Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.6925

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **6 (6):** 1042-1048 (2018)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Impact of Container Preference and Influence of Vegetation on the Oviposition of Dengue Vector, *Aedes aegypti* Linnaeus (Diptera; Culicidae)

E. Grace Marin*

Assistant Professor of Zoology, Scott Christian College (Autonomous) Nagercoil-629003

*Corresponding Author E-mail: gracemarinleslie@gmail.com

Received: 30.09.2018 | Revised: 28.10.2018 | Accepted: 7.11.2018

ABSTRACT

The vector of dengue Aedes aegypti, a day biting mosquito inhabits both in natural and manmade containers. Oviposition choice is a well-studied aspect of the mosquito life cycle and offers a potential avenue for species-specific surveillance and control. Larval collections were performed from June 2016 to July, 2017 in all the wet containers present in and around the houses of the study area. Immature stages of A. aegypti were recorded in pre and post monsoon season respectively. Among nine different container types searched and examined, wet grinders and discarded tyres were found to be positive for A. aegypti larvae The breeding preference ratio during all seasons was highest in grinding container and discarded tyre than other artificial containers during pre - monsoon season. Also clean and open waters provide a suitable place for breeding than the presence of vegetation.

Key words: *A. aegypti, Breeding preference, Pre-monsoon, Post-monsoon*

INTRODUCTION

Mosquitoes belong to the class Insecta, order Diptera and family Culicidae.Some of the genera which are important from the medical point of view include *Aedes*, *Culex* and *Anopheles*. They are the main vectors for the transmission of various disease of public health importance. including Malaria, Filariasis, Dengue, Japanese encephalitis and Yellow Fever.[19]. Mosquito breeding differs with geographic regions. Dengue fever is caused by dengue viruses of the family Flaviviridae, transmitted principally by *Aedes aegypti* and possibly *A. albopictus*, in the tropical and subtropical regions of the world and are found in forested habitats as well as in a variety of other habitats in rural and suburban areas. No effective vaccine or chemotheraphy is currently available for the prevention and treatment of dengue fever, therefore prevention and control of the disease depend entirely on vector surveillance and control[7,23].

A. aegypti is a more important threat for DHF. *A. albopictus* is encountered in the peripheral areas of towns where it replaces *A. aegypti* populations.

Cite this article: Grace Marin, E., Impact of Container Preference and Influence of Vegetation on the Oviposition of Dengue Vector, *Aedes aegypti* Linnaeus (Diptera; Culicidae), *Int. J. Pure App. Biosci.* **6(6):** 1042-1048 (2018). doi: http://dx.doi.org/10.18782/2320-7051.6925

The importance of size and shape of containers has received little systematic investigation for mosquito breeding albeit these physical parameters significantly increasing the probability of a container receiving eggs. The developmental stages (egg to adult) may take as little as 5 days to as long as 1 month depending on species as well as geographic location and temperature. The eggs are laid singly in water either singly in water on the edge infact numbering generally 100 to 150 with characteristic shell structure that prevents eggs from dessication.

Mosquito species exploiting flood water habitats like rain pools, snow pools, rain barrels and artificial containers like old tyres are *Aedes*, *Psorophora,*and *Culex* genera. Standing water habitats like fresh water marshes, lakes, ponds, drainage ditches etc are exploitated mainly by *Anopheles* and several *Culex* and *Coquilletifdia* species. Usually mosquitoes exploit small shallow water bodies which are high in nutrients and salinity and low in dissolved oxygen content. In such habitats, mosquitoes have higher rates of survival due to abundant food source and low predator populations. *Culex* mosquitoes are opportunistic breeders, preferring man made habitats to the natural ones.

In fact man-made habitats are the primary source of *Culex* mosquitoes. *Anopheles* and *Aedes* prefer clean water, whereas *Culex* prefers water with high biological oxygen demand. Mosquito larvae in natural waters are usually inhibited by extremes of pH conditions and occur mostly between the pH ranges 5.8 and 8.6 with *Anopheles* having higher range than *Culicines*. Stagnant water species usually tolerate higher alkalinity and moving water species tolerate higher acidity[1]. Biotic factors like vegetation type and proportion of coverage are implicated as being better predictors of larval abundance than the physico chemical factors.[15] The presence of vegetation and floating plants provide optimal breeding conditions by acting as food sources as well as shelter from predators. Vegetation also creates stagnant conditions by decreasing water movement[5].

