



**UNIVERSITI PUTRA MALAYSIA**

***EFFICACY OF FIVE INSECTICIDES AGAINST BAGWORM, *Metisa plana*  
WALKER AND THEIR SIDE EFFECTS ON OIL PALM POLLINATOR,  
*Elaeidobius kamerunicus* FAUST***

**SYED MAZUAN SYED MOHAMED**

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**By**

**SYED MAZUAN SYED MOHAMED**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra  
Malaysia, in Fulfilment of the Requirements for the Degree of Master of  
Science**

**January 2018**

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfillment of the requirement for the degree of Master of Science

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January 2018

**Chairperson : Professor Dzolkhifli Omar, PhD**  
**Faculty : Agriculture**

Oil Palm (*Elaeis guineensis* Jacq.) is a crucial economic crop in Malaysia which has become susceptible towards pests and diseases. Studies showed that the major leaf defoliator of oil palm in Malaysia is the bagworm, *Metisa plana*. Various spraying methods had been developed for controlling the bagworms. Nonetheless, a large amount of insecticides applied were at waste due to either improper or no calibration conducted on the sprayers prior to application. The residual effects of insecticides on beneficial insects were highly concerned to preserve oil palm ecosystem. A ground study was conducted in FELDA Gunung Besout 04, Perak, with its main focus on mistblower application towards *M. plana*, and its side effects on *Elaeidobius kamerunicus*. Optimising in spraying application technique proved the effectiveness of the treatment by evaluating the operator's walking speed, spraying swath width and droplet distribution. It was concluded that 40 seconds was the optimum time required for oil palm foliar sprayed with restrictor 3. Stihl SR420 mistblower was characterised by having 1.2L / min flow rate, produced volume median diameter of 80µm, and achieved productivity of approximately of 2.58 hectares per man day. The insecticides evaluated were chlorantraniliprole (Altacor® 34.9WG), *Bacillus thuringiensis kurstaki* (DiPel® ES), cypermethrin (Hextar Cyper 5.5EC), flubendiamide (Takumi® 20WG) and *B. thuringiensis* MPOB Bt1 (Ecobac-1 EC). The insecticides application rate was based on the manufacturer's recommendation. The *M. plana* was monitored before treatment and at 3, 7, 15, 30, 45, and 70 days after treatment (DAT). Post-census showed that all insecticides were able to reduce the bagworm population below the economic threshold level (10 larvae/ frond) within 15 DAT. Both cypermethrin and MPOB Bt1 resulted in highest mortality of *M. plana* by 83%, followed by flubendiamide, chlorantraniliprole and Btk with mortality rate of 82%, 75%, and 70% respectively. The insecticides applied were able to suppress the population of *M. plana* up to 30 DAT. The side effect of insecticides on pollinating weevil, *E. kamerunicus* was also studied by monitoring the population before treatment and

at 2, 4, 6 and 13 DAT. A sample population technique was designed to estimate the weevils population for every sample of male inflorescence. Cypermethrin indicated the highest population declined at 2 DAT with a mortality of 92.33%, followed by *B. thuringiensis*, flubendiamide, and chlorantraniliprole with mortality of 44.50%, 30.62% and 18.19% respectively. Cypermethrin caused a significant reduction of weevil population. Whilst chlorantraniliprole, *B. thuringiensis* and flubendiamide displayed no significant reduction on the weevil population, which exhibit the characteristic of environmental friendly insecticides. Optimised mistblower application alongside the potential ecosystem friendly insecticides were recommended for sustainable control of bagworm population in oil palm.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia  
sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

