THESIS

DYNAMICS OF *Aedes* POPULATION IN WESTERN PROVINCE OF SRI LANKA AND A STUDY ON THE FEASIBILITY OF STERILE INSECT TECHNIQUE (SIT) FOR CONTROLLING *Aedes albopictus*

Submitted by

Jeevanie Harishchandra (B.Sc Hons, M.Sc)

FGS/05/PhD/16/2015/01

A thesis submitted to the Faculty of Graduate Studies, University of Kelaniya in fulfillment of the requirements for the degree of Doctor of Philosophy in Medical Entomology

June 2022

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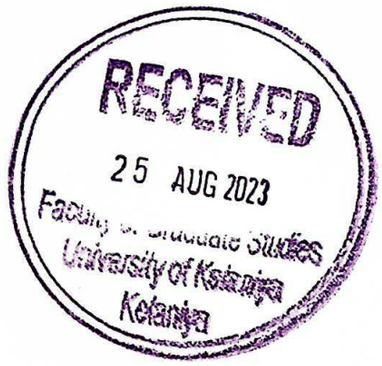

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DECLARATION

I declare that the work embodied in the thesis is my own and has not been submitted for any degree in this university or any other institute, and to the best of my knowledge and belief, it does not contain any material previously published or written or orally communicated by another person except where due reference is made in the text.

..... Signature of the candidate

To the best of our knowledge the above particulars are correct.

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I. CONTENTS

II. LIST OF FIGURES

III. LIST OF TABLES

IV. LIST OF APPENDICES

V. LIST OF ABBREVIATIONS

AEB	Atomic Energy Board
AGO	Autocidal Gravid Ovitrap
AMC	Anti-Malaria Campaign
ANOVA	Analysis of Variance
BFR	Blood Feeding Rate
BG	Bio Gent
BI	Breateau Index
Bti	*Bacillus thuringeiencis isralensis*
C	Core protein
CDC	Centre for Disease Control
CMC	Colombo Municipal Council
CI	Container Index
DDT	Dichlorodiphenyltrichloroethane
DENV	Dengue Virus
DF	Dengue Fever
DHF	Dengue Haemorrhagic Fever
DSS	Dengue Shock Syndrome
EDTA	Ethylene Diamine Tetra Acetic Acid
EIP	Extrinsic Incubation Period
FCI	Fried Competitiveness Index
GIS	Geographic Information System
GLM	General Linear Model
GM	Genetically Modified
GN	Grama Niladri
GPS	Global Positioning System
GSS	Genetic Sexing Strain
Gy	Grey

ha	hectare
hour	hr
HI	House Index
HSD	Honest Significant Difference
IAEA	International Atomic Energy Agency
Ig	Immuno globulin
IGR	Insect Growth Regulator
IIT	Insect Incompatibility Technique
ITN	Insecticide Treated Net
M	Membrane-associated protein
MAX	Maximum Distance Travelled
MDT	Mean Distance Travelled
MOH	Medical Officer of Health
MRR	Mark Release and Recapture
NDCU	National Dengue Control Unit
NRC	National Research Council
NS	Non-Structural
OI	Ovitrap Index
PHI	Public Health Inspectors
RDHS	Regional Director of Health Services
RIDL	Release of Insects carrying a Dominant Lethal
RNA	Ribonucleic Acid
SEA	South-East Asia
SIT	Sterile Insect Technique
SOP	Standard Operating Procedure
SPSS	Statistical Package for the Social Sciences
US$	United States Dollars
UV	Ultra Violet
WHO	World Health Organization

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VII. ABSTRACT

Dynamics of *Aedes* population in Western Province of Sri Lanka and study on the feasibility of Sterile Insect Technique (SIT) for controlling *Aedes albopictus* (Skuse)

Introduction - Dengue is the most important vector-borne disease in Sri Lanka. Controlling dengue vectors is a challenge which needs multiple approaches. Sterile Insect Technique (SIT), which has been successfully applied in other countries, is a potential candidate for integrated control of dengue vectors in Sri Lanka. This study aimed to determine the dynamics of *Aedes* populations and to study the feasibility of SIT for controlling *Aedes albopictus* (Skuse) under laboratory and semi-field settings.

Methodology - Dynamics of dengue vector populations were studied in two study areas in dengue high burdened districts, Colombo and Gampaha, in relation to climatic factors. Study area in the District of Gampaha where only a single dominant *Aedes* species reported was selected for the further studies. Size of the wild male population, survival and dispersal of *Ae. albopictus* were studied in Gampaha using Mark-Release-Recapture (MRR) method. A protocol for application of SIT for *Ae. albopictus* was developed including rearing, blood feeding, separation of male pupae, optimum radiation dose for sterilization and optimum release ratios of sterile males.

Results - The study revealed the presence of both *Ae. aegypti* and *Ae. albopictus* in Colombo and *Ae. albopictus* in Gampaha with a seasonal pattern. Significant correlations of entomological indices were found with rainfall, rainy days and relative humidity. Released males survived and dispersed up to 15 days and 200m respectively. Optimal radiation dose giving 99% induced sterility was 50Gy. Mating competitiveness quantified using Fried Competitiveness Index (FCI) of irradiated males against non-irradiated wild males resulted 0.5 which has met the international standards for competitiveness of Sri Lankan mosquitoes for application of SIT. Further, approximately 1245 male mosquitoes per hectare (ha) need to be released based on the density of the wild population.

Conclusion - Densities of dengue vectors correlate with key climatic factors. Study area in the District of Gampaha where the presence of a single dominant *Aedes* species was selected for future SIT field trials. Developed protocols and study on behaviour of the selected mosquito species in the field will be useful for future application of SIT in integrated management of *Ae. albopictus* in Sri Lanka.

Key words – Dengue, vector, *Aedes albopictus*, control, SIT