

THE EFFECT OF LEMONGRASS EXTRACT (*Cymbopogon citratus* L.) On Pest Mortality Of *Plutella xylostella* L. IN MUSTARD PLANTS (*Brassica juncea* L.)

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ABSTRACT

Cabbage leaf caterpillars (*Plutella xylostella* L., Lepidoptera: Plutellidae) are the main pests that are very damaging to Brassicaceae plants, especially cabbage, mustard greens, and caisin in Indonesia. The chemical content of lemongrass is citral, citronella, geraniol, mirsene, nerol, farnesol methyl heptenol and dipentene. The purpose of this study was to determine the effective concentration of *Plutella xylostella* pest mortality and the right LC50 value of *Plutella xylostella* pest mortality. This research is experimental using a completely randomized design. The subjects were 50 *Plutella xylostella* L. Instar III pests. The concentrations used were 10 g, 20 g, 30 g, 40 g with negative control 0 g (aquades) with 5 repetitions for each treatment group. Observations were made 24 hours after spraying and the results obtained were an increase in pest death with increasing concentration. Based on the results of analysis of variance seen in the calculated F value (41,962) > F table (2,866). This proves that the administration of lemongrass stem extract significantly influences the mortality of *Plutella xylostella* in mustard plants (*Brassica juncea*). The results of LC50 probit analysis were obtained at the concentration of lemongrass extract at 21,277% with a lower limit of 17,782 and an upper limit of 24,824, meaning that at a concentration of 21,277% lemongrass extract was able to kill 50% of the *Plutella xylostella* pest used after 24 hours of administration at a 95% confidence level.

Keywords: *cymbopogon citratus*, *plutella xylostella*, *brassica juncea*.

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INTRODUCTION

Mustard greens (*Brassica oleracea* var. *capitata* L.) are the most important vegetables in Indonesia, however, in their cultivation they face many obstacles, including pest and disease problems. According to Sastrosiswojo and Setiawati (1993), one of the important pests that attacks mustard greens is *Plutella xylostella* L. The results of research on lemongrass stem extract against *Plutella xylostella* pests on mustard greens in North Sulawesi show that the level of damage to cabbage plants caused by pests reached 40% (Rante et al., 1995). The presence of pest attacks on mustard greens has caused farmers to try to protect their plants from pest damage by using chemicals such as synthetic insecticides. Attack by plant pests (OPT), especially by leaf caterpillars, is one of the limiting factors in mustard greens production. Cabbage leaf caterpillars (*Plutella xylostella* L.) can cause up to 85-100% damage to mustard greens, especially during the dry season (Rukmana, 1994). Cabbage leaf caterpillars (*Plutella xylostella* L., Lepidoptera: Plutellidae) are the main pests that greatly damage Brassicaceae plants, especially cabbage, mustard greens and caisins in Indonesia (Kartusuwondo 1994; Winasa & Herlinda 2003).

In Indonesia, one type of plant that has the potential to be developed as a vegetable insecticide is lemon grass (*Andropogon nardus* L.). Lemongrass stem extract alone or in combination with other plant extracts is known to have insecticidal properties against warehouse pests (*Allosobruchus maculatus*) and leek caterpillars (*Achantoschelides obtectus*), leek cutters (*Spodoptera exigua*), mosquitoes (*Aedes aegypti*) (Wardani, 2009), *Crosidolomia binotalis* Zell (Makal and Turang, 2011) and subterranean termites

(Latumahina, 2010). According to research by Makal and Turang (2011), using crude extract of lemongrass stems to control *Crosidolomia binotalis* Zell larvae on cabbage plants for 72 hours, the effective concentration of crude extract of lemongrass stems on larval mortality, namely at a dose of 80 g per 50 ml, was able to control larvae. *Crosidolomia binotalis* Zell by 95%. Meanwhile, according to Shabudin and Anhary's research, the insecticidal activity of lemongrass leaves against *Plutella xylostella* is known to be an effective dose for the average mortality percentage of *Plutella xylostella* over 10 hours, namely at a dose of 10.5%.

The chemical constituents contained in the citronella plant include essential oil containing 0.4% with components consisting of citral, citronellol (66-85%), α -pinen, kamfen, sabinen, mirsen, β -felandren, psimen, limonene, cis-osimen, terpinol, citronellal, borneol, terpinen-4-ol, α -terpineol, geraniol, farnesol, methyl heptenone, n-decylaldehyde, dipentene, metalheptenone, bornyl acetate, geranyl formate, terpinyl acetate, citronellyl acetate, geranylacetate, β -element, β -karyophyllene, β -bergamoten, trans-methylisoeugenol, β -kadinen, elemol, caryophyllene oxide (Anonymous, 1984; Anonymous, 1985; and Rusli et al., 1979 in Kristiani, 2013). Kardinan (2004), stated that the lemongrass plant (*Andropogon nardus* L) is a plant that can also be used as a natural insecticide for controlling plant pests. The use of lemongrass extract as a botanical insecticide is an alternative pest control that is environmentally friendly. At first, synthetic insecticides really helped farmers to protect crops from pest attacks, but in the end, these insecticides had various negative impacts on the environment and humans. This lemongrass plant is easy to grow in infertile places even in barren places, with a high level of environmental adaptation, lemongrass does not require special care so it is easy to cultivate (Setiawati et al., 2010). Based on the description above, the authors are interested in conducting research on the effect of citronella stem extract (*Cymbopogon citratus* L.) on the mortality of the pest *Plutella xylostella* L. on mustard greens (*Brassica juncea* L.).

