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Study of aedes larval density in Alwar district, Rajasthan, India

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Abstract
Rajasthan is one of the dengue endemic states of India. Very few studies have been published on entomological aspects of dengue in this state. Owing to water scarcity, inhabitants in desert areas overstore domestic water which leads to the persistence of dengue vectors within the domestic premises. To study the significance of entomological surveillance, the house index (HI), container index (CI), and Breteau index (BI) were determined to estimate the degree of a major dengue outbreak. The HI, CI, and BI were determined in a primary health center (PHC) in the village of Haldina, Leeli and Balana by carrying out entomological surveillance, which involved door-to-door search for immature stages of Aedes spp. mosquitoes by trained field workers. A total of 150 houses were searched for detection of immatures of Aedes mosquitoes. Infestation indices are calculated as the percentage of positive houses, or percentage of positive containers, and are used to guide control actions and to issue alerts. The Balana village were having highest larval indices i.e. house index=32, container index =15.3 and breteau index =42 followed by Leeli and Haldina villages respectively. Because no specific medicine and vaccines are available to treat dengue fever and dengue hemorrhagic fever, entomological surveillance and its significance can be used to halt the outbreak.

Keywords: dengue, *Aedes aegypti*, indices, surveillance, Alwar, Rajasthan, India

Introduction
Aedes is a genus of mosquitoes originally found in tropical and subtropical zones and is considered a highly invasive in nature which can carry a variety of pathogens that can be transmitted to humans. The species *Aedes aegypti* L. and *Aedes albopictus* (Skuse) are the primary vectors of concern worldwide. *Ae. aegypti* mosquito is the main vector that transmits the viruses that cause dengue [1]. Dengue is a mosquito-borne flavivirus found in tropical and sub-tropical regions of the world, mostly in urban and semi-urban settings. It is the fastest spreading vector-borne viral disease and is now endemic in over 100 countries, resulting in 40% of the world's population living in an area at risk for dengue [2]. According to World Health Organization (WHO) (2009) an estimated 2.5 billion people live in areas where there is a risk of dengue transmission, with about 975 million of those living in built-up areas in different countries located tropically and sub-tropically in Southeast Asia, the Americas and the Pacific globally. In India, dengue is endemic in almost all states and is the leading cause of hospitalization. Dengue fever had a predominant urban distribution a few decades earlier, but is now also reported from peri-urban as well as rural areas [4]. The expansion of dengue in India has been related to unplanned urbanization, changes in environmental factors, host–pathogen interactions and population immunological factors. Inadequate vector control measures have also created favorable conditions for dengue virus transmission and its mosquito vectors. Both *Aedes aegypti* and *Aedes albopictus* are the main competent vectors for dengue virus in India [5]. In Rajasthan state, India, many outbreaks of dengue have been reported in the past. In 2019 there were 13706 cases and 17 deaths were recorded in Rajasthan [6]. Rajasthan representing arid, semi-arid and non-arid zones, presents wide heterogeneity in terms of water storage practices. Since transmission of dengue in a household is governed by the number and type of such water-filled indoor utensils, we need to generate entomological knowledge of dengue vectors [7]. This study aims at finding out the larval indices in the three villages of Alwar, Rajasthan. The valuable data thus obtained shall be used for planning and conducting vector control activities to prevent dengue outbreak. Also the results will serve for evaluating the effectiveness of the vector control measures undertaken so far in the area.

2. Materials and Methods

2.1 Survey area

Alwar district is located in the eastern part of Rajasthan and bounded by state of Haryana in the north, by Bharatpur district in the east, by Dausa south and by Jaipur district in the west. It stretches between 27º 02' 33.21" to 28º 13' 46.14" North latitude and 76º 06' 50.32'' to 77º 15' 31.79'' East longitude covering area of 8,382.9 sq kms. The climate of the district is moderate and is part of sub-humid region. The district is having a hot dry summer and a bracing cold season. Generally, winter season begins from November and lasts up to February while rainy season from July to the first half of September. While temperature continuously rises in the season from March to June it goes down after mid - November till it declines up to the minimum in the month of January. The mean annual rainfall of the district is 668.6 mm. The district lies in the north-easterly part of Aravalli range and presents an excellent arch type of folded mountain belt. In the east and southeast, the district has an undulating topography. Alwar over the years has faced a severe shortage of water. Alwar town has a number of industrial units. Migration of labour thus poses an increased threat for malaria and other vector-borne diseases, including DF/DHF. In rural areas, water from wells, bore-wells and natural streams are used for household purposes with minimal storage practices as no such piped water supply system exists.

