

UNIVERSITI TEKNOLOGI MARA

**AN EVALUATION ON THE
PERFORMANCE SUITABILITY AND
ADAPTABILITY OF BEES IN
PROTECTED AND NON-
PROTECTED BEEHIVES AT OIL
PALM SMALLHOLDERS**

MUHAMMAD SHAKIR BIN ZAKARIA

Thesis submitted in fulfillment
of the requirement for the degree of
Master of Science

Faculty of Plantation and Agrotechnology

August 2022

ABSTRACT

Nowadays, the oil palm is the largest plantated crop in Malaysia, most noteworthy yielding oil crop, and positioning first on the world in oil production. However, there were some challenges in every action and situation for the plantation industry especially the pest attack in oil palm contribute to human and elephant conflict (HEC). Several outbreaks have been reported around Malaysia including Kampung Gol, Jerantut, Pahang and problem has never been solved even though there have been all the types of controls that been introduced. The main issue in human-elephants conflict was the crop-raiding of oil palm. Following this, the effectiveness of selected bee (*Apis cerana*) will be studied in Malaysia as the first attempt in mitigating or controlling wild elephant attacks in smallholder's oil palm plantation. The purpose of the study was to evaluate the population abundance of *Apis cerana* over a year sampling in the beehives, to quantify the best practice for a successful mass rearing of *Apis cerana* in the selected testing area, to determine the relationship between the population of *Apis cerana* in different method practice and climatic factors and to measure the relationship between *Apis cerana* in different method practice and its predator. This study was conducted on 10 beehives from April 2018 until March 2019 in Kampung Gol, Jerantut, Pahang. *Apis cerana* colonies were being labeled and the data collection was done by counting bees. Every single comb or brood of the beehives was photographed, insert to the computer, marked by the grid area (cm²), and calculated by using empirical measures techniques. The bee population density per cm² was determined by counting the number of bees directly in square equaling one cm². The data bee's population were recorded and analyzed. However, protected beehive equipped with lathing mesh or net, bee excluder and water or grease oil as protection and non-protected beehive was origin beehive. The population of bees, *Apis cerana* was found significant different (P<0.05) in mean number of bees among of sampling periods. In addition, R-squared (R²) showed overall the total populations of bees was (93.83%), non-protection method was (80.21%) and protection method was (99.10%) of *Apis cerana* which were influenced by the whole sampling period. Besides, in protection method (22443.8±353.84) have higher bee's population compared to the non-protection method (20045.7±338.03). Paired sample t-test revealed that there was significance different (P<0.05) in mean number of *Apis cerana* among both methods that implies protection method had high ability to protect bee's population and helped for increasing the *Apis cerana* population in research area. There was no significant relationship (P>0.05) between the population of *Apis cerana* with abiotic factor whether in both methods except rainfall in protection beehives *Apis cerana* preferred to stay outside the beehives that equipped with has a zinc roof. The findings also showed that *Apis cerana* had significant relationship (P<0.05) with the hornet, ants, lizard and wax moth in non-protection method but not significant relationship (P>0.05) in protection beehive. As a recommendation for future research, beekeepers must consider the ventilation of beehives by making more aeration hole at beehives box to fulfil increment of abundance of bee population. The beehive must be arranged with optimum distance and using protection methods such as double lathing mesh to inhibit natural enemies attacked. Lastly, place the beehives at the place that reduce light intensity and avoid from extreme weather to avoid bee's absond from their beehive and to be more successful of the mass rearing of *Apis cerana* in mitigating human and elephant conflict the researcher must transfer the wild of *Apis cerana* colonies straight to the bee-fencing prototype at the field.

ACKNOWLEDGEMENT

Praise to Allah for giving me strength, help, and guidance in completing this thesis successfully.

Special thanks and gratitude to my supervisor, Associate Professor Ts. Dr. Mohd Rasdi Zaini for his supervision and guidance in conducting this thesis. His patience and dedication during supervision taught me a lot. His quest for searching a piece of knowledge and wisdom keeps my interest in completing this thesis.

I would also like to thank to Dr. Mohd Salleh Daim as my co-supervisor for his constructive advice and comment on my thesis. His hard work and patience inspired me to strive for the best.

