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Population dynamics of *Aedes* mosquito larvae from peridomestic water bodies

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Abstract
Monitoring of different types of standing water bodies was carried out from July –November during the year 2015-16 to investigate the presence of dengue vectors in artificial containers in houses and peridomestic water collections. Mosquito larval sampling was done with the help of pipette or dipper depending on the type of container. Larvae were identified morphologically and larval indices were also calculated. A total of 50 sites were monitored (30 desert coolers and 20 earthern pots and some discarded tires). Out of these 45 sites were found to have *Aedes* larvae showing 90% site positivity during 2015-2016. Maximum *Aedes* population count was recorded in the month of August while least population was recorded in the winter season (Oct – Nov). *Aedes* mosquito breeds in a wide range of artificial containers. To control these mosquitoes, the integration of different methods should be taken into consideration.

Keywords: *Aedes*, containers, monitoring, morphologically, peridomestic

1. Introduction
Mosquitoes are responsible for transmission of many medically important pathogens and parasites such as viruses, bacteria, protozoans and nematodes which spread serious diseases. Some of the world's worst life threatening and debilitating mosquito borne diseases are dengue, yellow fever and chickunguniya transmitted by *Aedes*. Globally, there were 96 million apparent instances of dengue infections and India alone contributed 34% (22-24 million) of the sicknesses in 2010. Dengue is endemic in all states and union territories (UTs) of India and a total of 99, 913 dengue cases and 220 deaths in 2016 were reported in 35 states and UTs of India [1]. Different standing water bodies like ponds, man-made reservoirs act as breeding grounds of mosquitoes. *Aedes* species breeds in peridomestic and other small water collections including desert coolers [2]. *Aedes* species present in abundance are influenced by the female behavior of oviposition, as well as their temporal space distribution, which has predominant dependency on the environment and the local climate in which they occur, with female mosquitoes searching for conditions favorable to survival of progeny [3]. Evaluation of larval mosquito habitats in terms of their species composition and population level is of paramount importance for their control. Therefore, the present study was planned to determine the population count of dengue spreading *Aedes* mosquito larvae in various temporary water collections under local environmental conditions.

2. Materials and Methods
The study was based on the monitoring of tires and artificial water containers from July-November 2015 and 2016. All containers both indoors and outdoors which might harbour mosquito larvae and pupae were inspected to determine whether they were wet or dry and to check the presence or absence of mosquito larvae and pupae. Potential containers were counted and the 3rd stage and 4th stage mosquito larvae and pupae were collected. Mosquito larvae were collected from discarded tires and other artificial containers with a plastic cup, pipette, or classical dipper. *Aedes* larvae were recognized on the basis of their morphological features by following the standard keys given by [4].

2.1 Statistical analysis
Data was statistically analyzed with the help of SPSS statistical software version 16 by comparing population indices of *Aedes* larvae recorded on monthly basis during the year 2015

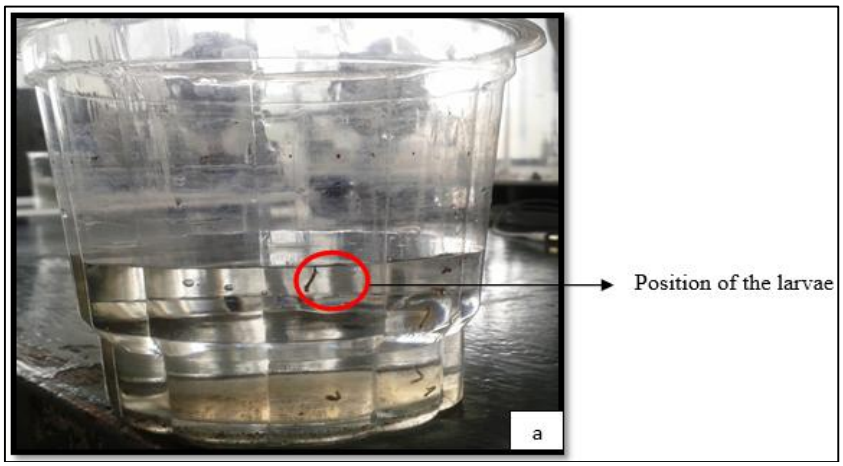
and 2016 by using one way ANNOVA (Duncun Multiple range test at 5% level of significance).