Balana is a Village in Sumerpur Tehsil in Pali District of Rajasthan State, India. It belongs to Jodhpur Division. It is located 68 KM towards South from District headquarters Pali. 11 KM from Sumerpur. 384 KM from State capital Jaipur. The Pali district is having whole dry and very hot in summer and cold in winter climate. January is the coldest month while May to early June is the hottest period of the year. Annual rainfall in the district is about 50 to 60 cms. During the south-west monsoon period, humidity is high. Whereas in the rest of the year, the air is dry. The average humidity percentage for the district is nearly 60 to 70 respectively.

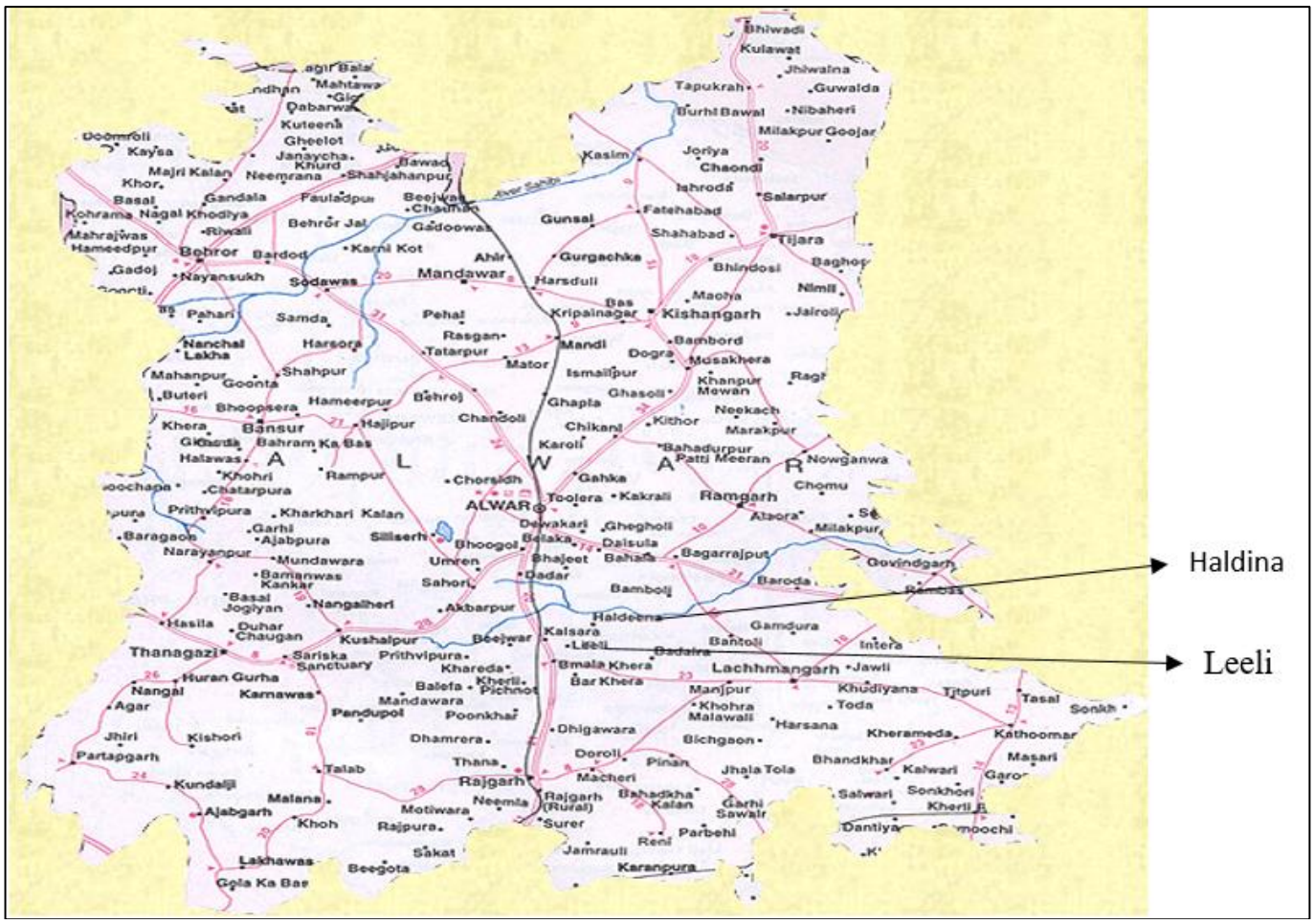

Fig 1: Map of Alwar showing study areas

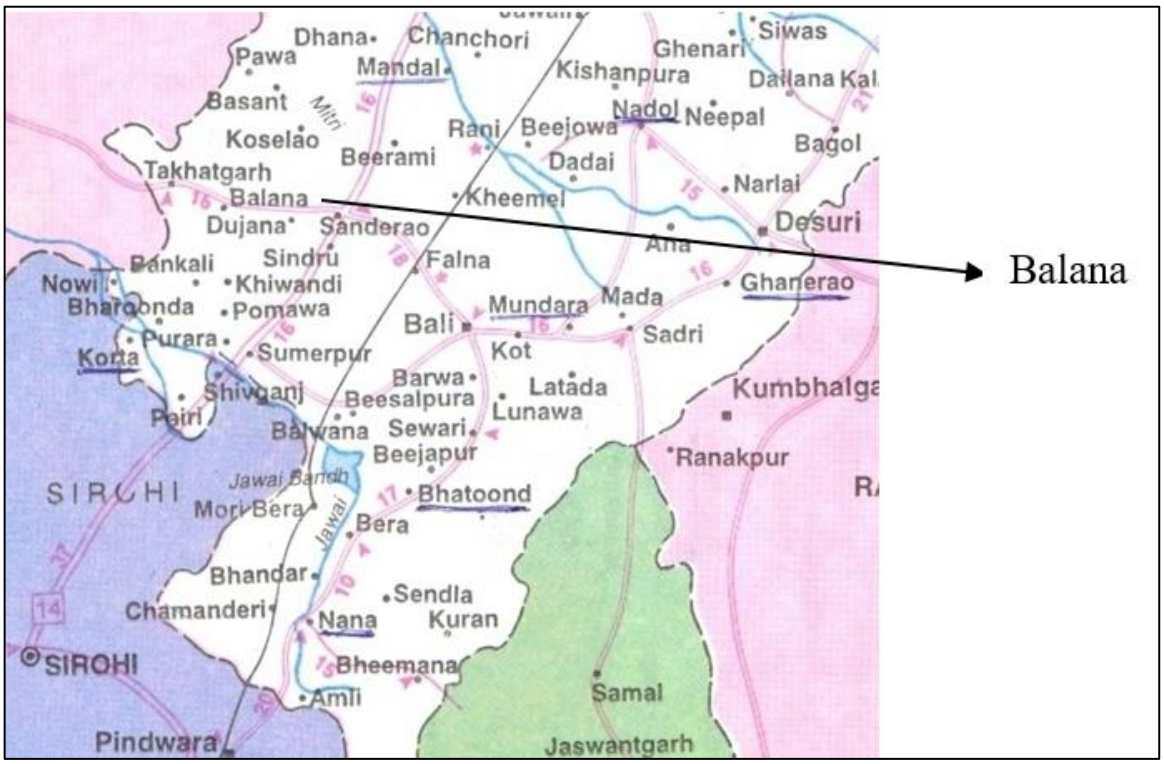

Fig 2: Map of Pali district showing study area

2.2 Entomological survey

Larval surveys were carried out in October 2020 in Alwar district, Rajasthan. Three villages *viz*. Haldina, Leeli of Alwar district and Balana village of Pali district were surveyed. The premises of the house were searched for all possible water collections and containers both indoors and outdoors after getting the consent from the head of the house. Details regarding potential mosquito breeding sites and those positive for larval presence were collected and entered on a pretested proforma. Manmade breeding habitats like coolers, cement tanks, metal containers, plastic drums, plastic containers, discarded containers, flowerpots, flower vases, tyres were searched. All containers containing any volume of water were considered as potential breeding sites. Every accessible water-holding container