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

I PUTU SUDIARTA[1]*)
KETUT SUMIARTHA[1]
NYOMAN SEMADI ANTARA[2]

[1]Faculty of Agriculture Udayana University
[2]Faculty of Food and Agriculture Technology Udayana University
*) E-mail address: putu.ueda@yahoo.com

ABSTRAK

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

Informasi tentang efikasi dan pitotoksisitas 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 pitotoksisitas 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 konsentrasi 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 pupulasi *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 dray 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 maculates* (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 4^{th} 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: $\mathbf{m_1.v_1 = m_2.v_2}$ (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
Lg1 : 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 trasplanting 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

Effication 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 effication 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 effected 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. 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 influent 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 persistence 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).

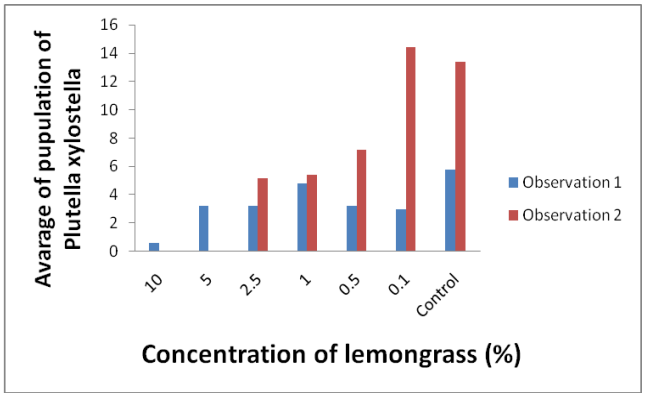

Figure 2. The development of *P. xylostella* in 1 week (observation 1) and 2 week (observation 2) after treatment

Table 1. The population of *P. xylostella* after treated by lemongraas oil

Con. of lemongrass (%)	*Observation 1*	*Observation 2*
10	0.6	0
5	3.2	0
2.5	3.2	5.2
1	4.8	5.4
0.5	3.2	7.2
0.1	3	14.4
Control	5.8	13.4

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*.

Acknowledgement

We are grateful thanks to USAID to funding for TPC project activity, and all of anonymous which were help during this experiment.

References

Adeniran O. I.and Fabiyi E. 2012. A cream formulation of an effective mosquito repellent: a topical product from lemongrass oil (Cymbopogon citratus) Stapf. J. Nat. Prod. Plant Resour., 2012, 2 (2):322-327.

Baroroh, Umi L. U. 2004. *Diktat Kimia Dasar I*. Banjarbaru: Universitas Lambung. Diakses dari http://annisanfushie.wordpress.com/2008/09/29, tanggal 30 Desember 2011.

Khan Rahmat Ali, Muhammad Rashid Khan, Sumaira Sahreen, Naseer Ali Shah, Jasia Bokhari, Umbreen Rashid, and Shumaila Jan. 2012. Phytotoxic characterization of various fractions of Launaea nudicaulis. Journal of Medicinal Plants Research Vol. 6(8), pp. 1403-1406.

Khater Hanem Fathy. 2012. Prospects of botanical biopesticides in insect pest management. Journal of Applied Pharmaceutical Science 02 (05); 2012: 244-259.

Paranagama P. A., A. A. C. K. Adhikari, K. P. Abeywickrama and K. A. N. Premarathne Bandara. 2002. Toxicity and repellant activity of Cymbopogon citratus (D.C.) Stapf. and Murraya koenigii Sprang. against Callosobruchus maculatus (F.) (Coleoptera; Bruchidae). Tropical Agricultural Research and Extension 5(1 & 2).

Shepard, B.M., G.R. Carner, A.T. Barrion, P.A.C. Ooi and H. van den Berg. 1999. Insects and their Natural Enemies Associated with Vegetables and Soybean in Southeast Asia. Clemson University USA. p. 54.

Sudiarta I P. and D. N. Suprapta. 2006. Development of Botanical Pesticide to Support Sustainable Agriculture. Proceeding International Workshop Ibaraki University Japan.

Sumiartha K., W. Susila and P. Sudiarta. 2005. Effect of "Selasih" (*Ocimum tenuiflorum*) Plant Oil on Fruit Flies (*Bactrocera dorsalis* Complex) in Long Chili. Journal of ISSAAS **11**(3)(*Sppl.*): 150-155.

Sumiartha and I P. Sudiarta. 2011. Efikasi Beberapa Jenis Ekstrak Daun Tanaman Terhadap Ulat Bulu, *Limantria Marginata* (Lepidoptera:Limantriidae). ISSAAS, Bogor 2011.

Sila Adnyana, I G., K. Sumiartha, I P. Sudiarta. 2012. Efikasi Pestisida Nabati Minyak Atsiri Tanaman Tropis terhadap Mortalitas Ulat Bulu Gempinis. E-Jurnal Agroekoteknologi 1(1):1-11. http://ojs.unud.ac.id/index.php/JAT

Suprapta, D. N., IW. Suanda, N. Arya and K. Ohsawa. 2003. Insecticidal Activity of Tinospora crispa Leaf Extract Against Diamond Back Mouth in Cabbage. Journal of ISSAAS **9**(2): 18-24.

Yang FL, Li XG, Zhu, F, Lei CL. 2009. Structural Characterization of Nanoparticles Loaded with Garlic Essential Oil and Their Insecticidal Activity against Tribolium castaneum (Herbst) (Coleoptera: Tenebrionidae). J Agric Food Chem.; 57(21): 10156-10162.