

Studies on effect of Areca nut extract solution on mortality of armyworm (*Spodoptera litura* F.) on lettuce (*Lactuca sativa* L.) plants

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(Received 10 October, 2021; Accepted 27 December, 2021)

ABSTRACT

Lettuce (*Lactuca sativa* L.) is a vegetable commodity that has high economic value. However, in the process of cultivation, this plant experienced problems which resulted in a decrease in total production yields and even resulted in crop failure caused by pest attacks, one of which was armyworm. Therefore, it is necessary to have an environmentally friendly control to suppress this pest population. One way of controlling that can be used is to use areca nut. This research was conducted in September 2021 – October 2021 at the Production Laboratory of the Department of Agro ecotechnology, Lambung Mangkurat University, Banjarbaru. The research design used was a completely randomized design (CRD) with 1 factor, with 5 treatments and 4 replications. The treatments used included P0 (control), P1 (concentration 1 g/l water), P2 (concentration 5 g/l water), P3 (concentration 10 g/l water), and P4 (concentration 15 g/l water). The results obtained showed that P4 treatment with a concentration of 15 g/l of water was effective in controlling armyworms because it showed the best results in the percentage of total mortality, and resulted in a mortality of more than 50% within 42 hours of observation after being treated and the LC₅₀ value in this study was at a dose of 44.309 g/l.

Key word : *Spodoptera litura* F., Vegetable pesticides, Areca nuts.

Introduction

Indonesia is an agricultural country with an area of agriculture land reaching 27.222.773 ha of land (central bureau of statistics, 2020). As an agricultural country, Indonesia has a very large diversity of cultivated plant species. Many types of vegetable plants are cultivated in Indonesia, because this type of plant contains a lot of fiber, vitamins and minerals that are essential for the development and

growth of the body. Among the various types of vegetables that are cultivated, lettuce (*Lactuca sativa* L.) is one of vegetable commodities that have high economic value (Laily, 2017). However, in the process of cultivating this plant it experienced obstacles which resulted in a decrease in total production yield about 4% until serious crop failure occurred due to attacks by plant pest organisms (Kardinan, 2000).

One of the organisms that interfere with lettuce

plants is the armyworm (*Spodoptera litura* F.). Armyworms become pests for lettuce plants because they eat lettuce leaves until they hollow and cut off (Cahyono, 2006). So that the damage to the leaves which are the main part of this plant will cause a low selling value and even crop failure due to the exhaustion of leaves due to this pest attack. Therefore, it is necessary to control it to prevent the occurrence of this pest attack. Control is generally carried out by farmers using high doses of chemical insecticides in the hope of reducing the level of attack, but the fact is that by using chemical pesticides with high doses that are not recommended, it results in negative impacts such as the occurrence of pest resurgence, and pests become resistant to pesticides, and also pollute the environment (Rusdy, 2009). Control with natural ingredients is recommended to reduce negative impacts on the environment. One of the vegetable ingredients that can be used is betel nut (*Areca catechu* L.).

Areca nut (*Areca catechu* L.) is spread evenly in Indonesia because this plant can grow from coastal areas to areas with an altitude of 1.000 meters above the sea level (Ananda, 1988). The part of the betel nut that is used as a vegetable pesticide is the part of the Areca nut, because the content contained in the Areca nut such as polyphenols, fat, starch and alkaloids is quite high (Amudhan *et al.*, 2012). The use of betel nut as a pesticide has been tested in several studies, according to Khairani *et al.* (2019) pesticide research from betel nut has a mortality percentage rate of 58.34% Areca against brown plant hopper pests. Rikardo *et al.* (2018) shows from the results of his research 100 percent of mortality of cabbage crop caterpillars. Therefore, it is necessary to do further research on the impact of using areca nut on the mortality of armyworms (*S. litura*).

Materials and Methods

Material needed in this research is: Lettuce (*Lactuca sativa* L.), armyworm (*S. litura*) three instars, Areca nut, ethanol 96%, soil, water, manure and NPK fertilizer. While the tools used are polibags, scales, hand sprayer, filter paper, blender, glass bottles, plastic, rotary evaporator, knife, jars, beakers, sieves, hoes, lid, insects, name tag, and a camera.

Statistical analysis

Statistical analysis was carried out in four replicates for the one control and experimental samples. The

data have been analyzed by one-way analysis of variance (ANOVA) followed by DMRT (*Duncan Multiple Range Test*) for the average value of parameter among the four treatments and used to compare the means values between each treatments.

There are 5 levels of statistical used in this treatment :

- P0 : control
- P1 : 1 g/l areca nut solution
- P₂ : 5 g/l areca nut solution
- P3 : 10 g/l areca nut solution
- P4 : 15 g/l areca nut solution

Armyworm (*S. litura*) insects is taken from the field, then cultured in a cage to get 200 larvae. Observations starting from 24 hours, 48, and 72, on the larvae mortality, up to 50 percent. And the 50% *lethal concentration* in this study was analyzed using probit analysis.

Results and Discussion

Percentage of Total Mortality

Based on the results of the analysis of variance, the results showed a significant effect on the percentage total mortality. The results of the percentage of total mortality observed can be seen in Figure 1.

