BIOLOGY AND CONTROL OF PALM WEEVIL *Rhabdoscelus maculatus* IN FOLIAGE NURSERIES

BY

MALAVIPATHIRANNEHELAGE DONA SUDRSHI UDAYANGANI KARUNARANE

Thesis submitted to the University of Sri Jayawardenepura for the award of the Degree of Master of Philosophy in Zoology on September 2010

BIOLOGY AND CONTROL OF THE PALM WEEVIL *Rhabdoscelus maculatus* IN FOLIAGE NURSERIES

Malavipathirannehelage Dona Sudarshi Udayangani Karunaratne

ABSTRACT

A study on the Biology and control of palm weevil *Rhabdoscelus maculatus* was carried out at Tropiflora ornamental palm nurseries in Sri Lanka. This weevil, an important pest of ornamental palms, was recorded for the very first time in Sri Lanka at Tropiflora Nurseries. Although the incidence of this weevil is restricted to ornamental palms at present, there is a very realistic threat of it becoming a pest of important cultivations such as coconut and sugarcane. The present investigation was therefore, carried out with the view of confirming the identification of weevil, studying its biology and ultimately finding a suitable, environmentally friendly method for its control.

Biological, morphological and behavioural aspects of the weevil were studied under laboratory, semi-natural and natural conditions. The adult is a small, reddish-brown weevil with two black markings on the elytra and the thorax. Mature female weevil lays eggs inside cavities made in the leaf sheath. Under laboratory conditions, period for egg incubation was 5.00 $\pm$ 0.82 days. The larva is creamy white, legless grub with rounded, highly sclerotized, reddish brown head capsule. The frequency distribution analysis of head capsule width revealed six larval instars. Early weevil infestation of palms is indicated by a jelly like substance oozing from the holes in the leaf sheaths. *R. maculatus* larvae take about 7.75$\pm$ 3.70weeks to complete its development and they pupate inside a cocoon made with tightly bound, fibrous material in 2.50 $\pm$ 0.76 weeks. The total life cycle of this weevil is completed in 10-12 weeks and observations of its life cycle in palm fields

indicated four generations per year. The life span of adult weevils is between 8-10 months under semi-natural conditions.

The female weevil preferred *Crysolidocarpus lutescens* most for oviposition followed by *Livistonia rotundofolia* and *Saccharum officinarum* respectively. However, host acceptability in the case of *Cocos nucifera* was zero.

The aggregation pheromone of the sugarcane weevil *R. obscurus*, (E2)-6-methyl-2-hepten-4-ol & 2-methyl-4-octonol (Rhynchophorol) and 2-methyl-4-octanol, was found in this study to be highly effective in attracting *R. maculatus*. Plastic bucket-traps baited with the aggregation pheromone in combination with plant kairomones (ethyl acetate and cut sugarcane) captured significantly more weevils than traps baited with the combination of pheromone and sugarcane or individual lures alone. In the field, such traps were effective in attracting weevils throughout the one month experimentation period. The Trapping-out strategy using different combinations of lures almost completely brought down the palm weevil population to an extremely low level in the field. Significantly, in this study, pheromone and kairomone combination was found to be the most efficacious agent for capture of adult weevils. The overall results of this study demonstrate amply that this trap-out strategy using the aggregation pheromone and host kairomones could be successfully incorporated into Integrated Pest Management (IPM) programmes to suppress palm weevil populations.

CONTENTS

	Page
LIST OF TABLES	vi
LIST OF FIGURES	vii
LIST OF PLATES	ix
ACKNOWLEDGEMENT	xi
ABSTRACT	xii
1. INTRODUCTION	
1.1 Pest Status of Cane Palms	3
1.2 Main Objectives of the Study	6
2. LITERATURE REIEW	
2.1 Botany of Palms	7
2.1.1. *Chrysalidocarpus lutescens*	8
2.1.2. *Livistona rotundifolia*	9
2.1.3. *Phoenix roebelenii*	10
2.2 Insect Pests of Palms	11
2.2.1 Pest Definition	11
2.2.2 Development of Pest Status	12
2.2.3 Insect Pests of Commercial and Ornamental Palms	12
2.2.3.1 Weevil Pests of Palms	13
2.2.3.2 Characteristics of Palm Weevils	14
2.2.3.3 Biology of Palm Weevils	15
2.2.3.4 Semiochemicals of Palm Weevils	16
2.2.3.5 Host Plant Kairomones	18
2.3 Palm Weevil Taxonomy	20

