

# Effect of soursop leaf extract solution on the death of armyworm (*Spodoptera litura* F.) on mustard plants

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(Received 14 November, 2021; Accepted 9 December, 2021)

## ABSTRACT

Mustard (*Brassica juncea* L.) is a type of vegetable plant that is widely cultivated because the content in it is beneficial for the body. Cultivation of mustard plants is experiencing problems, namely a decrease in production caused by armyworm attacks. Therefore, it is necessary to have an environmentally friendly control to suppress this pest population. One of the control methods that can be used is by using soursop leaves. The research design used was a completely randomized design (CRD) with 1 factor, with 4 treatments and 5 replications. The treatments used included P1 (control), P2 (concentration 10 g/l extract), P3 (concentration 20 g/l extract, and P4 (concentration 30 g/l extract). The results obtained showed treatment P4 soursop leaf extract solution was effectively used in the control of armyworms P4 is the best concentration be able to kill the armyworm (*Spodoptera litura*) amounted to 80% within 24 hours of observation after being treated, with a concentration of 30 g per liter because it showed the best results on all parameters, and the LC50 value in this study was at a dose of 16.64 g/l.

**Key words :** Armyworm, Vegetable pesticide, Soursop leaf

## Introduction

Mustard (*Brassica juncea* L.) is a type of horticultural plant that is familiar in Indonesia. Mustard plant is a type of leaf vegetable and is a source of fiber, vitamins, and minerals that are essential for the human body (Manullang *et al.*, 2014). The cultivation of mustard plants is experiencing obstacles that can cause production to decline, namely attack of armyworm (*Spodoptera litura* L.) (Samsudin, 2008). It is necessary to control the armyworm (*Spodoptera litura* L.) in a more environmentally friendly. One of the plants that has the potential as a vegetable insecticide is soursop leaf. Soursop plant which has the

Latin name *Annona muricata* L. is a plant originating from Central America, Latin America, and the Caribbean. This plant is generally cultivated as a gander plant because it has a delicious fruit taste and has a lot of vitamin C in it, and the leaves can be used as herbal medicine for body health (Elidar, 2017). Besides being used as herbal medicine, the leaves of this plant also contain many phytochemical compounds that can be used for pest control in cultivated plants.

Based on the results of the analysis of Gajalakshmi *et al.* (2012) and Gavamukulya *et al.*, (2014), on phytochemical compounds in soursop leaves are known to contain alkaloid, compounds,

Flavonoids, terpanoud, lactones, anthraquinones, tannins, cardiac glucoside phenols, phytosterols, and saponin. The compounds act as anti-feedants that work as stomach poison on insects (Septerina, 2002). So that the use of pesticides made from plant can reduce pollution of the environment and reduce farmer's expenditures to pest control. On the other hand, using botanical pesticides does not cause resistance to pests, and also does not cause resurgence in pests.

The use of soursop leaves as an insecticide was tested on the pest *Crocidolomia panonana* F. according to Arimbawa *et al.*, (2018), was able to cause a mortality of 99% on the fifth day. Hartini and Yudi (2015) stated that research the soursop leaf extract (*Annona murcica* L.) has the potential to cause 100% mortality of peach aphids at concentrations of 8% and 10%, respectively. Therefore, it is necessary to conduct research to determine the effectiveness of soursop leaf extract solution to the mortality of armyworm (*S. litura* L.) on mustard (*B. juncea* L.).

## Materials and Methods

Materials needed in this research is: Green mustard plants, armyworm (*S. litura*) three instars, soursop leaves, ethanol 96%, soil, water, manure and NPK fertilizer. While the tools used are polybags, 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 five replicates for the one control and experimental samples. The

data have been analyzed by one-way analysis of variance (ANOVA) followed by Turkey's test, Duncan's 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 4 levels of statisticals used in this treatment :

- P<sub>1</sub> : control
- P<sub>2</sub> : 10 g/l soursop leaf extract
- P<sub>3</sub> : 20 g/l soursop leaf extract
- P<sub>4</sub> : 30 g/l soursop leaf extract

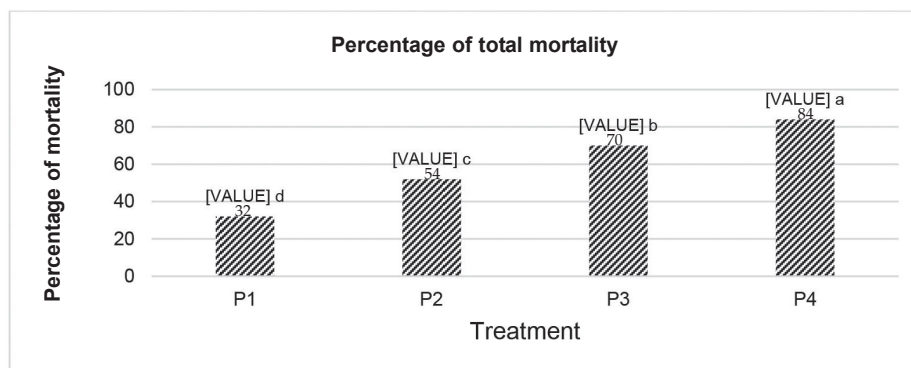
Armyworm (*S. litura*) insects is taken from the field, then cultured in a cage to get 200 larvae. Observations starting from 24, 48, and 72, on the larvae mortality, up to 50 percent. And the 50% lethal concentration in this study was analyzed using probit analysis.

