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Using *Bacillus thuringiensis* product in controlling caterpillars (*Plutella xylostella*) on green mustard plant

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Key words: *B. thuringiensis*, Caterpillar (*Plutella xylostella*), Green mustard, Micobioinsectcide

Abstract

Numerous chemical insecticides have been used in order to control pests, which damage for agriculture. While chemical insecticides have knock down effect to the insect pests, they are too expensive in the developing countries and harmful to both human and the environment. One of the most important global problems is protecting crops from insect. For the control insects, synthetic chemical are continuously used. The implementation of integrated pest management aims to suppress adverse effects of the use of synthetic pesticides, plant pest immunity, prevent resurgence, and utilize as much as possible the ability of nature with using environmentally friendly microbio insecticide. Green mustard is a plant widely cultivated farmers in Indonesia, but green mustard plants also contain vitamins and nutrient that are important for health, because of the many cases of low productivity, one pests of caterpillars of causing farmers to suffer losses and the impact on the use of chemical insecticides by semi subsistence for control of caterpillar pests. To cope with the excessive use of chemical insecticides, the uses of microbio insecticide are more environmentally friendly can be applied. This study aimed to determine the mortality of insects, the rapid of time to control caterpillar pests at green mustard plants and to determine the concentration of *B. thuringiensis* the most effective way to control caterpillar pests on green mustard. In this result of study that it was found that the application of the most influence very real to the intensity of death caterpillar green mustard plants is K1 (Turex WP) with a concentration of 1g per liter. The best concentration and able to kill the caterpillars (*Plutella xylostella*) amounted to 71.00% within one day of observation after being treated.

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Introduction

The mustard plant is included in the leaf vegetable of the *Cruciferae* family which has economic value. The mustard plant is a plant species in the genera *Brassica* and *Sinapsis* in the family *Brassicaceae*. Mustard, any of several herbs belonging to the mustard family of plants, *Brassicaceae* (*Cruciferae*), or the condiment made from these plants' pungent seeds. The leaves and swollen leaf stems of mustard plants are also used, as greens, or potherbs. The principal types are white, or yellow mustard (*Sinapis alba*), a plant of Mediterranean origin; and brown, or Indian, mustard (*Brassica juncea*), which is Himalayan origin. The latter species has almost entirely replaced the formerly used black mustard (*Brassica nigra*) which was unsuitable for mechanized cropping and which new occurs mainly as an introduced weed.

Numerous chemical insecticides have been used in order to control pests, which damage for agriculture. While chemical insecticides have knock down effect to the insect pests, they are too expensive in the developing countries and harmful to both human and the environment. In addition, target insect pests rapidly develop biological resistance especially at higher rates of application. The chemical insecticides are still contributing to human life enormously, but they have been distributed in ecological system of organisms including human beings because of their low specific toxicity to any organism and their low specific toxicity to any organism and their slight decomposition in nature (Ameriana *et al.*, 2000). Therefore, many biological controls of insects have been investigated. Currently, researches on the use pathogenic microorganisms to control insect pests are increasing. Microbial pest control is practiced in different parts of the world though utilization of pathogen likes fungi, bacteria, viruses and nematodes. Bacterial research causing disease in insects began in the late nineteenth century. It was a study of flacherie of the silkworm, *bombx mori* (Burges and Hussey, 1971; Burges, 1981). Ishiwata (1901) in this report on the discovery of *sotto bacillus*, reffered briefly to occurrence of sotto bacillus-like organism, which causes the disease to silkworm larvae.

Bacillus thuringiensis is a gram positive, soil-dwelling bacterium, commonly used as a biological pesticide. *B. thuringiensis* also occurs naturally in the gut of caterpillars of various types of moths and butterflies, as well on leaf surfaces, aquatic environments, animal feces, insect-rich environments, and flour mills and grain-storage facilities. It has also been observed to parasitize other moths such as *Cadra calidella* in laboratory experiments working with *C. calidella*, many of the moth were diseased due to this parasite.

Materials and methods

Material needed in this research is: Green mustard plants, caterpillar (*Plutella xylostella*), three instars, *B. thuringiensis* (Turex WP, Cutlass WP, and Delfin WDG), ethanol 96%, soil, water, manure and NPK fertilizer. While the tools used are poly bags, scales, hand sprayer, filter paper, blender, glass bottles, plastic, rotary evaporator, knife, jars, beakers, sieves, hoes, lid, insects, name tag, and a camera.

