

UNIVERSITI TEKNOLOGI MARA

**PESTICIDAL ACTIVITIES OF
SELECTED ZINGIBERACEAE
SPECIES AGAINST COCOA POD
BORER, OTHER PESTS AND
BENEFICIAL INSECTS**

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Thesis submitted in fulfilment an item
of the requirements for the degree of
Doctor of Philosophy

Faculty of Plantation and Agrotechnology

March 2024

ABSTRACT

Conopomorpha cramerella, (Lepidoptera: Gracillariidae) has been identified as the major pest causing significant damage to cocoa production in Southeast Asia. The management is focused on the use of synthetic insecticides, whereas the utilization of biopesticides receives comparatively little attention. Botanical extracts have potential as biopesticide due to their target-specific nature, biodegradability and utilization in pest management programs. The primary objective was to investigate the biopesticide potential of Zingiberaceae species, *Alpinia galanga* (lesser galanga), *Curcuma longa* (turmeric), and *Zingiber officinale* (ginger). Bioassays were conducted to investigate the effects of plant extracts and essential oils on the egg, pupa, and adult of CPB. The experimental observation revealed that *Z. officinale* and *A. galanga* have the capability to influence the oviposition behavior, facilitate effective egg penetration, increased malformations in pupa and adult, and decrease egg hatchability. The development of two concentrations of potential botanical pesticides was conducted using an emulsion formulation utilized from stripped palm oil methyl esters (SPME), combined with *Z. officinale* and *A. galanga* EOs. The composition of the emulsion consisted of 5% SPME, 2.16% Tween® 80, 0.64% Span® 80, and 90% water, resulting in a hydrophilic-lipophilic balance (HLB) value of 12. The formulation exhibited compliance with the quality parameters specified by the Food and Agriculture Organisation (FAO). The formulations underwent testing in laboratory and field against CPB, *Helopeltis*, and leaf-eating insects. The results demonstrated promising outcomes, with *A. galanga* F2 and *Z. officinale* F2 performing similar results or, in certain tests outperforming insecticides, particularly when at higher concentrations. The formulations likewise have minimal influence on the beneficial insects of cocoa. Based on the findings, the potential of utilizing Zingiberaceae-based botanical pesticide as an ecologically sustainable method for cocoa pest management appears promising for cocoa producers in the near future.

Keywords: *Alpinia galanga*, Biopesticide, Cocoa pod borer; *Curcuma longa*; *Zingiber officinale*; Zingiberaceae.

ACKNOWLEDGEMENT

Firstly, I express my gratitude to Allah S.W.T. for granting me the opportunity to embark on my doctoral studies and successfully navigate through this difficult and protracted academic endeavour. The road proved arduous, challenging, and nearly insurmountable, leaving me on the brink of failure. I was on the verge of giving up, but the belief shown by individuals around me in my ability to persevere instilled a profound sense of optimism that will forever be indelible in my memory.

I want to express my sincere gratitude and appreciation to my supervisor, Associate Professor Dr. Siti Noor Hajjar Md. Latip, for her invaluable guidance, support, and unwavering patience throughout my research journey. The completion of this thesis is contingent upon the guidance and support provided by my supervisor. I express my utmost gratitude for her invaluable contributions throughout this process. I shall hold this in high regard for the duration of my lifetime.

Sincere gratitude expressed to my supervising committee members, Dr. Alias Awang and Dr. Aijun Zhang, for their invaluable assistance and support during my academic journey.

I sincerely thank the Malaysian Cocoa Board for providing facilities and support during the sampling process. I would like to express my gratitude to the staff members of the Entomology Unit at the Cocoa Research and Development Centre in Bagan Datuk, Malaysian Cocoa Board (Mr. Ahmad Zaki, Mr. Abdul Mutalib and Mr. Mohamad Faiz) for their invaluable assistance and teamwork throughout this study.

This thesis is dedicated to the memory of my late father, Bakar bin Mat Resat, and my beloved mother, _____, who showed the vision and resolve to provide me with an education. They always believe and support me in maintaining a positive self-perception, perceiving me as very competent, even when I may have lacked the necessary confidence. Please keep me in your prayers, always. This triumphant piece is dedicated to both of you, and my family who always be there for me.

Alhamdulillah.

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CHAPTER ONE

INTRODUCTION

1.1 Research Background

Theobroma cacao (Linnaeus) (Malvales: Sterculiaceae) is an important crop widely planted in humid tropical regions. Malaysia is one of the most important cocoa-producing nations with high grinding capacity, ranking as the second-largest grinding nation in the Pacific region. Globally, Malaysia is ranked seventh behind the Netherlands, Côte d'Ivoire, the United States, Germany, and Indonesia. Annual Report published by the Ministry of Primary Industries in 2019 (MPI, 2022), reported that upstream and downstream sectors expanded with average growth, with the export value of dry cocoa beans being RM 3.42 billion and the export value of RM 4.68 billion. The exports value of cocoa products in 2022 increased by 13.7% (RM 7,816 billion) compared to RM 6.871 billion in 2021. The cocoa industry contributed 0.1% of the gross domestic product (GDP) between January and December of 2022, from 1,637.9 (2020), 1,733.1 (2021) to 1,976.1 in 2022, according to the most recent statistics (MPI, 2023).

The export of cocoa and cocoa-based products are from cocoa beans, cocoa butter, cocoa powder, cocoa paste not defatted, cocoa paste wholly or partly defatted, cocoa shell, and chocolate with total value in 2022 was 7,816.08 million. (MPI, 2023). Most of the products were exported to Singapore with a value of RM 1,509.69 million, followed by the United States of America (RM 901.51 million) and Japan (RM 709.69 million). The trend of production and consumption in the world plays a vital role in the expansion of the global cocoa scenarios. There was a global decline in cocoa production in 2022, which decreased by 8.0% from 4,823 tonnes to 5,242 tonnes in 2021. In contrast to the world cocoa production, consumption increased globally by 2.0% in 2022 (5,081 tonnes) compared to 4,981 tonnes in 2021. This data reflects the bright prospect of cocoa scenarios in the upcoming years, where the surplus of consumption which may lead to a better price in the international market.