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REVIEW ARTICLE

SPATIAL AND TEMPORAL PREVALENCE OF *Culex quinquefasciatus* (SAY) IN SOUTH EAST REGION OF PUDUCHERRY

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ABSTRACT

The breeding sites of *Culex quinquefasciatus* (Say) was investigated with seasonal prevalence during 2012-2013 in south west region of Puducherry. The study revealed the density of vector immature of L3 stage was dominant during pre monsoon and post monsoon seasons (420 and 390 individuals). The significant high numbers was due to the onset of monsoon rains available in the gutters, tree holes followed by earthen pots. Few numbers were identified in plastic bottles, coconut shells and tyres. The container-type breeding sites yielded approximately 1455 individuals in gutter and 1050 in tyres. The results indicate that *Culex quinquefasciatus* had invaded almost all different types of containers and significant ($p<0.05$) during post and pre monsoon seasons and non-significant during summer and monsoon. The present study highlights that *Cx. quinquefasciatus* had invaded urban areas of south west region of Puducherry with seasonal prevalence. The results also indicate the needs for studies locally, prior to larviciding.

INTRODUCTION

Mosquitoes are well known groups of insects belonging to the family *Culicidae* of the order *Diptera*. They are known to be the vectors of many dreadful human diseases like *malaria, dengue, chikungunya, filariasis* and *encephialtis* etc. Mosquitoes are distributed worldwide and practically no part of the globe that can serve for human existence is free from mosquitoes (Balakrishnan *et al*., 2011). Besides treatment of the diseases, other approaches for controlling mosquito borne diseases is the interruption of disease transmission by either killing or preventing mosquitoes to bite human beings (by using repellents) or by inducing larval mortality in a large scale at the breeding centers of the vectors. Nowadays, mosquito control is largely focused on killing of larva in their habitats using chemical or biological control agents (Shaalan 2009; Kovendan *et al*., 2012). Among these vectors, *Culex quinquefasciatus* is one of the mosquito species that are most studied because of their potential as vector of filariasis and also for the continuous biting nuisance caused to those living close to their larval habitats (Vythilingam, 2005). The geo-climatic conditions in India are conductive for the transmission of vector-borne diseases. The magnitude of the mosquito menace and prevalence of mosquito-borne diseases depend upon various factors such as developmental activities, human interference, climatic changes, availability of parasitic load in the community and socio-cultural practices (Panicker, 1986). *Culex quinquefasciatus* an ubiquitous urban mosquito breeds mainly in drains, cesspits and cesspools containing domestic effluents and such habitats are extensive and diverse (ICMR, 2000). In general, the breeding habitats of mosquito and density of their larvae and pupae vary according to the local conditions like climatic factors, physiochemical parameters, presence of predators etc., (Olayemi, 2010).

A wide variety of sites, mostly characterized by colored foul water with high nutrient values and low dissolved oxygen, such as gutter, tree holes, earthen pot, cement tank, plastic bottles, coconut shells and tyres are preferred as breeding habitats by *Culex quinquefasciatus* (Manas, 2012). However, complete and systematic information about the breeding habitats of the vector and its density in any area is essential to formulate an effective vector control strategy along with global programme to eliminate lymphatic filariasis (GPELF) which has not been given due importance in many studies (Molyneux *et al*., 2002). Hence, the presence study is intended to evolution the seasonal prevalence and container prevalence of *Culex quinquefasciatus* in South West region of Puducherry.

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MATERIALS AND METHODS

Description of the study area: The study was carried out in Puducherry, a coastal town in South India. It is located between 11°46' N and 12°15' N latitude and between 79°36' E and 79°53' E longitude. This region is a flat terrain of an average elevation of about 15 metres above the mean sea level. Tropical climatic conditions without drastic fluctuations in temperature prevail in this region. The present study was carried at Shanmukapuram, South East Puducherry from September 2012 – August 2013.

Study design: All breeding sources of *Culex quinquefasciatus* larvae were grouped into 7 different container types namely: Group A (Gutter), Group B (Tree holes), Group C (Earthern pot), Group D (Cement tank), Group E (Plastic bottles), Group F (Coconut shells), Group G (Tyres). The mosquito container surveys were conducted every month in monsoon season (Oct, Nov, Dec – 2012), post monsoon season (June, Feb, March – 2013), summer (April, May, June – 2012) and pre monsoon seasons (July, Aug, Sep – 2013).

