albopictus* mosquitoes emerged from larvae from Kerala, South India. *Virology Journal.* 2010; 7:189.
- Barraud PJ. The fauna of British India including Ceylon and Burma. Diptera Family: Culicidae; Tribes Megarhini and Culicini. Francis and Taylor, London, 1934; V:1-463.
- Lester AR. The coconut palm. Its potentialities in providing breeding places for mosquitoes. *Journal of Tropical Medicine and Hygiene.* 1927; 30(11):137-145.
- Preechapon W, Jaroensutasinee M, Jaroensutasinee K. The larval ecology of *Aedes aegypti* and *Aedes albopictus* in three topological areas of Southern Thailand. *Dengue Bulletin.* 2006; 30:204-213.
- Regu K, Rajendiran R, Tamilselvan M, Ganesh CT. Shed leaf sheaths of areca nut palm as a major breeding source of *Ae. albopictus* Skuse (Diptera: Culicidae) in Kerala. *Hexapoda.* 2008; 15:111-113.
- Shanasree M, Sumodan PK. 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. *International Journal of Mosquito Research.* 2019; 6(3):42-44.
- Sumodan PK. Potential of Rubber Plantations as Breeding Source for *Aedes albopictus* in Kerala, India. *Dengue Bulletin.* 2003; 27:197-198.
- Sumodan PK. Mosquito breeding in the rubber plantations of Kerala, India: A study based on ecosystem approach. VDM Verlag Dr. Müller 2010, 1-64.
- Sumodan PK. Species diversity of mosquito breeding in the rubber plantations of Kerala, India. *Journal of the American Mosquito Control Association.* 2012; 28(2):114-115.
- Jomon KV, Valampampil TT. Medically important mosquitoes in the rubber plantation belt of central Kerala, India. *Southeast Asian Journal of Tropical Medicine and Public Health.* 2014; 45(4):796-780
- Hiriyan J, Tyagi K. Cocoa pod (*Theobroma cacao*) – A potential breeding habitat of *Aedes albopictus* in dengue sensitive Kerala state, India. *Journal of the American Mosquito Control Association.* 2004; 20(3):323-325.
- Ramasamy R, Surendran SN. Mosquito vectors developing in atypical anthropogenic habitats: Global overview of recent observations, mechanisms and impact on disease transmission. *Journal of Vector Borne Diseases.* 2016; 53(2):91-98.
- Sumodan PK, Vargas RM, Pothikasikorn J, Sumanrote A, Lefait-Robin R, Dujardin JP. Rubber plantations as a mosquito box amplification in south and southeast Asia. In *Socio-Ecological dimensions of Infectious Diseases.* Ed. Morand S, Dujardin JP, and Lefait-Robin R. Springer, Singapore, 2015, 155-167.