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PUPAL INDEX (PI) AS A RELIABLE TOOL FOR ASSESSING ADULT POPULATION AND EARLY ADVANCE DIAGNOSIS IN DENGUE

.KALEB RAJA KUMAR[1],KRISHNAMOORTHY[2].PHILIP SAMUEL[3]

[1]*MADURAI KAMARAJ UNIVERSITY ,ICMR-NIE,CHENNAI ,INDIA*
2 ICMR-VCRC3

[3]*SCIENTIST-C,ICMR-VCRC, MADURAI, INDIA*

ABSTRACT

Objective of this study is to evaluate the Pupal productivity (a close proximity of adult population) in different geographical regions in Chennai to identify key containers to correlate transmission of dengue and dengue virus isolation from adults emerging from pupae for understanding the transovarial transmission (TOT) in nature. This Pupal Index (PI) tool was accurate, dependable and comparable, if viruses are found in asymptomatic population. Epidemiologically, pupae per person have been proposed as a measure of entomological risk for DENV transmission. In this study Pupal production in different geographical regions in Chennai was done to identify key containers to correlate the transmission of dengue. Discarded tires discarded containers storage drums had an especially high positivity rate for larvae and pupa of Aedes mosquitoes.

Key words: Dengue vector, pupal index,transmission , control.

Introduction

The *Aedes aegyptii*mosquito is responsible for the transmission of many arthropod-borne viruses (arboviruses), including dengue virus, yellow fever virus, Zika virus, and chikungunya virus [1]. Pupal Index (PI) of Aedes*aegypti* in the containers will be proxy to the number of adults.(2)

Ae.*aegypti* (Linnaeus) is currently distributed in urban areas and usually breeds in indoor and outdoor settings in a wide variety of natural and artificial water-holding containers such as plastic tanks, leaves, water storage jars, cement tanks, flower vases, curing tanks, glasses, rubber tires, and plastic bottles. Breeding habitats in urban areas arise mostly from neglected areas of construction sites and stagnant water that can create favorable conditions for mosquitoes to breed [2, 3]

The likelihood of Aedesmosquito mediated outbreaks can be predicted by the use of risk indices such as the house index (HI), container index (CI), and Breteau index (BI) [2].

These indices are based on the simple determination of the presence or absence of Aedes mosquito larvae either in individual containers or somewhere in each house. These indices indicate the presence of Aedes mosquitoes and the potential risk of arboviruses and can be used to deploy appropriate interventions for the control of arboviral infections [3].

Methodology

At this study Alandur area of Chennai is divided in to four zones ie North ward no 158 ,South ward no 164 West ward no 157 and East ward no 156 and each zone have two clusters (sub -divisions) and each cluster will have 100 houses (same house throughout the study) identified for the study (800 households in total) Eight hundred sample houses from four zones East ,West ,North , and South of Western Chennai ie…Four wards East zone156 (cluster 64 & 74), West zone 157 (cluster 99& 104), North zone 158 (116 & 120) , South zone164 (142 &155) of Polichalur/ Mouliwakkam locality and both lies beside the banks of river Adayar were chosen for study as the dengue fever cases were observed in these parts earlier and Same house was visited frequently in every week end to get adequate and authentic immature survey. Polichalur is in the latitude $12^0$59.29' N and .080^0 08.52'E with the altitude of 15m. Immature collections were done monthly 4- to 5 times from June 2016 to May ,2017 in the domestic and peri-domestic area of the chosen household.

All kinds of breeding habitats in the study areas like overhead tanks, curing tanks, plastic containers (tubs/ drums/ tanks, iron drums) in and arouind the premises were screened for the presence of immature stages of Aedes mosquitoes. Total count of pupae made in each container could be grouped for estimation. All pupae have to be brought to the laboratory to keep emergence for identifying species.Adults *Aedes* species both males and females have taken for virus isolation All larvae and pupae were reared to adult stage for species identification Both immature and mature stages of Aedes mosquitoes were collected. The larval collections were made from each locality with the help of flash-light, by dipping and pipetting methods (WHO,2009)(7).

.Meteorological data that was prevailing was obtained from meteorology department.

