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Prevalence of *Aedes* mosquitoes in various localities of Gadchiroli district of Maharashtra state, India

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Abstract
Entomological investigations were carried out in various localities of Gadchiroli district of Maharashtra state, India, during November 2014 with a view to study the prevalence of *Aedes* species and to identify high risk areas in the town prone to dengue/ DHF outbreak. A total of 267 houses and commercial premises were randomly searched for *Aedes* breeding. Of the total houses surveyed, *Aedes* breeding could be detected in domestic containers, water storage tanks in 116 houses. In all, a total of 2391 water containers were searched, out of which 392 were found positive for *Aedes* breeding. The overall house index (HI), container index (CI), breteau index (BI), and pupal index (PI) were 43.3, 16.4, 146.8 and 82.0 respectively. *Aedes aegypti* was the predominant species in domestic containers, while *Aedes albopictus* larvae were also observed in outdoor and peri domestic habitats. *Ae. aegypti* breeding was detected in all the localities, where dengue cases were recorded during the past 3 years. *Ae. aegypti* population was most prevalent in Gokul Nagar, Hanuman Vatika, Indira Nagar, Ram Nagar, Sneh Nagar localities - irrespective to the number of dengue cases.

Keywords: Dengue fever, *Aedes* breeding, breeding index, Gadchiroli district, Maharashtra state

1. Introduction
Dengue is a worldwide serious public health problem spread throughout the tropical and subtropical zones. It is endemic in South-East Asia, the Pacific, East and West Africa, the Caribbean and the Americas [1]. In India, dengue virus was first isolated in 1945 [2] and the first outbreak of Dengue hemorrhagic fever (DHF) in Calcutta occurred during 1963 [3] and subsequent DHF/ dengue shock syndrome (DSS) outbreak was documented in Delhi in 1988 [4]. DF, DHF and DSS has been identified as a re-emerging disease and already reported from 35 states including union territory by the National Vector Borne Disease Control Programme (NVBDCP) [5] during the last decade. A total of 75858 dengue cases with 193 deaths in 2013 and 36486 dengue cases with 92 deaths in 2014 were reported by the NVBDCP from all states of the country [5]. In Maharashtra state, 7410 dengue cases with 31 deaths in 2014 were reported by NVBDCP. Dengue and DHF are posing a problem of utmost importance to the public health of the Maharashtra state [5].

Dengue, the most common arboviral disease, is caused by four strains of dengue virus (DEN1, DEN2, DEN3 and DEN4) a member of flavivirus group in the family-flaviviridae and transmitted by female *Aedes aegypti* mosquitoes [2]. Dengue virus has also been recently detected in *Ae. albopictus*, a secondary vector of dengue [6]. Now this vector has spread to rural areas also and spreading in areas which were so far free from this disease due to increasing urban population, unplanned urbanization, rapid transportation (movement of human carriers and infected mosquitoes), unreliable water supply and storage practices [7-11]. Vector surveillance is an important tool to generate entomological data needed for control strategies [12].

Dengue has been reported in Gadchiroli district of Maharashtra state and for the first time during September to November 2012, when about 1000 fever cases were reported and among them there were 13 confirmed cases of dengue and few unreported cases also occurred. There was no entomological investigation has been carried out earlier in this regard. This is the first entomological study from Gadchiroli district that was carried out upon the request of the District Malaria Officer of Gadchiroli. A detailed entomological investigation was carried out in various dengue affected localities in different municipal wards of Gadchiroli during November 2014 with a view to study the prevalence, distribution and stratification of areas for

Aedes species. The results of the study are presented in this communication.

2. Material and Methods

2.1. Location & Geography of study area

Geographical area of Gadchiroli district is 14,412 km^2 and it is located on the north-eastern side of the state of Maharashtra. It is situated at 18.43' to 21.50' N latitude and 79.45' to 80.53' E longitude and has uneven terrain with hills, valleys and forests at different altitudes. The district has a total population of 10,71,795 (as of census 2011) [13]. The average rainfall is 1743.5 mm, temperature minimum 11.3 and maximum 47.7 °C.