in and around the house was searched for the presence of immature mosquitoes. Houses with one or more positive containers were noted. The larval indices: House Index (HI), Container Index (CI), and Breteau Index (BI) were used for measuring the larval density. The data collected were recorded in the pre-arranged and pre-planned survey forms. The larval Identification was done by using standard taxonomic Keys. The data were examined and different larval indices like house index (HI) container index (CI) and Breteau index (BI) were calculated.

House Index = No. of house positive (Larval)/No. of house inspected*100

Container Index = No. of container positive/No. of container inspected*100

Breteau Index = No. of container positive/No. of house inspected*100

3. Results and Discussion

Entomological surveys were conducted in three villages of Alwar and Pali district, Rajasthan during post-monsoon season in the month of October, 2020. A total of 150 houses were surveyed from 3 villages *viz*., Haldina, Leeli and Balana and 39houses had positive breeding sources for *Aedes* mosquitoes. Artificial and natural breeding sources were examined in which out of 388 containers searched53 containers were found to support the *Aedes* mosquito breeding (Table 1). The various larval indices were calculated on the basis of positive houses and positive containers which were observed to determine the distribution dynamics of *Aedes* species and to detect the dengue prone areas. Various types of natural and artificial breeding containers were observed for immature stages for *Aedes* mosquitoes in three villages visited during the abovementioned