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Studies on the Breeding of Aedes aegypti, the vector of Dengue/DHF in Urban Arid Areas of Western Rajasthan

KEYWORDS: Breeding sites, Aedes aegypti, Dengue/DHF, Anti-larval

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ABSTRACT *Dengue fever has re-emerged as an increasingly significant global health threat amid diminishing resources pledged for its control in developing nations. Controlling its mosquito vector Aedes aegypti is of public health importance because, at present, its control is the only means to stop dengue virus transmission. Efforts to limit breeding of vector are often insufficient for preventing dengue epidemics due to insufficient knowledge of breeding places. To improve control efficiency and cost-effectiveness, some advocate eliminating or treating only highly productive containers. To identify and targe the most productive dengue vector breeding sites in urban arid situations, the present study was carried out in three seasons i.e. Pre Monsoon, Monsoon and Post Monsoon. Three breeding sites i.e. Ground Cement Tanks, Ground Plastic Drum and Coolers altogether contributed 76.5 per cent container positivity, which is an important finding and may be considered while formulating anti-larval control strategy for the area. The findings also suggest to strengthened the control efforts during July month to reduce the container positivity and vector population in the following months.*

INTRODUCTION

Aedes aegypti is a common domestic vector mosquito, which lives in close association with and shows preference for feeding on humans, even when other hosts are available and is an efficient epidemic vector of several human diseases, including dengue fever, Chikungunya, and yellow fever due to its high degree of susceptibility to virus infection. *Aedes aegypti*, is widely present in India including the Thar desert in north-western Rajasthan. *Aedes aegypti* is a highly adapted container and household-breeder and preferably breed in artificial collections of water.

Control of Aedes *aegypti* is challenging because it is well-adapted to the domestic environment. The females deposit their eggs in a wide assortment of man-made containers, ranging from water storage drums to discarded bottles and cans, making exhaustive larval control impractical in most cases. The dengue virus transmission can be controlled or prevented only through suppressing mosquito vector populations (WHO, 2009) and preventive measures rely entirely on vector control, the most effective method for reducing disease transmission in urban and semi-urban areas of the world.

In India Dengue infections generally occur during or after rains along with the rise in the vector *Aedes aegypti* population and the dengue control programme is organised to check the breeding sites and reduce the immature and adult *Aedes aegypti*. In order to achieve sustainability for a successful dengue/DHF vector control programme, the focus is essentially diverted on the implementation of anti-larval measures using both safer larvicides and larval source reduction methods, focussing on the key containers which produce larvae in large numbers round the year. To investigate the prevalence of container breeding mosquitoes with emphasis on the seasonality, larval habitats and the breeding behaviour of *Ae. aegypti* in summer, monsoon and post-monsoon months, the present study has been carried out in Jodhpur city of Rajasthan state

METHODOLOGY

The study was carried-out in Jodhpur city, located in the western part of Rajasthan and is considered as the gateway to the Thar desert. Extreme of heat in summer and cold in winter are the characteristics of the this area. The temperature varies from 49° in summer to 1 degree in winter. There is scarcity of water and food throughout the year. So the common people store large amount of available water in the man-made artificial containers which serves as potential breeding sites for the dengue vector.

Pratap Nagar, a Housing Board colony, located in the peripheral area of Jodhpur city was selected for the investigations and the locality is less congested and sparsely populated. The majority of the houses were pucca with separate facilities for cooking, bathing and toilet purposes. The breeding sites of *Ae. aegypti* were detected in the domestic conditions located both inside and outside the houses. Prevalence of the *Ae. aegypti* was ascertained in the area by collecting information on breeding habitats, type of containers found positive for breeding, location of positive containers, etc. Entomological surveys were conducted month-wise in all three seasons- Pre Monsoons (May and June), Monsoons (July and August), Post Monsoons (September). Houses were selected randomly for the experiment purpose. Domestic water containers, present in the locality, were examined for the detection of immature stages of the *Ae. aegypti*. Different types of water containers made up of various materials placed at different locations in the house-holds (HHs), were identified as Underground Cemented Tanks, Overhead Syntex Plastic Tanks, Ground Cemented Tanks, Overhead Cemented Tanks, Ground Plastic Tanks, Ground Plastic Drums, Clay Pitchers, Metallic Pots, Coolers and Cow Pots.

RESULTS

13 types of domestic water containers, made up of various materials and placed at different locations were identified as Underground Cemented Tanks, Overhead Syntex Plastic Tanks, Ground Cemented Tanks, Overhead Cemented Tanks, Ground Plastic Tanks, Ground Plastic Drums, Clay Pitchers, Metallic Pots, Coolers and Cow Pots.

The breeding was detected in Underground Cemented

Tanks Overhead Syntex Plastic Tanks, Ground Cemented Tanks, Overhead Cemented Tanks, Ground Plastic Tanks, Ground Plastic Drums, Clay Pitchers, Metallic Pots, Coolers and Cow Pots (Table 1). Maximum number of positive containers were made up of cement (57.6%), followed by metal (23.6%), plastic (16.6%) and clay (2.1%). The highest container positivity was found of Ground Cemented Tanks (11.2%) and minimum of Clay Pitchers (0.1%). The Ground Plastic Drums and Coolers were other breeding sites which were found positive during all the study months. The relative positivity of breeding containers was found highest in case of Ground Cemented Tanks (45.8%), followed by Coolers (21.5%), Ground Plastic Tanks (7.6%) and Drums (7.6%), Underground Cemented Tanks (6.9%), Overhead Syntex Plastic Tanks (4.9%), Ground Metallic Pots (2.1%), Clay Pitchers (1.4%) and Cow Pots (0.7%). The ground Cemented Tanks were found highest positive during September (13.5%), followed by August (12.2%), July (11.8%), June (9.2%) and May (8.3%) months and the Ground Plastic Tanks also followed the same patterns (Table 1).

