Utilization of Essential Oil of Lemongrass (*Cymbopogon citratus*) as a Bio-pesticide to Control *Plutella xylostella* (Lepidoptera: Plutellidae)

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ABSTRAK

Pemanfaatan Minyak Atsiri Sereh Dapur (*Cymbopogon citratus*) sebagai Biopestisida untuk Mengendalikan *Plutella xylostella* (Lepidoptera: Plutellidae)

Informasi tentang efikasi dan pitotoksitas dari minyak atsiri sereh dapur sangat diperlukan dalam memanfaatkan minyaknya untuk mengendalikan *Plutella xylostella*. Penelitian efikasi minyak sereh di laboratorium sudah dilakukan sebagai penelitian pendahuluan sebelum melakukan penelitian di lapangan. Penelitian lapangan yang bertujuan untuk mengetahui efikasi dan pitotoksitas minyak sereh dapur dilakukan di Desa Pancasari, Kecamatan Sukasada, Kabupaten Buleleng (1200 m dpl). Hasil penelitian menunjukan, minyak atsiri sereh dapur pada konsentrasi 10 % menimbulkan gejala terbakar pada daun kubis. Sedangkan pada konsentrasi 2.5 % dan 5 % menunjukan gejala perubahan warna dari hijau menjadi ungu. Tetapi pada konsentrasi rendah 1 %, 0.5 %, dan 0.1 % minyak sereh tidak memiliki pengaruh pitotoksik terhadap tanaman kubis. Pengaruh minyak sereh terhadap populasi *P. xylostella* menunjukan tidak beda nyata pada konsentrasri rendah. Tetapi pada umumnya dapat menekan populasi *P. xylostella* dibandingkan dengan kontrol. Berdasarkan penelitian tersebut maka minyak sereh dapur dapat dimanfaatkan sebagai pengendali *P. xylostella* pada konsentrasi rendah yaitu dibawah konsentrasi 1 %, karena pada konsentrasi tersebut minyak sereh tidak bersifat pitotoksik dan mampu menekan populasi *P. xylostella* di laboratorium maupun di lapangan.

*Kata kunci: minyak atsiri sereh dapur, Plutella xylostella, efikasi, pitotosisitas*

1. Introduction

Cabbage is one of most economic agricultural commodities in Bali. On the other hand to produce cabbage base on consumer want is very difficult. The lost of yield of cabbage is causing by diseases and pests. The most serious disease has been reported, it is club root (*Plasmodiophora brassicae*) and the most important pest is diamondback moth (*Plutella xylostella*) (Shepard, *et al.* 1999). The population of *P. xylostella* is very high on dry season. To control *P. xylostella* have been conducted by using chemical pesticides. However the chemical pesticides have been known dangerous to environmental as well as human being. If we do not use properly this
chemicals can be cause the resistance of the insect, resurgence, and contamination to environmental (Suprapta, et al. 2003). To minimizing the effect of chemical pesticide, some considerations were created, one of them is using of bio-pesticides. Some of bio-pesticide has been found from essential oil. (Sumiartha et al. 2005; Sudiarta et al. 2006). The one of potential essential oil to use as bio-pesticide is lemongrass. Sila Adnyana et al. (2011) reported lemongrass was utilized to control hairy caterpillar. The result show, the caterpillars were lethal totally in 5 minute after treatment by lemongrass on the concentration of 0.5%. According Adeniran and Fabiyi 2012 lemongrass was investigated to control mosquito and sugar ant. On the other hand lemongrass oil was reported has the repellent activity to Callosobruchus maculatus (Paranagama et al., 2002). Base on the data the lemongrass is very potential to utilize as biopesticide. To utilize lemongrass as bio-pesticide, the important information of effication of lemongrass to P. xylostella and Phytotoxicity of lemongrass to cabbage are needed. Therefore the study was conducted in order to analyze the effication of lemongrass to P. xylostella and Phytotoxicity of lemongrass to cabbage.

2. Materials and methods

2.1 Rearing of diamondback moth

Imago of P. xylostella is collected from cabbage field (Bedugul area [1200 mdpl]). In laboratory imago is placed in rearing box with cabbage seedling (3 weeks after transplanting in polybag). The leaf of cabbage is covered by parafilm, it is use for imago to laying their eggs. After larvae are emerged, the cabbage seedling is changed by cabbage plant (more than 1 moth after transplanting in polybag) for feeding of larvae. After 4th instar the larva was used to analysis of effication of lemongrass.

2.2 Effication test of lemongrass

The concentration of lemongrass is made by formula: \( m_1 \cdot v_1 = m_2 \cdot v_2 \) (Baroroh [2004]).

Note: 
- \( m_1 \): Concentration before dilution
- \( v_1 \): Volume before dilution
- \( m_2 \): Concentration after dilution
- \( v_2 \): Volume after dilution

The effication test of lemongrass was conducted with 7 treatments including control and with 5 replications:

- Lg 5: Lemongrass 2.5% concentration
- Lg 2.5: Lemongrass 2.5% concentration
- Lg 1: Lemongrass 1% concentration
- Lg 0.5: Lemongrass 0.5% concentration
Lg 0.25  : Lemongrass 0.5% concentration  
Lg 0.1   : Lemongrass 0.1% concentration  
C       : Control

The solution contains DW (Distillate Water) and tween 80 (with maximum concentration 5%), after solution soluble completely, lemongrass is added.