period. Total breeding sites of *Aedes* mosquitoes including desert coolers, plastic storage, flower pots, cement tank, syntax tank, earthen pot, metallic container, pit (Table 2) were found outdoor / indoor. The most productive breeding for larval production is cement tank which is 45% positivity which is followed by syntax tank (14%), water coolers (13%), plastic storage (4%), and earthen pot (3%) (Fig. 4).

In our study the highest larval indices were found in Balana village of indices H.I-32, C.I-15.3 and B.I- 42 followed by Leeli (H.I-26, C.I-10.8 and B.I- 28) and Haldina of larval indices H.I-20, C.I- 14.7and B.I- 36which were all above the critical level and there is a risk of transmission in the areas in future (Fig.3). Due to irregular pipe water supply in these villages, water were stored in cement tanks, earthen pots and other containers in and around their houses that provide favorable habitats of *Aedes* breeding. It was observed that Aedes breeding was detected in cement containers used for providing drinking water to cattle as most of the villages have cattles in their surrounding houses. Control of mosquito by environmental management was done simultaneously during survey in which people were made to remove water holding containers in and around their surroundings. People were also

made them aware that different types of water holding containers could be the potential breeding places of *Aedes* mosquitoes which causes Dengue, Chikungunya and yellow fever. The survey was done during post-monsoon and the climate is part of sub-humid region which in turn could be the reason for more breeding of *Aedes* mosquitoes.