Table1: Month-wise positivity of different domestic containers in the study area.

Type of containers	Month-wise positivity of different containers					Total	Relative Percentage (%)
	May	June	July	August	September		
	Examined/ Positive	Examined/ Positive	Examined/ Positive	Examined/ Positive	Examined/ Positive	Examined/ Positive	
Underground Cemented Tank (Tanka)	32/00	35/00	34/00	44/04 (9.1%)*	56/06 (10.7%)	201/10 (4.9%)	6.9
Overhead Syntex Plastic Tanks	66/00	71/01 (1.4%)	70/00	107/00	104/01 (0.96%)	418/02 (0.4%)	1.4
Ground Plastic Tanks	38/01 (2.6%)	31/01 (3.2%)	26/01 (3.8%)	27/04 (14.8%)	26/04 (15.4%)	148/11 (7.4%)	7.6
Ground Cement Tanks	96/08 (8.3%)	120/11 (9.2%)	93/11 (11.8%)	148/18 (12.2%)	133/18 (13.5%)	590/66 (11.2%)	45.8
Overhead Cement Tanks	76/00	78/00	82/00	120/03 (2.5%)	121/04 (3.3%)	477/7 (1.5%)	4.9
Ground Plastic Drum	84/03 (3.6%)	81/01 (1.2%)	77/03 (3.9%)	78/03 (3.8%)	70/01 (1.4%)	390/11 (2.8%)	7.6
Ground Plastic Tubs	640/00	604/00	638/00	804/00	787/00	3473/00	0.0
Clay Pitchers	519/00	544/00	533/01 (0.2%)	679/00	690/01 (0.1%)	2965/02 (0-1%)	1.4
Ground Metallic Pots	183/00	210/00	190/00	239/00	235/03 (1.3%)	1057/03 (0.2%)	2.1
Coolers	92/03 (3.3%)	94/01 (1.1%)	104/05 (4.8%)	152/13 (8.6%)	157/09 (5.7%)	599/31 (5.1%)	21.5
Cow Pots	6/0	6/0	6/1 (16.7%)	6/0	4/0	28/01 (3.6%)	0.7
Bird Pots	8/0	7/0	10/0	9/0	8/0	42/00	0.0
Iron Tanks	4/0	4/0	4/0	4/0	0/0	16/00	0.0
Total	1842/15 (0.81%)	1881/15 (0.79%)	1864/22 (1.18%)	2414/45 (1.86%)	2391/47 (1.96%)	10392/144 (1.39%)	99.9

***Percentage**

The records of Fourth Instar Larvae (L-4) and Pupae (Table 2), which are epidemiologically important stages, in different breeding sites revealed that were recorded highest in Ground Cemented Tanks (47.1 & 55.4%), followed by Coolers (22.9 & 20.3%) and Ground Plastic Drums (9.2 & 11.5%). The Ground Cemented Tanks, Coolers and Ground Plastic Tanks alone contributed 68.7 per cent L-4 Larvae and 87.2 per cent pupae, which is an important finding for the study area and indicates that if only these breeding sites are targeted during the control measures the majority of the Aedes population can be eliminated.

Table 2: Relative prevalence of L-4 Larvae and Pupae in different breeding sites in study area.

Type of Container	**L-4 Larvae**		Pupae	
	No.	Relative Percentage (%)	No.	Relative Percentage (%)
Underground Cemented Tank (Tanka)	99	6.8	15	3.8
Overhead Syntex Plastic Tanks	25	1.7	02	0.5
Ground Plastic Tanks	85	5.8	15	3.8
Ground Cement Tanks	689	47.1	221	55.4
Overhead Cement Tanks	65	4.4	17	4.3
Ground Plastic Drum	135	9.2	46	11.5
Ground Plastic Tubs	00	0.0	00	0.0
Clay Pitchers	15	1.0	00	0.0
Ground Metallic Pots	10	0.7	02	0.5
Coolers	335	22.9	81	20.3
Cow Pots	05	0.3	00	0.0
Bird Pots	00	0.0	00	0.0
Iron Tanks	00	00	00	00

DISCUSSION

It is apparent from the studies that in desert areas, due to shortage of water, the people have tendency to store water for a prolonged period, which in turns supports and enhances the breeding of container breeding mosquitoes. In the study area the domestic breeding sites like Ground Cement Tanks, Ground Plastic Drum, Ground Plastic Tanks and Coolers, reported positive during all the part of the study, supposed to be key supposed to be key containers of the area. Joshi *et al.*, (1996) and Tyagi (1994) also found that *Aedes aegypti* was collected from the Thar desert only from townships and /or desert fringe areas in the vicinity of urban environment, breeding mostly in household pitchers and cement tanks.

Three breeding sites i.e. Ground Cement Tanks, Ground Plastic Drum and Coolers altogether contributed 76.5 per cent container positivity, which is an important finding and may be considered while formulating anti-larval control strategy for the area. Tun-Lin *et al.* (1995) reported from Charters Towers that rain water tanks as the key containers were responsible for the production of 60-63 per cent of the immature forms. Favier *et al.*, 2006 advocated that some premises and container types, particularly at risk and suitable for breeding should be focussed for reducing Aedes population.

The breeding positivity of the containers also revealed that the control measures may be strengthened in the study area during July month to reduce the positivity of the containers which were reported high during August and September months.

The studies revealed that the choice of oviposition site can be exploited for vector control by limiting the production and number of adults as during the study it was observed that there occurs a certain degree of stability with regard to positive premises as well as some container types, contributing disproportionately to the *Ae. aegypti* production. The findings could make the control programmes more efficient if the efforts are concentrated on the sites of key vector productivity.

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