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Biopesticide for Overcoming Caterpillar Pests on Cabbage Plant (*Brassica oleracea L*)

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Abstract. Bukit Rumah Sendi Farmer Group is one of the farmer groups in Ujung Sampun Village, which consists of 22 family heads. Ujung Sampun Village is one of the villages in Dolat Rayat subdistrict, Karo District in Provinsi Sumatera Utara. This partner distance is about 70 km from Universitas Sumatera Utara. Cabbage (*Brassica oleracea L*) is a commodity planted by this farmer group. *Plutella xylostella* caterpillars available in cabbage are very much harming the harvest so they need to be eradicated. Garlic is a crop planted by farmers and also one of the local commodities besides cabbage. Garlic (*Allium sativum*) which releases biopesticides can kill caterpillars on cabbage. This activity is to provide innovations about the appropriate technology of biopesticides from raw materials of garlic to eradicate caterpillars as pests of partner's cabbage planting. The activities that have been carried out are preparation of garlic as a raw material for biopesticides, applying biopesticides to selected community cabbage land every day at 9 am for 30 days. The results show that biopesticides are very effective in killing caterpillar pests with a mortality rate of 95%.

Keywords: Biopesticides, Caterpillars, Cabbage, Garlic, Mortality

Abstrak. *Kelompok Tani Bukit Rumah Sendi adalah salah satu kelompok tani yang berada di Desa Ujung Sampun, terdiri dari 22 kepala keluarga. Desa Ujung Sampun adalah salah satu Desa di Kecamatan Dolat Rayat, Kabupaten Karo di Provinsi Sumatera Utara. Jarak mitra ini sekitar 70 km dari Universitas Sumatera Utara. Kubis (Brassica oleracea L) merupakantanaman komoditas yang ditanam oleh kelompok tani ini. Ulat Plutella xylostella yang menyerang tanaman kubis sangat merugikan sehingga perlu diberantas. Bawang putih merupakan tanaman yang*

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budidayakan oleh petani yang juga merupakan salah satu komoditas lokal selain kubis. Bawang putih (Allium sativum) yang memiliki sifat sebagai biopestisida dapat membunuh ulat pada kubis. Kegiatan ini memberikan inovasi tentang teknologi tepat guna biopestisida dari bahan baku bawang putih untuk membasmi ulat bulu sebagai hama penyakit tanaman kubis mitra. Kegiatan yang dilakukan meliputi persiapan bawang putih sebagai bahan baku untuk biopestida, pemberian biopestisida pada tanaman kubis setiap hari pada jam 9 pagi selama 30 hari. Hasil penelitian menunjukkan bahwa biopestisida sangat efektif dalam membunuh hama ulat dengan mortalitas sebesar 95%.

***Kata Kunci**: Biopestisida, Ulat, Kubis, Bawang putih, Mortalitas*

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1. Introduction

Bukit Rumah Sendi Farmer Group is one of the Farmer Groups in the village of Ujung sampun consisting of 22 households [1]. Ujung Sampun Village is one of the villages in Dolat Rayat sub-district, Karo Regency, North Sumatra Province [2]. Karo Regency is one of 33 regencies / cities in North Sumatra with quite extensive agricultural land. Daulat Rakyat District with an area of 32.35 KM has superior commodities such as sweet potatoes (*Ipomoea batatas*), potatoes (*Solanum tuberosum*), chili (*Capsicum annum L*), cabbage (*Brassica oleracea L*), carrots (*Daucus carota)* and oranges (*Citrus*)[1].

The general Farmers in Ujung Sampun Village on average are planting cabbage (*Brassica oleracea L*) as a commodity that is distributed to several regions in North Sumatra and Java [2][1]. In 2018, the farmers in this area have been disadvantaged by the presence of *Plutella xylostella* caterpillar pests, especially cabbage farmers (*Brassica oleracea L*). Cabbage was damaged by these pests causes yields to decline both in quantity and quality. Classification of *Plutella xylostella* caterpillars are kingdom of Animalia, phylum of Arthropods, class of Insecta, order of Lepidoptera, family of Yponomeutidae, genus of Plutella and, species of *P. Xylostella* [3]. *Plutella xylostella* caterpillar pests can be seen in Figure 1.