*Stegomyia*indices *viz.*, house index (HI), container index (CI) and Breteau index (BI) were calculated in addition to pupal index was also calculated as per the protocol.

Results.

Entomological collections in the selected clusters were completed in wet and dry seasons.Dengue cases observed in City and Sudy areas were recorded .(able 1) Altogether *Ae.aegypti* immature were found in different types of water holding receptacles, of these commonly observed were cemented tank (CT) and cisterns (CC), plastic container (PC) and metal containers (MC), Plastic drum (PD) and metal drums (MD) which were used to store the potable water during wet season (Table 2). Habitat wise analysis shows that CC/CT has significantly higher pupal production than other habitats indicating that these relatively larger capacity holding between 20 and 200 liter of water containers are perennial, potential habitats, although these constitute only about a less of the total containers examined. People store water in smaller containers (plastic/metal) having capacity of about 10-15 liter of water, which constitute more proportion of the containers surveyed. However, *Ae.aegypti* infestation rate was extremely low and pupal production was also very low in these small containers (< 20 lit, capacity) indicate that these having least role in the proliferation of dengue vector *Ae. aegypti*in the study area.

Discussions.

A total of 800 houses were surveyed in the selected four zones during wet season and 19.45 % of houses were positive for *Ae. aegypti* larval stages and pupal stages. (Fig 6) A total of 1250 water-holding containers were analyzed, of which 5.3% were positive for *Ae. aegypti* larvae and pupae. The analysis showed regarding indoor containers cemented containers were found highly potential when compared to plastic and metal containers. (Fig 7) The other bigger water storage containers like drums (PD/MD) have also a role to play because the relative pupal production was generally higher than other containers. Habitat wise analysis shows that indoor big size containers have significantly higher pupal production than other miscellaneous habitats in all the clusters surveyed, indicating that these relatively larger capacity containers are perennial, potential habitats (Fig-4)

The most productive breeding habitats were found to be CT/CC, DC, drum and grinding stones which produced >80% of total pupae. The other containers namely plastic pot and mud pots commonly used by the community (prevalence rate was 66.90) to store potable water produced only around 10% of pupae.

The habitat wise container positivity sources of water, containers with lid, shade level, vegetation in breeding habitats and indoor/peri-domestic location of the habitats is shown (Fig 7). *Ae.aegypti* immature were found in different types of receptacles, of these commonly observed were cemented tank (CT), cement cisterns (CC), plastic container (PC) and metal containers (MC), Plastic drum (PD) and metal drums (MD) which were used to store the potable water during wet season (Fig 2). The total number pupae collected during dry season were lesser than the rainy season.Habitat wise analysis shows that indoor big size containers have significantly higher pupal production like rainy season than other miscellaneous habitats in all the clusters surveyed, indicating that these relatively larger capacity containers are perennial, potential habitats (Fig 3, 4 ,& 7). These containers can be defined as key containers.

Mean number of pupae per positive containers for different containers ranged from 1.0 (flower vase) to 84.0 (DC) (fig7 & 8). . The most productive breeding habitats were found to be CT/CC, DC, drum which produced >85% of total pupae. Bigger size containers like cemented tank/cistern; drums were found highly potential when compared to plastic and metal containers because the relative pupal production was higher than other containers. . The salient findings were mean number of pupae was high in rain water containers in rainy season and containers without any lids were found more supportive for Aedesbreeding.

Conclusion

The ecological factors of Chennai city highly favorable for the transmission of dengue virus and breeding of dengue vectors. Its proximity to the sea gives it a hot and humid climate for most of the year. Lack of natural water system (70% of the population depends metro water) and irregular water supply lead to water storing practice in plenty of water holding containers with stored water. Inadequate water management system, moderate relative humidity throughout the year, intermittent rainfall from May-December, improper solid waste disposal contributed to the perennial breeding of dengue vectors and transmission of dengue virus.

Table-1

Dengue cases and (death) reported in Chennai (Jan 2016 to Dec 2016)

Season	East	West	North	South
Hot and Dry April – June	34 (1)	22 (2)	17 (2)	16 (1)
Hot and Wet July to September	42 (3)	38(4)	12	12
Cool and Wet October – December ‘	38 (2)	48 (6)	32(2)	23 (1)

Source : Chennai Corp.