Oviposition is controlled largely by extrinsic light cues. In normal, fluctuating conditions, most eggs are laid towards the end of the afternoon. In experiments in which the temperature and relative humidity were kept constant but the light fluctuated normally, *A. aegypti* showed a regular cycle of egg-laying with a peak of major activity late in the afternoon. This cyclical pattern of behaviour is initiated by only a short exposure to light and experiments with a Southern Nigerian Strain showed that a single exposure to light for five seconds of females reared and maintained in darkness to be a time-cue for initiating a 24-hour oviposition cycle. The depth and surface area of an aquatic environment may affect mosquito development and oviposition[3].

Biotic factors like vegetation type and proportion of coverage are implicated as being better predictors of larval abundance than the physico chemical factors. The presence of vegetation and floating plants provide optimal breeding conditions by acting as food sources as well as shelter from predators[22]. A number of studies have used the pattern of larvae and pupae found in containers in the field to suggest the importance of physical container characteristics in oviposition choice for a variety of mosquito species but there are obvious problems of inference to actual oviposition choices[21,8,13,3,24]. The behavioral ecology of oviposition choice in container mosquitores has been studied, particularly the effects of various biotic inputs into the aquatic media such as nutrients, conspecific larvae and eggs, or larval predators. The present study is carried to observe the container preference of dengue vector *A. aegypti* in different artificial containers and the influence of vegetation in oviposition. of *A. aegypti* On a global scale, dengue viruses are primarily transmitted by *Aedes aegypti* and *Aedes albopictus* mosquito while *A. aegypti* is considered to be the primary vector of dengue viruses and has repeatedly been incriminated as a driving force in the world wide emergence of DF[17].

Mosquito larvae occupy a wide range of habitats in diverse environmental conditions and these environments may be natural or man-made and may also differ in the amount or type of vegetation present and the amount of sun or shade. Abundance of different mosquito species in a water body may differ depending on the geographic location, water level fluctuation as well as perpetual presence of water, size of water body, vegetation, predator abundance and organic composition of the water.[22].

Mosquito species exploiting flood water habitats like rain pools, snow pools, tree holes, rain barrels and artificial containers like old tires are *Aedes, Psorophora* and *Culex* genera. Standing water habitats like freshwater marshes, lakes, ponds, drainage ditches etc. are exploited mainly by *Anopheles* and several *Culex* species and Coquillettifdia.[11,12]. Usually mosquitoes exploit small shallow water bodies which are high in nutrients and salinity and low in dissolved oxygen content. In such habitats mosquitoes have higher rates of survival due to abundant food source and low predator populations. *Culex* mosquitoes are opportunistic breeders, preferring man-made habitats to the natural ones. The objective of the study was to study the impact of container preference and the influence of vegetation on the oviposition of the dengue vector, Aedes aegypti.

MATERIAL AND METHODS

Study area

The study was carried out in a rubber plantation in Kozhivilai, near Kaliyakkavilai, 30 km away from Nagercoil. Rubber plantation is an ideal place for breeding of mosquitoes especially. *A. aegypti* since it provides enough canopy vegetation and humidity for its survival. In the rubber plantation grinding container, discarded tyre, plastic bucket, water bottle, cement tank, silver container, coconut shell, mud pot, flower vase were kept 50 cm apart from one another and the number of larvae found in these containers were collected and noted for an interval of 7 days during the study period. (June 2016-July 2018) The larvae collected from each containers were transported to the laboratory and reared up to adult and identified.

Influence of vegetation on ovipositional preferance of *A. aegypti*

A series of three shallow glass containers of 50mm depth and 90cm^2 surface area were provided for egg-laying by *A. aegypti* and are marked as A, B and C respectively. A freshly breeding colony of *A. aegypti* was allowed to oviposit in a series of glass containers of 50mm depth and 90cm^2 surface area with three sets of in which container with (i) no vegetation (open water) (ii) emergent vegetation and (iii) submerged vegetation. Number of *A. aegypti* larvae found in each containers were noted once in 10 days and the data tabulated.