**KEBERKESANAN LIMA JENIS RACUN SERANGGA TERHADAP SPESIS  
ULAT BUNGKUS, *Metisa plana* WALKER DAN KESAN SAMPINGAN  
KEPADA AGEN PENDEBUNGAAN SAWIT, *Elaeidobius kamerunicus*  
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Kelapa sawit (*Elaeis guineensis* Jacq.,) merupakan tanaman ekonomi utama di Malaysia, namun tidak lari daripada masalah serangan musuh dan penyakit. Kajian mendapati bahawa ulat bungkus, *Metisa plana* adalah punca utama kepada kerosakan daun tanaman kelapa sawit di Malaysia. Pelbagai jenis kaedah kawalan telah wujud bagi tujuan membasmi serangan ulat bungkus. Namun, masalah ketidakperhatian terhadap aspek kalibrasi alatan menyebabkan pembaziran racun serangga berlaku ketika operasi kawalan dilaksanakan. Justeru itu, perkara ini telah memberikan impak negatif kepada kesan kawalan ulat bungkus. Selain itu, impak dan kesan sampingan racun kepada serangga berfaedah juga diambil perhatian semasa kawalan dalam memastikan kesinambungan ekosistem terjamin. Oleh yang demikian, satu kajian tapak telah dijalankan di FELDA Gunung Besout 04, Perak yang memfokuskan penggunaan aplikasi penyembur kabus terhadap *M. plana* dan kesan sampingannya kepada agen pendebungaan sawit *Elaeidobius kamerunicus*. Keberkesanan rawatan telah dibuktikan dengan mengoptimumkan kaedah teknik berjalan, ayunan semburan, dan serakan titisan semburan. Adalah disimpulkan bahawa masa yang optimum bagi tujuan semburan pelepah sawit dengan menggunakan pelaras penentu ke-tiga adalah 40 saat. Penyembur kabus Stihl SR420 mempunyai kelajuan kadar aliran air sebanyak 1.2 L/min dengan mengeluarkan jumlah diameter median titisan sebesar 80µm dan mencapai produktiviti seluas 2.58 hektar bagi seorang pekerja sehari. Kajian racun serangga chlorantraniliprole (Altacor® 34.9WG), *Bacillus thuringiensis kurstaki* (DiPel® ES), cypermethrin (Hextar Cyper 5.5 EC), flubendiamide (Takumi® 20WG) and *B. thuringiensis* MPOB Bt1 (Ecobac-1 EC) telah dilaksanakan. Kadar penggunaan racun serangga adalah berdasarkan ketetapan daripada pengeluar. Pemantauan populasi *M. plana* dilaksanakan berdasarkan bancian sebelum dan selepas pada hari ke 3, 7, 15, 30, 45, dan 70 selepas rawatan (DAT). Bancian selepas penggunaan racun menunjukkan

bahawa keseluruhan racun serangga berjaya mengurangkan populasi ulat bungkus di bawah tahap ambang ekonomi (10 larva / pelepah) dalam tempoh 15 hari rawatan. Cypermethrin dan MPOB Bt1 menunjukkan kadar kematian yang tertinggi iaitu sebanyak 83%, diikuti dengan flubendiamide, chlorantraniliprole dan Btk dengan kadar kematian masing-masing adalah sebanyak 82%, 75% dan 70%. Keberkesanan racun serangga berjaya mampu mengawal populasi *M. plana* dengan berjaya sehingga hari ke 30 selepas semburan. Kajian lanjut telah dilaksanakan bagi meneliti kesan sampingan racun serangga ke atas agen pendebungaan, *E. kamerunicus* dengan memantau bancian sebelum aplikasi semburan dilaksanakan, dan selepas bancian dilaksanakan pada 2, 4, 6 dan 13 hari selepas semburan (DAT). Teknik sampel populasi telah direka bentuk untuk menganggarkan populasi kumbang pendebungaan dalam setiap sampel bunga jantan sawit yang ditetapkan. Cypermethrin menunjukkan penurunan populasi yang paling banyak dengan kadar kematian sebanyak 92.33%, diikuti dengan *B. thuringiensis*, flubendiamide dan chlorantraniliprole dengan kadar kematian masing-masing adalah sebanyak 44.50%, 30.62% dan 18.19%. Cypermethrin memberikan kesan penurunan yang ketara kepada populasi kumbang pendebungaan. Manakala, racun chlorantraniliprole, *B. thuringiensis* dan flubendiamide pula tidak menunjukkan kesan yang ketara kepada penurunan populasi kumbang pendebungaan oleh kerana ciri-ciri racun serangga tersebut bersifat mesra alam. Aplikasi penyembur kabus yang terbaik bersama-sama racun serangga yang mesra alam adalah disarankan penggunaannya bagi mengawal populasi ulat bungkus di tanaman kelapa sawit.