Jan – Mar : Nil case

Table 2

Comparison of *Aedes aegypti* breeding in indoor and outdoor (peridomestic) habitats

Zone	Ward	INDOOR			OUTDOOR		
		No.of Container Examined	Positive Container	CI	No. of Container Examined	Positive Container	CI
East	64	281	1	0.36	1106	49	4.43
	74	387	4	1.03	821	41	4.99
West	99	733	12	1.64	797	49	6.15
	104	219	12	5.48	945	51	5.40
North	116	502	19	3.78	796	56	7.04
	120	521	3	0.58	848	49	5.78
South	142	639	14	2.19	678	27	3.98
	155	562	11	1.96	619	21	3.39
	TOTAL	**3844**	**76**	**1.98**	**10282**	**639**	**6.21**

Table 3

Breeding habitats of *Ae. aegypti* in different season

Type of containers	Avg. No./100 houses	Avg. +ve	Avg. No. +ve in dry season	Avg. No +ve in wet season
arge size (>25lt)				
C/CT	20	30.20	27.90	33.00
letal / Plastic drum	93	6.40	5.90	6.90
mall size (<25lt)	560	0.80	0.73	0.94
iscarded container	13	28.50	6.25	36.73

Fig1

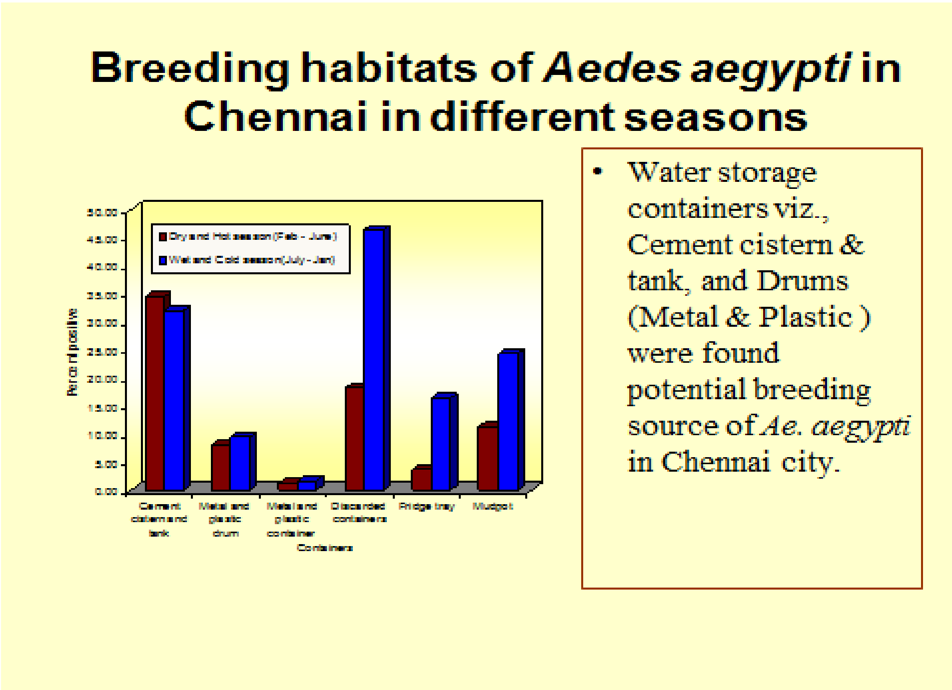

Breeding habitats of *Aedes aegypti* in Chennai in different seasons
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Percent positive
Dry and Hot season (Feb - June)
Wet and Cold season (July - Jan)
Cement cistern and tank
Metal and plastic drum
Metal and plastic container
Discarded containers
Fridge tray
Mudpot
Containers
• Water storage containers viz., Cement cistern & tank, and Drums (Metal & Plastic) were found potential breeding source of *Ae. aegypti* in Chennai city.

