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RESEARCH

Comparative study on the larvicidal effect of some ciliated protists on *Culex gelidus*, *Culex tritaeniorhynchus*, and *Aedes aegypti* in Sri Lanka

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Abstract
Rice fields in Sri Lanka create suitable breeding places for vector mosquitoes. Such sites provide habitats for diversified naturally occurring microbiota. Ciliated protists, *Zoothamnium* sp., *Chilodonella* sp., and *Vorticella microstoma* are among such microbiota found in vector mosquito habitats especially in rice field habitats in Sri Lanka. The present study was carried out to determine the comparative larvicidal effect of these ciliated protists collected from naturally infested mosquito larvae in some rice-field habitats in Kurunegala, Sri Lanka, against vector mosquito larvae. Vector mosquito larvae, *Culex tritaeniorhynchus*, and *Culex gelidus* were reared in the laboratory from field-collected water samples while *Aedes aegypti* mosquito larvae were reared using egg sheets, for the laboratory bioassays. *V. microstoma* showed the potential for infection and mortality of *Cx. tritaeniorhynchus* larvae (71.33% ± 5.23). Results revealed a minimum of 1000 V. *microstoma* is required to kill a single third instar larva of *Cx. tritaeniorhynchus* at 69.60 ± 2.40 h of exposure. *Cx. gelidus* larvae showed 41.33% ± 3.43 mortality due to *V. microstoma* infestation. However, none of the ciliates were effective against *Ae. aegypti* larvae. *Chilodonella* sp. was very occasionally reported during this study hence was not possible to the mass rear for experimentations. This study concludes that *V. microstoma* is an effective ciliated parasite of *Cx. tritaeniorhynchus* larvae. Due to their effectiveness and eco-friendly nature, this species can be developed as an effective bio-controlling agent against *Cx. tritaeniorhynchus* mosquito species.

Keywords *Chilodonella* · *Culex* · Epibiont · *Vorticella* · *Zoothamnium*

Introduction

Rice fields in Sri Lanka create suitable breeding places for vector mosquitoes because they keep accumulating irrigated or rainwater for cultivation. Six species of *Culex* mosquitoes namely *Culex bitaeniorhynchus*, *Culex psuedovishnui*, *Culex gelidus*, *Culex quinquefaciatus*, *Culex tritaeniorhynchus*, and *Culex fuscocephala,* have been recorded from rice fields and surrounding irrigational canals (Peiris et al. 1992; Amerasinghe et al. 1998). In marshlands, *Cx. gelidus* occur in higher densities (Amarasinghe and Weerakkodi 2014). Floating plants and vegetation in such habitats provide ideal conditions for their breeding (Hasegawa et al. 2008). *Mansonia* species which is the vector of brugian filariasis (Mallawarachchi 2018) also prefer to lay eggs in habitats that are covered by vegetation and sometimes floating leaves on aquatic habitats (Day 2016). Other than natural mosquito breeding places, some species select artificial containers as their breeding habitat. Mainly *Aedes aegypti* and *Ae. albopictus* species larvae inhabit in water-retaining containers, earthenware jars, tin cans, low-roof gutters, ant traps, and tires. *Ae. albopictus* are also found in natural habitats besides artificial containers such as holes of bamboo tree stumps, leaf axils, coconut shells, and rock holes (Weeraratne et al. 2013). Most *Cx. quinquefasciatus* larvae are found in blocked drains and they prefer to lay eggs in water that is polluted by organic matter such as garbage-filled pools, ditches, and drains (Ranasinghe and Amarasinghe 2020a).

In Sri Lanka, mainly *Chilodonella* sp., *Vorticella microstoma*, and *Zoothamnium* sp. have been recorded as

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