## 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.

Based on Figure 1. Shows that the best results on the parameter of the percentage of total mortality, namely being treatment P<sub>4</sub> with a concentration of 30 g/l gave a result of 84% and was different from other treatments. This treatment is considered effective because it can kill more than 80% of armyworm, according to Prijono (2002), states that the effectiveness of an extract can be seen from the amount of mortality produced, which is more than 80%. While



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

Description : P<sub>1</sub> = without giving soursop leaf extract (control), P<sub>2</sub> = giving a concentration 10 g/l soursop leaf extract, P<sub>3</sub> = giving a concentration 20 g/l soursop leaf extract solution, P<sub>4</sub> = giving a concentration 30 g/l soursop leaf extract solution.

the P3, P2, and P1 treatments are still below than P4 treatment. P1 got 32% results, the lowest mortality percentage, because there were no toxic compounds accumulated in the armyworm's body, causing low mortality.

Giving of soursop leaf extract solution has a significant effect on armyworm mortality, because the acetogenin content contained in soursop leaves is antifeedant (Arimbawa *et al.*, 2018). According to Sumantri *et al.* (2014), acetogenin compounds are one of the phenolic compounds that have toxic properties. Giving different concentration of soursop leaf extract has an effect on the amount of mortality produced. The higher the concentration given, the higher the amount of mortality produced. This is presumably because the armyworm lacks nutrients as a result of the antifeedant effect it produces, thereby disrupting the development and growth of the armyworm. According to Parkinson and Ogilvie (20018), which states that the condition of food containing toxic compound causes the energy produced from food to be allocated to detoxify the body, so the body lacks nutrients for growth and development. Although the number of leaves consumed by armyworm is small as result of the antifeedant effect, but the solution extract given causes toxic compounds to have accumulated in the armyworm's body so that it will causes death. The higher the concentration given, the higher the amount of accumulated toxic compounds (Syah, 2016).

### 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.

Based on Figure 2. It can be seen that the fastest early mortality time in this study was obtained in treatments P2, P3, and P4. P4 treatment with a concentration 30 g/l obtained an initial time of mortality of 24 hours, The result is not different from the P3 and P2, the initial time of mortality is 24 hours. While the treatment which was the control treatment in this study obtained the longest initial time of mortality, which was 43.2 hours, and significantly different from other treatments.

Giving of soursop leaf extract solution showed an effect on the speed of time in causing mortality in the test pests. This is thought to be due to the effect of compounds attached to mustard leaves, which causes decreased growth and development in armyworm caused by the antifeedant effect. The tannins contained in soursop leaf extract can have a lethal effect on insect because these compounds can inhibit enzyme activity in the digestive tract so that it will damage digestion in insects and cause death. Besides tannin compounds, alkaloid, and terpenoid compounds also have potential to inhibit feeding activity in insects. According to Arimbawa *et al.*, (2018), stated that in the larval body there are sensilla cells that can respond to various alkaloid compounds that can react as food inhibitors. Alkaloid compounds can also work by poisoning the nervous system can inhibit the enzyme acetylcholinesterase, which plays a role in nerve infusion. So that the result of this causes the larvae to become convulsively and continuously due to failure of the central nervous system to send messages to cause paralysis and mortality (Kaihena *et al.*, 2011). In Addition, the phenolic compounds contained in the soursop leaf extract solution can cause larvae to lose a lot of fluid

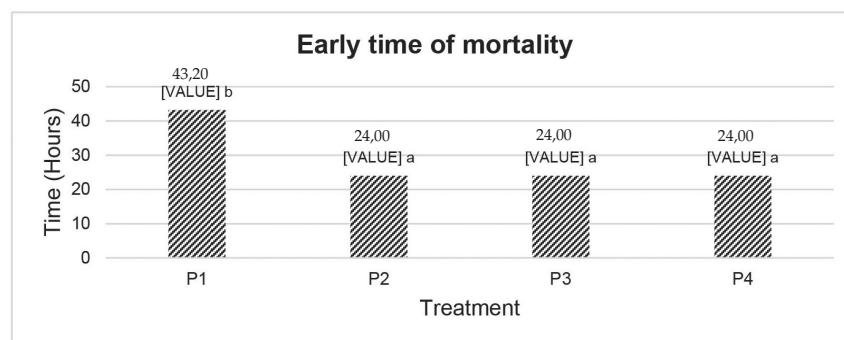


Fig. 2. First time mortality of armyworm (*Spodoptera litura* F.)