Description : P0 = without giving areca nut pow-

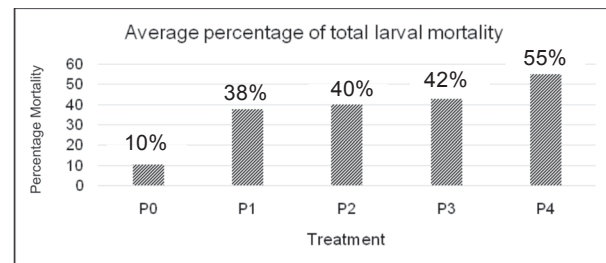


Fig. 1. Percentage of armyworm (*S. litura*) total mortality.

der (control), P1 = giving a concentration 5 g/l areca nut extract solution, P2 = giving a concentration 10 g/l areca nut extract solution, P3 = giving a concentration 15 g/l areca nut extract solution, P4 = giving a concentration 20 g/l areca nut extract solution.

Figure 1 shows that the best results on the parameter of the percentage of total mortality, namely being treatment P4 with a concentration of 15 g/l gave a result of 55% until the end of observation 72 hours, which did not differ from the P3, P2, and P1 treatments. While the treatment that got the lowest results was in the P0 treatment, as the control treat-

ment of 10%.

Giving extract of areca betel nut solution has an effect on armyworm mortality, this can be shown from figure 1. Where the treatment with areca betel nut extract solution obtained a higher percentage of total mortality compared to the control treatment, It is suspected that there are toxic compounds in the solution extract of areca nut that cause more mortality in armyworm. According to Eri *et al.*, (2014), areca nut can cause mortality in armyworms. So that by giving a higher concentration, the more arecoline compounds that accumulate in the armyworm's body, thus accelerating the occurrence of death.

Treatment with a concentration of 1 g/l water showed lower results than the treatment with a concentration of 5 g/l water, as well as with a higher concentration, the mortality obtained was also higher, In this study, the concentration of areca betel nut extract solution from a concentration of 1 g/l water to 15 g/l water did not show a different effect based on the results of the analysis obtained. Hence, the test caterpillars will still withstand the arecoline compounds with the given concentration, so they could provide a response that did not differ between treatments, according to Syah, (2016), the higher the concentration of a pesticide causes the number of toxic compounds that accumulate in the body is also higher.

Toxic compounds contained in the areca nut are arecoline and phenolic compounds, according to Gassa, (2011), can lead to a decrease in cell viability so that it interferes with the speed of DNA and protein synthesis, and can interfere with the respiratory system. Phenolic compounds are toxic crystalline compounds that will form reactive oxygen that can damage DNA or epithelial cell (Mind of the People, 2005). So that by giving a solution Pikiran Rakyat of areca betel nut extract with a toxic content in it causes higher mortality rate.

Time of Mortality (hours)

Based on the results of analysis of variance, showed results that had a significant effect on the first time of mortality. The results of the observed on the first time of mortality can be shown in Figure 2.

Description : P0 = without giving areca nut extract solution (control), P1 = giving a concentration 5 g/l areca nut extract solution, P2 = giving a concentration 10 g/l areca nut extract solution, P3 = giving a concentration 15 g/l areca nut extract solution, P4 = giving a concentration 20 g/l areca nut extract

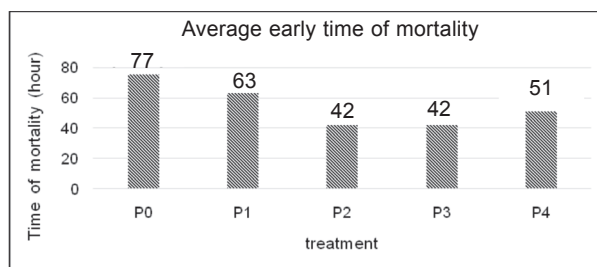


Fig. 2. Time of Early death of armyworm

solution.

Based on Figure 2. It can be seen that the fastest of the mortality In this study was obtained in treatments P2 and P3 with an early death time of 42 hours, this result was not significantly different from treatment P1 and P4, treatment P4 got an average early death time of 51 hours and P1 got an average early death time of 63 hours. While the treatment with the longest average initial time of death was found in the P0 treatment.

Giving of areca betel nut extract solution with various concentrations showed different effects on the speed of time in causing death in the tested pests. The treatment with concentrations of 5 g/l and 10 g/l showed the best results in causing early time of death, whereas the giving of higher concentrations of 15 g/l, the results were not significantly different from those of 5 g/l and 10 g/l. This is predicted to occur because the treatment of 15 g/l armyworm is still able to withstand the toxic compounds that accumulate in its body so that at a concentration of 5 g/l it causes the fastest death time in armyworm.

The content contained in the areca nut solution extract works as a digestive poison and contact poison. Phenol compounds in the form of tannins contained in areca nut are thought to work as digestive poisons, supported by the statement of Wicaksono *et al.*, (2019) which states that the tannin compounds given will work as digestive toxin by interfering with the absorption of proteins needed by the body. Reduced absorption of protein in the body will cause the body's immune system to weaken so that the body is unable to neutralize toxins that enter the body.