A B C

Fig. 1. Microbioinsecticide (*B. thuringiensis*) A. Turex WP B. Cutlass WP C. Delfin WDG.

Statistical analysis

Statistical analysis was carried out in six replicates for the one control and experimental samples. The data has 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 3 levels of statistical used in this treatment:

K1 : *B. thuringiensis* (Turex WP) with dose 1 g per liter

K₂ : *B. thuringiensis* (Cutlass WP) with dose 0.75 per liter

K3 : *B. thuringiensis* (Delfin WDG)) with dose 1 g per liter

Cabbage worm (*Plutella xyllostela*) insects is taken from the field, and then cultured in a cage to get 160 larvae. Observations were made every day, starting on days 1, 2 and 3, on the larvae mortality, up to 50 percent.

Results and discussion

The Percentage of Mortality Caterpillar (P. xylostella)

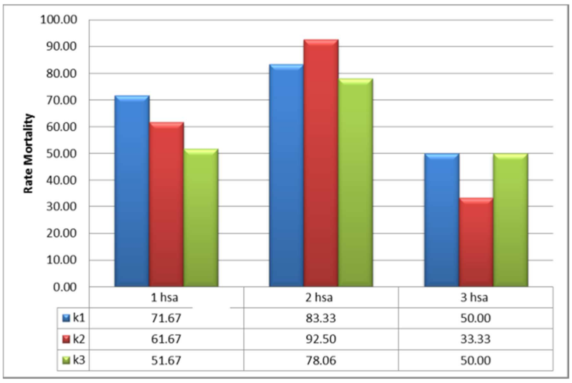

Fig. 2. Cabbage worm mortality (*Plutella xylostella*).

Description: 1 hsa = one day after application

2 hsa = two days after application

3 has = three days after application

In Fig. 1 show that, the *B. thuringiensis* to caterpillar of the treatment as K1 =*B. thuringiensis* (Turex WP) with dose 1 g per liter in the percentage of mortality amounted to 71.00%, in one day after application, if we compare to K2= *B. thuringiensis* (Cutlass WP) with dose 0.75 per liter in the percentage of mortality amounted to 61.67% and K3= *B. thuringiensis,* (Delfin WDG)) with dose 1g per liter in the percentage of mortality amounted to 51.67%, the results were not significantly different between K1, K2 and K3 (in mortality). Mortality in two days after application as K1 =*B. thuringiensis* (Turex WP) with dose 1g per liter in the percentage of mortality amounted to 83.33%, in one day after application, if we compare to K2= *B. thuringiensis* (Cutlass WP) with dose 0.75 per liter in the percentage of mortality amounted to 92.50% and K3= *B. thuringiensis* (Delfin WDG)) with dose 1g per liter in the percentage of mortality amounted to 78.06%, The mortality of K1, K2, and K3 were not different. Mortality in three days after application as K1 =*B. thuringiensis* (Turex WP) with dose 1 g per liter in the percentage of mortality amounted to 50.00%, in one day after application, if we compare to K2= *B. thuringiensis* (Cutlass WP) with dose 0.75 per liter in the percentage of mortality amounted to 33.33% and K3= *B. thuringiensis* (Delfin WDG)) with dose 1 g per liter in the percentage of mortality amounted to50.00%, the same as result in treatment 1, 2 and 3 were not different, but this treatment showed that the mortality were decreased.

The data shows that the value of the percentage of mortality in the treatment K1 (Turex WP) provide a very real effect 71.00% in one days after application more able to suppress caterpillar pests on plants in the greenhouse. This is due to the inclusion of several other compounds into the body of the caterpillar freely, and cause tissue damage to the membrane and also the disruption of physiological functions in the body of caterpillars. Other cause of caterpillar death is in the form of secondary metabolites contained therein. According to (Wahid, 2010) Turex WP bioinsecticide contains *B. thuringiensis* var. *kurstaki* strain EG-2731: 10% which is applied to suppress leaf damage caused by bag worms on mangrove plant, which cause death in the caterpillar. According to Ekayanti, 2018 conducted a study on the concentration of *B. thuringiensis* as a natural microbioinsecticide on the mortality of stink bugs (*Leptocorisa oratorius* F.), with the application of *B. thuringiensis* 20 percent which was the most likely to cause death in the insect of stink bugs (*L. oratorius* F.) with 92 percent mortality.

