Summary
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*Aedes aegypti* is known to transmit a variety of disease causing viruses belonging to the family alphaviridae and flaviviridae, that cause Chikungunya, Ross fever, Yellow fever and Dengue/Dengue Haemorrhagic fever (DHF). Dengue viruses are now prevalent in most countries in tropical Asia, including India, Myanmar, Bangladesh and Sri Lanka. The mosquito is capable of transmitting Japanese encephalitis and chandipura viruses as well. In India, *Aedes aegypti* is the main vector of chikungunya as well as the dengue/DHF viruses which have caused serious outbreaks of the diseases mainly among urban populations.

The present studies on different biological aspects of *Aedes aegypti* were carried out in four ecologically distinct localities of Delhi viz., DCM Railway Colony, Sadique Nagar, Munirka village and Shahdara. The results are as follows:

**Prevalence of Aedes aegypti**

**Prevalence during dengue outbreak**

- During 1996, an outbreak of Dengue/DHF occurred in Delhi in which as many as 8900 cases of Dengue and 375 deaths were recorded.
The affected localities in Delhi were surveyed to find out the prevalence and density of *Ae. aegypti* by recording the House, Container and Breteau indices and to suggest suitable control measures. This entomological surveillance of *Ae. aegypti* mosquito was undertaken in 51 localities falling in five different zones of Delhi.

The larval House index in different localities surveyed varied from 20.4 to 76.0 percent in September, 0 to 58.6 percent in October, 0 to 23.0 percent in November 96. It came down to 0 to 6.6 percent during December due to unfavourable climatic conditions.

At the time of dengue outbreak, the House index was as high as 35.5 percent, it decreased subsequently and the outbreak stopped in November when the House index was less than 20 i.e., 6.6 percent and finally ended with the House index of 2.5 percent in December 1996. It may be mentioned that the House index during all the outbreaks of dengue was more than 20.

The percent study, confirms that outbreak situation of Dengue/ DHF occurs in an area where the House index is more than 20 in the Indian context.
As a general guide, WHO has described the interpretation of various *Aedes* indices in terms of Dengue transmission as under:

- Breteau index more than 50: high risk of transmission
- Breteau index less than 5: low risk of transmission
- House index more than 10 percent: high risk of transmission
- House index less than 1 percent: Low risk of transmission

**Seasonal Prevalence of *Aedes aegypti***

- The *Aedes aegypti* population starts building up in March-April and attains peak between July and September and then falls to the minimum during the winter months.
- The general population trend points to two high peaks, the lower peak in the pre-monsoon period and the higher peak in the monsoon period.
- Similarly, the first decline in the density is observed during June and the second more drastic decrease in indices is observed during December - January.
- The most risky period from the point of Dengue/DHF out break could be between August to November, depending on the monsoon activity in a particular year.
Summary

- House index in all the areas during the monsoon period has been found to vary from the minimum of 28.5 to the maximum of 33.3 during 1997 and from the minimum of 19.5 to the maximum of 30.2 during 1998.

- There is a need to study the seasonal prevalence of *Ae. aegypti* in desert and coastal areas where the prevalence of this mosquito is governed by extreme temperature, extreme rainfall and nature and variety of artificial water containers present in these areas.

**Breeding Habitats**

- During the year 1997 a total of 2782 containers of all possible types of breeding containers were searched, out of which 384 (13.8%) were found to be positive for *Ae. aegypti* breeding. During 1997 pitchers comprising of 35.4% (136) of positive breeding containers were the major breeding sites of the vector species followed by coolers 25.5% (98), cement tanks 23.4% (90), discarded tyres 5.9% (23), metallic drums 4.6%(18), money plant bottles 4.6%(18) and others 0.26%(1).

- During 1998, a total of 2341 breeding containers of all possible types were searched, out of which 291 (12.4%) were found positive for *Aedes aegypti* breeding. The pitchers comprising 46.7% (136) were the major breeding sites of the vector species.
followed by cement tanks 23.0% (67), coolers 18.9% (55), metallic drums 5.1% (15), money plant bottles 3.7% (11), discarded tyres 1.3% (4) and others 1% (3).

- The breeding of *Aedes aegypti* spreads from the Primary breeding containers (cement tanks, drums, pitchers) to secondary breeding containers (coolers, tyres, money plant bottles) during post monsoon period but again shrinks back to original primary breeding containers during winter months.

- In DCM Railway Colony and Shahdara the most preferred breeding containers were cement tanks, in Munirka village the preferred breeding containers were the pitchers but in Sadique Nagar the most preferred breeding containers were the coolers and money plant bottles.

- Thus the preferred breeding places change from locality to locality depending upon the socio-ecological conditions prevailing in those areas.

- It is suggested that the primary breeding places should be targeted in the pre-monsoon period by appropriate methodology in order to timely check the further spread of breeding places in the monsoon and post monsoon periods.
During dengue outbreak of 1996 the most preferred breeding containers during September were coolers (33.1%), followed by cement tanks (28.9%), pitchers (24.4%), drums (23.4%) and buckets (15.0%). During October 1996, the maximum breeding was detected in tyres (51.8%) followed by coolers (23.0%), cement tanks (21.0%), money plant bottles (17.8%), pitchers (17.5%), drums (15.8%) and buckets (3.5%). During November 1996, the maximum breeding was recorded in coolers (19.5%) followed by cement tanks (7.9%), drums (4.5%) pitchers (4.3%), and money plant bottle (0.9%). No breeding was detected in tyres and buckets. During December, 1996, when the outbreak subsided, the breeding which was maximum in coolers during the start of outbreak shifted from coolers to money plant bottles (5.2%) followed by cement tanks (3.1%) and drums (2.4%). No breeding was detected in pitchers, and buckets.

