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Effect of Berenuk Fruit Extract (*Crescentia cujete* L.) on Mortality of *Plutella xylostella* on Mustard Plants

Feri Bakhtiar Rinaldi[1]*, Taupik Sopyan[2], Jeti Rachmawati[3], Ai Nurfadilah[4]
[1,2,3,4]Biology Education, Faculty of Teacher Training and Education, Universitas Galuh
RE Martadinata St. 150, Ciamis, Indonesia
*Corresponding author: feribakhtiar@unigal.ac.id

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Abstrak: *Mustard production in Indonesia in 2022 decreased by 2.9% from the previous year, caused by the Plutella xylostella attack. Efforts to control P. xylostella usually uses synthetic pesticides but harms the environment, so other alternatives are needed. Vegetable pesticides derived from Berenuk fruit (Crescentia cujete) containing phenol compounds, alkaloids, flavonoids, tannins, steroids, and saponins have the potential to control the population of P. xylostella. This study aimed to determine the effect of berenuk (C. cujete) extract on P. xylostella mortality. This study used an experimental method with a research design in the form of a Randomized Group Design consisting of 6 treatments and 4 replicates, namely the provision of test extracts with concentrations of 0%, 6.25%, 12.5%, 25%, 50%, and 100%. Observations of mortality of test larvae were made at 24, 48, and 72 hours after the test. Based on Probit analysis for LC10, LC25 and LC50 showed that for LC10 = 1.377%, LC25 11.549% and LC50 the lowest was 55.9%. Berenuk fruit extract (C. cujete) affects the mortality of P. xylostella; the higher the concentration of the extract, the higher the ability to control the population of Plutella xylostella.*

Keywords: *Berenuk Fruit, Brassica juncea, Crescentia cujete, Organic Pesticides, Plutella xylostella.*

1. INTRODUCTION

Mustard (*Brassica juncea* (L.) Czern. is one of the horticultural crops favored by the public because it contains minerals, vitamins, fats, carbohydrates, Ca, P, Fe, Vitamins A, B and C (Tati & Anhar, 2022). Mustard can grow at various altitudes, from lowlands to highlands, between 5 - 1200 meters above sea level (Gaol et al., 2019).

According to the Indonesian Central Bureau of Statistics, mustard production in Indonesia decreased by 2.9% in 2022 compared to the previous year. (Badan Pusat Statistik, 2022).

The decline in mustard production shows that there are obstacles to mustard cultivation. One obstacle is the presence of Plant Helper Organisms (OPT), including hanging caterpillars (Plutella xylostella and Crocidolomia binotalis). These caterpillars cause holes in the leaves and only leave the leaf bones on the strands. (Taslia et al., 2022). P. xylostella is a major pest of mustard, among other insects, that causes 90% of global damage (Furlong et al., 2013).

There needs to be a serious handling of the threat to mustard cultivation caused by the main pests of mustard plants, including the caterpillar P. xylostella. control of P. xylostella caterpillars. The popular pest control applied by farmers is the intensive use of synthetic pesticides, which raises new problems that are side effects of pesticide use, such as pest resistance, pest resurgence, secondary pest explosion, insecticide residues, human health, and environmental problems. (Rinaldi, F. B., Udiarto & Rachmawati, 2016).

Chemicals from pesticides can enter the soil directly during spraying or indirectly when fallen leaves or parts of sprayed plants exposed to

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pesticides fall to the ground, causing toxic substances to enter the soil (Cycoń et al., 2017). Chemical substances that accumulate in the soil undergo chemical processes such as hydrolysis, photolysis, and chemical degradation. These processes interact with the soil's microbiota, resulting in biological degradation (Salazar-Ledesma et al., 2018); (Shaheen et al., 2019).

Toxic compounds from pesticides reach water resources (surface and groundwater), which become polluted and can lead to active cancer cells (carcinogenic) when in contact with humans when consumed for a long period. Solving pest problems should not cause new problems, so alternative solutions are needed that can solve problems without side effects. One alternative way is to use vegetable pesticides that are more environmentally friendly and easily decomposed so as not to leave new problems.

Vegetable pesticides, often also referred to as botanical pesticides, are natural chemicals extracted from organs or parts of plants that have pesticidal properties and can be used as an alternative to replace the role of synthetic pesticides in plant protection efforts to avoid negative impacts or side effects from the use of synthetic pesticides (Hikal et al., 2017).

