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Control of caterpillars (*chrysodeixis calcites*) in the green mustard using red ginger extract (*zingiber officinale* var. *rubrum*)

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Abstract

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 plant pesticides. 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 inch 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 use of botanical pesticides are more environmentally friendly can be applied. This study aimed to determine the mortality of insects, the effect of the red ginger extract to control caterpillar pests at green mustard plants and to determine the concentration of red ginger extract 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 JM2 with a concentration of 10%. The the best concentration and able to kill the caterpillars (*Chrysodeixis calcites*) amounted to 58.00% within seven days of observation after being treated.

Keywords: red ginger extract, caterpillar, green mustard, vegetable pesticides

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INTRODUCTION

Red Ginger is a plant species that is widely available in Indonesia. Red ginger plant contains several secondary metabolites such as phenolics, flavonoids, terpenoids, ketones and aldehydes. Red Ginger potential as a pesticide plant because it contains several compounds oleoresin which give a spicy flavor and red ginger also has a volatile compound that contains components such as zingiberol, kaempferol, bisabolene, and zingiberene (Kusumaningati 2009). The results of the study (Asfi *et al* 2014) in the laboratory using a filtration red ginger rhizome to give a concentration of 20% for mortality and inhibits the feeding activity of larvae.

In agriculture. Farmers still use fewer plant pesticides and use synthetic pesticides more often to pests control. The use of synthetic pesticides for a long time will be very dangerous for humans and organisms (Astuti, and Widyastuti 2016). Therefore, there need to be other alternatives in controlling pests that are environmentally friendly and not toxic to other organisms by using vegetable pesticides. Vegetables pesticides have

several advantages such as environmentally friendly, inexpensive and easily available, do not poison plants, do not cause pests resistance, and contain nutrients needed by plants, and produce agricultural products that are free of synthetic pesticides residues (Irfan 2016).

Insects are the most diverse species of animal living on earth and can be found in all habitats. Less than 5% of the total number of the known insect species are considered pest. One pest that attacks on green mustard plants that caterpillars (*Chrysodeixis calcites*). Inch caterpillar pests have caused damage to the leaves, where the average area of about 5,005 caterpillar ha / year in 14 provinces in Indonesia (Arifin 1992). These pests have polipag properties (consuming virtually all parts of the plant). Caterpillar larvae attack soybean plants when the plants enter a period of vegetative to generative. This pest attacks resulting in

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white patches on the leaves because the epidermis and bone just behind the leaves (Ampnir *et al.* 2012).

Pesticidal plants have used from way back 1940s itself, in commercial agriculture, since when drastically increased the modern synthetic pesticides in Agricultural system and excess application synthetic insecticides cause a problem of such as environmental contamination, residue problem and various health hazards to public and also evident that continues use of synthetic pesticides has create resistance problem in various insect and others negative impact to natural enemies and pollinators. Nearly 90 percent of sprayed pesticides substances are do the environment pollution.

The implementation of integrated pest management and pesticide use vegetable are the two things are mutually supportive. 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 the aim of using environmentally friendly plant pesticides (Novizan 2002). Then overcoming the use of chemical pesticides can damage the environment, so it is necessary to consider using environmentally friendly plant pesticides, such as the application of plant pesticides from red ginger extract. Providing environmentally friendly vegetable crops is very good step in fulfilling daily basic needs. One of the most popular vegetables by people is red ginger plant (*Zingiber officinale* var. *rubrum*).

Saputra (2011) revealed that several types of pest that often attack green mustard plants include cabbage crop caterpillars (*Crocidolomia binotalis* Zell), tritip caterpillars (*Plutella maculipennis*), armyworm caterpillars (*Spodoptera* sp.), soil caterpillars (*Agrotis ipsilon*), and caterpillars (*Chrysodeixis calcites*). However, pests are animals that attack and damage the cultivated plants thus, causing harm to the parties involved in agriculture. One pest that attacks on green mustard plants that caterpillars (*Chrysodeixis calcites*). Inch caterpillar pests have caused damage to the leaves, where the average area of about 5,005 caterpillar ha / year in 14 provinces in Indonesia (Arifin, 1992). These pests have polipag properties (consuming virtually all parts of the plant). Caterpillar larvae attack green mustard plants when the plants enter a period of vegetative to generative. This pest attacks resulting in white patches on the leaves because the epidermis and bone just behind the leaves (Ampnir *et al.*, 2012). In order for green mustard production to continue to increase, it is necessary to do research using red ginger extract as a vegetable pesticide in caterpillar controlling that attack green mustard plants.

Based on the problems, it is necessary to conduct research related to control of caterpillar (*Chrysodeixis calcites*) in the green mustard plants using red ginger extract. This research aims to determine mortality of insects and the effect of red ginger extract as a

vegetable pesticide on caterpillar (*Chrysodeixis calcites*) in the green mustard plants.

MATERIALS AND METHODS

Material needed in this research is: Green mustard plants, caterpillar (three instars), red ginger, 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.

Statistical analysis

Statistical analysis was carried out in five 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 4 levels of statistical used in this treatment:

K : Control (concentration 0%)

JM1 : Extract with a concentration of 5% + 100 ml of water.

JM₂ : Extract with a concentration of 10% + 100 ml of water.

JM3 : Extract with a concentration of 15% + 100 ml of water.

Caterpillar (*Chrysodeixis calcites*) insects is taken from the field, then cultured in a cage to get 200 larvae. Observations were made every 2 days, starting on days 3, 5, 7, 9, and 11, on the larvae mortality, up to 50 percent.