METHOD

This research was conducted at the Laboratory of Insect Taxonomy, Department of Biology, Faculty of Mathematics and Natural Sciences, Pattimura University, Ambon, from 12 November 2015 to 11 December 2015. The design used in this study was a Completely Randomized Design, with 5 treatments and 4 replications so there were 20 experimental units. The treatment can be broken down as follows: K1 = Control, K2 = 10 g of lemongrass extract in 100 ml of distilled water; K3 = 20 g lemongrass stem extract in 100 ml distilled water; K4 = 30 g lemongrass stem extract in 100 ml distilled water; and K5 = 40 g of lemongrass stem extract in 100 ml of distilled water. Combination treatment with lemongrass stem extract solution. The parameter observed was the percentage mortality of *Plutella xylostella* pests which was calculated using the formula proposed by Kundra (1981), as follows:

$$M = a / b \times 100\%$$

M = Percentage of pest mortality *Plutella xylostella*

a = Number of dead caterpillar pests

b = Number of pests used

Procedure

Pest collection

Plutella xylostella pests as test material were taken from mustard plantations around the Waiheru garden, then taken to the Plant Taxonomy Laboratory, Faculty of Mathematics and Natural Sciences, Pattimura University, Ambon to be reared in the jars provided, then the imago were fed a solution of 10% larval honey. The imagos are paired to lay eggs and develop into third instar larvae to be used as test pests. Ten *Plutella xylostella* pests were taken to be used in each treatment.

Preparation of extract

The steps in making lemongrass extract are as follows:

1. Clean and grind the lemongrass stalks using a blender, adding 100 ml of distilled water, at each concentration of 10 g, 20 g, 30 g and 40 g.
2. The finely ground lemongrass stems are left for 24 hours so that the active substances contained in the lemongrass stem extract can dissolve.
3. Then stir until evenly mixed, then slowly filter the precipitated solution.

Treatment with lemongrass extract

The administration of lemongrass stem extract is carried out as follows:

1. Transfer the pests that have been fasted for 3 hours into 5 sample bottles.
2. Each sample bottle is filled with 10 pests, then the lemongrass stem extract is sprayed 5 times on the pests that have been filled in the container, until the pest mortality rate is seen.
3. Each treatment was repeated 5 times.
4. Calculation of *Plutella xylostella* pest mortality

At the end of the study, pest mortality was calculated as follows:

1. Count the number of pests that died after spraying lemongrass stem extract.
2. Enter the results into a table and carry out analysis and discussion.

Data analysis

The results of observations of mortality values for each treatment with 5 replications were used to calculate the average value. The average value is made into a graph to show the tendency of mortality for each treatment. To study the level of variability in mortality due to treatment, an analysis of variance (Anova) was carried out using SPSS version 21 software, then if the anova results showed a significant level, then the BNT test was carried out to see the level of differences between treatments. Determine the concentration of lemongrass stem extract that can kill half (50%) of the test animals used, a Probit analysis was carried out, using SAS version 9 software.

DISCUSSION RESULT

Based on the research results, the effect of lemongrass stem extract (*Cymbopogon citratus*) on the mortality of *Plutella xylostella* pests can be seen in the following table.

Table 1. Average mortality and percentage of mortality of *Plutella Xylostella* observed for 24 hours.

Treatment	Repit					mean	% Mortality
	1	2	3	4	5		
K1 0 g	0	0	0	0	0	0.00 ± 0.000	0
K2 10 g	4	6	6	4	4	4.80 ± 1.095	48
K3 20 g	4	4	6	7	4	5.00 ± 1.414	50
K4 30 g	6	6	6	8	8	6.80 ± 1.095	68
K5 40 g	8	8	6	8	8	7.60 ± 0.894	76

The results of the research are in Table 1. It can be seen that the average value of the mortality rate of *Plutella xylostella* at the lowest concentration of K2 (10 g) was only able to kill 48% of the 10 individuals of the *Plutella xylostella* pest tested, while at K3 (20 g), the extract Lemongrass stalks can kill 50% of the tested *Plutella xylostella* pests. Furthermore, in the K4 treatment (30 g) the mortality of *Plutella xylostella* began to increase, reaching a mortality rate of 68%, while in the K5 treatment (40 g) the mortality increased to 76%. The higher the concentration used, the greater the mortality rate of *Plutella xylostella*. The mortality of *Plutella xylostella* after 24 hours is thought to contain the active substance contained in lemongrass leaf extract, namely essential oil. Where can you see the characteristics of the death of the *Plutella xylostella* pest which at first was active but after being given treatment, this pest looked weak, the body changed from green to blackish brown, the body was circular and did not move at all when touched, this was because the *Plutella Xylostella* pest was exposed stomach poison.