RESULTS

The ovipositional preference of *A. aegypti* during premonsoon season in different artificial breeding containers namely Grinding container, plastic bucket, water bottle, discard typre, cement tank, silver container, coconut shell, mudpot and flower vase were noted and tabulated. In the present study during the pre monsoon season maximum number of larval mosquitoes were found in grinding container (35.29%) followed by Discard tyre (25.88%), mud pot (14.11%), coconut shell (10.58%), plastic bucket (8.23%), silver container (1.411%), flower vase (1.17%) and water bottle (0.941%) respectively (Figure 1.)

Similarly during the post monsoon season, maximum number of larval mosquitoes were observed in grinding container (31.42%) and discarded tyre (27.72%) moderate amount of larval mosquitoes are found in mudpot (10.16%) and plastic bucket (9.24%) low number of larval mosquitoes are observed in other containers coconut shell (11.09%), cement tank (3.69%), flower vase (2.03%) and water bottle (2.033%) (Figure 2).Comparative account on the occurrence of larval mosquitoes in these containers were depicted in figure-3.

Influence of vegetation

Significant difference are found between mosquito count in open waters and submerged as well as floating in vegetation. Open waters act as a breeding ground for mosquitoes. Equal number of larvae were observed between emergent and submerged vegetation (Figure 4).

DISCUSSION

Mosquitoes have great public health importance as vectors for the transmission of various diseases including dengue where *A. aegypt i*is considered to be the primary vector of dengue. *A. aegypti* breeds in a wide variety of micro-habitats and in a range of water conditions from clear to highly contaminated. Eggs are laid in the relatively clean water of rock pools and urban domestic water containers *A. aegypti* showed a regular cycle of egg-laying with a peak of major activity late in the afternoon. *A. aegypti* breeds in a wide assortment to domestic containers whereas *A. albopictus* is more likely to be found in natural containers, such as bamboo stumps and coconut shells, or in artificial containers outside the houses such as tyres, opened cans and plastic bottles[16,14].

A. aegypti breeds in a wide assortment of domestic containers and they have been found in forested habitats well as in a variety of other habitats in rural and suburban area[24]. Effect control of this mosquito particularly during an outbreak of disease can be achieved through different strategies targetting specific life - history stages. The life cycle of mosquitoes offers several critical junctures for control including the juvenile stage, host, resting site or oviposition site seeking females[7].

Oviposition choice is a well studied aspect of the mosquito life cycle and offers a potential avenue for species specific surveillance and control. In container inhabiting mosquitoes, these has been focus on how the components of the aquatic media determine choice, with little work on the physical characteristics of the container themselves[18,24]. Importance of physical container is an important characteristic feature, mainly the importance of size and shape of containers has received little systemic investigation for mosquitoes[6,13] conducted a semi field a experiment that used linear regression of egg numbers on container diameter, volume, and surface area to conclude that *A. aegypti* deposited more eggs in larger containers in all three physical aspects. They also concluded that these physical parameters significantly increased the probability of a container receiving any eggs. Others have suggested water depth might be an important factors for oviposition choice in *Culex mosquitoes,* although the important of this factor appeared species specific within *Culex.*

Water body parameters have a considerable effect on the communities that develop within them. In small container habitats like tires, depth, surface area and volume affect the development and success of mosquito communities. Changes in depth certainly have a far reaching effects on distribution, population densities, risk of predation, and availability of resources Another possibility is that ovipositing females are determining the likelihood of colonization of a habitat by a larval predator. Larvae of *A. albopictus* are susceptible to predation by a variety of insect predators in larger containers[21,8].

Many studies have shown that *A. aegypti* lay eggs in natural indoor water containers that are generally filled with water even during dry season Wongkoon *et al*.,[24]. The present study clearly demonstrates that number of *Aedes* larvae was higher during the post monsoon season than in pre-monsoon season. Also our results showed that positive containers were higher among earthern ones than the plastic containers. This study supports the observations of Luemoh *et al*.[10] l stating the lower occurrence of *Aedes* larvae in plastic water containers than in earthern ones.

