UNDERGRADUATE THESIS

EFFECTS OF LEMONGRASS (*Cymbopogon citratus*) BOTANICAL INSECTICIDE APPLICATION ON THE ARTHROPOD DIVERSITY OF BOTTLE GOURD (*Lagenaria siceraria*) IN THAI NGUYEN, VIETNAM

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PLANT PROTECTION STUDY PROGRAM
DEPARTMENT OF PESTS AND PLANT DISEASES
FACULTY OF AGRICULTURE
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SUMMARY

NOVIANI. Effects of Lemongrass (*Cymbopogon citratus*) Botanical Insecticide Application on the Arthropod Diversity of Bottle Gourd (*Lagenaria siceraria*) in Thai Nguyen, Vietnam (Supervised by **ARINAFRIL** and **ARSI**).

Lagenaria siceraria, an essential Cucurbitaceae plant widely cultivated for its nutritional and medicinal benefits. *L. siceraria* is vulnerable to pests which can cause significant yield losses. Conventional chemical insecticides are effective but pose risks to biodiversity and ecosystem health. Botanical insecticides, such as lemongrass, offer a safer alternative due to their biodegradability and lower toxicity to non-target organisms. This study evaluated the effects of lemongrass (*Cymbopogon citratus*) botanical insecticide on arthropod diversity in *L. siceraria* crops. Three treatments were applied: T0 (control), T1 (25% lemongrass botanical insecticide), and T2 (0.02% emamectin benzoate). Observations identified 1,373 individual arthropods from 9 orders, 30 families, and 34 species, performing roles as phytophages, predators, pollinators, decomposers, and parasitoids. Results revealed T1 achieved the highest Shannon-Wiener diversity index (1.96), while T2 had the highest evenness index (0.51), indicating a balanced species distribution. However, increased treatment frequency led to declines in arthropod diversity, reflecting environmental stress. Environmental factors which are humidity, temperature and precipitation supported crop growth but indirectly impacted arthropod populations. T1 was effective in controlling *Batrocera cucurbitae*, leveraging bioactive compounds like citronellal, citronellol, and geraniol with insecticidal properties. While T2 prevented species dominance, it also risked reducing diversity. The findings suggest T1 as a sustainable pest management strategy, balancing effective pest control with biodiversity conservation, while excessive use of synthetic insecticides like T2 could undermine long-term ecosystem health. This study underscores the need for environmentally friendly pest control to maintain agricultural sustainability.

Keywords: lemongrass, arthropod diversity, bottle gourd, botanical insecticide, environment

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VERIFICATION PAGE

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LIFE HISTORY

The author was born in Muara Enim on November 6, 2003. She was born to Arsyad Mudin and Elmianah and the second child of four siblings, with an older sister named Agustina, a younger brother named Febri Ady, and youngest sister named Fathiyyah. The author completed elementary school education at SDN 18 Muara Enim in 2015, junior high school at MTsN 1 Muara Enim graduated in 2018, and senior high school at MAN 1 Muara Enim graduated in 2021.

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FOREWORD

All praise and gratitude from the author for the presence of Allah SWT for all His gifts, the author was able to complete the undergraduate thesis entitled "Effects of Lemongrass (*Cymbopogon citratus*) Botanical Insecticide Application on the Arthropods Diversity of Bottle Gourd (*Lagenaria siceraria*) in Thai Nguyen, Vietnam". This thesis was prepared to meet one of the requirements to get a Bachelor of Agriculture degree in the Department of Pests and Plant Diseases at Sriwijaya University.

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The author realizes that this thesis report is far from perfect. Therefore, the author welcomes any feedback and suggestions from all parties to improve this work. It is hoped that this thesis will provide valuable information and benefits to the readers.

Indralaya, December 2024

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CHAPTER 1
INTRODUCTION

1.1 Background

Bottle gourd or Opo-Squash, scientifically known as *Lagenaria siceraria,* is a member of the family Cucurbitaceae and an essential agricultural crop. In Vietnam, this vegetable is known as "bầu sao" and commonly used for Vietnamese cuisine such as stir-fry and soup dishes. This plant is classified as an annual because it only bears fruit once in its life cycle (Abdillah *et al*., 2024). With a wide range of uses, bottle gourd is a rich source of nutrients, including vitamin B complex, choline, and vitamin C, and contains natural antioxidants (Gajera *et al.*, 2017). It is used in traditional medicine for its cardioprotective, diuretic, and tonic properties, among others. The fruit is beneficial for various health conditions, including cardiovascular disorders, epilepsy, and other nervous diseases (Azizuddin, 2022). The mature dried fruits of bottle gourds are also used by people throughout the world as containers, kitchen utensils, musical instruments, for artistic purposes or in some coastal regions, fishing net holders (Tas *et al*., 2019).