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I certify that a Thesis Examination Committee has met on 22 January 2018 to conduct the final examination of Syed Mazuan bin Syed Mohamed on his thesis entitled "Efficacy of Five Insecticides Against Bagworm, *Metisa plana* Walker and their Side Effects on Oil Palm Pollinator, *Elaeidobius kamerunicus* Faust" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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## TABLE OF CONTENTS

	Page
ABSTRACT	i
ABSTRAK	iii
ACKNOWLEDGEMENT	v
APPROVAL	vi
DECLARATION	viii
LIST OF TABLES	xii
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS	xiv
LIST OF APPENDICES	xv
<b>CHAPTER</b>	
<b>1. INTRODUCTION</b>	<b>1</b>
<b>2. LITERATURE REVIEW</b>	
2.1 The bagworm	3
2.2 Control of bagworm	5
2.2.1 Training	5
2.2.2 Detection, census and control timing	6
2.2.3 Mapping	6
2.2.4 Action	7
2.3 Application of pesticide	8
2.3.1 Ground pesticide application on oil palm	9
2.3.2 Motorized backpacked-Mistblower	10
2.3.3 Pesticide application via aerial spraying	11
2.3.4 Trunk injection technique	11
2.3.5 Biological control through natural enemies	12
2.4 Overview of ground spraying insecticides	14
2.4.1 Chlorantraniliprole	14
2.4.2 <i>Bacillus thuringiensis</i>	15
2.4.3 Flubendiamide	16
2.4.4 Cypermethrin	18
2.5 Oil palm inflorescences	19
2.5.1 Female inflorescence	19
2.5.2 Male inflorescence	19
2.6 The pollinating weevil <i>Edaeidobius kamerunicus</i>	20
2.6.1 Biology and ecology of <i>E. kamerunicus</i>	20
2.6.2 Effect of pesticides on pollinating weevil	21
2.7 Water sensitive paper	21
2.7.1 Handling	22
<b>3. CALIBRATION OF MISTBLOWER FOR EFFICIENT APPLICATION OF PESTICIDES</b>	
3.1 Introduction	23
3.2 Materials and Method	24
3.2.1 Spraying pattern application	24
3.2.2 Optimum spray duration	25

3.2.3	Determine the specific restrictor	25
3.2.4	Flow rate of mistblower Stihl SR 420	25
3.2.5	Data analysis	25
3.3	Results and Discussion	26
3.3.1	Spraying technique	26
3.3.2	Spraying duration for an oil palm	27
3.3.3	Mistblower restrictor	27
3.3.4	Application flow rate of mistblower	29
3.3.5	Spray volume (litre per hectare)	31
3.3.6	Average time to spray per hectare / man-day	32
3.4	Conclusion	33
<b>4.</b>	<b>EFFICACY OF INSECTICIDES APPLIED USING MISTBLOWER AGAINST METISA PLANA WALKER</b>	
4.1	Introduction	34
4.2	Materials and Method	35
4.2.1	The Study Site	35
4.2.2	Experimental Design	36
4.2.3	Treatment Application	37
4.2.4	Pre- & Post-Census of <i>M. plana</i> Population	38
4.2.5	Spray Deposition Analysis	39
4.2.6	Data Analysis	40
4.3	Results	41
4.3.1	Spraying Application	41
4.3.2	The Bagworms Census	41
4.3.3	Fluorescence Tracer	47
4.4	Discussion	48
4.5	Conclusion	52
<b>5.</b>	<b>SIDE EFFECT OF INSECTICIDES APPLIED USING MISTBLOWER ON OIL PALM POLLINATING WEEVIL – ELAEIDOBIOUS KAMERUNICUS</b>	
5.1	Introduction	53
5.2	Materials and Method	54
4.2.1	The Study Site	54
4.2.2	Experimental Design	55
4.2.3	Sample Population	55
4.2.4	Treatment Application	56
4.2.5	Sample Population Tapping Technique	57
4.2.6	Data Analysis	59
5.3	Results	59
5.4	Discussion	64
5.5	Conclusion	66
<b>6.</b>	<b>GENERAL CONCLUSION, RECOMMENDATIONS AND FUTURE RESEARCH</b>	<b>67</b>
	<b>REFERENCES</b>	<b>68</b>
	<b>APPENDICES</b>	<b>73</b>
	<b>BIODATA OF STUDENT</b>	<b>89</b>