Figure-1

Graph showing container preference of *A. aegypti* during Pre - monsoon season

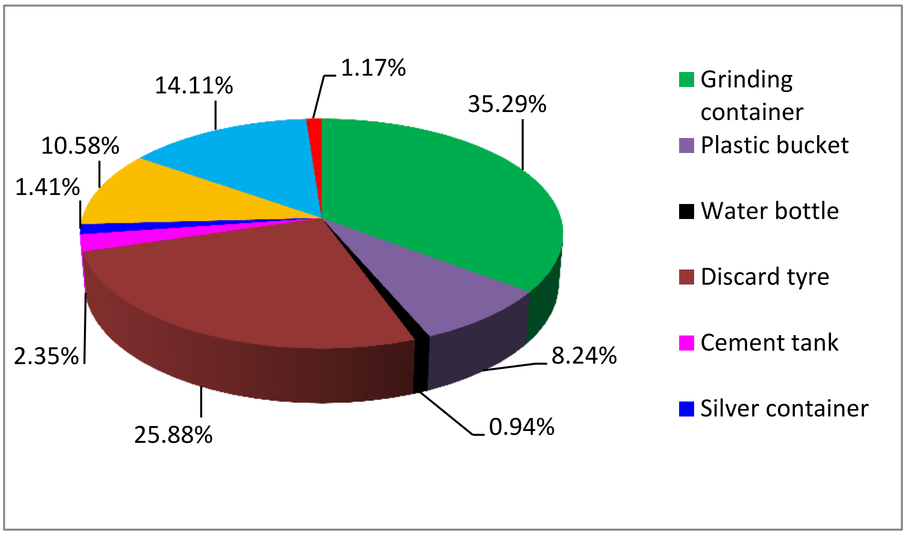


Figure-2

Graph showing container preference of *A. aegypti* during Post - monsoon season

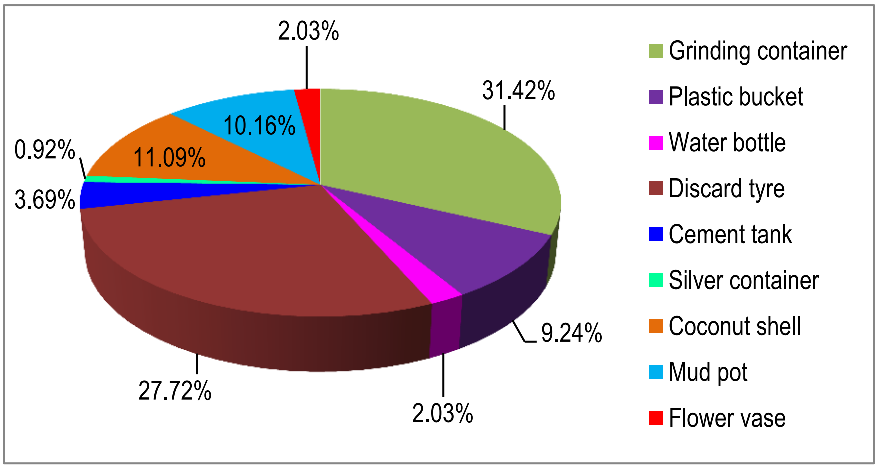


Figure- 3

Graph showing container preference of *Aedes aegypti* during Pre-monsoon and Post-monsoon seasons