Table 2. Results of analysis of variance (Anova) of lemongrass stem extract on the mortality of *Plutella xylostella* during 24 hours of observation.

Source of Diversity	DB	Sum of Squares	Middle Square	F Value	F Table	Sig.
Treatment	4	174.560	43.640	41.962	2.866	0.000
Galat	20	20.800	1.040			
Total	24	195.360				

Based on the results of the analysis of variance, it can be seen that the calculated F value (41,962) > F table (2,866). This proves that giving lemongrass stem extract has a significant effect on the mortality of *Plutella xylostella* on mustard greens (*Brassica juncea*).

Mortality (%)	Concentration (%)	Level of confidence (%)	Confidence intervals	
			Lower limit	Upper limit
50	21.277	95%	17.782	24.824

The results of further tests using a significant difference test (LSD) using the SPSS program were carried out to determine the effective dose of lemongrass extract against *Plutella xylostella*. The results of the least significant difference test (LSD) for each treatment of the concentration of citronella stem extract (*Cymbopogon citrates*) against *Plutella xylostella* on mustard greens (*Brassica juncea*) for 24 hours of observation showed that the control group was significantly different with a concentration of 10 g, 20 g, 30 g, and 40 g. The 10 g concentration was significantly different from the control, 30 g and 40 g concentrations,

but significantly different from the 20 g concentration. While the 20 g concentration was significantly different from the control, the 30 g and 40 g concentrations were not significantly different from the 10 g concentration. The 30 g concentration was significantly different from the control, 10 g and 20 g concentrations, but not significantly different from the 40 g concentration. While the 40 g concentration was significantly different from the control, 10 g and 20 g concentrations, but not significantly different from 30 g. The LC_{50} value was obtained at a concentration of lemongrass stem extract of 21,277% with a lower limit of 17,782 and an upper limit of 24,824, meaning that at a concentration of 21,277% lemongrass stem extract was able to kill 50% of the *Plutella xylostella* pests used after administering the extract for 24 hours at a 95% confidence level.

The results of *Plutella xylostella* pest treatment in the group given lemongrass stem extract were different from those in the group without lemongrass stem extract. In the untreated control group (without lemongrass stem extract) the pest samples looked normal and there was no mortality. This was different when *Plutella xylostella* pests were given lemongrass stem extract (treatment group) with various concentrations, *Plutella xylostella* pests became weak, their bodies were blackish in color, and looked stiff. This shows that the extract of lemongrass stems has active compounds that have an effect on *Plutella xylostella* pests. Nursal (1997) stated that the active compounds contained in insecticides are compounds that can cause body parts to become stiff, so that activities are disrupted and result in a decrease in body activity.

In this study, the mortality of *Plutella xylostella* was thought to have died because the stalks of lemongrass (*Cymbopogon citratus*) contained toxic compounds. According to Roger and Hamraqui (1996), citronella plants contain essential oils which are toxic. Lemongrass essential oil consists of citral, citronella, geraniol, myrsena, nerol, methyl heptenol and dipentene pharnasol. The largest content is citronella, which is 35% and geraniol, which is 35-40%. Furthermore, according to Setiawati et al., (2010) the citronella compound is a contact poison and causes dehydration so that insects lose fluids continuously and result in death. Initially, the citronella compound enters the body of the *Plutella xylostella* pest through the body surface, especially the thin skin, in the areas connected to the segments, the indentations formed by the body plates, in the respiratory tract. The poison that has been attached to the pest *Plutella xylostella* will soon enter the body and poisoning will occur (Untung 2006).

Mutchler (1991) explained that the mechanism of citronella contact poison is by inhibiting the acetylcholine-esterase enzyme, resulting in phosphorylation of the amino acid serine at the asteratic center of the enzyme in question. Symptoms of poisoning arise due to the accumulation of acetylcholine which causes central nervous system disorders, seizures, paralysis and gradual death. According to Untung (2006), contact poison can be absorbed through the skin when insecticide is applied or can also be exposed to residual insecticide some time after spraying. The insecticide enters the body of the *Plutella xylostella* pest through the insect's mouthparts, by sucking the liquid on mustard leaves which have been sprayed with lemongrass stem extract, then enters through the pest's digestive tract which disrupts the feeding activities of the *Plutella xylostella* pest.

CONCLUSION

Administrated of 30 g of lemongrass stem extract (*Cymbopogon citratus*) is effective against pests (*Plutella xylostella*) and has great potential as a botanical pesticide with a mortality rate of up to 68%. The LC_{50} value of citronella stem extract (*Cymbopogon citratus*) against pests (*Plutella xylostella*) was 21.277%, which means that at a concentration of 21.277%, lemongrass extract was able to kill 50% of pests (*Plutella xylostella*).

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