3. Results and Discussion

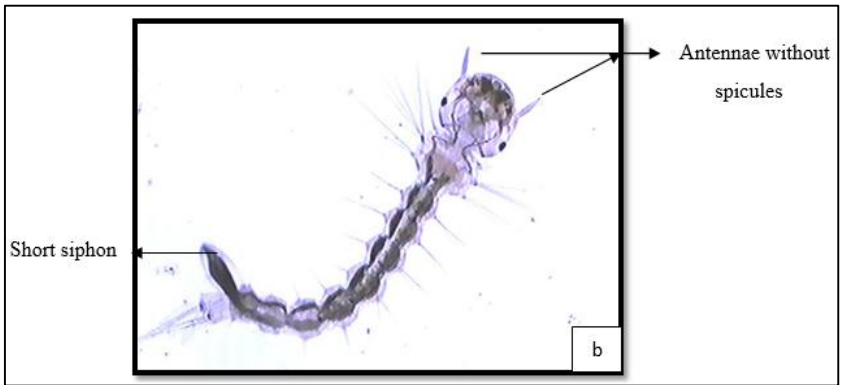
The major morphological characters taken into consideration for identification of *Aedes* larvae at genus level are given in Table 1 and Plate 1.

Table 1: Identification of *Aedes* larvae on the basis of morphological features following standard keys

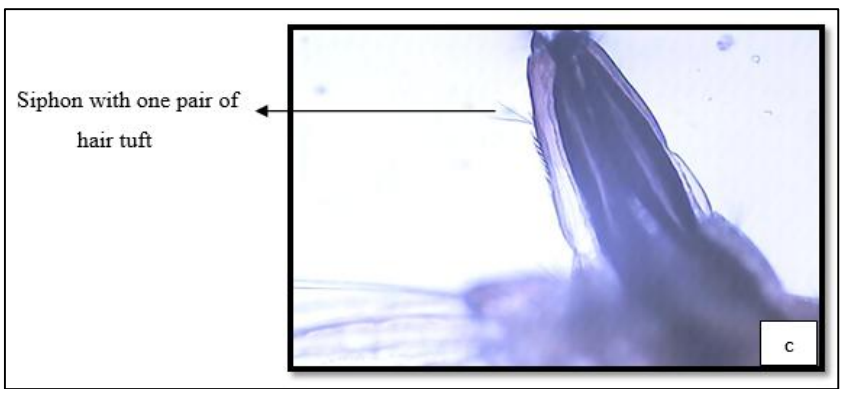
Morphological features	*Aedes* larvae
1) Position of larva	Larva lying parallel to the surface of the water
2) Siphon	Short
3) Structure of antennae	Without spicules
4) Head hair	Absent
5) Palmate hair	Absent
6) Spikes at end of anal segment	Absent



a) Position of *Aedes* larvae (making an angle to the water surface)



b) Short siphon and antennae without spicules (4x)



c) Siphon with one pair of hair tuft (10x)

Plate 1: Morphological features of *Aedes* larvae

Aedes larvae were found only in samples collected from desert coolers and earthen pots [2, 5] because *Aedes* is a freshwater mosquito, generally prefers to lay eggs in artificial containers. During the present study a total of 30 desert coolers and 20 earthen pots were surveyed and out of these 45 sites were found to have *Aedes* larvae showing 90% site positivity during 2015-2016. An average of 36.66±7.26 *Aedes* larval density/300ml was recorded in the month of July (ranging from 7-30) from the collected desert cooler water samples. *Aedes* larval density was found to be maximum in the month of August i.e. 61.33±1.55/300 ml with larval count ranging from 23-80 which then declined to 51±4.50/300 ml and 17.33±1.45/300ml in the months of September and October with larval count ranging from 25-60 and 1-15 respectively. No *Aedes* larvae were found afterwards. On the other hand, earthen pots showed an average larval density of 57±8.5/300ml in the month of July (ranging from 25-45). Maximum *Aedes* larval density i.e. 63.33±6.00/300ml (ranging from 34-85) was recorded in the month of August. September onwards decline in larval population was reported i.e. 49.33±1.20/300ml and 47.66±1.45/300ml (larval count ranging from 20-40 and 15-30) in the month of October and least larval density ranging from 5-20 (average 21.33±1.85/300 ml) was recorded in the month of November respectively (Table 2). Annual collection of water samples from village ponds of Ludhiana district revealed almost a similar population dynamics trend at all the selected sites i.e. maximum larval density in rainy season, less in summer and no mosquito larvae during extreme winter [6].