## LIST OF TABLES

Table		Page
2.1	Life-history of 18 species of bagworms	3
2.2	Economic threshold level for selected leaf eating caterpillar species	7
2.3	Droplet densities required for each usage control	9
2.4	Chemical and recommendation rate for trunk injection	11
2.5	Natural enemies associated with a population of <i>M. plana</i>	13
2.6	Commercial Bt product and their species correlated	16
2.7	Type of Lepidopteran species susceptible to flubendiamide	17
3.1	Duration for time for each operator on spraying 10 palms	27
3.2	Mean rating score for each restrictors on different WSP location	29
3.3	The volume of water consumed at designated time	30
3.4	Calculation of mistblower application per man day	32
4.1	Insecticides and recommendation rates per hectare	37
4.2	Mean population and percentage mortality of <i>Metisa plana</i> at each DAT after treatment application	42
4.3	Mean concentration of spray deposition in each treatment application	48
5.1	Insecticides with recommended rate per hectare	57
5.2	Means population and percentage mortality of weevil after treatment application	61

## LIST OF FIGURES

Figure	Page
2.1 Complete life cycle of <i>Metisa plana</i>	4
2.2 Size of each larval stages of <i>M. plana</i>	5
2.3 Census walking pathway in one area	6
2.4 Attack zone and buffer zone for bagworm occurring	7
2.5 ASABE classification based on the application congruity	8
2.6 Bravo 600 Flexigun 65S with tractor mounted use in oil palm plantation	10
2.7 Mistblower Stihl SR420 use for agricultural spraying in oil palm	10
2.8 Aircraft VHFOS Dromader use in bagworm aerial spraying in FELDA Keratong	11
2.9 Trunk injection process	12
2.10 Chemical structure of chlorantraniliprole	14
2.11 The action of biological spores and crystal toxins inside the caterpillars after the introduction of <i>Bacillus thuringiensis</i>	16
2.12 2D structure of flubendiamide	17
2.13 2D Structure of cypermethrin	18
2.14 Material for monitoring droplet distribution	22
3.1 The design and location for water sensitive paper pool laid on oil palm	24
3.2 Droplet distribution differences between both techniques	26
3.3 Example of WSPs with visual coverage rating	28
3.4 Visual rating score of WSP for each restrictor on different WSP location	29
3.5 The graph of Stihl 420 Mistblower Flow Rate (Volume against Time)	30
3.6 Standard Graph of Volume Median Diameter (VMD) size for several type of mistblower	31
4.1 The map of FELDA Gunung Besout 04 oil palm plantation	35
4.2 Location of experimental triplication	36
4.3 Experimental design in RCBD for one replication	38
4.4 Fluorometer Model 450 Sequoia-Turner	40
4.5 The mean number of bagworm over days of treatment	43
4.6 Bagworm mortality (%) over days of treatment	44
4.7 Distribution of larvae stages on population of <i>M. plana</i> prior to treatment application	45
4.8 Standard graph of fluorometer concentration	47
5.1 The map of FELDA Gunung Besout 04 oil palm plantation	54
5.2 Experiment design with CRD	55
5.3 Example of near-to full anthesis of male inflorescence	56
5.4 MD180DX Maruyama Mistblower	57
5.5 Example of weevils trapped on the sticky paper	58
5.6 Number of weevil population over days of treatment.	62
5.7 Weevil percentage mortality over days of treatment (DAT)	63



