

# Salinity-tolerant larvae of mosquito vectors in the tropical coast of Jaffna, Sri Lanka and the effect of salinity on the toxicity of *Bacillus thuringiensis* to *Aedes aegypti* larvae

Jude, P.J.<sup>a</sup> , Tharmasegaram, T.<sup>a</sup> , Sivasubramaniyam, G.<sup>b</sup> , Senthilnathanan, M.<sup>b</sup> , Kannathasan, S.<sup>c</sup> , Raveendran, S.<sup>d</sup> , Ramasamy, R.<sup>e</sup> and Surendran, S.N.<sup>a</sup>

<sup>a</sup> Department of Zoology, Faculty of Science, University of Jaffna, Jaffna 40000, Sri Lanka

<sup>b</sup> Department of Chemistry, Faculty of Science, University of Jaffna, Jaffna, Sri Lanka

<sup>c</sup> Department of Pathology, Faculty of Medicine, University of Jaffna, Jaffna, Sri Lanka

<sup>d</sup> Department of Geography, Faculty of Arts, University of Jaffna, Jaffna, Sri Lanka

<sup>e</sup> Institute of Health Sciences, Universiti Brunei Darussalam, Gadong, BE 1410, Brunei Darussalam

## Abstract

Dengue, chikungunya, malaria, filariasis and Japanese encephalitis are common mosquito-borne diseases endemic to Sri Lanka. *Aedes aegypti* and *Aedes albopictus*, the major vectors of dengue, were recently shown to undergo pre-imaginal development in brackish water bodies in the island. A limited survey of selected coastal localities of the Jaffna district in northern Sri Lanka was carried out to identify mosquito species undergoing pre-imaginal development in brackish and saline waters. The effect of salinity on the toxicity of *Bacillus thuringiensis israelensis* larvicide to *Ae. aegypti* larvae at salinity levels naturally tolerated by *Ae. aegypti* was examined. Larvae collected at the selected sites along the Jaffna coast were identified and salinity of habitat water determined in the laboratory. The LC<sub>50</sub> and LC<sub>90</sub> of *B. thuringiensis* toxin, the active ingredient of a commercial formulation of the larvicide BACTIVECr, were determined with *Ae. aegypti* larvae. Bioassays were also carried out at salinities varying from 0 to 18 ppt to determine the toxicity of *Bacillus thuringiensis* to fresh and brackish water-derived larvae of *Ae. aegypti*. Larvae of four *Anopheles*, two *Aedes*, one *Culex* and one *Lutzia* species were collected from brackish and saline sites with salinity in the range 2 to 68 ppt. The LC<sub>50</sub> and LC<sub>90</sub> of *B. thuringiensis* toxin for the second instar larvae of *Ae. aegypti* in fresh water were 0.006 ppm and 0.013 ppm respectively, with corresponding values for brackish water populations of 0.008 and 0.012 ppm respectively. One hundred percent survival of second instar fresh water and brackish water-derived *Ae. aegypti* larvae was recorded at salinity up to 10 and 12 ppt and 100% mortality at 16 and 18 ppt, yielding an LC<sub>50</sub> for salinity of 13.9 ppt and 15.4 ppt at 24 h post-treatment respectively for the two populations. Statistical analysis showed significantly reduced toxicity of *B. thuringiensis* to fresh and brackish water-derived

## Author keywords

*Aedes aegypti*; *Bacillus thuringiensis*; Dengue; Jaffna; Mosquito vectors; Salinity; Sri Lanka

## Indexed keywords

**EMTREE drug terms:** *Bacillus thuringiensis* toxin; fresh water; larvicidal agent; water

**EMTREE medical terms:** *Aedes aegypti*; animal experiment; *Anopheles*; article; *Bacillus thuringiensis*; bacterial strain; bioassay; chemical composition; controlled study; *Culex*; freshwater environment; habitat; laboratory; larva; mosquito; mosquito larva; nonhuman; salinity; Sri Lanka; tropics

**MeSH:** Aedes; Animals; Bacterial Toxins; Ecosystem; Filariasis; Insect Vectors; Insecticides; Larva; Malaria; Salinity; Salt-Tolerance; Sodium Chloride; Sri Lanka; Virus Diseases

*Medline is the source for the MeSH terms of this document.*

**Species Index:** Aedes aegypti; Aedes albopictus; Bacillus thuringiensis; Bacillus thuringiensis serovar israelensis; Japanese encephalitis virus; Lutzia