2.2. Entomological survey

The entomological survey was carried out in the five localities of urban areas of Gadchiroli town and in the rural areas of nine Primary Health Centre's (Murumgaon, Karwafa, Pendhari, Malewada, Gatta, Kasansur, Godalwahi, Pernili and Kotgul) of the district Gadchiroli during November 2014. A total of 267 houses and commercial premises were randomly selected in Gadchiroli town to detect *Aedes* breeding during November 2014 as shown in table 1. All localities were selected on the basis of confirmed dengue cases reported during the previous three years. A total of 60 houses in each locality, except one locality, were visited and larval collections were made to find out the *Aedes* breeding in all the wet containers present in and around the houses. The larval collections were made simultaneously in each locality following the single larval technique [14-15]. We also surveyed the gardens and parks. All kinds of breeding habitats in the study area like cemented tubs/tanks, overhead tanks, iron and plastic drums, junk materials, desert coolers, discarded tyres etc. were screened for the presence of immature stages of *Aedes* mosquitoes and identified up to species level with the help of standard identification keys [16]. All the water containers were searched with the help of flash light and pipette, while bigger containers were searched with the help of dipper of 250 ml capacity (having white background for better visibility). The type of breeding habitats and their location were recorded. The data on larval survey were analyzed and calculated in terms of different indices like container index (CI), house index(HI), breteau index(B1), pupal index(PI) as per the procedure of WHO [15, 17].

3. Results

A total of 267 houses and commercial premises randomly were searched for *Aedes* breeding in all kinds of containers both indoors and outdoors in all the residential and commercial areas. Breeding could be detected in 116 houses. A total of 2391 water containers were searched for *Aedes* breeding, out of which 392 were found positive for *Aedes* breeding mostly *Ae. aegypti*. The overall house index (HI), container index (CI), breteau index (BI), and pupal index (PI) were 43.3, 16.4, 146.8 and 82.0 respectively (Table-1). *Aedes* larvae were recorded in all the dengue affected localities and breeding was found to vary from locality to locality, irrespective to the number of dengue cases recorded during the past three years in these localities. In all the rural areas, both the species *Ae. aegypti* and *Ae. albopictus* were found to be breeding in various water holding habitats.

Table 1: Prevalence indices of *Aedes* in different localities of Gadchiroli district of Maharashtra state

Localities searched	Houses visited	Houses positive	Containers searched	Containers positive	Pupae collected	HI (%)	CI (%)	BI (%)	PI (%)
Gokul Nagar	60	33	689	166	82	55.0	24.1	276.7	136.6
Sneh Nagar	37	7	148	9	05	18.9	6.1	243.0	13.5
Indira Nagar	60	26	512	62	18	43.3	12.1	103.0	30.0
Ram Nagar	60	09	331	24	11	15.0	7.3	40.0	18.3
Hanuman Vatika	60	41	711	131	103	68.3	18.4	218.3	171.6
Total	267	116	2391	392	219	43.3	16.4	146.8	82.0

The distribution of *Aedes* larvae and breeding preference ratio (BPR) in different type of breeding habitats is given in Table-2. Among all the habitats, highest positivity of *Ae. aegypti* larvae was recorded in constructed sites in ground level cemented tanks (3.0) followed by desert coolers (1.7), discarded tyres (1.5) and cemented tanks (1.3) respectively (Table-2). In addition, breeding of *Aedes* was also observed in broken glass- -wares (1.0) and iron drums/tubs/tanks left in open spaces in houses during survey (1.1). Ground level cemented tanks in construction site in Ram Nagar locality nearby Indira chowk and district Hospital were the most preferred outdoor habitats for breeding of *Aedes*.