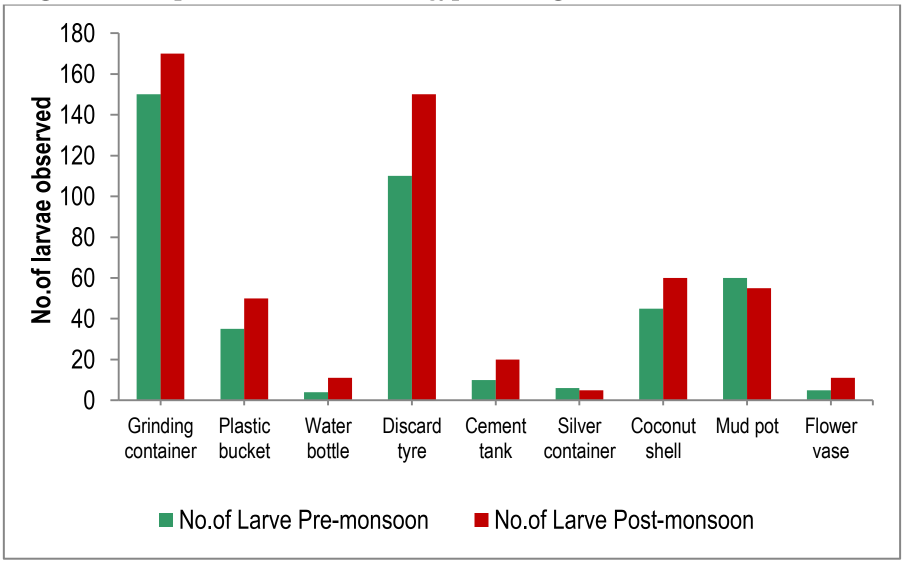
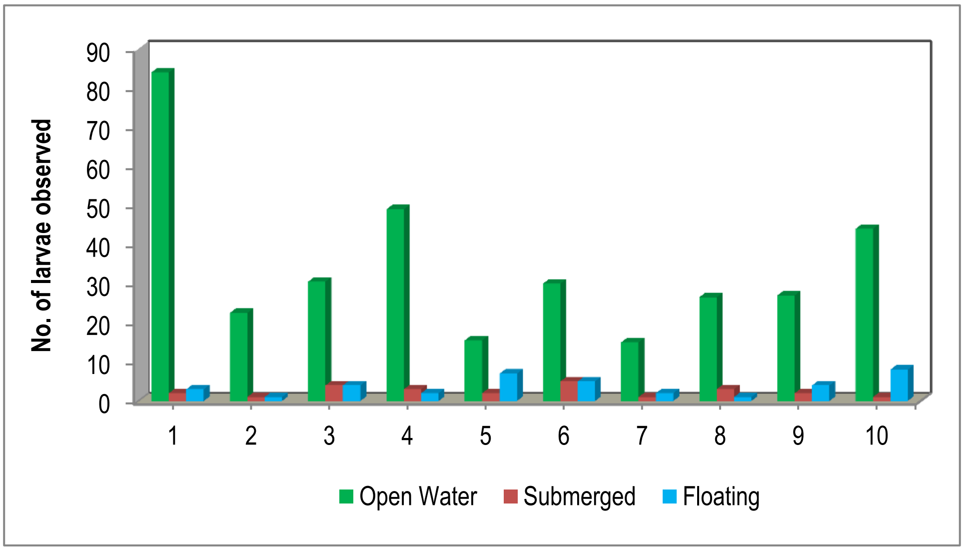


Figure- 4

Graph showing number of larval occurence in open, submerged and floating vegetation



REFERENCES

1. Adebote, D. A., Onlye, S. J. and Muhammed, Y. A., Studies on mosquitoes breeding in rock pools on inselbergs around zaria, Northern Nigeria. *J. Vector Borne Dis.*, **45:** 21-28 (2008).
2. Clements, A. N., The biology of mosquitoes: volume I development nutrition and reproduction. Oxfordrhire, U. K: CABI publishing (2000).
3. Derraik, J. G. B. and Slaney, D., Container aperture size and nutrient preferances of mosquitoes (Diptera: Culicided) in the Auckland region, New Zealand. *Vector Ecol.*, *J.* **30:** 73-82 (2005).
4. Fontenille, D. and Toto, J. C., *Aedes* (Stegomyia) *albopictus* (Skuse), a potential New dengue Vector in Southern Cameroon. *Emerging Infectious Diseases*, **7:** 920-921 (2001).
5. Gu, W. D., Regens, J. L., Beier, J. C. and Novak, R. K., Source reduction of mosquito larval habitats has unexpected consequences on malaria transmission. *Proc. Natl. Acad. Sci.*, U.S.A.: 17560 – 17563 (2006).
6. Harrington, L. C., Ponlawat, A., Edman, J. D., Scott, T. W. and Vermeylen, F., Influence of container size, location and time of day on oviposition patterns of the dengue vector, *Aedes aegypti*, in Thailand. *Vector Borne Zoonotic Dis*., **8:** 415 – 423 (2008).
7. Knight, R. L., Walton, W. E. O., Meara, G. F., Raisen, W. K. and Wass, R., Strategies for effective mosquito control in constructed treatment wetlands. *Ecological Engineering*, **21:** 211-232 (2003).
8. Lester, P. J. and Pike, A. J., Container surface area and water depth influence the population dynamics of the mosquito *Culex pervigilans* (Diptera: Culicldae) and its associated predators in New Zealand. *Vector Ecol*, *J. Dec.*, **28(2):** 267 – 74 (2003).
9. Lounibos, L. P., Invasions by insect vectors of human disease. Annu. *Rev. Entomol*, **47:** 233-266 (2002).
10. Luemoh, A., Mc Neil, D. and Kuning, M., Water consumption and distribution of dengue larvae in pattani villages. Songklanakarind *Med. J.*, **21(3):** 209-16 (2003).
11. Mayhew, C. R., Raman, D. R., Gerhardt, R. R., Burns, R. T. and Younger, M. S., Periodic draining reduces mosquito emergence from free-water surface constructed wetlands. *Trans ASAE (Am SOCA gricEng)*, **47:** 567-573 (2004).
12. Mercer, D. R., Sheeley, S. L. and Brown, E. J., Mosquito (Diptera: Culicidae) Development within microhabitats of an Iowa Wetland, *J., Med, Entomol.*, **42(4):** 685-693 (2005).