## LIST OF ABBREVIATIONS

ASABE	American Society of Agricultural and Biological Engineers
ANOVA	Analysis Of Variance
Bt	<i>Bacillus thuringiensis</i>
Btk	<i>Bacillus thuringiensis</i> kurstaki
CRD	Completely Randomised Design
DAT	Day After Treatment
EC	Emulsifiable Concentrate
EC <sub>50</sub>	Effective concentration
ES	Emulsifiable Suspension
ETL	Economic Threshold Level
FELDA	Federal Land Development Authority
IPM	Integrated Pest Management
IUPAC	International Union of Pure and Applied Chemistry
LC <sub>50</sub>	Lethal Concentration
MPOB	Malaysian Palm Oil Board
NaOH	Sodium hydroxide
PORIM	Palm Oil Research Institute of Malaysia
RCBD	Randomised Complete Block Design
VMD	Volume Median Diameter
WSP	Water sensitive paper
SAS	Statistical Analysis System

## LIST OF APPENDICES

Appendix		Page
A	Example of data census form for recording of life population bagworm	73
B	Specification of mistblower	74
C	Rating score for each restrictors on different WSP location	75
D	Volume of water consumed at designated time (Calibration)	77
E	Specification of Fluorometer Model 450 Sequoia-Turner	78
F	SAS result for fluorescence deposition analysis	79
G	SAS result for bagworm population analysis	83
H	SAS result for weevil population analysis	84
I	Activities during the experiments	87

## CHAPTER 1

### GENERAL INTRODUCTION

Oil palm (Palmae: *Elaeis guineensis* Jacquin) was originated from West Africa, and brought into South-East Asia early of the 20<sup>th</sup> Century. It was first introduced in Malaysia as an ornamental plant, originated from Bogor, Indonesia (Arnott, 1963). Development of agricultural industry has improved across the year as a result increase people's socioeconomic and lifestyle. Afterwards, Federal Land Development Authority (FELDA) has been established by Land Development Act 1956 for the purpose of introducing land settlement schemes under Group Settlement Act 1960 to the people with non-fixed income earner, poor, landless or unemployed, by planting the oil palm crop in order to eradicate the poverty. In 2016, the total area planted with oil palm was 5.74 million hectares whereby 12.3% out of the total planted area belong to FELDA (Malaysian Palm Oil Board [MPOB], 2016a).

Nonetheless, hot and humid climate as well as local policy practices replanting made on the same land. These result in susceptibility toward pests and diseases. Although various types of control applied, yet the outbreak still exist. Example of a critical pest happened nowadays is leaf eating caterpillars, comprising bagworms and nettle caterpillars. A species of bagworm, *Metisa plana*, is a major leaf defoliator of oil palm production in Malaysia (Basri, Halim & Zulkifli 1988). *Metisa plana* Walker is a native pest, which adapted with introduced African Oil Palm (Wood, 1976). It causes damage by feeding on oil palm leaves. Moderate defoliation by bagworm can cause declining in yield around 30-40% in two years (Basri, 1993). Chemical control has been used widely to prevent outbreak and to lower the bagworm population below economic threshold level (ETL). Development of Integrated Pest Management (IPM) promote the usage of selective chemical which is safe for natural enemies and so controlling the population of bagworm (Wood, 1971). There are numerous ways for applying insecticides towards the Oil Palm such as ground spraying, trunk injection, aerial spraying and root absorption. A study showed that the ground spraying method required a short period of spraying time at approximately 4.5 hours per worker to spray insecticides per hectare (Noor Hisham & Hasber, 2012). A study also reported that ground spraying application will provide higher spray deposition compared to aerial application while increasing in plant height can reduce the tendency of spray deposition (Nansen et al., 2011). Many factors need to be considered when using insecticides such as the impact on non-target organism. Consideration of non-target organism is very crucial. For example, *Elaeidobius kamerunicus* is an important pollination insect, able to increase the yield by bunch per hectare and also the oil extraction rate (OER) (Basri, Halim & Tarmizi, 1985).

Several common insecticides were evaluated for their efficiency, effectiveness toward *Metisa plana*. Two novel insecticides comprising of chlorantraniliprole and flubendiamide are believed to have a potential of environmental friendly. Therefore, the objectives of this study were:

1. To optimise the use of motorized backpack mistblower for efficient application of pesticides.
2. To evaluate the efficacy of insecticides applied using mistblower against *Metisa plana* Walker.
3. To examine the side effect of insecticides applied using mistblower on the oil palm pollinating weevil, *Elaeidobius kamerunius* Faust

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