Fig 2

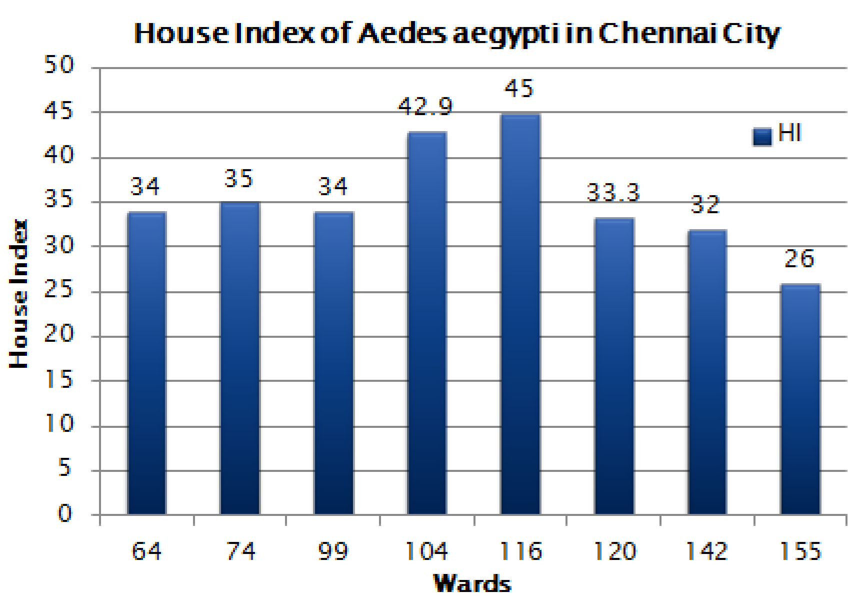

House Index of Aedes aegypti in Chennai City
50
45
40
35
30
25
20
15
10
5
0
House Index
34
35
34
42.9
45
33.3
32
26
HI
64
74
99
104
116
120
142
155
Wards

Fig 3

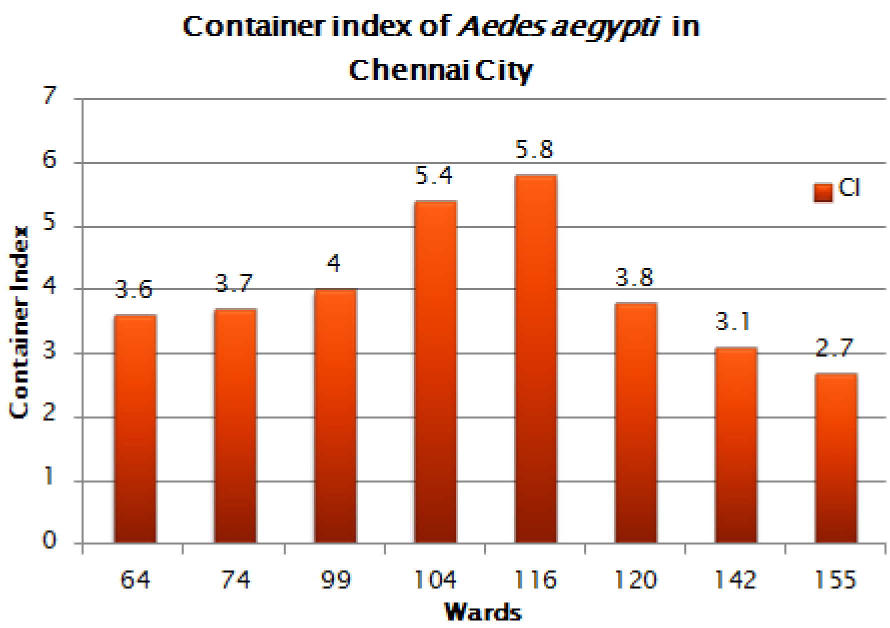

Container index of *Aedes aegypti* in Chennai City
Container Index
Wards
CI
0
1
2
3
4
5
6
7
3.6
3.7
4
5.4
5.8
3.8
3.1
2.7
64
74
99
104
116
120
142
155