13. Morrison, A. C., Gray, K., Getis, A., Astete, H., Sihuincha, M., Focks, D., Watts, D., Stancil, J. G., Olson abd Blair, P., Temporal and geographic Patterns of *Aedes aegypti* (Diptera: Culicidae) production in Iquitos, Peru, *J., Med. Entomol.,* **41:** 1123-1142 (2004).
14. Preechaporn, W., Jaroensutasinee, M. and Jaroensutasinee, K., The larval ecology of *Aedes aegypti* and *A. albopictus* in three topographicae areas of Southern Thailand. *Dengue Bull.,* **30:** 204-13 (2006).
15. Promprou, S., Jaroensutasinee, M. and Jaroensutasinee, K., Climatic factors affecting dengue haemorrhagic fever incidence in Southern Thailand. *Dengue Bull.,* **29:** 41-8 (2005).
16. Rao, B. B. Larval habitats of *Aedes albopictus* (skuse) in rural areas of Calicut, Kerala, India. *Journal of vector borne diseases,* **47:** 175-177 (2010).
17. Reeves, W. C., The threat of exotic virus introductions into California. Proceedings of the Mosquito and vector control Association of California, **68:** 9-10 (2000).
18. Reiskind, M. H. and Zarrabi, A. A., Water surface area and depth determine oviposition choice in *Aedes albopictus* (Diptera:Culicidae), *Entomological Society of America,* **49(1):** 71-76 (2012).
19. Stephenson, I., Roper, J., Fraser, M., Nicholson, K. and Wiselka, M., Dengue fever in febrile returning travellers to a UK regional infectious diseases unit. *Travel Med. Infect. Dis.* May; **1(2):** 89-93 (2003).
20. Sumodan, P. K., Potential of rubber plantation as breeding source for A. *albopictus* in Kerala, India. *Dengue Bulletin,* **27:** 197-198 (2008).
21. Sunahara, T., Ishizaka, K. and Mogi, M., Habitat size, a factor determining the opportunity or encounters between mosquito larva and aquatic predators. *J. Vect. Ecol.,* **27:** 217-220 (2002).
22. Thullen, J. S., Sartoris, J. J. and Walton, W. E., Effects of vegetation management in constructed wetland treatment cells on water quality and mosquito production. *Ecological Engineering,* **18:** 441-457 (2002).
23. WHO Comprehensive guidelines for the prevention and control of Dengue and Dengue haemorrhagic fever.http:/www .searo.whr.link.cm section 10 section 332 section 554 htm (2011).
24. Wongkoon, S., Jaroensutasinee, M. and Jaroensutasinee, K., Larval Infestations of *Aedes aegypti* and *A. albopictus* in Nakhon Si Thammarat, Thailand. *Dengue Bull.,* **29:** 169-75 (2011).