**2.3 Phytotoxicity test of essential oil of lemongrass to cabbage plant**

Phytotoxicity is the degree to which a chemical or other compound is toxic to plants. To utilize lemongrass as bio-pesticide the phytotoxicity of lemongrass test is very necessary. The phytotoxicity test is conducted in field with several concentration of lemongrass (5, 2.5, 1, 0.5, 0.25, 0.1 % and control). The plant was sprayed by solution of lemongrass 3 weeks after transplanting until harvest. The damage or morphological change of leaf of cabbage will be necessary to observe and collect the data. The experiment design was Randomise Complete Block Design (RCBD), with 3 replications.

**3. Result and Discussion**

Efficacy of lemongrass to *P. xylostella* in laboratory was conducted in Laboratory of Plan Protection Faculty of Agriculture Udayana University as an introduction of research. The efficacy of lemongrass was observed on 24 h and 48 h after application of lemongrass. The result shown the lemongrass was affected to mortality of *P. xylostella*. The field experiment of efficacity of lemongrass oil to *P. xylostella* and Phytotoxicity of lemongrass to cabbage has been conducted in Pancasari, Buleleng, Bali (1200 m asl). The result shown the high concentration of lemongrass (10%) was effect to cabbage as a phytotoxic. The symptom of high concentration (10 %) of lemongrass was detected as a burn in the leaf of cabbage. On the other hand in 5 % and 2.5 % concentration the effect of phytotoxic of lemongrass was detected as a change colour of leaf from green to purple. However for low concentration 1 %, 0.5 %, and 0.1 % the lemongrass no phytotoxic effect (Fig. 1).

![Figure 1](http://ojs.unud.ac.id/index.php/JAT)

Figure 1. The phytotoxic effect of essential oil of lemongrass to cabbage. A) the health cabbage was treated with essential oil of lemongrass (1 %); B) the effect of 2.5 % concentration of essential oil of lemongrass; C) Burning symptom of essential oil of lemongrass on concentration 10 %.
Some essential oil or extract of bio-pesticide was reported had influence to the plant. The effect was reported as phytotoxic effect. The symptom of phytotoxic usually effect for morphological symptom (physic) and functional effect. The analysis of phytotoxicity was reported in radish growth. Some chemical was produce as phytotoxic such as methanolic and ethyl acetate. Those fraction markedly showed inhibition of root and radical growth compared to other fraction (Khan et al. 2012). Khater (2012) reported Essential oils have limited efficacy against large chewing insects, as lepidopterans, coleopterans, and they can be phytotoxic if misused (e.g., applied at rates exceeding that recommended on the product label). The disadvantages of limited persistency and phytotoxicity could be lessened through microencapsulation of essential oils when formulated (Yang et al., 2009).

The influence of lemongrass oil to control *P. xylostella* was conducted. The planning of observation is until harvesting, however on two months after transplanting 50 % of cabbage was attacked by club root disease. Therefore the data collection was conducted only tow time. The result show on 2.5 %, 1 %, and 0.5 % concentration of lemongrass oil did not have significantly different activity to control *P. xylostella*. However the different concentrations had activity to reduce the population of *P. xylostella* (Fig. 2 ant Table 1).

![Figure 2. The development of *P. xylostella* in 1 week (observation 1) and 2 week (observation 2) after treatment](image)

<table>
<thead>
<tr>
<th>Con. of lemongrass (%)</th>
<th><em>Observation 1</em></th>
<th><em>Observation 2</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>5.8</td>
<td>13.4</td>
</tr>
<tr>
<td>0.1</td>
<td>3</td>
<td>14.4</td>
</tr>
<tr>
<td>0.5</td>
<td>3.2</td>
<td>7.2</td>
</tr>
<tr>
<td>1</td>
<td>4.8</td>
<td>5.4</td>
</tr>
<tr>
<td>2.5</td>
<td>3.2</td>
<td>5.2</td>
</tr>
<tr>
<td>5</td>
<td>3.2</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0.6</td>
<td>0</td>
</tr>
</tbody>
</table>
The low concentration 1% and 0.5% of lemongrass oil are potential as a biopesticide because can control the population of *P. xylostella* as well as no phytotoxic to cabbage. The activity of lemongrass oil is influenced by the characteristic of lemongrass oil as volatile oil. Therefore the activity of lemongrass oil related with the calamite condition such as sun or high temperature.

4. Conclusion

The result shown the high concentration of lemongrass (10%) was effect as a phytotoxic with burned symptom of the cabbage leaf. On the other hand in 5% and 2.5% concentration the effect of phytotoxic of lemongrass was detected as a change colour of leaf from green to purple. However for low concentration 1%, 0.5%, and 0.1% the lemongrass did not have phytotoxic effect. The different concentrations of essential oil of lemongrass had activity to reduce the population of *P. xylostella*. Therefore the low concentration of essential oil of lemongrass is recommended to use to control *P. xylostella*.

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References