Fig 4

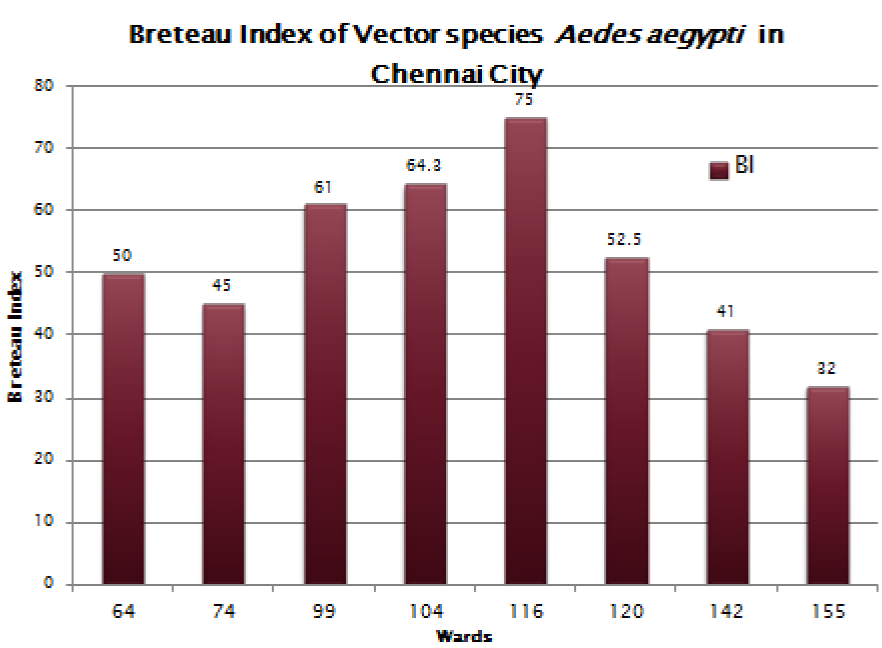

Breteau Index of Vector species *Aedes aegypti* in Chennai City
Breteau Index
Wards
BI
0
10
20
30
40
50
60
70
80
50
45
61
64.3
75
52.5
41
32
64
74
99
104
116
120
142
155

Fig 5

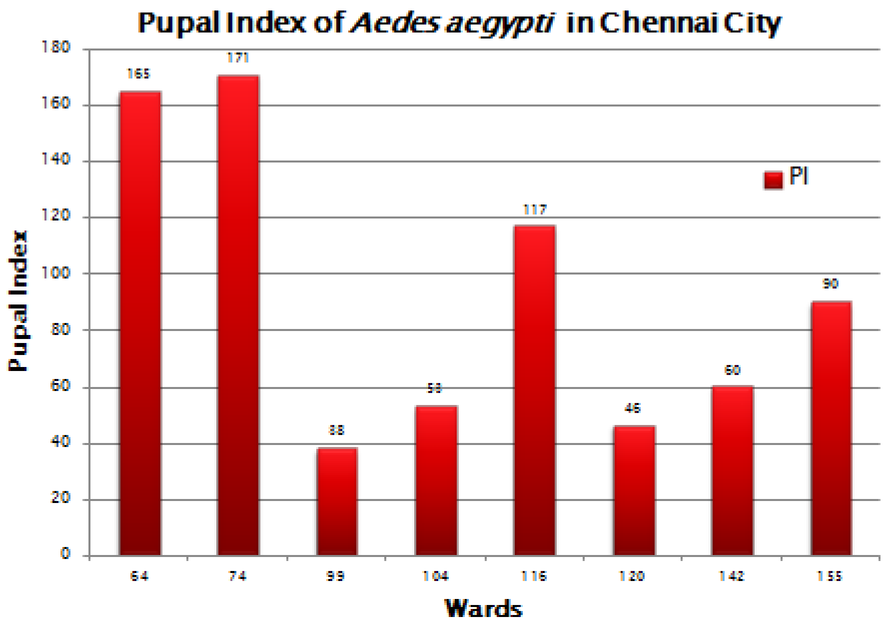

Pupal Index of *Aedes aegypti* in Chennai City
Pupal Index
Wards
PI
180
160
140
120
100
80
60
40
20
0
165
171
38
53
117
46
60
90
64
74
99
104
116
120
142
155