The Survey has been done in this location and Bukit Rumah Sendi farmer group generally plants cabbage with an average production of 800 tons of cabbage with a harvest period of 90 days. In 2018, cabbage plants experienced problems with the appearance of caterpillars that lowered the market value of cabbage, so efforts should be made to minimize these caterpillar pests. Cabbage crop fields can be seen in Figure 2.

Figure 1. *Plutella xylostella* caterpillar pest

Figure 2. The cabbage field of the Bukit Rumah Sendi farmer group

The management of the partner's business has been carried out in an integrated manner and basic principle as well as deliberation to reach consensus. The village head coordinates the farmer groups to produce good quality harvests with the high sale value. Farmer meeting activities in Bukit Rumah Sendi in Ujung Sampun Village can be seen as in Figure 3.

Figure 3. Farmer meeting activity at Bukit Rumah Sendi in Ujung Sampun Village, Dolat Rakyat District, Karo Regency

Synthetic pesticides have long been used by farmers in this village in dealing with caterpillar pests [4]. This harms the environment, especially during post-harvest, and cabbage that is not washed before distribution [5][6]. The use of synthetic pesticides also harms humans and ecosystems [7]. In addition to endangering human health, synthetic pesticides from chemicals can also kill non-target organisms and damage the balance of the ecosystem [8]. Biopesticides are natural pesticides derived from plants [9][10]. The use of biopesticides is known to be safer than synthetic pesticides. The content of secondary metabolites in several types of plants is known to have effectiveness in eradicating insect pests [11][12].

In 2016, garlic (*Allium sativum*) is a tuber crop that is widely cultivated in Tanah Karo District, precisely in each sub-district and farmer group [12]. This government activity is supported by all farmers so that many farmers grow garlic as an intercrop. The hallmark of garlic (*Allium sativum*) is its distinctive aroma and very pungent [12]. Usually, garlic is used as a spice in cooking [13]. Garlic is not just a food ingredient, but also has a myriad of benefits. Garlic is efficacious for healthy plants. Garlic extract is known to be useful for controlling several types of plant pests, both insect pests (caterpillars), bacteria, and fungal pathogens [12]. This biopesticide is used as an alternative to killing cabbage-destroying caterpillars to produce good and fresh fruit [14][5].

The biopesticides are very specific. Damaging the development of eggs, larvae, and pupae, inhibiting skin turnover, disrupting insect communication, causing insects to refuse food, inhibiting reproduction of female insects, reducing appetite, blocking the ability to eat insects, repelling insects, inhibiting the development of disease pathogens [3][8][11]. Biopesticides from vegetables have several advantages and disadvantages. The advantages of biopesticides are cheap and easily made by farmers, relatively safe for the environment, does not cause poisoning to plants, difficult to cause resistance to pests, compatible combined with other means of control, produce healthy agricultural products because it is free of chemical pesticide residues. The disadvantages are its working power is relatively slow, does not kill the target's body directly, is not resistant to sunlight, is less practical, cannot stand stored. sometimes it must be applied/sprayed repeatedly [15][16].

In this work, Biopesticide from garlic (*Allium sativum*) is an alternative pesticide in the Bukit Rumah Sendi Farmer Group in Ujung Sampun Village, Karo District. The mortality rates are measured to determine the effectiveness of the biopesticides that were made.

2. Methods

2.1 Materials

The ingredients used for a formula are 1000 g of garlic (*Allium sativum*), 20 cc palm oil, 105 L of water, 100 mL of detergent. Material for identification of compounds contained in onions using methanol as a solvent.

2.2 Procedures

Garlic was dried, crushed, soaked in eating oil for 24 h. Then add 0.5 liter of water and detergent were added and stirred until evenly distributed and then filtered.

2.3 The use of biopesticides to plants

The product of biopesticide in this work was added 100 L of water and then mixed well.Spray process was doing to all parts of the plant that are attacked by caterpillars in the morning at 9 am for 30 days.

2.4 Analysis

The observation of treated and untreated cabbage plants which were carried out by comparing the number of caterpillars found in cabbage plants [17]. The number of samples for untreated and treated cabbage each was 10 plants. The mortality rate is calculated.