My gratitude also goes to all Kg. Gol local communities for being supportive during my study period. Experiences and knowledge that I have gained are much appreciated. To all my friends and those who are involved directly and indirectly in this study, your support and help are much appreciated.

I would like to express my gratitude to all of UiTM staff from the Department of Crop Protection in Faculty of Plantation and Agrotechnology especially the entomology team, and staff from faculty of Architecture, Planning and Surveying. Special thanks to all lecturers for their support and guidance. My appreciation also goes to Dr Ismail Rakibe, Ms. Aqila Binti Nor Ain, Ms. Puteri Shahirah Binti Megat Jamual Fawaeed and to all my friends who had rendered their help in one way towards the completion of this master thesis.

Thanks, are extended to my family especially my parents for their encouragement, prayers, and understanding throughout the study. Last but not least, my appreciation also goes to my mum, Nurul Fuaddi Binti Sulaiman, my siblings and most of all of my appreciation goes to my father, Zakaria Bin Sulaiman for being my teacher for 27 years of my life in this world.

TABLE OF CONTENTS

	Page
CONFIRMATION BY PANELS OF EXAMINERS	ii
AUTHOR'S DECLARATION	iii
ABSTRACT	iv
ACKNOWLEDGEMENT	v
TABLE OF CONTENTS	vi
LIST OF TABLES	x
LIST OF FIGURES	xii
LIST OF PLATES	xiv
LIST OF ABBREVIATIONS	xv
CHAPTER ONE: INTRODUCTION	1
1.1 Background of study	1
1.2 Problem Statements	3
1.3 Research Objectives	4
1.4 Research Questions	4
1.5 Hypothesis	5
1.6 Scope and Limitation of Study	6
1.7 Significance of Study	7
CHAPTER TWO: LITERATURE REVIEW	8
2.1 Oil Palm	8
2.1.1 Introduction to Oil Palm (<i>Elaeis guineensis</i>)	8
2.1.2 Economic Important of Oil Palm	8
2.2 Bees	10
2.2.1 Introduction to Bees	10
2.2.2 Castes of Bees	13
2.2.3 Biology of Bees (Taxonomy and Morphology of Bees)	17
2.2.4 Importance of Bees	20
2.2.5 Bees as Beneficial Insect in Plantation Ecosystem	21
2.2.6 Beehive Fencing	22

2.2.7	Potentials of Bee-fencing to Mitigate the Human and Elephant Conflict at Oil Palm Plantation	23
2.3	Elephants	25
2.3.1	Pest in Oil Palm	25
2.3.2	Oil Palm Plantation and Elephant Conflict	25
2.3.3	Human and Elephant Conflict	27
2.3.4	Indirect Conflict Caused by Elephants	28

CHAPTER THREE: SEASONAL ABUNDANCE AND ESTABLISHMENT OF ASIAN HONEY BEE (*APIS CERANA*) IN SMALLHOLDER OIL PALM PLANTATION **29**

3.1	Research Background	29
3.2	Materials and Sampling Methods	30
3.2.1	Location and Durations of Study	30
3.2.2	Flow of Works	31
3.2.3	Establishment of Colony	33
3.2.4	Material	34
3.3	Collection of <i>Apis cerana</i> Colony	38
3.3.1	Method in Culture Wild Bees (Sources: Primary Data, 2019)	39
3.3.2	Experimental Design	40
3.4	Data Collection	41
3.5	Data Analysis	42
3.6	Results	43
3.6.1	Population Abundance of <i>Apis cerana</i> in Smallholder Oil Palm Area	43
3.6.2	Population Abundance of Asian Honey Bee (<i>Apis cerana</i>) in Non-Protection Method and Protection Method of Beehives	45
3.6.2.1	<i>Non-Protection Method Beehives Practices</i>	45
3.6.2.2	<i>Protection Method Beehive Practices</i>	47
3.6.2.3	<i>Comparison between Population Abundance of <i>Apis cerana</i> at Non-Protection Method Beehives and Protection Method Beehives Practices.</i>	49
3.7	Discussion	52
3.7.1	Population Abundance of Asian Honey Bee (<i>Apis cerana</i>)	52