Fig 6

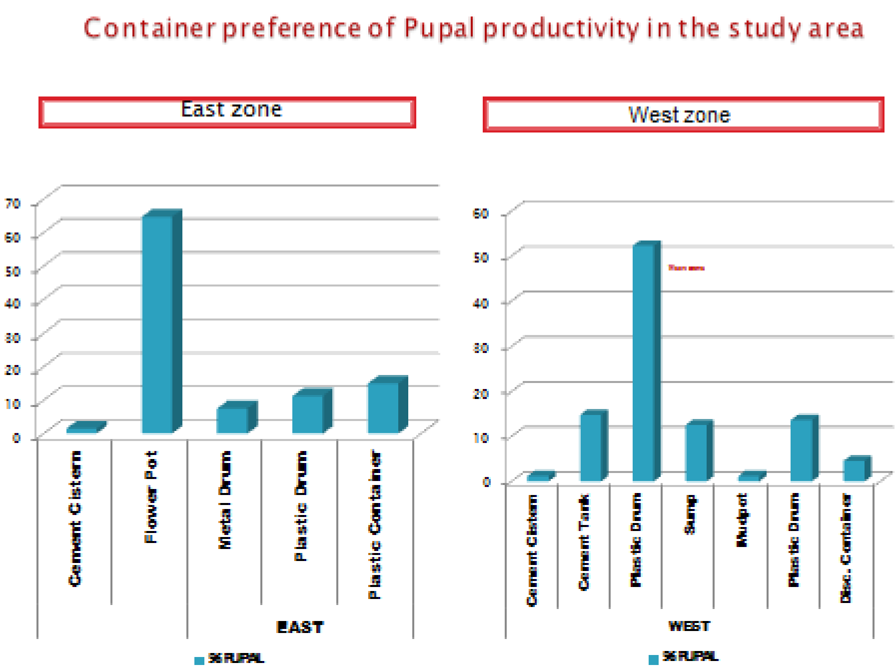
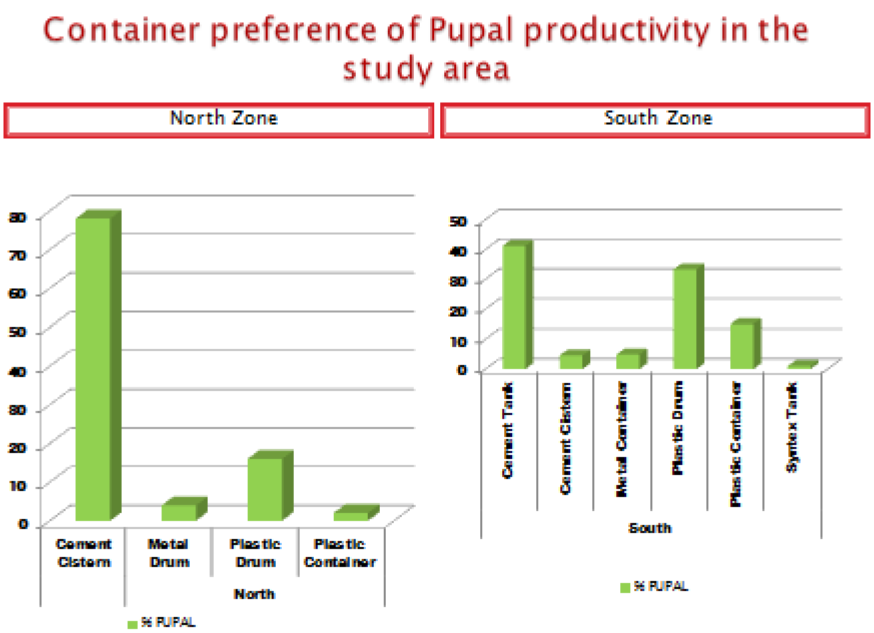

Container preference of Pupal productivity in the study area
East zone
West zone
70
60
50
40
30
20
10
0
Cement Cistern
Flower Pot
Metal Drum
Plastic Drum
Plastic Container
EAST
% PUPAL
60
50
40
30
20
10
0
Cement Cistern
Cement Tank
Plastic Drum
Sump
Budget
Plastic Drum
Disc. Container
WEST
% PUPAL

Fig 7



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