Some of the peculiar or unusual breeding places recorded during the survey in Delhi were tarpals on Jhuggies, underground tanks in the milk dairies, depressions on the cement shelves under the pitchers, brass flower pots containing earthen flower pots, flower pots having mud and containers placed under the air conditioners.
Summary

- *Ae. aegypti* prefers to breed in all the containers containing clean water available in the locality irrespective of their size.

**Feeding and Resting behaviour**

- Feeding activity of the species was observed by fixing 12 hour biting schedule on human bait once in every month of 1997 in DCM Railway Colony of Delhi. The mosquitoes usually attack the human bait during day time but a few mosquitoes could be collected on human bait after dusk in the rainy season. There are generally two peaks of biting activity, one occurring 3 to 4 hours after the sun rise and the other 3 hours before the sun set. The biting activity peaks seem to be controlled by the cycle of day and night.

- The feeding activity of this mosquito starts from March onwards and gradually increases and attains its peak in the month of July and in general the feeding activity is significantly enhanced in the monsoon and post monsoon period. The mosquitoes do not appear on the human bait during December to February.

- Keeping in view the feeding behaviour of *Ae. aegypti*, utmost vigilance is required against the bite of this mosquito during the monsoon and post monsoon months.
Summary

- The conditions which seem to attract the adult mosquitoes are a combination of darkness/diffused light, high relative humidity and minimum air movement.
- The adults can be easily collected on the hanging clothes in the dark corners and from under the furniture. They generally rest close to the floor. The other peculiar resting places are the wood wool of the coolers, tyres lying outside and the empty coal tar drums.

Feeding Preference

- *Ae. aegypti* is basically an active diurnal mosquito and is known to feed during the daytime on a variety of hosts ranging from cattles, dogs, pigs, birds and reptiles depending on their presence or absence in the immediate environment of its breeding sites.
- Out of a total of 387 samples tested, 304 had fed on humans (80.8%), 32 on bovines (8.5%), 17 on pigs (4.5%), 12 on goats (3.1%) and 11 on dogs (2.9%).
- The mosquito feeds on a maximum of two hosts and one of the hosts is always a human. 19 (5%) samples showed double feeding on humans and bovines, 16 (4.2%) on pigs and humans, 8 (2.1%) on humans and goats and 5 (1.3%) on humans and dogs.
From the present study it is evident that the species mainly feeds on human host. Even in the cases of double feeding, one of the host is always human. The species is thus mainly anthropophilic in nature. The bovines, pigs and goats are given only secondary preference.

No feeding was recorded on birds in the present study but outside India occasional feeding on birds has been reported.

Double feeding of *Ae. aegypti* on humans and pigs as recorded in the present studies, assumes greater importance as pigs / piglets are confirmed amplyfying hosts for Japanese encephalities.

**Aestivation of eggs**

The ability of the mosquito eggs to withstand desiccation enables the transportation of *Ae. aegypti* over long distances in dried receptacles or containers.

Percentage of egg hatching is more in the scraps taken from pitchers and cement tanks followed by tyres. The least emergence was observed in the eggs scrapped from metallic coolers.
Summary

- Survival of *Ae. aegypti* through the aestivation of eggs could be checked/controlled through thorough cleaning/scrapping of the containers before the onset of monsoon.
- The eggs stored up to 4 months show 84% hatching while those stored for two months 90% hatching. The percentage of hatching starts declining after 4th month, it was below 20% in the 8th month and only 1.6% in the 9th month.
- The eggs of *Ae. aegypti* may survive up to 3 to 4 months in the field conditions but in the laboratory the eggs can survive up to 9 months or more.

**Effect of temperature**

- The thermal ranges for the survival of *Ae. aegypti* reveal that the eggs, larvae and pupae exposed to 48°C for 5 minutes and adult mosquitoes for 10 minutes, suffer 100% mortality. The time of exposure for centpercent mortality goes on increasing with fall in temperature so that at 40°C 100% mortality occurs when the eggs, larvae and pupae are exposed for 240 minutes and adults for 220 minutes.
- Eggs exposed for 300 minutes to 20°C, larvae and pupae for 160 minutes and adults for 60 minutes suffer 100% mortality. With the lowering of temperature, the exposure period for the
stages decreases correspondingly for obtaining 100% mortality. At
0°C, the exposure required by eggs, larva and pupae for 100%
mortality is 20 minutes and for adults it is 5 minutes.

**Susceptibility Status**

- Larval susceptibility tests revealed that all the three tested
  larvicides viz., Temephos, Fenthion and Malathion induce 99%,
  99.5% and 100% mortality within 24 hours of exposure,
  indicating their susceptible status.

- The results of the susceptibility trials with adults revealed that
  the *Ae. aegypti* suffers 74% and 46% mortality with the
  standard dosages of DDT and Dieldrin respectively, showing the
  resistance of the species to these insecticides. Dosages of
  Fenitrothion and Propoxur however cause 91.0 percent and
  85.0 percent mortality respectively, indicating tolerance of the
  species to these insecticides. On the contrary, exposure of
  adults to the dosages of Malathion, Deltamethrin, Permethrin
  and Lambda-cyhalothin induce 100 Percent mortality,
  indicating that the species is susceptible to these insecticides.

- *Aedes aegypti* should be treated with recommended doses of
  Temephos (Abate) and Malathion respectively for effective
  control of *Ae. aegypti* as these two insecticides have low
toxicity for mammals.