

Potential Use of a Combined Sterile Insect Technique (SIT) and *Wolbachia*-Based Approach for the Control of the Dengue Vector *Aedes albopictus* in Sri Lanka

N.D.A.D. Wijegunawardana¹, T.G.A.N. Chandrasena², W. Abeyewickreme³, R. S. Dassanayake⁴, Zhiyong Xi⁵, K. Bourtzis⁶, Y. I. N. Silva Gunawardene⁷

This study addresses the possibility of using a novel and environmental friendly strategy of combined sterile insect technique (SIT) and a *Wolbachia*-based approach in *Aedes albopictus* population control efforts in Sri Lanka. The above strategy combines irradiation and the intracellular endosymbiont bacteria *Wolbachia*, in insects which are vertically transmitted from mother to offspring. Releasing sterile male mosquitoes in the wild will introduce sterility for suppression of *Ae. albopictus* wild mosquito population. The strategy aims at the releasing of sexually incompatible *Wolbachia* triple infected and irradiated male mosquitoes on a large scale to the natural environment. By integrating irradiation, any accidentally released female mosquito will be made fully sterile, and hence the risk of population replacement of the target population with triple infected mosquitoes is eliminated. Therefore, the combined SIT/IIT approach offers a safe and bio-secure strategy for the population suppression of *Ae. albopictus* in Sri Lanka. The overall work involved assessment of the density and species abundance of wild mosquito populations, introgression, and characterization of *Wolbachia* triple infected *Ae. albopictus* line in a Sri Lankan genetic background and determination of minimum sterility dose for the males and females of the introgressed line. Results revealed that *Ae. albopictus* mosquito was the dominant vector species in the study area (Narangodapaluwa PHI area) with an average ovitrap index of 75.25% (range; 56.9% - 94.7%) over the study year. The frequency of *Wolbachia* infection among the mosquito population was ~17% (13/78). The most prominent *Wolbachia* super group infecting the wild mosquito species was the B group and *Ae. albopictus* was naturally infected with both strains A and B. Eighty-five new alleles and 8 complete allelic profiles were submitted to the *Wolbachia* MLST database. All sequencing data were deposited in the Genbank under the accession numbers MH447376-MH470292 and MH756095-MH777430. Successful transfer of *Wolbachia* triple infection to *Ae. albopictus* into Sri Lankan genetic background was achieved through an introgression experiment and characterization of the newly developed *Ae. albopictus* line expressed partial CI and revealed competitive fitness cost for fecundity, fertility, and longevity compared with wild-type while there was no cost for pupation rate, adult emergence and sex ratio. Therefore, integration of an irradiation (dose; 30Gy) is recommended to achieve complete male and female sterility prior to mosquito release (minimum sterility dose for males - 28 Gy and females - 30 Gy). This minimum sterility dose is lower than the irradiation dose applied for SIT and had not resulted in a significant effect on male competitiveness. Therefore, a combined SIT and *Wolbachia* based approach in *Ae. albopictus* dengue vector control is recommended as an additional tool in integrated vector management in Sri Lanka.

Keywords: SIT, IIT, *Wolbachia*, Population Suppression, *Ae. albopictus*

¹ Molecular Medicine Unit, Department of Parasitology, Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka

² Department of Parasitology, Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka

³ Department of Parasitology, Faculty of Medicine, General Sir John Kotelawala Defence University, Sri Lanka

⁴ Department of Chemistry, Faculty of Science, University of Colombo, Sri Lanka

⁵ Sun Yat-sen University-Michigan State University Joint Center of Vector Control for Tropical Diseases, Zhongshan School of Medicine, China

⁶ Insect Pest Control Laboratory, Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, Vienna, Austria

⁷ Molecular Medicine Unit, Department of Parasitology, Faculty of Medicine, University of Kelaniya, Ragama, Sri Lanka; nilminisg@kln.ac.lk