RESULTS AND DISCUSSION

The Percentage of Mortality Caterpillar (*Chrysodeixis calcites*)

Fig. 1 show that the red ginger extract to caterpillar of the treatment without the use of red ginger extract as K = Control (red ginger concentration of 0%) in the percentage of mortality amounted to 38.00%, abuse JM1 (5% concentration of red ginger extract) with the percentage of mortality influenced by 48.00%, JM2 treatment (10% concentration of red ginger extract) with the percentage of mortality influenced by 58.00%, and the treatment JM3 (15% concentration of red ginger extract) with the percentage of mortality effect by 78.00%. The data shows that the value of the percentage of mortality in the treatment JM3 inch caterpillar provide a very real effect where the red ginger extract with a concentration of 15% 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



Fig. 1. The process of making red ginger extract (*zingiber officinale* var. *rubrum*)



Fig. 2. Graph of the percentage of mortality caterpillars (*Chrysodeixis calcites*)

Description: K = Control (concentration of 0%), JM1 = 5% concentration of red ginger, red ginger concentration JM2 = 10%, JM3 = red ginger concentration of 15%

causes of caterpillar death is in the form of secondary metabolites contained therein. According to (Astuti, 2011) red ginger rhizome also contains active compounds such as astiri oils and oleoresin which cause death in the caterpillar. According to Ekayanti, 2018 conducted a study on the concentration of red zinger extract (*zingiber officinale* Rosc.) as a natural insecticide on the mortality of stink bugs (*Leptocorisia oratorius* F.), with the application of red ginger extract 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. 2 is based on a graph of mortality observation of the first day until the fourth day since the mortality caterpillar can already be seen, but on the observation from 5 to 7 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

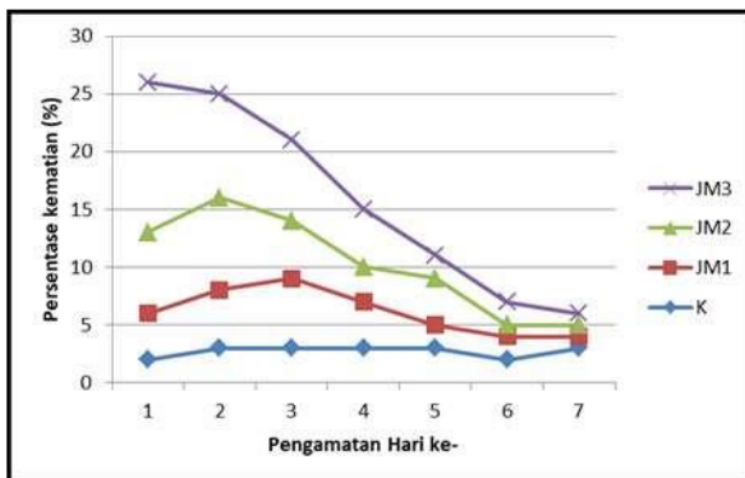


Fig. 3. Graph time of mortality caterpillar (*Chrysodeixis calcites*)

Description: K = Control, JM1 = 5% concentration of red ginger, red ginger concentration JM2 = 10%, JM3 = red ginger concentration of 15%

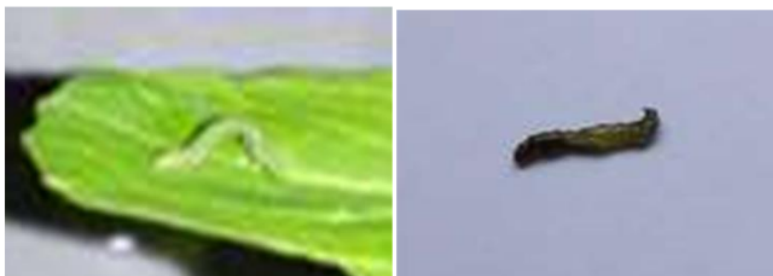


Fig. 4. (A) healthy insect, (B) death insect

the ginger extract of red, where the pesticide plant has a weakness in the form of persistence short and impactful the toxicity of botanical 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 plant has some short comings such as the active ingredients are biodegradable so that pesticide plant cannot stand when stored in the long term.

Symptoms of mortality caterpillar

Fig. 4 show that the symptoms of death caterpillars (*Chrysodeixis calcites*) caused by red ginger extract 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. This is because red ginger contains chemical compounds red ginger, where the compound is giving hot and spicy flavor. According to (Ekayanti, 2018) when the zingiberen content is dissolved and come into

contact with the animal to be tested, the content of the zingiberen will be absorbed and accumulated by the test animals. which results in receptors that activate anti-feeding signals in the central nerve, resulting caterpillars cannot smell and cannot recognize the existence of food that is around it. Obstruction of the olfactory organs and damage to the digestive tract will reduce the feeding activity of caterpillars and caused the caterpillars to become limp and then die slowly.

Another mortality in the caterpillar caused by content of ginger oleoresin which contains many components such as a spicy flavor, while the dominant spicy flavor found in ginger caused by colored zingeron ketones. zingeron defined as a substance component that has a spicy flavor and aroma. This zingeron make caterpillar becomes hotter, resulting in the death of a worm inch (Made et al., 2012). Red Ginger contains saverals components such as volatile consisting of monoterpenes derivatives and sesquiterpenes derivatives, where these components give the characteristic aroma of red ginger (Kusumaningati, 2009).

CONCLUSION

The results found that 1(one) treatment, is the best concentration be able to kill the caterpillars (*Chrysodeixis calcites*) amounted to 58.00% within seven days of observation after being treated, with a concentration of 10%.

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