However, like other crops, the bottle gourd is vulnerable to damage caused by various pests. Among them, the red pumpkin beetle (*Aulacophora foveicollis*) from the Chrysomelidae family and fruit flies (*Bactrocera* spp.) from the Tephritidae family are the major limiting factors for commercial cultivation of bottle gourd (Patra *et al*., 2022). Mirid bugs, *Nesidiocoris cruentatus*, which incidence occurred on tender leaves and young fruits of bottle gourd in many parts are a new emerging pest on bottle gourd, causing damage failed to fetch a good market price (Halder *et al*., 2021). The average economic loss caused by these insect's pests in cucurbits is around 40%. Among these pests, *A. foveicollis* and *Bactrocera* sp. are the most damaging insect pests causing the yield losses up to 30-100% depending on the cucurbit species and season (Parajuli, 2020).

To safeguard their crops, farmers have traditionally used chemical insecticides as the primary method of pest control. Vietnam is reported to be the

highest application pesticide rate of 16.5kg/hectare cropland in Southeast Asia region (Schreinemachers *et al*., 2015). Insecticides are effective in quickly reducing pest population however, prolonged and excessive use of chemical pesticides can lead to negative consequences. Pesticides are degraded into organic micropollutants, which negatively impact the environment. Through the processes of biomagnification and bioconcentration, they pose harmful effects on living organisms (Santosh., 2022). Their contribute significantly to the loss of biodiversity, affecting birds, aquatic organisms, soil invertebrates, and other non-target species (Mahmood *et al*., 2016). Over time, pests can develop resistance to chemicals, rendering them less effective and forcing farmers to apply higher doses or switch to stronger, potentially more harmful pesticides. Additionally, chemical insecticides often have non-selective effects, meaning they can kill beneficial insects, such as pollinators and natural predators, along with the harmful ones. This disruption can result in pest resurgence and long-term negative impacts on agroecosystems (Sánchez-Bayo, 2021).

Botanical insecticides, derived from plant extracts, offer a promising alternative to mitigate these impacts and ensure healthy crop yields. These natural insecticides are biodegradable, less toxic to humans and wildlife, and have minimal impact on non-target organisms, making them environmentally friendly (Gajger and Dar, 2021). One of them is botanical insecticide from lemongrass (*Cymbopogon citratus*). This plant consists of citral, citronella, geraniol, myrsena, nerol, methyl heptenol and dipentene pharmasol with insecticidal essential oils, primarily citronella (35%) and geraniol (35-40%). Citronella acts as a contact poison, causing dehydration in pest, which leads to their death (Moniharapon *et al*., 2021).

In addition the essential oil has insecticidal properties attributed to neurotoxic and cytotoxic responses in insects (Mukarram *et al*., 2021). The insecticidal properties of it to black cutworm *Agrotis ipsilon*, cotton leafworm *Spodoptera littoralis*, velvet caterpillar *Anticarsia gemmatalis*, greater wax moth *Galleria mellonella*, and cowpea weevil *Callosobruchus maculatus* have been demonstrated *(Moustafa et al*., 2024). Furthermore, it also shows lower toxicity to non-target organisms compared to conventional insecticides like deltamethrin

and malathion, making it a safer alternative for pest control (Aljedani, 2021). Therefore, based on the explanation above, this study is conducted to evaluate the effects of lemongrass *C. citratus* as a botanical insecticide in preserving arthropod diversity in *L. siceraria* crops.

1.2 Problem

Although lemongrass (*C. citratus*) botanical insecticides are widely considered as eco-friendly alternatives, their specific impact on non-target arthropods in bottle gourd crops remains underexplored. This study will investigate whether lemongrass insecticides can effectively control pests while preserving beneficial arthropod diversity.

1.3 Objective

The primary objective of this study is to assess the impact of botanical insecticide derived from lemongrass (*C. citratus*) on the diversity of arthropods inhabiting bottle gourd plants (L. siceraria) in Thai Nguyen, Vietnam.

1.4 Hypothesis

The hypothesis for this study is that the application of lemongrass *C. citratus* botanical insecticide would effectively reduce pest populations in bottle gourd (*L. siceraria*) crops, while maintaining or enhancing the diversity of non-target beneficial arthropods, compared to synthetic insecticide.

1.5 Benefit

This study disseminates insights into the effects of *C. citratus* botanical insecticide on arthropod diversity in bottle gourd crops. Understanding these effects helps assess the impact of pest control methods on non-target organisms and ecosystem health.

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