Since last decade Vector borne diseases are on the rise with epidemics reported in many countries. In the present study, it was assessed how different types of containers contribute to the breeding of *Ae. aegypti* and how all this knowledge may help in establishing better control strategy for *Ae. aegypti* mosquitoes [8]. A similar study to calculate larval indices was conducted in Alwar district, Rajasthan in March 2016 showed that all entomological indices were above critical level. The indices H.I=58.62, C.I=12.44 and B.I=64.66 showed high chances for outbreaks of mosquito borne diseases. Also, two key containers such as cement tanks and plastic water storage containers harbored 85.33% of Aedes. Among them, cement tanks alone contributed about one third of the positive containers of *A. aegypti* breeding [9]. Likewise a study on the 60 houses selected from three affected villages and 118 houses in the affected municipal ward in Tiruppur India found that Aedes larvae indices and adult density were above the critical level, indicating that potential outbreak would occur in the future [10]. A similar study was conducted in Alwar district, Rajasthan in 2004 in which in urban larval indices were House, Container and Breteau indices ranged from 20.0% to 36.0%, 8.5% to 27.4% and 20.0 to 60.0, respectively. Also, mixed breeding of *Aedes aegypti* and *Anopheles stephensi* was also detected in cement tanks in some areas. In comparison, the House Index was nil in rural residential areas as no mosquito breeding could be detected; however, shops in the marketplaces near the villages and their adjacent houses were found to be positive. The House/Premise Index in these localities ranged from 10.0% to 20.0%, Container Index 6.7% to 25.0% and Breteau Index from 10.0 to 20.0 only. Their larval indices in urban area were higher than our results whereas indices in rural areas were lower than our indices [11]. Another study was conducted in Tirunelveli, Tamil Nadu, India during Dengue outbreak in which the HI, CI, and BI was 48.2%, 28.6%, and 48.2% before the entomological intervention; however, after the intervention these indices were considerably reduced as the HI values were 10.2%, 5.2%, 2.5%, and 1.6% in the 2nd, 3rd, 4th, and 5th week, respectively; the CI values were 2.3%, 0.9%, 0.4%, and 0.3%, respectively; and BI values were 12.9%, 6.2%, 2.8%, and 1.6%, respectively which revealed that in the last week the indices were very low and below the critical level as compared to our study [12] Also in another study which was conducted in Tirunelveli district of Tamil Nadu, The larval indices like house index, container index, breteau index, and pupal index varied from 5.00 – 43.33, 0.87-7.50, 5.00 – 63.33 and 00 – 200.00 respectively which were higher than our study. Also the most common storage containers used by the residents of Tirunelveli were plastic drums, cement tanks, plastic containers and aluminium utensils which were found the major breeding sources which were different with our study. In our study, Aedes breeding sources were desert coolers, plastic storage, flower pots, cement tank, syntax tank, earthen pot, metallic container and pit [13]. Since *Aedes aegypti* breeds in domestic water containers, emphasis should be placed on species sanitation which can also be supplemented by stringent legislative measures [14].

On examining Table 1, which represents the results of entomological indices calculated in the villages shows high risk of transmission of the dengue due to High House Index and Breteau Index. This also shows that the application of control measures of vector is not been carried out effectively in these villages. These high indices also shows the early warning signal for the occurrence of further outbreak of Dengue & Chikungunya to be happened in these areas in near coming days.

Table 1: Larval indices of *Aedes* mosquitoes in three villages of Alwar and Pali district of Rajasthan.

Villages	No of houses searched	No of houses found positive	No. of containers searched	No of containers found positive	HI	CI	BI
Haldina	50	10	122	18	20	14.7	36
Leeli	50	13	129	14	26	10.8	28
Balana	50	16	137	21	32	15.3	42
Total	150	39	388	53			

Table 2: Details of positive containers for Aedes breeding in three villages of Alwar and Pali District.

Name of villages	Cooler searched	+ve	Plastic storage searched	+ve	Cement tank searched	+ve	Syntax tank searched	+ve	Earthen pot searched	+ ve	Metallic container	+ve	Pit	+ve
Haldina	28	3	42	2	31	12	2	-	10	1	9	-	-	-
Leeli	30	4	41	-	11	5	24	5	13	-	10	-	-	-
Balana	32	5	57	4	22	12	8	-	7	-	10	-	1	-
Total	90	12	140	6	64	29	34	5	30	1	29	-	1	-