Description : P1 = without giving soursop leaf extract (control), P2 = giving a concentration 10 g/l soursop leaf extract, P3 = giving a concentration 20 g/l soursop leaf extract solution, P4 = giving a concentration 30 g/l soursop leaf extract solution

due to the nature of these compounds, according to Syah (2016) is a dehydration poison. So that giving of soursop leaf extract solution causes mortality faster than control.

**Lethal concentration 50% (LC<sub>50</sub>)**

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. And Table 1.

Interval has an effective dose level in controlling the armyworm population of 50%. The results of the probit analysis is shown in Figure 3. And Table 1 show that the LC<sub>50</sub> value tested using a 95% confidence. According to the analysis, the right concentration in controlling 50% of the armyworm population was at a concentration of 16.64 g/l with a concentration interval of 7.7 g/l to 22.98 g/l, which means if the concentration low than 7.7 g/l or more than 22.98 g/l is not included in the LC<sub>50</sub>.

Soursop leaf extract causes the content of compounds contained in it to accumulate more in one solution. Toxic compound contained in the solution can enter the larva's body through the body wall or through the mouth during feeding activities. According to Sastrodiharjo (1984) states the body wall of insects that accumulate toxic compounds can directly spread in the body. According to Yunita (2009) the failure of larvae to detoxify their bodies from toxic compounds will cause mortality.

Stomach poison occurs from the eating activity of armyworms, so that the toxic compounds on the surface of the mustard leaf will easily enter the armyworm's body and cause an antifeedant effect. The poisoning that occurs in Figure 4 (b.c), the body part of armyworm hardens and changes color to blackish brown, and the insect body becomes soft and elongated. This is thought to occur because secondary metabolites such as alkaloids and saponins reduce the surface pressure of the mucrosatractus digestivus membrane in larve so that the wall be-

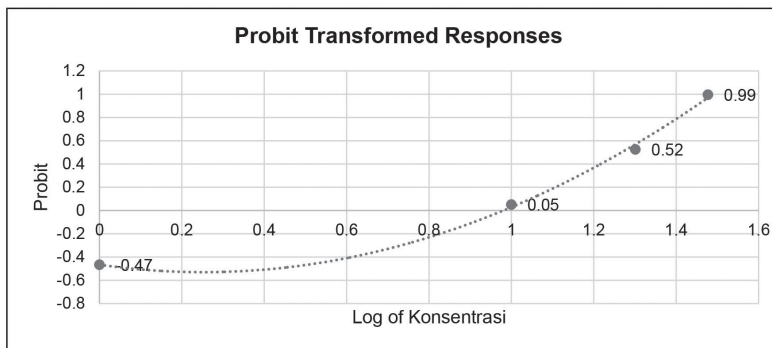


Fig. 3. Soursop leaf extract Concentration log curve.

Table 1. Estimation of toxicity parameters concentration of soursop leaf extract solution.

Prameter	SK (%)	Estimate concentration (g/l)	Interval concentration (g/l)
LC <sub>50</sub>	95%	16.64	7.7 – 22.98

Description : SK = Confidence Interval.

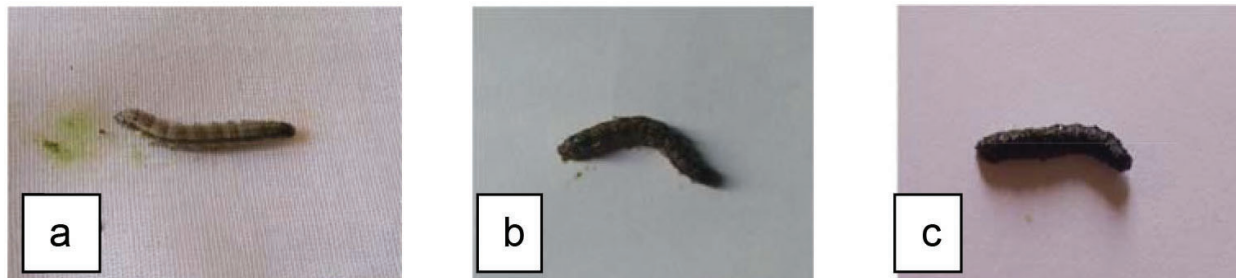


Fig. 4. Poisoning Symptoms: (a) Healthy armyworm, (b) Armyworm's body softened and longated, and (c) The armyworm's body turns black.

comes cystic (Syah, 2016).