Table 2: Breeding Preference Ratio (BPR) of *Aedes* in different habitats

Type of breeding habitats	Number of containers with water				Breeding Preferences Ratio
	Examined	(X %)	With *Aedes* larvae/pupae	(Y %)	BPR (Y/X)
Desert coolers	93	3.9	26	6.6	1.7
Flower pots	457	19.1	61	15.6	0.8
Earthen pots	406	17.0	49	12.5	0.7
Cement tanks	568	23.8	120	30.6	1.3
Discarded tyres	258	10.8	64	16.3	1.5
Broken glass wares	166	6.9	28	7.1	1.0
Plastic tub/drum/tanks/OHTs	130	5.4	12	3.1	0.6
Iron drums/tubs/tanks	29	1.2	5	1.3	1.1
Constructed sites (Ground level cemented tanks)	2	0.1	1	0.3	3.0
Junk materials	282	11.8	26	6.6	0.6
Total	2391		392		

4. Discussion

Observations in Gadchiroli showed the occurrence of *Ae. aegypti* in rural and urban area, thus showing the possibilities for future outbreak of DF/DHF in these areas at any time. Gadchiroli town has irregular piped water supply resulting in water storage practices for household purposes. In rural areas no such piped water supply system exists as the water taken from wells and bore wells is used for household purposes. Immature and adult stages of *Aedes* were recorded probably for the first time in all the localities surveyed within the urban and rural agglomeration of Gadchiroli. Water storage habits were found as one of the factor responsible for high *Aedes* breeding in Gadchiroli district.

Larval indices were above the critical level in almost all localities (i. e. more than 10) and cause of this seems to be the compulsion of storing water in different water containers, mostly without cover, to meet the acute shortage of water in this area; since most of people, may not be aware of the factors exacerbating mosquitoes breeding conditions. A similar observation was made earlier by Tandan *et al.* [18] in the residential area of Calcutta city and by Kalra in North, North-east and Central India [6]. Other studies conducted on *Aedes* survey in Lal Kuan Town, Nainital in Uttrakhand state, Ranchi city in Jharkhand state and Delhi state, also support this finding [19-22]. In Lal Kuan and Ranchi city *Aedes* disposition varied from area to area. Contrary to this, its breeding was equally distributed in the entire sector in Rourkela steel plant [23] and the spatial pattern of *Ae. aegypti* was studied in Ajmer [24] and Port Blair where centripetal distribution of this species was observed [25]. However, *Ae. aegypti* was recorded in manmade habitats in houses and also left open space nearby houses and construction sites of study area.

During the survey, *Ae. albopictus* breeding was recorded outdoor in some places. This may be due to adaptation of *Ae. albopictus* in manmade habitats besides restriction of natural habitats. Similarly observations on adaptation were recorded in Malaysia by Lee in 1991 [26]. Pant *et al.* (1973) reported that *Ae. albopictus* are more likely to feed outdoor as compared with *Ae. aegypti* [12]. *Ae. albopictus* may play the role in maintenance of vertical transmission or as an amplifier in dengue transmission and could be just like a bridge from monkeys to man acting as a reservoir of dengue virus. Trans-ovarian cycle of dengue virus in *Ae. albopictus* reared from viable eggs retrieved from the soil of tree holes has been reported [27-28]. Tewari *et al.* reported natural infections of dengue virus in *Ae. albopictus* reared from *Aedes* larvae collected from tree holes in south India [29]. Recently, Kumari *et al.* found natural infections in *Ae. albopictus* in Delhi [30]. The spread of both *Aedes* species in Gadchiroli should be checked before the transmission season and more attention be paid to clarify the involvement of *Ae. albopictus* in the transmission dynamics of dengue in study area.

As described earlier, major breeding of *Aedes* larvae was recorded in ground level cemented tanks (3.0) followed by desert coolers (1.7), discarded tyres (1.5) and cemented tanks (1.3). These observations suggest that source reduction programme should specifically be directed at proper disposal of these objects with special attention to contain breeding in the area for effective control of dengue and chikungunya vectors. Entomological surveillance should be undertaken effectively in the known localities and the information should be utilized to forecast the possibility of future outbreaks of dengue fever/DHF, with necessary control measures before possible dengue and chikungunya outbreaks.

5. Conclusion

It can be concluded that *Ae. aegypti* is well-established within the urban agglomeration of Gadchiroli town including rural area, with most of the areas showing high larval indices may be the probable reason for sudden spurt of dengue in this area. The preventive strategy needs to be directed towards minimizing the breeding potential of *Aedes* by adopting bottom up programme, for water management practice by individuals along with implementation of urban bye-laws as well as IEC activities are suggested for further containment to contain epidemics in future.

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