All the breeding sources of these vectors were screened during the rainy months (Oct – Dec). The water content from all (groups A – G) containers were poured directly into an enamel tray. An enamel dipper of 300 ml capacity was used to sample water in all groups of containers. A strainer and muslin cloth (pore size < 0.5 mm) were used to strain the mosquito immature collected from these habitats. The number, type and water condition that may serve as potential breeding sites were examined and recorded. The total immature stages of *Culex quinquefasciatus* were counted and recorded. Sampling was done at weekly intervals. All live mosquito larvae were collected in plastic bags, taken to the vector control research centre (VCRC,Puducherry) and were identified up to species level using standard entomological procedures as outlined by WHO (1975) and Rattanarithikul and Panthusiri (1994).

RESULTS

Monthly and seasonal prevalence of *Culex quinquefasciatus* were analyzed in different seasons between October 2012 to September 2013. A total of 1455 *Cx. quinquefasciatus* larvae were collected from gutter, 1330 from tree holes, 1235 from earthern pot, 1202 from cement tank, 1165 from plastic bottles, 1135 and 1050 from coconut shells and tyres respectively.

There were two peaks in the prevalence of *Cx. quinquefasciatus* during pre monsoon (420) and post monsoon (390) seasons, followed by monsoon (325) and summer (320). However, the preferences of *Cx. quinquefasciatus* among seven different types of habitats studied, the gutter and tree holes were found to be significant ($p<0.05$) and coconut shells and tyres non-significant. There was a declining trend from monsoon season starting from October, November, December to summer season including April, May and June months. However, the population of *Cx. quinquefasciatus* started during the months of July, August and September hitting the second peak in January, February and March months (Table 1 & Figure 1). The two way factorial ANOVA test results revealed the seasonal prevalence and container preferences of *Cx. quinquefasciatus* such as plastic bottles, coconut shells and tyres during monsoon and summer that were significant ($p<0.05$) during pre monsoon and post monsoon seasons in tree holes, earthern pots and cement tanks. However, between the habitats they were less significant ($p<0.105$).

DISCUSSION

The prevalence of *Culex quinquefasciatus* among all the months in the studied area of Puducherry confirms earlier data from different parts of the country (Mariappan *et al*., 1994; Sabesan *et al*., 2010; Manas *et al*., 2012). The density variation between the habitats such as selected containers though not statistically significant, the high density

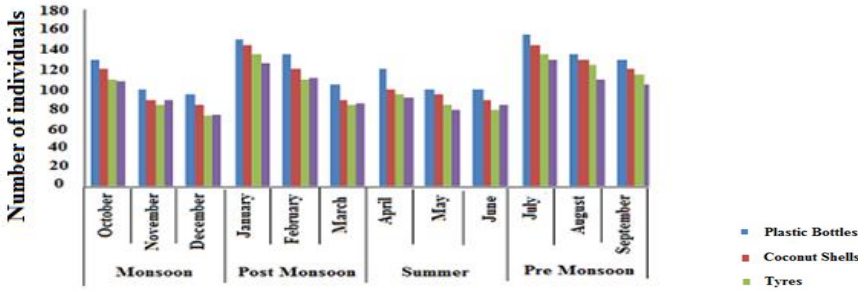

Figure 1(a): The seasonal variations in the number of *Culex Quinquefasciatus* breeding in different containers

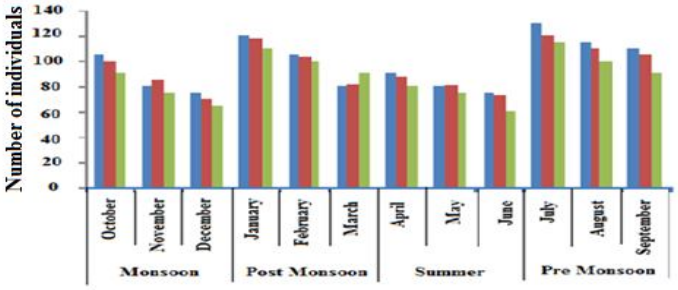

Figure 1(b): The seasonal variations in the number of *Culex quinquefasciatus* breeding in different containers

Table 1: Seasonal variations in the number of *Culex quinquefasciatus* in different containers