3. Results and Discussions

Farmers are the main profession of the Indonesian population, especially in rural areas [5]. The use of excessive chemical pesticides in the agricultural sector harms the surrounding environment and humans, the natural balance will be disrupted by the emergence of resistant pests and parasites [18]. One of the causes of the negative impact that chemical pesticides bring is the presence of pesticide residues in the soil that can poison non-target organisms, even being carried into streams to water sources and can poison the surrounding environment [4]. Therefore, an environmentally friendly substitute for pesticides is needed. Biopesticide is a pesticide made from plants. Plants are rich in active ingredients that function as a natural defense tool against intruders. Biopesticides function as repellents, attractors, antifertility, and killers, and other forms [16].

The problems that occur in agriculture will affect other sectors such as food and the economic sector. Therefore, productivity becomes important in the agricultural sector [19]. However, this is what makes farmers not sensitive to the environment. The use of chemical pesticides that are considered efficient in preventing the decline in productivity can only affect the environment and indirectly reduce productivity.

Pollution of chemical pesticides on the soil, making pests resistant, and increasing production costs are negative impacts that can reduce productivity if chemical pesticides are overused. Pesticide prices continue to rise will increase production costs. Unfortunately, this is not offset by greater production [20][5].

The solution that farmers can do about this problem is by implementing a shift in the use of pesticides, from chemical pesticides to natural pesticides or biopesticides. Biopesticides are pesticides made from natural materials such as plants that are potentially used to control plant pests. Environmentally friendly biopesticides that can reduce the negative effects of using chemical pesticides. The use of biopesticides is highly recommended in the cultivation of organic vegetables. This is because biopesticides are effective, economical, easy to apply, and environmentally friendly. Besides, biopesticides can also reduce adverse effects on plants and the environment.

In this work, community service has been carried out in Ujung Sampun Village in the Cabbage Field owned by the community. Figure 4 shows the location of cabbage fields as the location of research on biopesticides produced.

Figure 4. Research sites of *Allium sativum* as a biopesticide

Garlic (*Allium sativum*) has great benefits for human life because garlic can cure diseases caused by fungi and bacteria [12]. Since ancient times garlic has been widely used by people to treat infections. Garlic has a broad antimicrobial spectrum so it can kill gram-negative and gram-positive bacteria. Garlic can kill normal intestinal bacteria that become pathogens, overcoming bacteria that are resistant to antibiotics [13].

In this study, garlic was used because the bioactive component found in garlic was the presence of an excess amount of sulfide compounds such as diallyl sulfide or in an oxidized form called allisin and scordinine [12]. Allisin has the role of giving the aroma of garlic as well as the dual role of killing gram-positive and gram-negative

bacteria because it has a group of amino acids aminobenzoate, while scordinine is a thioglicoside complex compound that functions as an antioxidant.Allisin and Scordinine can inhibit the life path of the *Plutella xylostella* caterpillar. The inhibition mechanism needs to be further investigated. Figure 5 shows the application of biopesticides from garlic used for the *Plutella xylostella* caterpillar. The rate of caterpillar mortality is measured for one month.

Figure 5. Application of biopesticides from garlic used for the *Plutella xylostella* caterpillar

The advantages of biopesticides are cheap and easy to obtain, do not cause residues in the soil, safe for humans, produce healthy agricultural products, and do not cause resistance to pests and others. Biopesticides in this work are friendly to the environment and also as a pest eradication. however, the mortality was obtained at 95%. This activity shows that biopesticides are very potential to be developed.

4. Conclusions

The activities that have been carried out are the preparation of garlic as a raw material for biopesticides, applying biopesticides on selected cabbage plants every day at 9 am for 30 days. The results show that biopesticides are very effective in killing caterpillar pests with a mortality rate of 95%. Biopesticide from garlic (*Allium sativum*) can be used to inhibit caterpillar pests on cabbage plants (*Brassica olearacea L*).

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References

[1] Brawijaya and H. Sucahyono, *Kspn Berastagi*. Indonesia: Center for Strategic Area Development and Regional Infrastructure Development of the Ministry of Public Works and Public Housing, 2016.

[2] I. W. Arsanti, A. L. Sayekti, and A. M. Kiloes, "Value Chain Analysis of Cabbages : Case Study in Karo District Production Centre". *Pusat Penelitian dan Pengembangan Hortikultura,* vol. 2, pp. 69-78, 2017.