The use of botanical pesticides is one solution to reducing the side effects of pesticides because they are more effective and nonpersistent. (Arora & Mishra, 2016) ; (Parsa et al., 2014) These botanical pesticides can complement an integrated pest management system.

Chemical compounds extracted from plants include essential oils, flavonoids, alkaloids, glycosides, esters, and fatty acids. These compounds affect insects as repellents, antifeedants, toxicants, insect growth and development inhibitors, chemosterilants, and attractants. One of the potential organic pesticides that can be used is a pesticide based on berenuk (C. cujete L.) plant organs (Rinaldi et al., 2024).

Berenuk or C. cujete is a plant native to Central America and South America. Currently, berenuk fruit is widely found in Indonesia with the local names tabu kayu, berenuk, bila balanda, buah no and often referred to as majapahit.

Physically, the berenuk fruit has characteristics similar to the maja fruit, so it often needs clarification. However, these two fruits come from different species and origins. Maja fruit (Aegle marmelos) comes from the Rutaceae family, known as sweet maja, while berenuk or bitter maja (C. cujete) comes from the Bignoniaceae family.

Berenuk fruit contains phenol compounds, alkaloids, flavonoids, tannins, steroids, and saponins (Dewi, M. K., Ratnasari, E., & Trimulyono, 2014) (Arel et al., 2018). Chemical compounds such as flavonoids, alkaloids, and polyphenols can be pesticides (Astar et al., 2022).

Fruit or leaf extracts of berenuk or bitter maja have previously been used to control several pests, such as ladybugs (Epilachna admirabilis) (Astar et al., 2022), Cocoa Pod Borer Pest (Conopomorpha cramerella) (Rismayani, 2013), As well as other plant-disrupting organisms.

Berenuk fruit extract can be used to control P. xyllostella. The use of berenuk fruit as a vegetable insecticide is not only expected to overcome the problem of P. xyllostella caterpillar attack without causing side effects or new problems but also a way to optimize the benefits of berenuk itself, which was previously considered to provide less benefit to the community both from the fruit and leaves.

2. RESEARCH METHOD

This study used an experimental method with a research design in the form of a Randomized Group Design consisting of 6 treatments and 4 replicates, namely the provision of test extracts with concentrations of 0%, 6.25%, 12.5%, 25%, 50%, and 100%, v/v = (extract/ethanol).

Research Phase:

a. **Preparation of test insects (rearing)**: Preparation of test insects (rearing): *P. xylostella* caterpillar larvae explored from the field were reared in the laboratory by being fed until they became imago; imago was given a 10% honey solution and filter paper as a place to lay eggs, eggs attached to filter paper were then transferred to a container covered with gauze at the top. Eggs are left for 3-6 days until they hatch into larvae, and the life cycle of *P. xylostella* larvae from instar I-IV is, at most, 10 days.

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b. **Manufacture of botanical pesticides**: Berenuk extract is made through the maceration method (soaking): mashed berenuk fruit is put in a dark glass bottle plus 70% ethanol solvent in a ratio of 1 5, tightly closed, and left for 2 x 24 hours. After soaking, the solution was filtered to separate the pulp from the filtrate. The filtrate was concentrated using a rotary evaporator below 40 until a thick ethanol extract was obtained. (Raymon et al., 2016). The extraction process from maceration to concentration using a rotary evaporator was performed at the Gadjah Mada University (UGM) Pharmacy Laboratory.
c. **Botanical Pesticides testing**: Mustard leaves cut into 4 x 4 cm sizes sprayed with test extracts with different concentrations were dried and then put into each jar containing 10 *P. xylostella* larvae as larval feed. Mortality observations were made 24, 48, and 72 hours after the test. Berenuk extract was tested against *P. xylostella* mortality in the Biology laboratory of Galuh University.
d. **Data Analysis Technique**: The data collected is processed using probit analysis, a regression analysis that describes the relationship between the dependent and independent variables (Tinungki, 2010). The Polo Plus Probit and Logit Analysis Version 1.0 applications were used for the analysis.

3. RESULTS AND DISCUSSION

Data from the test results of berenuk (*C. cujete*) extract against *P. xylostella* caterpillars showed differences in the number of caterpillars affected. Data on the percentage of death of *P. xylostella* caterpillars after 72 hours is presented in Table 1.