Lethal concentration 50% (LC₅₀)

The calculation of the lethal concentration value is carried out using probit analysis, so that a 50% lethal concentration result is obtained, as in Figure 3.

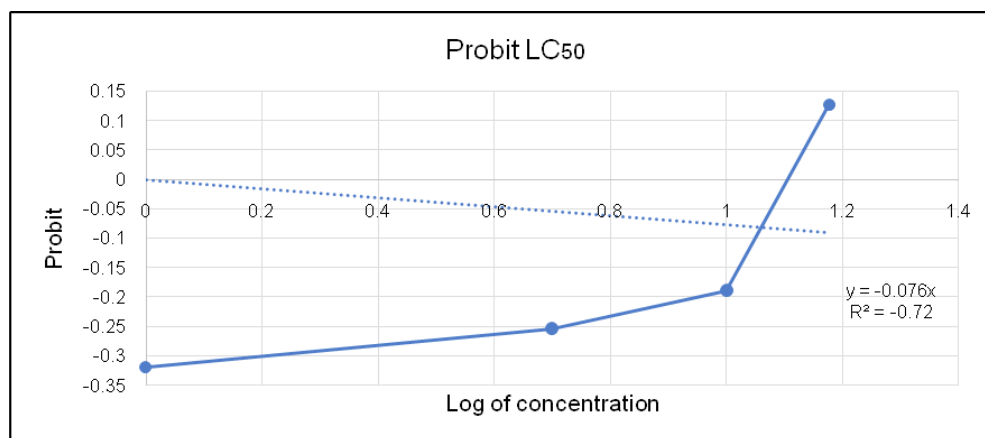


Fig. 3. Betel nut extract concentration log curve.

Table 1. Estimation of toxicity parameters of areca nut extract solution concentration

Parameter	SK (%)	Estimate concentration (g/l)
LC ₅₀	95%	44,309

The results of the probit analysis in Figure 3 and Table 1. Show that the LC₅₀ value tested using 95% confidence interval has an effective dose level in controlling the armyworm population as much as LC50 of 44.309. According to the results of the analysis, the right concentration in controlling 50% of the armyworm population is at a concentration above 10 g/l and below of 15 g/l, which is shown on the intersecting linear line.

Areca nut contains toxic compound, it is known that the toxic compounds are arekoline and phenol compounds. Arekoline compounds are classified as toxic alkaloids because the it can cause paralysis and stop breathing (Jaiswal *et al.*, 2011). Phenolic compounds contained in areca nut are tannin and flavonoid compounds. Tannin compounds have digestive toxic properties that can reduce the activity of digestive enzymes so that they can interfere with the absorption of protein (Haditomo, 2010). Flavonoid compounds are thought to work as respiratory inhibitors that interfere with energy metabolism in the mitochondria (Sasmilati *et al.*, 2017).

Symptoms of mortality that occur in armyworms can be seen in Figure 4, mortality that occurs in armyworms is characterized by the body wall of the larvae being damaged and shriveled (Figure 4a), body parts becoming stiff or hardened in blackish brown color (Figure 4b), and the body is elongated

and flexible (Figure 4c). This is thought to occur because secondary metabolites such as alkaloids can reduce the surface tension of the mucous membrane of the digestive tract in larvae so that the wall be-



Fig. 4. Symptoms of poisoning: (a) the armyworm shrivels, (b) the armyworm's body hardens, and (c) the body is elongated and flexible.

comes corrosive (Syah, 2006).

The larvae that died experienced various physiological changes, namely the color of the dorsal part was yellow, pale and the ventral part turned light brown, and hardening of the body and changing color to blackish brown (Makal, 2011). The mortality is due to the secondary metabolites contained in the areca nut test are toxic. These toxic compounds enter the body through the body wall and mouth of the larvae. The insect body wall is the part that can absorb large amounts of toxic substances (Yunita *et al.*, 2009).

The inclusion of compounds in the areca nut so-

lution extract is due to vegetable pesticide dissolving the fat of waxy coating on the cuticles, causing the active ingredients to penetrate the insect's body (Pradani *et al.*, 2011). The incoming compound is indicated by the shrinking of the armyworm's body wall and damage. The way the alkaloid compound works in the form of arecoline is by degrading the cell membrane in to the insect's body and damaging the cell by changing the color of the cuticle (Syah, 2016).

Conclusion

The results found that 1(one) treatment, P4 is the best concentration be able to kill the armyworm (*Spodoptera litura*) best concentration of areca nut amounted to 50% within 42 hours of observation after being treated, with a concentration of 15 g per liter, and was able to give the best results on all treatment parameters and LC₅₀ values in this study, namely at concentration of 44.309 g per liter.

Acknowledgments

The Authors would like to thank the Dean and Head of the Agroechotechnology Department of the Faculty of Agriculture, Lambung Mangkurat University for permission and facilities provided during the study and to Antar Sofyan who has provided much input in improving this paper.

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