[3] W. Loso, "Puttle Control Technology of Plutella xylostella With Biological Insecticide and Agency In Cabbage in Karo District". *Jurnal Pengkajian dan Pengembangan Teknologi Pertanian,* vol. 7, pp. 27-34, 2004.

[4] W. Ghasemian, "Extract as a Preventive to the Vibriosis in Western White Shrimp (*Litopenaeus vannamei*) in Bushehr Province". vol. 6, pp. 2-6, 2018.

[5] Sumartini, "Biopesticides for the Control of Pests and Diseases of Various Beans and Tubers". *Iptek Tanaman Pangan,* vol. 11, pp. 159-166, 2016.

[6] A. S. See, A. B. Salleh, F. A. Bakar, and N. A. Yusof, "Risk and Health Effect of Boric Acid". *American Journal Applied Science,* vol. 7, pp. 620-627, 2010.

[7] J. Mariyono and Irham, "Efforts to Reduce the Use of Chemical Pesticides with the Integrated Pest Management Program". *Manusia dan Lingkungan,* vol. VIII, pp. 30–36, 2001.

[8] A. Arif, "The influence of chemicals on the use of environmental pesticides". *JF FIK Uinam,* vol. 3, pp. 134–143, 2015.

[9] H. Roliadi and D. A. Dulsalam, "Determination of the optimal technical cycle and factors of exploitation of Eucalyptus hybrid plantations as raw material for paper pulp". *Jurnal Litbang Pertanian,* vol. 1, pp. 1–20, 2010.

[10] K. Rusevska and Z. Zdravkovski, "Simple Extraction Method for Detecting Exogenous Substances In Scalp Hair By GC-MS". *Journal of Hygienic Engineering Design.* vol. 3, pp. 1–9, 2011.

[11] S. D. Pohan, "Utilization of Plant Extracts as Natural Pesticides (Biopesticides) in Insect Pest Control". *Jurnal Pengabdian Kepada Masyarakat,* vol. 20, pp. 94–99, 2014.

[12] A. P. Pritacindy, "Effectiveness Test of Garlic Extract (Allium sativum) as an Insecticide on Head lice (*Pediculus capitis*)". *Jurnal Kimia UNM,* vol. 1, pp. 1–9, 2013.

[13] D. Prasonto, E. Riyanti, and M. Gartika, "Antioxidant Activity Test of Garlic Extract (*Allium sativum*)". *Odonto Dentistry Journal,* vol. 4, pp. 122–8, 2017.

[14] H. Nurhasnawati and A. F. Samarinda, "Comparison of Ethanol and Water Solution in Making Umwai Umbi Extract (*Eleutherine americana Merr*)". *Jurnal Ilmu MANUNTUNG,* vol. 1, pp. 149–153, 2015.

[15] F. Casalinuovo, T. Gazzotti, P. Rippa, L. Ciambrone, R. Musarella, E. Pratticò, and E. Bo, "Microbiological stability of canned tuna produced in Italy and in non-European countries". *Italy Journal Food Safety,* vol. 4, pp. 4–7, 2015.

[16] A. Djunaedy, Biopestisida as Plant Pest Control which is environmentally friendly". *Embryo,* vol. 6, pp. 88–95, 2009.

[17] Z. Alfian, H. Marpaung, M. Taufik, S. Lenny, Andriayani, and S. J. Samosir, "GC-MS Analysis of Chemical Contents and Physical Properties of Essential Oil of *Eucalyptus grandis* from PT. Toba Pulp Lestari". *Asian Journal Chemical",* vol. 3, pp. 2319–2322, 2019.

[18] Z. Burčová, F. Kreps, P. Grivnová, P. Strižincová, and A. Ház, "Spruce Bark as a Source of Antioxidant Active Substances". vol. 14, pp. 5980–5987, 2017.

[19] S. Prabowo, U. Mulawarman, and A. A. Rahman, "Halal Certification of Halal Agriculture Product Processing Industry". *Forum Penelitian Agro Ekonomi,* vol. 34, pp. 57–70, 2017.

[20] C. B. Ezekannagha, C. N. Ude, and O. D. Onukwuli, "Optimization of the methanolysis of lard oil in the production of biodiesel with response surface methodology". *Egyptian Journal of Petroleum,* vol. 26**,** pp. 1001–1011, 2017.