Time of the caterpillar mortality

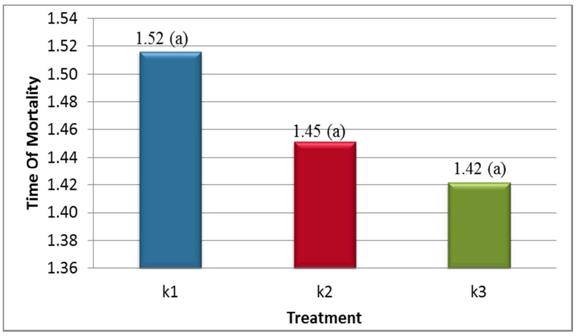

Fig. 3. Graph time of mortality caterpillar (*Plutella xylostella*).

Description: K1 =*B. thuringiensis* (Turex WP) with dose 1 g per liter, K_2 = *B. thuringiensis* (Cutlass WP) with dose 0.75 per liter, K3 = *B. thuringiensis* (Delfin WDG)) with dose 1 g per liter.

In Fig. 2 is based on a graph of mortality observation of the first day until the three days since the mortality caterpillar can already be seen, but on the observation from 2 to 3 days give death on caterpillar has begun to decline. This can be seen in the graph time mortality caterpillar.

The cause of the decline in death rates in the caterpillar of it, because at that time the weather is hot, resulting in room temperature in the greenhouse is getting hot, resulting in evaporation and easy to unravel the bio insecticide, where the *B. thuringiensis* has a weakness in the form of persistence short and impactful the toxicity of pesticides are applied in the field, so that the biodegradable material and dissolved feared would evaporate when exposed to sunlight, and will dissolve when exposed to rain.

According to (Subli, 2010) that the pesticide has some short comings such as the active ingredients are biodegradable so that pesticide cannot stand when stored in the long term.

Symptoms of mortality caterpillar

A **B.** Turex WP (k_1) **C.** Cutlass WP (k_2) **D.** Delfin WDG (k_3)

Fig. 4. (A) healthy insect, (B, C, D) death insect.

In Fig. 3 (B, C, and D) show that the symptoms of mortality caterpillars (*P. xylostella)*) caused by *B. thuringiensis* after application, occurs in the form of physical changes such as: body curl, caterpillars are not as active as before, a change of color on the body of a caterpillar into a brownish black, and the body of a caterpillar into a soft damp. According to Trizelia (2010), The caterpillars that will die from the *B. thuringiensis* treatment can be observed from physical characteristics such as brown, or black-colored bodies, shriveled, curved, dry and stiff. Khaeruni (2012), state that the symptoms caused by test larvae infected with *B. thuringiensis* are the test larvae change their behavior to become sluggish and eventually stop moving and sometimes secrete a green liquid from their mouth, then the feces become watery (diarrhea) and eventually die. In terms of morphology, the color of the mortality larva becomes dark or brownish black, the body becomes flabby and slimy. The mortality test larvae carcass smelled as the larvae carcass was attacked by bacteria. This is because *B. thuringiensis* produce crystal protein (proteinaceous inclusion), called delta endotoxins, that have insecticidal action.

This has led to their use as insecticides, and more recently to genetically modified crops using *B. thuringiensis* genes, such as *B. thuringiensis* strain corn. Many crystal-producing *B. thuringiensis* strains though, do not have insecticidal properties. The subspecies *israelensis* is commonly used for control of mosquitoes.

Conclusion

The results found that 1(one) treatment, K1 is the best concentration be able to kill the caterpillars (*Plutella xylostella*) amounted to 71.00% within one day of observation after being treated, with a concentration of 1 g per liter.

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References

Adam T, Juliana Nurhayati R, Thalib R. 2014. Biosei bioinsecticide with active ingredient *bacillus thuringiensis* from lebak soil against *Spodoptera litura* larvae. Agriculture faculty, University of Sriwijaya. Palembang.

Alves SB, Rossi LS, Lopes RB, Tamai MA, Pereira RM. 2002. *Beauveria bassiana* yeast phase on agar medium and its pathogenicity againts *Diatraea saccharalis* (Lepidoptera: Cerambidae) and *Tetranychus urticae* (Acari: Tetranychidae). J. Invert. Pathol **81,** 70-77.