Table 1. Mortality data of *P. xylostella* after 72 hours of exposure to berenuk extracts

Extract concentration (%)	Percentage of dead caterpillars (%)
0%	12
6,5 %	31
12,5%	35
25%	40
50%	41,6
100%	58,3

Table 1 shows that the application of berenuk extract affects the death of *P. xylostella* caterpillars even though it cannot kill 100% of the test insects. The higher the concentration of the extract, the higher the mortality rate of the test insects. This is presented in Figure 1.

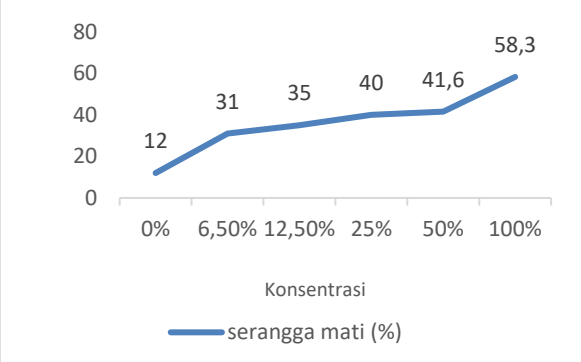

Figure 1. Mortality of *P. xylostella* at each concentration

Probit regression analysis was conducted to determine the effective concentration. The results of probit analysis provide information for three Lethal concentrations (LC), including LC10, LC25, and LC50. The data are presented in Table 2.

Table 2. Concentration Effectiveness Data

LC	Concentration Average	Limits	0.90	0.95	0.99
LC 10	1,377	Lower	0,009	0,000	
		Upper	5,572	6,601	
LC 25	11,549	Lower	1.353	0.395	
		Upper	25.893	29.448	
LC 50	122,627	Lower	55.990	49.036	
		Upper	860.186	2567.456	

Treatment with different concentrations showed different deaths of *P. xylostella* larvae after 72 hours. LC10 showed that to kill 10% of the Plutella xylostella caterpillar population required an average concentration of 1.377% with a range of 0.009 - 5.572%, LC25 showed that to kill 25% of the *P. xylostella* population used an average concentration of 11.549% with a concentration range of 1.353% - 25.893%. In contrast, LC50 showed that killing 50% of the *P. xylostella* caterpillar population required a fairly

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high concentration; the lowest concentration to kill 50% of the population at 72 hours after pesticide exposure was 55.9%.

Conditions like this show that vegetable pesticides have different toxicity levels and other effects on target insects besides death. They can also affect insect growth, development, feeding, and reproductive activity.

Flavonoids in berenuk act as botanical pesticides, affecting insect behavior, growth, and development. (Vagiri et al., 2017). Flavonoids, saponins, and tannins in berenuk also act as antifeedants (Mawuntu, 2016). In addition, polyphenol compounds, flavonoids, and saponins can also affect the respiratory system (Romansyah et al., 2021).

Toxicants that damage the nervous tissue deform or impair surviving P. xylostella larvae, delaying the process of turning larvae into pupae (Mawuntu, 2016).

An overview of the differences in lethal concentration (LC) is presented in Figure 2.

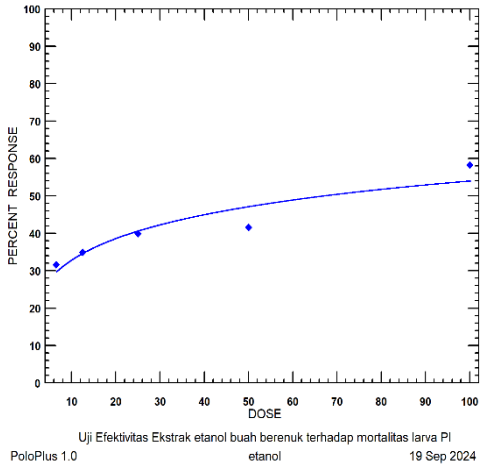

Figure 2. Effectiveness curve of berenuk fruit extract on mortality of *P. xylostella* larvae

The curve in Figure 2 shows that the increase in concentration is directly proportional to the increase in the effectiveness of berenuk extract on the mortality of *Plutella xylostella* larvae. The higher the concentration of the extract, the more effective it is in controlling the population of *P. xylostella*.

4. CONCLUSION

Berenuk fruit extract (*C. cujete*) affects *P. xylostella* mortality. The higher the concentration of the extract, the greater its ability to control *P. xylostella* populations.

5. ACKNOWLEDGEMENTS

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