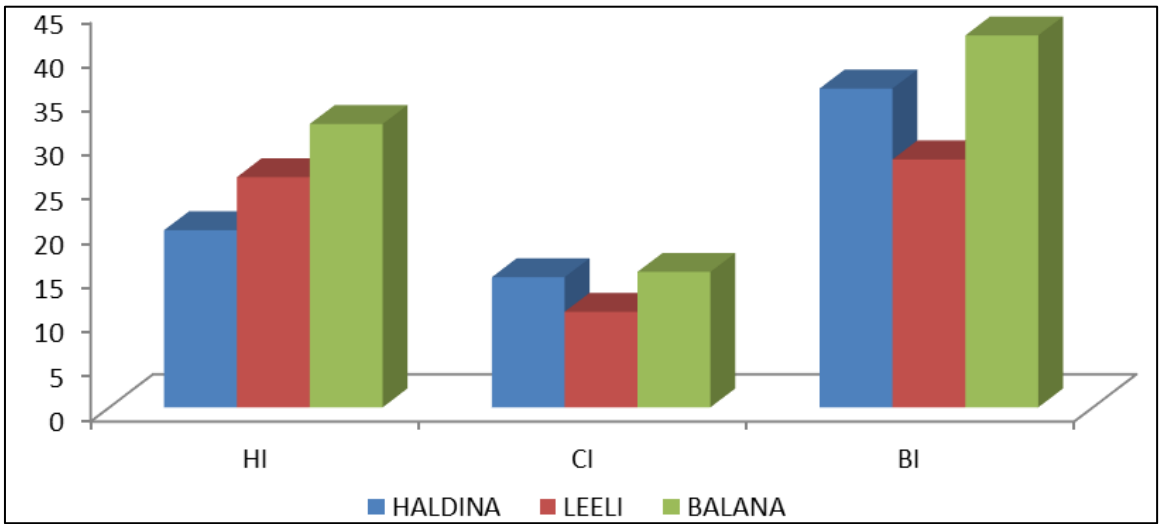

Fig 3: Details of larval density in three villages of Alwar and Pali district

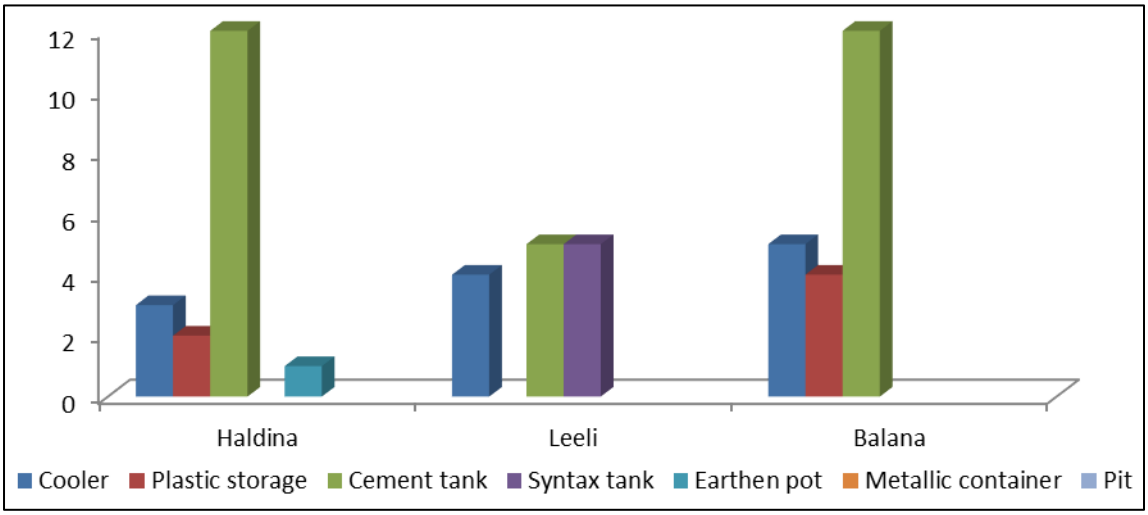

Fig 4: Details of positive breeding container of *Aedes* mosquitoes

Conclusion

This study revealed that *Aedes aegypti* is prevalent in Alwar and Pali district of Rajasthan and larval indices were above a critical level in three villages *viz*., Haldina, Leeli and Balana villages which posed high risks of Dengue transmission in these villages. Plastic containers were the most abundant and productive containers followed by coolers for Aedes mosquito breeding. For effective control control strategy, vector control through regular inspection and destruction of potential container types is recommended to prevent the dengue outbreak.

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