Ameriana M. 2008. The behavior of vegetable farmers in using chemical pesticides. Jurnal Hortikultura **18(1),** 95-106.

Bhalla OP, Dubey JK. 1986. Bionomics of the diamondback moth in the northwestern Himalaya. pp. 55-62. In. N.S Taleker & T.D. Griggs (Eds). Diamondback moth management. Proceedings of the first international workshop, Tainan, Taiwan, 11-15 march 1985. The asia vegetable research & development center. Shansua, Taiwan.

Bravo A. 1997. Phylogenetic relationship of *Bacillus thuringiensis* d-endotoksin family protein and their functional domains. Journal Bacterial **179(9),** 2793-2801.

Gazali A, Jaelani & Ilhamiyah A. 2017. Agroecosystem Stability and Breakdown Leaves on Mustard Cropping after Application by the *Bacillus thuringiensis*. International Journal of Science and Research (IJSR) **6(4),** 433-437.

Geden CJ, Steinhaus DC. 2003. Evaluation of three formulations of *Beauveria bassiana* for control of lesser mealworm and hide beetle in Georgia poultry houses. Journal Entomol **96,**1602-1607.

Gill SS, Knowles EA, Pietrantonio PV. 1992. The mode of action of *Bacillus thuringiensis* endotoxins. Journal Entomol **37,** 615-636.

Ho TH. 1995. The life history and control of the diamondback moht in Malaysia. Div. of agriculture. Bull. No 118. Malaysia.

Hofte H, Whiteley HR. 1989. Distribution of *Bacillus thuringiensis*. Journal Microbiol **53(2),** 242-255.

Ignoffo CM, Anderson RF. 1979. Bioinsecticides. Microbial Technology. Acad. Press. New York.

Koswanudin, Harnoto D. 2004. The effect of bioinsecticide *Bacillus thuringiensis* Var. aizaway Serotype H-7 on the development of *Plutella xylostella* and *Crocidolomia binotalis* in mustard greens plant. In: *Prosiding Seminar Nasional Entomologi dalam Perubahan Lingkungan dan Sosial*. Bogor. PEI. Hlm 619-626.

Kumar PA, Sharma RP, Malik VS. 1996. The insecticidal proteins of *Bacillus thuringiensis*. Advance in Applied Microbiology **42,** 1-3.

Roh JY, Choi JY, Li MS, Jin BR, Je YH. 2017. *Bacillus thuringiensis* as a specific, safe, and effective tool for insect pest control. Journal of Microbiology and Biotechnology **17(4),** 547-549.

Rueda, Shelton. 1995. Diamondback mont (DBM) ; information, control, laboratory rearing. Cornell international institute for food agriculture and development. New york.

Sarfat MS. 2010. Bioinsecticide production from *Bacillus thuringiensis* subsp.*aizawai* subsp. Using tohu industrial waste as a substrate. Skripsi. Technologi Faculty of Agriculture. Institut Pertanian Bogor. Bogor.

Sastrosiswojo S. 1987. A combination of biological and chemical control against cabbage leaf caterpillar (*Plutella xylostella* L;Lepidoptera : Yponomeutidae) in cabbage plants. Disertasi. Graduate school of UNPAD. Bandung.

Shieh TR. 1994. Identification and Classification of *Bacillus thuringiensis*. Pesticide commission of Agriculture Deparment. Jakarta.

Sriniastuti. 2005. The efektivitas of the use of *Bacillus thuringiensis* against the attack of caterpillar (*Plutella xylostella*) on the mustard plant (*Brassica juncea*) in Selamat river. Skripsi. Agriculture faculty of Tanjung Pura University. Pontianak.

Steinhause E. 2012. Insect Pathology: An Advanced Treatise. Elsevier p. 32.

Tarigan B, Syahriani, U, Mena T. 2014. *beauveria basianna* dan *bacillus thuringiensis* effectiveness test against caterpillars (*setothosea asigna* eeck, Lepidoptera, limacodidae) in laboratorium. Journal Online Agroekoteknologi **2(2),** 471-472.

Trizelia. 2001. Utilization of *Bacillus thuringiensis* for pest control *Crocidolomia binotalis* [disertasi]. Bogor: Graduate School, Institut Pertanian Bogor.

Xu J. Liu Q. Yin X. Zhu S. 2006. A review of recent development of *Bacillus thuringiensis* ICP genetically engineered microbes. Entomological Journal of East China **15(1),** 53-58.