During the year 2016, average population count of *Aedes* larvae was 42.33±4.33/300 ml in the month of July (ranging from 22-45). Maximum larval density was observed in the month of August with larval count ranging from 30-80 with an average mean of 60±2.88/300ml respectively. In the month of September population count was found to be 48.66±1.85/300ml (ranging from 22-42). Least larval density was recorded in the month of October i.e. 11.66±1.66/300ml (ranging from 1-9) recorded from desert coolers. From the water samples collected from earthen pots, average larval population was found to be 55±5.00/300ml (ranging from 20-39) in the month of July. In the month of August maximum larval population was recorded with an average of 60.00±5.77/300ml (ranging from 35-83). Decline in population count of *Aedes* larvae was recorded from September onwards i.e. 50.66±3.48/300 ml (ranging from 21-50) and 48.33±0.88 in the month of October with larvae count ranging from 15-32 respectively. No population count was recorded in the month of November (Table 2). It has been also reported that containers which retained water for long periods of time make good or suitable breeding habitats for mosquitoes such as the artificial containers [7, 8]. Studies carried out by Yee *et al*. [9] showed that *Ae. aegypti* was found to be the most dominant species breeding in artificial containers. The containers were abundantly located close to human habitation and were potentially more durable than natural containers. *Aedes aegypti* prefers clean water found in many types of domestic containers inside or near human dwellings, whereas *Ae. albopictus* is more likely to be found in natural containers or outdoor man-made habitats containing a greater amount of organic debris [10]. Azil *et al*. [11] noted that the minimum and daily average temperatures were the most significant factors associated with short- and long-term vector abundance and suggested the prospective use of meteorological variables in predicting changes in the dengue-virus vector abundance. Spatial distribution and abundance of *Ae. aegypti* are related to the effects of anthropogenic changes on the environment [12].

Table 2: Population density of *Aedes* larvae/300ml in peridomestic water bodies during the year 2015-16 (July - November)

Year 2015					
Peridomestic water bodies	**July**	**August**	**September**	**October**	**November**
Desert coolers (LD/300ml)	36.66±7.26^{a}	61.33±1.85^{a}	51.00±4.50^{b}	17.33±1.45^{b}	0.00±0.00^{a}
Range	7-30	23-80	25-60	1-15	-
Earthern pots (LD/300 ml)	57.00±8.5^{d}	63.33±6.00^{b}	49.33±1.20^{a}	47.66±1.45^{c}	21.33±1.85^{b}
Range	25-45	34-85	20-40	15-30	5-20
Year 2016					
Desert coolers (LD/300ml)	42.33±4.33^{b}	60.00±2.88^{a}	48.66±1.85^{a}	11.66±1.66^{a}	0.00±0.00^{a}
Range	22-45	30-80	22-42	1-9	-
Earthern pots (LD/300 ml)	55.00±5.00^{c}	60.00±5.77^{a}	50.66±3.48^{b}	48.33±0.88^{c}	0.00±0.00^{a}
Range	20-39	35-83	21-50	15-32	-

*****Values are Mean±S.D

* LD- Larval density

* Figures followed with different superscripts indicate significant difference (p<0.05) by One way ANNOVA using Duncan multiple range test

Conclusion

As our study showed, most of the peridomestic water containers were infested with *Aedes* mosquitoes which may serve as vector of dengue disease. From this investigation, it is clear that there are many chances of mild dengue viral infection spreading in the sampling location. However, to determine whether this mosquito is transmitting disease or not by looking for the virus in the mosquitoes needs further investigation.

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