2.3.1 Superfamily Curculionoidea 20

2.3.2 Family Dryophthoridae 21

2.3.3 Genus *Rhabdoscelus* 21

2.3.3.1 Taxonomy of *Rhabdoscelus maculatus* 27

2.4 Geographical Distribution of *Rhabdoscelus obscurus* and *Rhabdoscelus maculatus* 27

2.5 Management of *Rhabdoscelus* Palm Weevils 29

2.5.1 Physical and Cultural Control 29

2.5.2 Biological Control 30

2.5.3 Host-Plant Resistance 31

2.5. 4 Chemical Control 32

2.5.5 Phytosanitary Measures 32

2.5.6 Semiochemicals in Palm Weevil Management 33

3. MATERIALS AND METHODS

3.1 Distribution and Abundance of *Rhabdoscelus maculatus* in Foliage Nurseries 36

3.2 Biology of *Rhabdoscelus maculatus* 39

3.2.1 Life History Parameters of *R. maculatus* 39

3.2.1.1 Ovipositiional Preference and Incubation period of Eggs 39

3.2.1.2 Duration of Larval and Pupal Stages 41

3.2.1.3 Determination of Larval Instars 42

3.2.1.4 Duration of the Total Life Cycle of *R. maculatus* 43

3.3 Morphological Characteristics and Behavioural Aspects of *Rhabdoscelus maculatus* 44

3.3.1 Morphological Characteristics 44

3.3.2 Behavioral Aspects of *R. maculatus* 44

3.3.2.1 Behaviour of Adult Weevil 44

3.3.2.2 Feeding Habits 44

3.3.2.3 Host Acceptability 45

3.4 Palm Weevil Damage and Damage Symptoms 45

3.5 Control of *Rhabdoscelus maculatus*

3.5.1 Olfactory Responses of Adult Weevils to Different Lures in a Still-Air Bioassay under Laboratory Conditions 46

3.5.2 Attraction of Adult Weevils to Different Food Lures under Semi-Natural Conditions 51

3.5.3 Field Trials 53

3.5.3.1 Responses of Adult Weevils to Food Lures 53

3.5.3.2 Responses of adult weevils to Food Lures and Aggregation Pheromone in Different Combinations 54

3.5.3.3 Field-Trapping with Aggregation Pheromone and Food Lures for the Management of *R. maculatus* 56

3.6 Data Analysis 57

4. RESULTS AND DISCUSSION

4.1 Distribution and Abundance of *Rhabdoscelus maculatus* in Foliage Nurseries. 58

4.2 Biology of *R. maculatus* 63

4.2.1 Life History Parameters of *R. maculatus* 63

4.2.1.1 Ovipositiional Preference and Incubation period

of Eggs 63

4.2.1.2 Duration of Larval and Pupal Stages 64

4.2.1.3 Determination of Larval Instars 65

4.2.1.4 Duration of the Total Life Cycle 68

4.3 Morphology and Behavioural Aspects of *R. maculatus* 69

4.3.1 Morphological Characters 69

4.3.2 Behavioural Aspects 74

4.3.2.1 Behaviour of Adult Weevil 74

4.3.2.2 Feeding Habits 75

4.3.2.3 Host Acceptibility 77

4.4 Palm Weevil Damage and Damage Symptoms 78

4.5 Control of *Rhabdoscelus maculatus* 81

4.5.1 Olfactory Responses of Adult Weevils to Different Lures in a Still-Air Bioassay under Laboratory Conditions 81

4.5.2 Attraction of Adult Weevils to different Food Lures under Semi-Natural Conditions 84

4.5.3 Field Trials 86

4.5.3.1 Responses of Adult Palm Weevils to Food Lures in *Crysolidocarpus* Field 86

4.5.3.2 Responses of Adult Weevils to Food Lures and Aggregation Pheromone in Different Combinations 88

4.5.3.3 Field-Trapping with Aggregation Pheromone and Food Lures for the Management of *R. maculatus* 95

5. CONCLUSIONS 99

6. REFFERENCES 101

7. APPENDIX 109