Season	Months	Gutter	Tree holes	Earthern pot	Cement tank	Plastic bottles	Coconut shells	Tyres
		Number of *Culex quinquefasciatus* larvae						
Monsoon	October	130*	120	110	108	105	100	90
	November	100	90	85	90	80	85	75
	December	95	85	75	76	75	70	65[a]
Post monsoon	January	150*	145	135	127	120	118	110
	February	135	120	110	112	105	103	100
	March	105	90	85	87	80	82	90
Summer	April	120	100	95	92	90	88	80
	May	100	95	85	80	80	81	75
	June	100	90	80	85	75	73	60[a]
Pre monsoon	July	155*	145	135	130	130	120	115
	August	135	130	125	110	115	110	100
	September	130	120	115	105	110	105	90
Total		1455	1330	1235	1202	1165	1135	1050
Mean		121.6	110.8	102.9	100.1	97	94.5	87.5
SE ±		240.5	208.7	91.5	82.4	56.5	42.8	32.1

*P value less than 0.05 are significant at 5% level ($p<0.05$). a - Non-significant.

of *Cx. quinquefasciatus* encounted in gutter followed by tree holes and earthern pots are attributed towards the presence of open drainage system which is running in zigzag and providing breeding ground, as the vector species prefers to breed in polluted waters. The tree holes and earthern pots that are unnoticed reveals dominant habitat with the locality-wise density variations in Puducherry. Similarly, plastic bottles, coconut shells and tyres that are dumped in the vicinity of human residences plays an important role in the density of *Cx. quinquefasciatus*. Similar results have been highlighted by Subramanian *et al*., (1999) and Sabesan *et al*., (2000).

Density variations of *Cx. quinquefasciatus* between the months including four different seasons in the studied area were significant. The first peak in larval density during July, August and September appeared to be associated with the pre monsoon showers in September months and the onset of monsoon rains in the month of October, November and December. The subsequent decline in the larval density in October, November and December may be attributed towards the flushing of drains, flooding of other breeding foci and the mortality caused due to physical imports of heavy rains during monsoon season. The population of *Cx. quinquefasciatus* started building up again in post monsoon in January, February and March months due to the cessation of heavy rain and the stagnations in the drains, cesspits, etc., followed by July, August and September months. The density gradually attained the second peak in post monsoon followed by a declined trend in April due to the drain of breeding sites and high temperature (Victor and Reuben, 1999; Chena *et al.*, 2009).

The high numbers of total *Cx. quinquefasciatus* larvae collected in the studied area, indicated that the species, once considered as a rural species is increased in distribution and colonizing in the urban pockets that were once free of these mosquito, an aspect of *Cx. quinquefasciatus* distribution that was also observed by Chavasse *et al*., (1995). In urban areas, the typical breeding sites were described as stagnant polluted water and in rural areas, mainly privies (pit latrines). The extensive distribution of breeding sites (Gutter, Tree holes, Earthern pot, Cement tank, Plastic bottles, Coconut shells and Tyres) are indicators of changes in the ovipositor behavior of *Cx. quinquefasciatus* however, pit latrines, typical of polluted habitats did not occur in the randomly selected grids. The dominance of containers as breeding sites of *Cx. quinquefasciatus* parallel to the present study have been reported earlier by Hardine *et al*., (2007). The different density patterns and impact of climatic and environmental factors (Kaul *et al*., 1968; Dhar *et al*., 1968; Rajagopalan, 1980; Dixit *et al*., 2002) on the prevalence of vector in different seasons have been studied elsewhere in India (Rajagopalan *et al*., 1977) and abroad (Subra, 1973). Temperature in Arthala (Kaul *et al*., 1968) and both temperature and humidity in Rajahmundry (Dhar *et al*., 1968) played a vital role in regulating the population density. On the contrary, the temperature did not play any role, but the physical environment appeared to regulate the population growth in Puducherry as evaluated in the present study. A clear understanding of density pattern during seasonal prevalence and container preferences in the vector mosquitoes of *Cx. quinquefasciatus* helps to plan appropriate and timely vector control measures using mass drug administration (MDA). The mass drug administration (MDA) with single dose of diethylcarbamazine (DEC) along with albendazole is been administered in Puducherry by National Vector Borne Diseases Control Programme (NVBDCP) once in the month of November every year from 2004 with the target to cover entire population of Puducherry. In the light of the present findings, showing from the high vector prevalence in the gutters of the studied area reveals the risk of auto transmission of filariasis in the studied area. It is known that the most convenient way of controlling mosquitoes is to control them in their breeding habitats. Therefore, in the light of above findings, season wise or rather a month wise vector control strategy is recommended in those habitats. Moreover different control strategy should be tried locally and habitat wise to find an effective and suitable measures.

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