The compounds contained in soursop leaves that act as antifeedants are alkaloids, flavonoids, saponins, and tannins. Tannins interfere with the digestive system of insects through the inhibition of the protein absorption process and the bitter taste of tannins cause decreased eating activity (Ningsih, 2013). Saponin compounds interfere with the armyworm's digestive system by binding to sterols which will affect the skin turnover process in insect, and result in disturbed hormone balance (Syah, 2016). Resulting in disruption of the balance of the armyworm's hormone system, causing failure in the process of organ formation which ends in death (Shinta *et al.*, 2012).

## Conclusion

The results found that 1 (one) treatment, P4 is the best concentration be able to kill the armyworm (*Spodoptera litura*) amounted to 80% within 24 hours of observation after being treated, with a concentration of 30 g per liter, and was able to give the best results on all treatment parameters and LC<sub>50</sub> values in this study, namely at concentration of 16.64 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 Dr. Yusriadi Marsuni who has provided much input in improving this paper.

## Reference

- Arimbawa, I. D. M., Martiningsih, N. G. A. G. and Javandira, C. 2018. Test the Potency of soursop leaf (*Annona muricata* L.) to control crop pests (*Crocidolomia pavonana* F.). *Agrimeta*. 8(15).
- Elidar, Y. 2017. Soursop cultivation and its health benefits. *Abdimas Mahakam Journal*. 1(1).
- Gajalakshmi, S., Vijayalakshmi, S. and Rajeswari, Dv. 2012. Phytochemical and Pharmacological properties of *Annona muricata*: A Review. *International Journal of Pharmacy and Pharmaceutical Sciences*.
- Gavamukulya, Y., Elella Fa. and Wamunyokoli, F. 2014. Phtochemical Screening, Anti Oxidant Activity and *In vitro* Anticancer Potential of Ethanolic and Water Leaves Extracts of *Annona muricata* (Graviola). *Asian Pac J Trop Med*.
- Hartini, F. and Yahdi. 2015. Soursop extract potency (*Annona muricata* L.) as an insecticide for peach aphids (*Myzus persicae* Sulz) on the leaves of the cayenne pepper plant (*Capsicum frutescens*). *Tadris Journal*. 8(1).
- Kaihena, M., Lalihatu, V. and Nindatu, M. 2011. Effectiveness of betel leaf ethanol extract (*Piper betle* L) on the mortality of Anopheles sp mosquito larvae and Culex. *Molucca Medica Journal*. 4(1): 88-105.
- Manullang, G. S., Rahmi, A. and Astuti, P. 2014. The effect of the type and concentration of liquid organic fertilizer on the growth and yield of mustard plants (*Brassica juncea*L.) Variety Tosakan. *JurnalAgrifor*. 13(1).
- Ningsih, T.U. 2013. Effect of filtrate of gadung tuber, soursop leaf, and antingan herb on larval mortality of *Spodoptera litura*. *Lentera Bio. Journal*. 2(1) : 33-36.
- Parkinson, A. and Ogilvie, B.W. 2008. *Biotransformation of Xenobiotics*. In: klaassen CD, editor. *Casarett and Doulls toxicology*. The basic science of poisons. New York. Mc Graw Hill. 161-304.
- Prijono, D. 2002. Testing the effectiveness of insecticide mixture *Pengujian: Guidelines for the implementation of efficacy testing for pesticide registration*. Institut Pertanian Bogor.
- Samsudin. 2008. Environmentally friendly bio-insecticide insect pathogen virus. <http://LembagaPertanianSehat/DevelopUsefulInnovationForFamersRubrik>.
- Sastrodihardjo, 1984. *Introduction to Applied Entomology*. Institut Teknologi Bandung, Bandung.
- Septerina, N. J. 2002. The effect of soursop leaf extract as a rational inecticide on the growth and yield of bell boy variety peppers. Dept. of Agronomy. Bandung
- Shinta, A., Wigiati, Y. and Sukowati, S. 2012. Effectiveness of Larvasida Altosid 1,3G to *Aedes aegypti* in Laboratorium. *Bul. Penelit. Kesehat*. 39(3).
- Sumantri, I., Hermawan, G. P. and Laksono, H. 2014. Sour-sop extract leaf (*Annona muricata* L.) using ethanol solvent. *Momentum*. 10(1).
- Syah, B. W. 2016. The effect of wuluh starfruit extract and development (*Averrhoa bilimbi*) to development on mortality of *Spodoptera litura* larvae. Institut Teknologi Sepuluh Nopember
- Yunita, E.A., Suprapti, N.H. and Hidayat, J.S. 2009. Teklan leaf extract (*Eupatorium riparium*) on mortality and growth of *Aedes aegypti* larvae. *Bioma Journal*. 11(1): 11-17.